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Real Convergence, Capital Flows, and Competitiveness in Central and Eastern Europe*

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15 October 2009

Abstract

The paper scrutinizes the role of wages and capital flows for competitiveness in the new EU member states in the context of real convergence. For this purpose it extends the seminal Balassa-Samuelson model by international capital markets. The augmented Balassa-Samuelson model is linked to the monetary overinvestment theories of Wicksell and Hayek in order to trace cyclical deviations of real exchange rates from the productivity-driven equilibrium path. Panel estimations for the period from 1993 to 2008 reveal mixed evidence for the role of capital markets for both the economic catch-up process and international competitiveness of the Central and Eastern European countries.

JEL Codes: E24, F16, F31, F32

Keywords: Exchange rate regime, wages, Central and Eastern Europe, EMU accession, panel model

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1. Introduction

Since the start of the transformation process, the productivity of the industrial sector has been regarded as a crucial determinant of economic development and wealth in Central and Eastern Europe. Rising productivity in the industrial sector has been accompanied by rising GDP per capita. In the context of the economic catch-up process negative current account balances have been, on the one hand, interpreted as the *outcome of higher returns on investment*. On the other hand, since the turn of the millennium up to the 2008/09 financial and economic crisis, rising current account deficits of many Central and Eastern European countries have been taken as an *indication of declining competitiveness*. When the crisis struck, high current account deficits were linked to financial vulnerability and crisis.

The issue of productivity catch-up and relative price level development in Central and Eastern Europe has been modelled extensively based on the seminal Balassa-Samuelson framework (Balassa 1964, Samuelson 1964). Empirical estimations concerning the existence of the Balassa-Samuelson effect in Central and Eastern Europe (see for instance Buiter and Grafe 2002, De Grauwe and Schnabl 2005, Mihaljek and Klau 2008, Égert and Podpiera 2008) have come to mixed results, leading to scepticism (see for instance Égert and Podpiera 2008).

We extend the literature on the Balassa-Samuelson effect in Central and Eastern Europe in two regards. First, we take into account that financial markets have gained a prominent role for the economic development of emerging market economies compared to the 1960s. We therefore augment the seminal goods market based Balassa-Samuelson model by capital markets. The additional availability of foreign capital via portfolio investment and foreign direct investment (FDI) is likely to accelerate the catch-up of productivity and prices.

Second, we acknowledge the fact that international capital markets have tended to be highly cyclical. While Balassa (1964) and Samuelson (1964) interpreted the economic catch-up process as an equilibrium phenomenon (which does not affect international competitiveness and the current account balance), we take into account the seminal overinvestment theories of Hayek (1929) and Wicksell (1898) to model fluctuations in the real exchange rate, international competitiveness and current account balances in the Central and Eastern Europe.

As will be shown, our twofold innovation helps to trace the most recent boom and bust cycle in Central and Eastern Europe. While open capital markets have accelerated the catch-up

process, the credit boom in some Central and Eastern European countries has led to rising current account deficits which can be associated with declining competitiveness and vulnerability to crisis. The results of our panel estimation exercise provide some indication for an impact of capital inflows on the competitiveness of the Central and Eastern European countries as well as a mitigating impact of capital flows on the original Balassa-Samuelson effect.

2. The Balassa-Samuelson model augmented with capital markets

Previous research has intensively discussed the impact of the economic catch-up process on inflation and competitiveness in emerging market economies. The seminal Balassa-Samuelson supply-side hypothesis (Balassa 1964, Samuelson 1964) has been augmented by demand-side effects (Bergstrand 1991) and other issues including quality improvements (Égert and Podpiera 2008). Less attention has been paid to the role of international capital markets for inflation and competitiveness in countries which find themselves in an economic catch-up process.

2.1. The baseline Balassa-Samuelson model

In the 1960s, Balassa (1964) and Samuelson (1964) observed that fast growing emerging markets, much the same as today the Central and Eastern European economies, experienced higher productivity gains in the tradable sector than industrial countries. At the same time higher consumer price inflation contributed to a secular "catch-up" of general price levels. The real convergence process as it is currently observed in Central and Eastern Europe was linked to nominal convergence in terms of consumer price levels and, given fixed exchange rates, a real appreciation of the domestic currencies. Given that the Balassa-Samuelson effect had also an impact on prices and the real exchange rate it can be linked to issues of international competitiveness.

The basic version of the Balassa-Samuelson model is a two-country model with a tradable goods (industry) and a non-tradable goods (service) sector as described by De Grauwe and Schnabl (2005). Balassa (1964) and Samuelson (1964) assumed perfect competition in the tradable goods markets as represented by purchasing power parity and perfect mobility in

national labour markets, but with no international labour mobility. However, competition between the non-traded goods sectors of the two countries and between the traded and non-traded goods sector in domestic markets was supposed to be absent.

In the following, we assume that the production of traded and non-traded goods in each country is based on two Cobb-Douglas production functions for the traded goods sector T and the non-traded goods sector NT:

$$Y^i = A^i (K^i)^{\gamma^i} (L^i)^{1-\gamma^i} \text{ with } 0 < \gamma^i < 1 \text{ and i = T, NT} \quad (1)$$

In equation (1) Y^i is the (real) output; A^i represents technology; K^i stands for (fixed) capital; and L^i is the labour force employed in sector i.[1] In both sectors, output is generated by combining technology, capital and labour. Assuming competitive markets and profit maximization, the marginal productivity of labour ($(1-\gamma^i)\frac{Y^i}{L^i}$) must correspond to the real wage in the respective sector which is defined as the nominal wage divided by the price level of the respective goods:

$$(1-\gamma^i)\frac{Y^i}{L^i} = \frac{W^i}{P^i} \quad (2)$$

Nominal wages in the traded and non-traded sectors are supposed to be equal as perfect labour mobility between the traded and non-traded sector is assumed ($W^T = W^{NT} = W$). This yields:

$$c\frac{Q^T}{Q^{NT}} = \frac{P^{NT}}{P^T} \quad (3)$$

where Q^i represent the labour productivities in the respective sectors ($\frac{Y^i}{L^i}$) and c is a positive[2] constant depending on the weights of tradable and non-tradable goods ($\frac{1-\gamma^T}{1-\gamma^{NT}}$). Taking the

[1] The overall labor force of the economy $\overline{L}$ is assumed to be constant: $\overline{L} = L^T + L^{NT}$.

[2] As γ^T and γ^{NT} are larger than zero and smaller than unity.

first derivation, changes[3] in the productivity differential between the traded and non-traded goods sector are determined by relative price changes ($\hat{p}^i$) between non-traded and traded goods. Balassa (1964) and Samuelson (1964) also assumed that productivity growth is larger in the traded goods than in the non-traded goods sector.

$$\hat{p}_{NT} - \hat{p}_T = c[\hat{q}_T - \hat{q}_{NT}] \quad \text{with} \quad \hat{q}_T - \hat{q}_{NT} > 0 \tag{4}$$

As long as productivity in the traded goods sector is growing faster than in the non-traded goods sector, prices in the non-traded goods sector rise relative to prices in the traded goods sector. Overall inflation can be assumed to be a composite of traded and non-traded goods with the weights α and (1-α):

$$\hat{p} = \alpha\hat{p}_T + (1-\alpha)\hat{p}_{NT} \tag{5}$$

Given equations (4) and (5), the domestic price level is a function of the domestically-traded goods price level and the productivity growth differential between the traded and non-traded goods sector. With constant traded goods prices ($\hat{p}_T = 0$) inflation is driven by relative productivity increases of traded goods versus non-traded goods.

$$\hat{p} = \hat{p}_T + (1-\alpha)c[\hat{q}_T - \hat{q}_{NT}] \tag{6}$$

The impact of international goods markets can be modelled based on the assumption by Balassa (1964) and Samuelson (1964) that in goods markets purchasing power parity holds, i.e. domestic traded goods inflation $\hat{p}_T$ is equivalent to traded goods inflation on world or euro area traded goods markets $\hat{p}_T^{EA}$, corrected by exchange rate changes $\hat{e}$:

$$\hat{p}_T = \hat{p}_T^{EA} + \hat{e} \tag{7}$$

Inserting equation (7) into equation (6) yields equation (8) which can be seen as an equation to determine supply driven inflation, taking into account international goods markets and the exchange rate. The term $(1-\alpha)c$ is a positive constant depending on the weights of traded

[3] Exchange rates are expressed in small letters with with a ^.

and non-traded goods in the economy and the consumer price index.

$$\hat{p} = \hat{p}_T^{EA} + \hat{e} + (1-\alpha)c[\hat{q}_T - \hat{q}_{NT}] \quad (8)$$

According to equation (8), inflation in Central and Eastern European countries is driven by inflation in the euro area traded goods sector (as the main reference market for Central and Eastern Europe), exchange rate changes against the euro and the differential of productivity gains between the traded and non-traded goods sectors.

