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Beyond Balassa and Samuelson: Real Convergence, Capital Flows, and Competitiveness in Greece

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Abstract

We scrutinize the role of capital flows for competitiveness in seven euro-area countries in the context of real convergence and crisis with a specific focus on Greece. The paper extends the seminal Balassa-Samuelson model to include international capital markets. Capital flows are assumed to be able to invert the traditional direction of transmission of real wage increases from the tradable to the non-tradable sector and to cause real wages to increase beyond productivity increases. Panel estimations for the period from 1995 to 2013 show evidence in favour of capital inflow-driven real wage increases in excess of productivity increases in Greece.

JEL-Code: E240, F160, F310, F320.

Keywords: Balassa-Samuelson effect, capital inflows, exchange rate regime, inflation, Estonia, Greece, Latvia, Lithuania