Based on equation (8) two corner solutions of exchange rate regimes can be distinguished. Under a fixed exchange rate regime (ê=0) the exchange rate term drops out and domestic inflation would be solely driven by domestic productivity development and price development in world markets. Under flexible exchange rates, exchange rate changes would constitute a pivotal additional determinant of domestic inflation.

2.2 Capital markets and a new equilibrium path

The Balassa-Samuelson model is a pure goods market model. Productivity increases are assumed to be exogenous and driven by domestic capital formation. This assumption was realistic during the Bretton-Woods system when international private capital flows were strongly restricted. Current account deficits were mainly subject to government financing, and therefore usually not sustainable and small. In contrast to the emerging markets in the 1950s, investment and productivity in Central and Eastern Europe up to the 2008/09 crisis has been driven by substantial capital inflows from the highly developed, low interest rate euro and dollar capital markets via foreign direct investment and bank lending.[4] This has been reflected in rising current account deficits.

Introducing capital markets into the Balassa-Samuelson model modifies the adjustment mechanism in two ways. First, because capital markets in emerging market economies are shallow, underdeveloped and rather closed (Eichengreen and Hausmann 1999), capital tends to be scarce which constitutes a bottleneck for domestic productivity increases, growth, and economic development. Opening up to international capital markets is equivalent to providing

[4] In contrast to Emerging Europe, in East Asia and other parts of the emerging world current account surpluses have emerged (Freitag and Schnabl 2008).

a higher supply of capital at a substantially lower interest rate. Portfolio investment and inflows of bank credit allow upgrading the domestic production technologies and investment in new production sites. The inflow of FDI is equivalent to substituting relatively inefficient production sites by leading edge production technologies. In both cases labour productivity and overall productivity increases.

Second, in the context of the Balassa-Samuelson framework the direction of wage and productivity adjustment may change. For instance, Goretti (2008) observes for Central and Eastern Europe that wage increases originated in the non-traded goods sector and were followed by wage increases in the traded goods sector. In the Central and Eastern European countries capital inflows may reflect privatizations receipts as public enterprises are sold off to international investors. The privatization receipts would allow for public sector wage increases which would trigger wage adjustment in the other parts of the non-traded goods sector and in the traded goods sector. The wage increase in the traded goods sector would then – given constant world market prices – necessitate productivity increases in the traded goods sector to maintain international competitiveness. The direction of the adjustment process of wages and productivity is reversed.

As experienced by Central and Eastern European countries, international capital inflows have been targeting in the first place the industrial (tradable goods) sector as well as the non-tradable sector such as the banking sector. Generally the capital inflows into the region have contributed to productivity increases in both sectors by providing more efficient production technologies and management knowhow than in a setting without international capital markets. The assumption of Balassa (1964) and Samuelson (1964) that the potential for productivity increases in the traded goods (industrial) sector is higher than in the non-traded goods (services) sector can be maintained, as the potential for productivity increases in the non-traded and traded goods sector remains unchanged under both environments ($\hat{q}_{Tcap} > \hat{q}_{NTcap}$).[5]

This is confirmed by Figure 1 which shows the average productivity increases in the traded and non-traded sectors of eleven Central and Eastern European countries. To decompose overall productivity increases into productivity increases originating from domestic capital formation and those which stem from capital inflows we split sectoral output in domestic

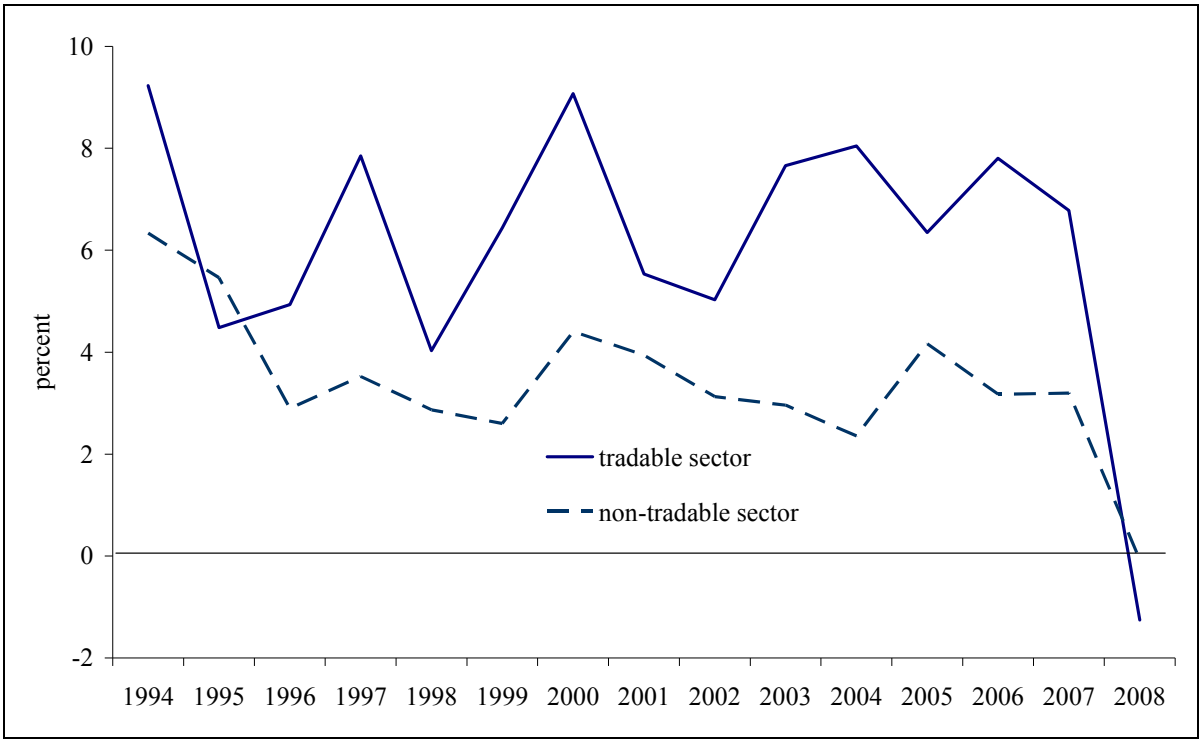
[5] The subscript „cap“ denotes that the Balassa-Samuelson model is extended to capital markets.

driven output and foreign capital inflow related output. Relative labour productivity increases $\hat{q}_T - \hat{q}_{NT}$ are decomposed into labour productivity increases driven by domestic capital formation and labour productivity increases driven by capital inflows (see Annex for derivation): $\hat{q}_T - \hat{q}_{NT} = c[\hat{q}_{Tdom} - \hat{q}_{NTdom}] + d[\hat{q}_{Tcap} - \hat{q}_{NTcap}]$. This yields:

$$\hat{p}_{cap} = \hat{p}_T^{EA} + \hat{e} + b_{dom}[\hat{q}_{Tdom} - \hat{q}_{NTdom}] + b_{cap}[\hat{q}_{Tcap} - \hat{q}_{NTcap}] \text{ with } \hat{q}_{Tdom} > \hat{q}_{NTdom}, \hat{q}_{Tcap} > \hat{q}_{NTcap} \quad (9)$$

Given capital inflows, domestic inflation should be higher than in an economy with a closed capital account ($\hat{p}_{cap} > \hat{p}$). The coefficient b_{dom} is equal to (1-α)c and b_{cap} is equal to (1-α)d (see Annex for derivation) with both being positive constants. Adding capital inflows to the model implies in the first place a disequilibrium between current account and financial account, because the net capital inflows would not fully be used for purchases of foreign goods. Yet, the relative price increase of non-traded goods shifts demand from non-traded to traded goods and the current account and the financial account will be balanced.

Figure 1 - *Productivity growth in the tradable and non-tradable sector*



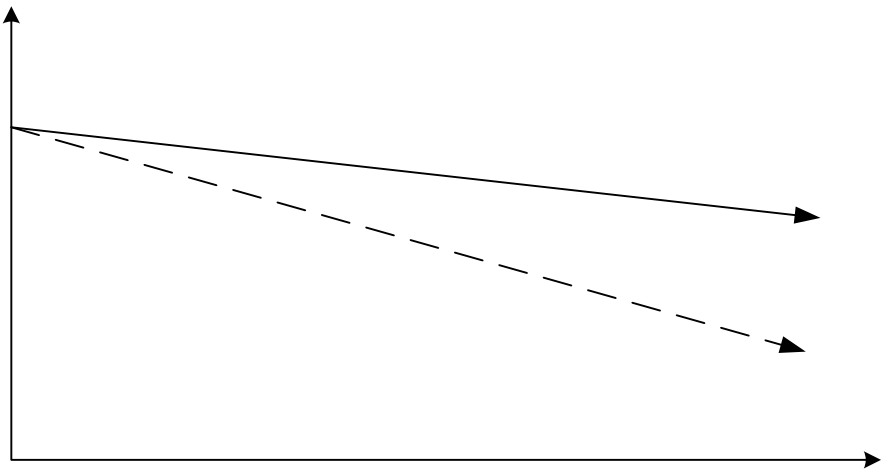
Source: European Commission. Arithmetic averages of even Central and Eastern European countries. Productivity is measured by changes of real value added per person employed.

Assuming for simplicity that the price levels of traded as well as non-traded goods in the euro area are constant, i.e. $\hat{p}_T^{EA} = \hat{p}_{NT}^{EA} = \hat{p}^{EA} = 0$, the real exchange rate of the emerging market economy $\hat{e} - \hat{p}_{cap}$ will be a negative function of the productivity differential between the traded and the non-traded goods sectors.

$$-\left(\hat{e} - \hat{p}_{cap}\right) = b_{dom}\left[\hat{q}_{Tdom} - \hat{q}_{NTdom}\right] + b_{cap}\left[\hat{q}_{Tcap} - \hat{q}_{NTcap}\right] \tag{10}$$

The real appreciation of the emerging market currency during the economic catch-up process as reflected by the negative sign of the left hand side of equation (8) is driven by the catch-up of productivity. As shown by De Grauwe and Schnabl (2005) this real appreciation can be achieved either by a nominal appreciation of the exchange rate (-ê) or relative price increases versus the euro area ($+\hat{p}_{cap}$) as assumed by Balassa (1964) and Samuelson (1964). In both cases the current account balance would be unchanged. In both cases the real appreciation would be a steady process which reflects relative productivity catch-up, but not changes in international competitiveness and the current account position. Thus, adding international capital markets implies an accelerated real appreciation path (Figure 2).

Figure 2 - *Goods and capital market driven real appreciation path*



3. Changes in international competitiveness and cyclical fluctuations due to capital flows

Balassa (1964) and Samuelson (1964) assumed that productivity growth in the economic catch-up is a gradual process without changes in the current account position. Productivity increases in the industrial sector are balanced by relative price changes leaving competitiveness unchanged. Nevertheless it has been observed that the current account positions of emerging market economies have deteriorated or fluctuated during the economic catch-up process. As recently in Central and Eastern Europe, high current account deficits have been perceived as an indication for eroded competitiveness, economic turmoil, and crisis. In the following, changes in international competitiveness are defined as wage increases higher than productivity increases and are linked to rising current account deficits and cyclical fluctuations in international capital inflows.

3.1. Changes in international competitiveness

Lindbeck (1979) linked the domestically driven wage bargaining process of Balassa (1964) and Samuelson (1964) to international goods markets. He assumed in line with equation (1) that trade unions in the traded goods sector of countries in the economic catch-up process do not negotiate wage increases higher than productivity increases and world market inflation. By doing this they help to maintain the competitiveness of the domestic export industry (and therefore prevent rising unemployment). In contrast, in emerging markets with buoyant capital inflows wages may rise above domestic productivity increases.

$$(1-\gamma^i)\frac{Y^i_{cap}}{L^i_{cap}} < \frac{W^i_{cap}}{P^i_{cap}} \tag{11}$$

If nominal wages in the traded and non-traded sectors are assumed to be equal due to perfect labor mobility between sectors this yields:

$$c\frac{Q^T_{cap}}{Q^{NT}_{cap}} < \frac{P^{NT}_{cap}}{P^T_{cap}} \tag{12}$$

In equation (12) as outlined above the direction of causality may have changed compared to

the seminal Balassa-Samuelson model as capital inflows allow for a simultaneous increase of productivity and wages in both sectors with wages increasing faster than productivity. The outcome is that domestic inflation in the country in the economic catch-up process rises above what would otherwise be justified by relative productivity increases. Domestic inflation is decomposed in a factor driven by relative productivity increases originating in domestic capital formation and one which is driven by capital inflows.

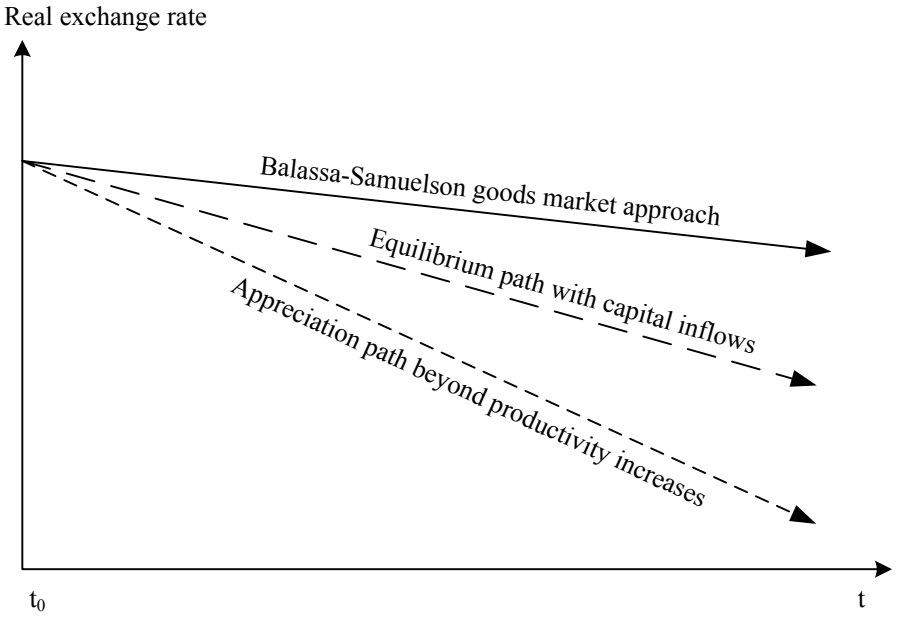
$$\hat{p}_{cap} > \hat{p}_T^{EA} + \hat{e} + b_{dom}[\hat{q}_{Tdom} - \hat{q}_{NTdom}] + b_{cap}[\hat{q}_{Tcap} - \hat{q}_{NTcap}] \text{ with } \hat{q}_{Tdom} > \hat{q}_{NTdom}, \; \hat{q}_{Tcap} > \hat{q}_{NTcap} \quad (13)$$

The outcome would be that – assuming constant prices for traded and non-traded goods in the euro area – the real appreciation of the emerging market currency would go beyond what would be indicated by the emerging markets relative productivity gains.

$$-(\hat{e} - \hat{p}_{cap}) > b_{dom}[\hat{q}_{Tdom} - \hat{q}_{NTdom}] + b_{cap}[\hat{q}_{Tcap} - \hat{q}_{NTcap}] \text{ with } \hat{q}_{Tdom} > \hat{q}_{NTdom}, \; \hat{q}_{Tcap} > \hat{q}_{NTcap} \quad (14)$$

The gradual deviation of the real exchange rate from the productivity-driven path is modelled in Figure 3. The consequence of a real appreciation beyond what would be justified by relative productivity increases is a deteriorated current account position which is fuelled by capital inflows.

Figure 3 - *Goods and capital market driven real appreciation path II*



3.2. Cyclical fluctuations in competitiveness

A deviation of the productivity driven real appreciation path as modelled in Figure 3 can not go for ever as the underlying investment would turn out to have a low or negative profitability. Capital inflows that nurture wage increases instead of productivity increases would be reversed and competitiveness would have to be restored via nominal exchange rate depreciation or real wage cuts. This suggests cyclical deviations from the real appreciation path.

Such cyclical deviations from this productivity-driven real appreciation path may occur if – given sound macroeconomic fundamentals and/or low interest rate levels in the international capital markets – buoyant international capital inflows contribute to brisk monetary expansion, fast rising credit growth and overinvestment. In particular, as international capital markets in emerging market economies are underdeveloped, buoyant and excessive capital inflows can be easily reversed when economic sentiment changes. Then, euphoric investment booms, wage hikes, and fast real appreciation are followed by severe recessions, real wage cuts, and real depreciation. Inflation in Central and Eastern Europe has not only tended to be higher than in the euro area (as assumed by the Balassa-Samuelson hypothesis), it has also exhibited strong cyclical fluctuations as shown in Figure 4 (what is not modelled by the Balassa-Samuelson effect). The strong *cyclicality of inflation* in Central and Eastern Europe may point at a prominent role of capital inflows for inflation in these catching-up economies.

The seminal monetary overinvestment theories by Hayek (1929) and Wicksell (1898) and more recent research (McKinnon and Pill 1997, Krugman 1998, Corsetti et al. 1999, Saxena and Wong 2002, Hoffmann and Schnabl 2008) provide theoretical frameworks suitable to explain capital market-driven fluctuations in inflation, wages and a (temporary) departure of the real exchange rate from the equilibrium path. To model business cycle fluctuations in closed economies, Wicksell (1898) and Hayek (1929) distinguished between "good" investment which yields returns above a "natural" equilibrium interest rate[6] and low return (speculative) investment which is induced by an interest rate below the equilibrium (I>S). Overinvestment is triggered when the central bank (Wicksell 1898) or the banking sector (Hayek 1929) keep interest rates below the equilibrium interest rate during the economic upswing. Whereas the monetary overinvestment theories were modelled for closed economies,

[6] At the equilibrium interest rate, saving is equal to investment: S=I.

in today's liberalized international capital markets interest rates in emerging markets can decline "below the natural interest rate" due to buoyant capital inflows from highly liquid, low yield developed capital markets (Hoffmann and Schnabl 2008).

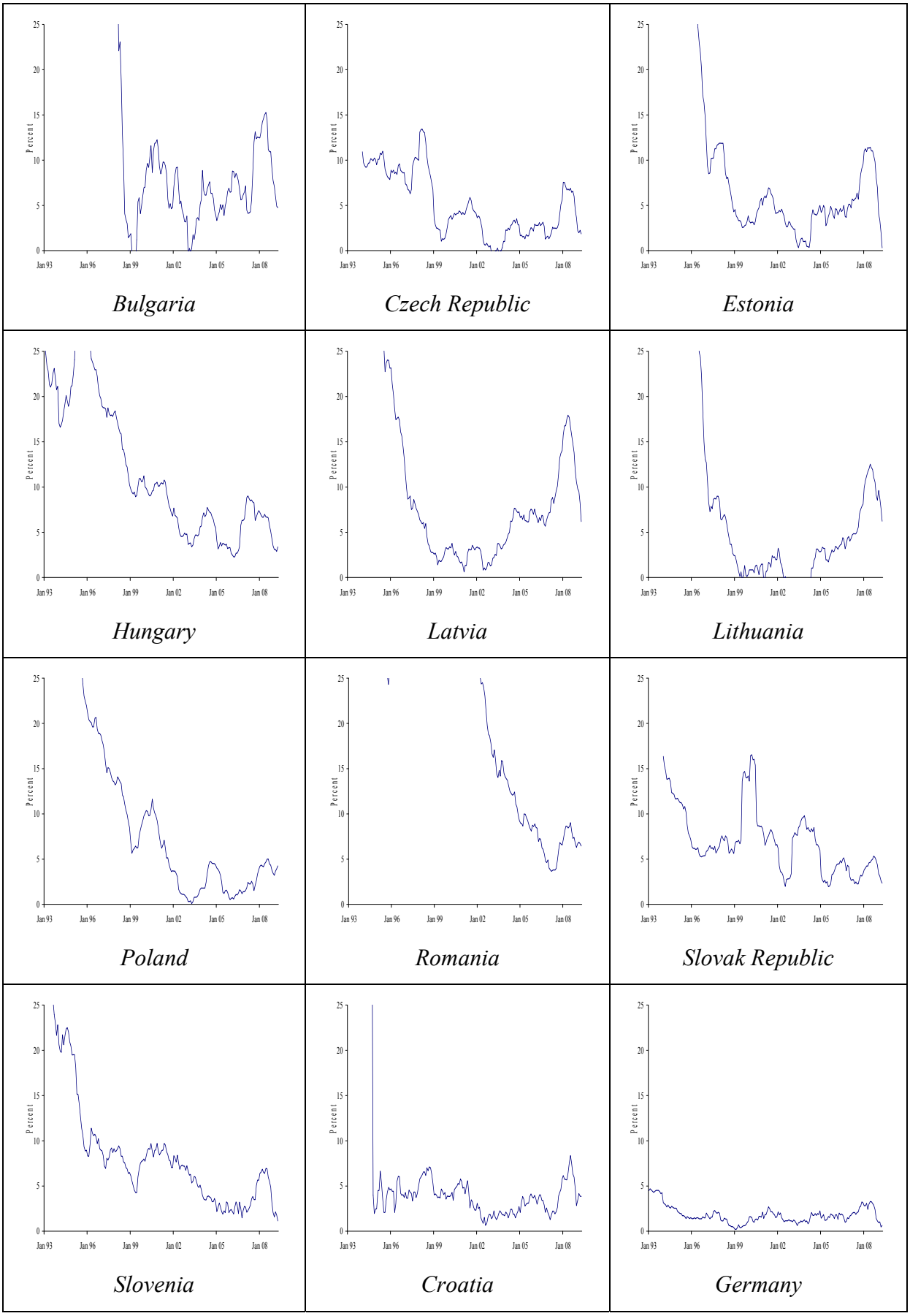
Overinvestment is induced during the economic upswing (boom), for instance, because (international) financial institutions (for instance in the euro area) compete for borrowing to high-yield emerging market economies (for instance in Central and Eastern Europe). Together with declining refinancing costs for banks and lower lending rates for enterprises, the (expected) profitability of the realized investment projects decreases (for instance represented by declining productivity increases in Central and Eastern Europe as shown in Figure 1). Moral hazard in financing low return investment may occur when financial institutions anticipate a lender of last resort in the case of crisis (Krugman 1998, Corsetti et al. 1999).[7] In this case, domestic financial institutions tend to borrow to enterprises without an adequate assessment of the expected returns (McKinnon and Pill 1997).

In the models of Wicksell (1898) and Hayek (1929) the upswing continues as the demand for investment goods rises. In this phase, capacity reserves are activated. What is more, wages and consumption increase. The positive economic expectations can well be transmitted to asset markets where speculation may set in (Schumpeter 1912).[8] With credit growth becoming speculative (as it seems to have happened in Central and Eastern Europe), productivity increases slow down (as shown in Figure 1). Finally, consumer price inflation accelerates which conveys a signal supportive of building up additional capacities and increasing wages further.

[7] The IMF and the European Institutions became lenders of last resort in Central and Eastern Europe during the current crisis.

[8] A speculative mania may emerge, in which speculative price projections and "*the symptoms of prosperity themselves finally become, in the well known manner, a factor of prosperity*" (Schumpeter 1912, 226).

Figure 4 - *Inflation in Central and Eastern Europe and Germany*



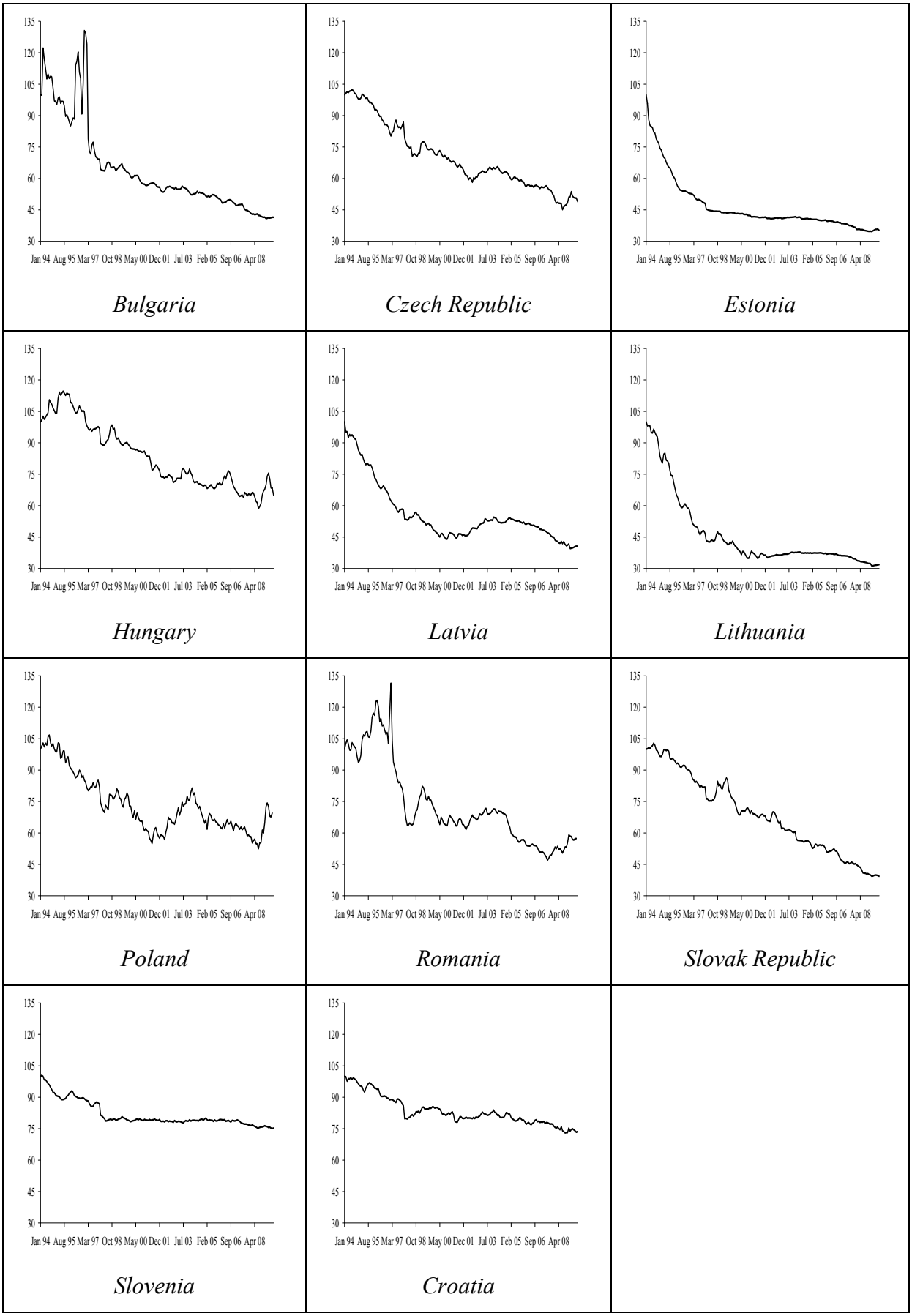
Source: IMF.

Such boom-and-bust cycles in emerging markets have been observed frequently since the mid-1990s (McKinnon and Pill 1997). In practice, although overinvestment may be difficult to identify ex ante, it can be linked to buoyant capital inflows into the emerging market economies which contribute to monetary expansion, declining interest rates and inflation rising above levels which are justified by productivity growth. Indeed, rising inflation has been observed in many Central and Eastern European countries before the recent crisis (Figure 4).

Speculative capital inflows, overheating and inflation can be seen as the main reason of strong real appreciations and rising current account deficits of the Central and Eastern European currencies since the turn of the millennium (Bini-Smaghi 2007). When the crisis hit, the reversal of the capital flows triggered the dismantling of investment projects (i.e. by declining productivity) as well as nominal exchange rate depreciations and/or wage austerity. A real depreciation of the emerging market currency occurred via nominal depreciation for instance in Hungary, Poland, and Romania (Figure 5). In other Central and Eastern European economies such as the Baltics real depreciation is engineered via nominal and real wage cuts.

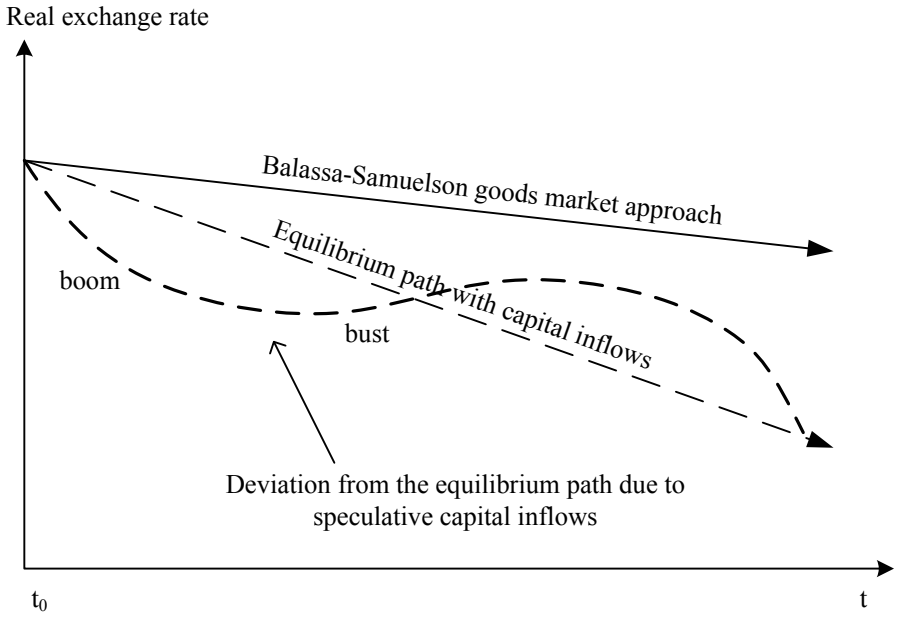
All in all, the overinvestment and related theories help us to model cyclical fluctuations in the real exchange rate and therefore of fluctuations in the competitiveness of the Central and Eastern European economies during the economic catch-up process. As international capital outflows from emerging markets tend to overshoot in times of crisis (because investors overestimate the risk), the emerging market currencies tend to depreciate beyond what would be compatible with the levels of relative productivity changes. The resulting cyclical evolvement of the real exchange rate is modelled in Figure 6.

Figure 5 - *Real exchange rates, national currency per euro, Index: Jan 1994=100.*



Source: IMF.

Figure 6 - *Cyclical deviation of the real exchange rate from its productivity-determined equilibrium*



4. Empirical Analysis

In sections 2 and 3 we have argued that relative productivity changes during the economic catch-up originate in domestic capital formation as well as in capital inflows. Previous empirical research on the Balassa-Samuelson effect in Central and Eastern Europe (see for instance Ègert 2009) has mainly focused on the seminal goods market based model. We aim to extend this research by adding proxies for capital inflows. Our estimations will reveal a significant impact of capital inflows for inflation in the region.

4.1. Data and estimation framework

We empirically test our model as formulated in equation (9) which explains consumer price inflation in Central and Eastern Europe by inflation in the euro area tradable goods sector, variations of nominal exchange rate and relative productivity changes in the tradable and non-tradable sectors. We isolate the role of capital flows by adding an interaction term to relative productivity increases to split overall productivity growth into relative productivity growth driven by domestic capital formation and relative productivity growth caused by capital inflows. We base our empirical analysis on a dynamic panel of annual data for eleven Central

and Eastern European countries.[9] Additional to the Central and Eastern European EU member countries, we include Croatia as EU candidate country with data being available. Our data set covers the period from 1996 to 2008. The data prior to the year 1996 are very fragmented which limits the number of observations. We are aware of the fact that the degrees of freedom are low, but quarterly data are not available for sectoral productivity.

Data sources are the IMF-IFS Database and the AMECO Database of the European Commission. Annual consumer price inflation data is from the IMF-IFS database. For euro area tradable goods inflation, we use German export price inflation as a proxy.[10] Nominal exchange rate appreciations/depreciations vis-à-vis the euro are calculated from annual average exchange rate data from IMF-IFS. Exchange rates prior to the year 1999 are those vis-à-vis the German mark and have been converted into euro based on the mark/euro conversion rate. With an eye on eq. (9), we expect that a nominal appreciation (depreciation) lowers (increases) domestic inflation in Central and Eastern Europe.

We derive the relative productivity growth of tradable versus non-tradable goods from sectoral data on gross value added per person employed at constant prices (provided by the European Commission). The industry sector (ISIC sections C to E) is assumed to correspond to tradable goods while the service sector (ISIC sections G to P) and the construction sector (ISIC section F) are classified as non-tradable goods. Gross value added of services and construction are merged into the non-tradable goods sector by weighting them by the share of people employed in this sector. Then we compute change rates over time. On average across all 11 countries productivity growth in the tradable sector exceeds productivity growth in the non-tradable sector almost every year (Figure 1).

We use several proxies of capital inflows from the IMF-IFS database. The financial account balance as percent of GDP, the current account balance as percent of GDP (as proxy of recorded and unrecorded private capital and capital flows), net foreign asset accumulation of the monetary authority[11], changes in foreign liabilities of domestic banks vs. foreign banks[12], and real interest rate changes. As capital flows in, real interest rates are expected to fall.

[9] The respective countries are Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, and Slovenia.
[10] We use Germany as the benchmark because data for the euro area prior to 1999 are available.
[11] Capital flows into countries with fixed or managed exchange rates affect official reserves which have an impact on base money creation and credit growth.

The empirical estimation is based on the theoretical framework as summarized in equation (9) and the discussion of section 3. The coefficient β_1 captures the impact of euro area traded goods prices on inflation, whereas β_2 measures the influence of exchange rate movements. To decompose overall relative productivity growth into domestically driven and capital inflow-induced productivity growth, we add an interaction term.[13] Multiplying the overall productivity differential $(\hat{q}_T - \hat{q}_{NT})_{i,t}$ by the capital inflow proxy $\hat{k}_{i,t}$ isolates what capital inflows add to domestically driven relative productivity growth (β_4). The coefficient β_3 captures the productivity growth originating in domestic capital formation. The capital inflow proxy is added as a separate variable and isolates inflation which purely driven by capital inflows without being backed by productivity growth (β_5). We use equation (15) for our panel estimation where *t* indicates the time index, while the index *i* refers to the respective country. γ_i represents the country specific fixed effect to account for structural country differences and $\mu_{i,t}$ is the white noise error term:

$$\hat{p}_{i,t} = \beta_0 + \beta_1 \hat{p}_{T,i,t}^{Germany} + \beta_2 \hat{e}_{i,t} + \beta_3 (\hat{q}_T - \hat{q}_{NT})_{i,t} + \beta_4 \left[(\hat{q}_T - \hat{q}_{NT})_{i,t} * k_{i,t} \right] + \beta_5 k_{i,t} + \gamma_i + \mu_{i,t} \qquad (15)$$

We estimate a standard fixed effect least square dummy variable (LSDV) estimator with robust standard errors. Panel unit-root tests based on Im/Pesaran/Shin 2003, Maddala/Wu 1999 and Choi 2001 do reject non-stationarity of the levels of our time series. Only for the financial account balance, the Im-Pesaran-Shin test cannot (although only slightly) reject the null of an individual unit root (see Table 1). Therefore, the results concerning the financial account have to be treated with caution.

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[12] BIS data of consolidated foreign claims of European commercial banks against banks in Central and Eastern Europe.

[13] Interaction terms are product terms of the independent variable $(\hat{q}_T - \hat{q}_{NT})_{i,t}$ (focal variable) and the second independent variable $\hat{k}_{i,t}$ (moderator variable) (Jaccard/Turrisi 2003). The coefficient β_3 captures the effect of $(\hat{q}_T - \hat{q}_{NT})_{i,t}$ on $\hat{p}_{i,t}$ when $\hat{k}_{i,t} = 0$. The parameter β_5 estimates the effect of $\hat{k}_{i,t}$ on $\hat{p}_{i,t}$ when $(\hat{q}_T - \hat{q}_{NT})_{i,t} = 0$. The coefficient of the interaction term, β_4, indicates the number of units that β_3 increases if $\hat{k}_{i,t}$ grows by one unit. The alternative explanation is that: β_4 indicates the number of units that β_5 increases/decreases if $(\hat{q}_T - \hat{q}_{NT})_{i,t}$ grows by one unit. However, we focus on the interpretation above which is in line with our model that capital inflows drive productivity growth.

Table 1 - *Panel unit root tests for the inflation differential and its potentially forcing variables (1993-2008)*

	Panel Unit Root Test		
	Im/Pesaran/ Shin	**ADF-Fisher chi-square**	**PP-Fisher chi-square**
Inflation	0.000	0.000	0.000
Wage growth	0.000	0.000	0.000
Export price inflation *(Germany)*	0.000	0.000	0.000
Δ Exchange rate	0.000	0.000	0.000
Relative productivity growth	0.037	0.018	0.000
Financial account balance	0.157	0.033	0.000
(-1) Current account balance	0.001	0.003	0.001
Δ Real interest rates *(domestic)*	0.000	0.000	0.000
Δ Reserves of monetary authority	0.000	0.000	0.000
Money growth *(money+quasi money)*	0.000	0.000	0.000
Δ Foreign liabilities of banks *(BIS Data)*	0.000	0.000	0.000

Note: Lag selection has been conducted using the modified Hannan-Quinn criterion, allowing for an individual intercept.[14] Entries are p-values.

4.2. Estimation Results

Table 2 displays the results for LSDV estimations using productivity difference as relative productivity growth as formulated in the Balassa-Samuelson model. The evidence in favor of the seminal Balassa-Samuelson effect as formulated in equation (8) turns out to be weak. The estimated coefficients of export price inflation (β_1) and of the nominal exchange rate (β_2) display the expected sign and are statistically significant at the common significance levels. However, the coefficients are larger/smaller than unity, indicating more than complete / incomplete pass-through from foreign export prices and exchange rates to domestic prices. This is in line with a recent paper by María-Dolores (2009). In a second step, we add the different proxies for capital inflows and the interaction term. The impact of the German export prices and exchange rates on domestic inflation in Central and Eastern Europe remains

[14] A variation of the lag selection criteria as well as estimating the regression equation without intercept and trend or without trend does not change the results significantly.

robust, but the proxies for capital inflows and the interaction term are mainly insignificant. This suggests weak evidence for the Balassa-Samuelson effect.

Table 2 - *Determinants of Central and Eastern European inflation – LSDV estimations, accounting for productivity growth in the tradable and non-tradable sector.*

Dependent variable:	**Inflation**						
	#	1	2	3	4	5	6
Export price inflation	β_1	**1.856****	**1.843****	**1.913****	**1.941****	**1.981****	**2.071****
(Germany)		(0.762)	(0.734)	(0.777)	(0.842)	(0.690)	(0.802)
Δ Exchange rate	β_2	**0.354***	**0.344***	**0.354***	**0.354***	**0.343***	**0.339***
		(0.177)	(0.167)	(0.175)	(0.174)	(0.175)	(0.160)
Relative productivity growth	β_3	-0.108	-0.140	-0.122	-0.112	-0.151	-0.048
(Domestic Balassa-Samuelson effect)		(0.074)	(0.136)	(0.158)	(0.068)	(0.133)	(0.087)
Financial account balance			-0.188				
			(0.172)				
(-1) Current account balance				-0.094			
				(0.203)			
Δ Real interest rates	β_5				0.011		
(domestic)					(0.017)		
Δ Reserves of monetary authority						**1.011****	
						(0.457)	
Δ Foreign liabilities of banks							**-0.155****
(BIS Data)							(0.053)
Interaction term	β_4		-0.001	-0.002	-0.008	0.110	-0.009
(Balassa-Samuelson effect due to capital inflows)			(0.012)	(0.015)	(0.017)	(0.099)	(0.006)
Constant		**4.731*****	**6.645*****	**5.437*****	**4.514*****	**3.235****	**5.723*****
		(1.140)	(1.177)	(1.354)	(1.292)	(1.039)	(0.778)
N		112	107	110	112	106	112
R-squared (within)		0.22	0.25	0.23	0.29	0.41	0.31

Robust standard errors are reported in parentheses. *, ** and *** indicate significance at 10%, 5% and 1% level.

We conduct two robustness checks. First, the data basis for productivity in the emerging market economies' non-tradable sectors is thin and data may not be very reliable. Therefore, we assume that productivity growth in the service sector is zero. The results of this exercise are reported in Table 3. Again, the estimated coefficients of export price inflation (β_1) and the nominal exchange rate (β_2) turn out to be statistically significant at the common significance levels. Now, in five out of six specifications productivity growth (β_3) has the expected sign and is significant at the common levels (columns 7, 8, 9, 10, and 12).

In some specifications the capital inflow induced (β_4) productivity effect turns out to be significant with productivity driven inflation declining as capital flows in.[15] This may indicate

[15] For real interest rates (column 10) the sign of the interaction term needs to be positive, as capital inflows are associated with declining real interest rates.

that capital inflows reduce productivity increases and simply feed into inflation via – for instance – wages increases. In the spirit of the overinvestment theories one could argue that capital flows have a negative impact on productivity increases which reduces the overall Balassa-Samuelson effect. Instead prices are inflated by capital inflows as indicated by the coefficient β_5, the price increases which are not backed by productivity increases would erode the international competitiveness as indicated by rising current deficits. Net private capital inflows and real interest rate cuts contribute to rising inflation.

Table 3 - *Determinants of CEEC inflation – GLS estimation assuming zero productivity growth in the non-tradable sector*

Dependent variable:	**Inflation**						
	#	7	8	9	10	11	12
Export price inflation	β_1	**1.070*** **	**0.885*** **	**0.845*** **	**1.066** **	**1.309*** **	**1.561*** **
(Germany)		(0.267)	(0.164)	(0.186)	(0.353)	(0.334)	(0.400)
Δ Exchange rate	β_2	**0.219** **	**0.147*** **	**0.171***	**0.223** **	**0.234** **	**0.219** **
		(0.093)	(0.042)	(0.079)	(0.076)	(0.101)	(0.084)
Productivity growth of tradable sector	β_3	**0.311** **	**0.617*** **	**0.522*** **	**0.272***	0.229	**0.292*** **
(Domestic Balassa-Samuelson effect)		(0.129)	(0.187)	(0.122)	(0.136)	(0.132)	(0.086)
Financial account balance			**0.394** **				
			(0.147)				
(-1) Current account balance				**0.387*** **			
				(0.102)			
Δ Real interest rates	β_5				**-0.349*** **		
(domestic)					(0.084)		
Δ Reserves of monetary authority						0.659	
						(0.427)	
Δ Foreign liabilities of banks							0.041
(BIS Data)							(0.079)
Interaction term	β_4		**-0.35** **	**-0.027*** **	**0.011*** **	0.017	**-0.018***
(Balassa-Samuelson effect due to capital inflows)			(0.014)	(0.007)	(0.002)	(0.010)	(0.009)
Constant		1.929	-1.376	-0.681	2.132	1.364	**2.872** **
		(1.711)	(2.001)	(1.417)	(1.875)	(1.736)	(1.209)
N		114	109	112	114	108	114
R-squared (within)		0.33	0.41	0.36	0.38	0.50	0.35

Robust standard errors are reported in parentheses. *, ** and *** indicate significance at 10%, 5% and 1% level.

Third, we weight productivity growth of the tradable and non-tradable sector by sector employment (*emp*) to account for different sector size.[16] The estimation results are reported in Table 4. Export price inflation (β_1) and nominal exchange rates (β_2) are significant with the

[16] Sectoral employment data are provided by the AMECO database. The relative productivity growth is calculated by $\left(\hat{q}_T * \frac{emp_T}{emp_T + emp_{NT}}\right) + \left(\hat{q}_{NT} * \frac{emp_{NT}}{emp_T + emp_{NT}}\right)$.

expected sign but not equal to unity. The domestic Balassa-Samuelson effect (β_3) becomes significant only once, in column 14, with an expected positive sign. The results for the capital inflow driven Balassa-Samuelson effect and direct effects of capital flows turn out to be mixed. The estimated coefficients of the capital driven Balassa-Samuelson (β_4) effect indicate in 2 of 5 cases an inflation increasing effect of capital inflows via productivity increases (see columns 16 and 17). The reverse result shows up for two specifications (columns 14 and 18). The same mixed evidence appears for the direct impact of capital inflows on inflation (β_5). Two coefficients (columns 16 and 17) show an inflation increasing effect and two (columns 14 and 18) seem to have the reverse effect.

Table 4 - *Determinants of CEEC inflation – GLS estimation using employment weighted relative productivity growth*

Dependent variable:	**Inflation**						
	#	13	14	15	16	17	18
Export price inflation	β_1	**3.470****	**3.252****	**3.489****	**1.662*****	1.219	**3.287***
(Germany)		(1.509)	(1.438)	(1.439)	(0.477)	(0.783)	(1.574)
Δ Exchange rate	β_2	**0.862****	**0.798****	**0.839****	**0.367****	0.413	**0.686***
		(0.297)	(0.264)	(0.279)	(0.159)	(0.244)	(0.317)
Weighted relative productivity growth	β_3	0.741	**2.337***	1.534	0.196	-0.616	0.721
(Domestic Balassa-Samuelson effect)		(0.498)	(1.185)	(0.989)	(0.185)	(0.418)	(0.548)
Financial account balance			**-0.643****				
			(0.258)				
(-1) Current account balance				-0.514			
				(0.383)			
Δ Real interest rates	β_5				**-0.257*****		
(domestic)					(0.019)		
Δ Reserves of monetary authority						**3.744***	
						(1.857)	
Δ Foreign liabilities of banks							**-0.295*****
(BIS Data)							(0.089)
Interaction term	β_4		**-0.167***	-0.096	**-0.120*****	**0.929***	**-0.037***
(Balassa-Samuelson effect due to capital inflows)			(0.087)	(0.080)	(0.006)	(0.508)	(0.017)
Constant		2.174	**8.018****	5.434	**4.510*****	2.509	**5.965****
		(2.733)	(3.211)	(3.062)	(1.043)	(2.682)	(2.655)
N		132	125	130	122	124	136
R-squared (within)		0.44	0.49	0.45	0.74	0.40	0.33

Robust standard errors are reported in parentheses. *, ** and *** indicate significance at 10%, 5% and 1% level.

Table 5 and 6 display results when imposing on the estimation the restriction that coefficients of export price inflation (β_1) and nominal exchange rate (β_2) are equal to one. German export prices and the exchange rate against the euro are imperfect proxies for imported inflation, because also other than German prices as well as the exchange rate against other

currencies such as the dollar can matter for domestic inflation. We derive this restriction from the Balassa-Samuelson model. Given that purchasing power parity holds, both variables should have a one-to-one pass-through into national prices. This implies:

$$\hat{p}_{i,t} - \left(1 * \hat{p}_{T,i,t}^{Germany} + 1 * \hat{e}_{i,t}\right) = \beta_0 + \beta_3 \left(\hat{q}_T - \hat{q}_{NT}\right)_{i,t} + \beta_4 \left[\left(\hat{q}_T - \hat{q}_{NT}\right)_{i,t} * k_{i,t}\right] + \beta_5 k_{i,t} + \gamma_i + \mu_{i,t} \quad (17)$$

Again, the results turn out to be mixed and convey no clear evidence for or against the Balassa-Samuelson effect augmented by capital markets (Tables 5 and 6).[17]

Table 5 - *Determinants of CEEC inflation – GLS estimation, coefficients of export price inflation and nominal exchange rate restricted to 1*

Dependent variable:	**Inflation**						
	#	19	20	21	22	23	24
Export price inflation	β_1	1.000	1.000	1.000	1.000	1.000	1.000
(Germany)							
Δ Exchange rate	β_2	1.000	1.000	1.000	1.000	1.000	1.000
Relative productivity growth	β_3	2.168	5.624	9.702	-0.142	0.090	3.089
(Domestic Balassa-Samuelson effect)		(2.330)	(5.540)	(8.241)	(0.124)	(0.249)	(3.331)
Financial account balance			-1.941				
			(1.644)				
(-1) Current account balance				-3.979			
				(3.176)			
Δ Real interest rates	β_5				**-0.047*** **		
(domestic)					(0.003)		
Δ Reserves of monetary authority						**3.573***	
						(1.753)	
Δ Foreign liabilities of banks							-0.426
(BIS Data)							(0.397)
Interaction term	β_4		-0.382	-1.121	**-0.075*** **	-0.284	-0.164
(Balassa-Samuelson effect due to capital inflows)			(0.363)	(0.973)	(0.000)	(0.267)	(0.178)
Constant		3.582	**19.119****	24.665	**2.344*** **	-0.642	6.677
		(7.165)	(6.260)	(15.236)	(0.364)	(1.801)	(4.668)
N		133	126	131	133	121	133
R-squared (within)		0.02	0.006	0.22	0.98	0.14	0.04

Robust standard errors are reported in parentheses. *, ** and *** indicate significance at 10%, 5% and 1% level.

[17] Complementarily, we also weighed the capital inflow variable with a proxy of union power to evaluate whether union power affects the direct effect of capital inflow on inflation. High union power is assumed to elevate wage increases above what is justified by productivity growth, which further increases inflation and would deteriorate competitiveness. We proxied union power by the number of strike days. However, limited data availability led to unstable estimation results.

Table 6 - *Determinants of CEEC inflation – GLS estimation, coefficients of export price inflation and nominal exchange rate restricted to 1, using employment weighted relative productivity growth*

Dependent variable:	**Inflation**						
	#	25	26	27	28	29	30
Export price inflation	β_1	1.000	1.000	1.000	1.000	1.000	1.000
(Germany)							
Δ Exchange rate	β_2	1.000	1.000	1.000	1.000	1.000	1.000
Relative productivity growth	β_3	8.701	22.018	**29.407***	0.370	-0.547	10.865
(Domestic Balassa-Samuelson effect)		(8.274)	(17.993)	(15.798)	(0.395)	(0.339)	(10.122)
Financial account balance			-3.362				
			(1.929)				
(-1) Current account balance				**-7.789***			
				(3.606)			
Δ Real interest rates	β_5				**-0.174*****		
(domestic)					(0.002)		
Δ Reserves of monetary authority						**2.517***	
						(1.336)	
Δ Foreign liabilities of banks							-0.949
(BIS Data)							(0.854)
Interaction term	β_4		-1.445	-3.148	**-0.082*****	**0.779***	-0.494
(Balassa-Samuelson effect due to capital inflows)			(1.128)	(1.744)	(0.000)	(0.371)	(0.483)
Constant		**13.959*****	**38.783****	**53.168****	**3.188*****	0.103	16.592
		(3.525)	(16.298)	(20.310)	(0.202)	(1.130)	(5.720)
N		133	126	131	133	121	133
R-squared (within)		0.09	0.18	0.49	0.97	0.14	0.13

Robust standard errors are reported in parentheses. *, ** and *** indicate significance at 10%, 5% and 1% level.

5. Conclusions

The new member states and EU candidate countries face the challenges of achieving low inflation and exchange rate stability against the euro during their real convergence process. Although the uncertainty concerning the scope and transmission channels of the Balassa-Samuelson-Bergstrand effect remains high the Central and Eastern European countries are likely to experience higher inflation than the euro area. As a result, all currencies of the new member states and candidate countries have embarked on real appreciation paths. From this point of view, the empirical evidence in favour of a Balassa-Samuelson effect and other effects reinforcing it is strong.

Nevertheless, it turns out that it is difficult to disentangle the reasons for the catch-up of productivity and prices. Prices may catch-up due to productivity increases originating in domestic or international capital formation. International capital inflows, however, incorporate the risk that they feed directly into inflation thereby causing departures of the real exchange rate from the productivity driven appreciation path.

Our empirical analysis confirms to some extent that capital inflows are an important determinant of inflation in the region. This impact may cover both capital inflows which contribute to productivity-driven inflation and capital inflows which are translated directly into inflation and are not backed by respective productivity gains. Our estimations can be seen as an approach to capture the cyclical capital inflows which may contribute to non-productivity backed in flation and therefore to a structural loss in competitiveness.

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Annex

Derivation of Equation 9

We assume that the production of each sector (traded and non-traded goods sectors) can be subdivided into two production functions. One part depends on domestic capital and technology (denoted by dom) and the second one depends on capital inflows (denoted by cap):

$$Y^i = Y^i_{dom} + Y^i_{cap} = A_{dom}{}^i (K^i)_{dom}{}^{\gamma^i} (L^i)_{dom}{}^{1-\gamma^i} + A_{cap}{}^i (K^i)_{cap}{}^{\rho^i} (L^i)_{cap}{}^{1-\rho^i} \quad \text{(A1)}$$

with $0 < \gamma^i < 1$; $0 < \rho^i < 1$ and i = T, NT and $L^i = L^i_{dom} + L^i_{cap}$ and $A^i_{dom} < A^i_{cap}$

If there is perfect wage arbitrage between sub-sectors, than we can derive:

$$\left[(1-\gamma^i)\frac{Y_{dom}{}^i}{L_{dom}{}^i}\right] + \left[(1-\rho^i)\frac{Y_{cap}{}^i}{L_{cap}{}^i}\right] = \frac{W^i}{P^i} \quad \text{(A2)}$$

$$\left(c\frac{Q_{dom}{}^T}{Q_{dom}{}^{NT}}\right) + \left(d\frac{Q^T_{cap}}{Q^{NT}_{cap}}\right) = \frac{P^{NT}}{P^T} \quad \text{(A3)}$$

where ($Q^i_{dom} + Q^i_{cap}$) represent the labour productivities in the respective sectors ($\frac{Y^i}{L^i}$). *c* is a positive[18] constant depending on the weights of tradable and non-tradable goods $\left(\frac{1-\gamma^T}{1-\gamma^{NT}}\right)_{dom}$ with respect to domestic driven labour productivity growth and *d* is also a positive[19] constant depending on the weights of tradable and non-tradable goods $\left(\frac{1-\rho^T}{1-\rho^{NT}}\right)_{cap}$ with respect to foreign capital driven labour productivity growth.

Calculating growth rates yields:

$$\hat{p}_{NT} - \hat{p}_T = c[\hat{q}_{Tdom} - \hat{q}_{NTdom}] + d[\hat{q}_{Tcap} - \hat{q}_{NTcap}] \quad \text{(A4)}$$

[18] As γ^T and γ^{NT} are larger than zero and smaller than unity.
[19] As ρ^T and ρ^{NT} are larger than zero and smaller than unity.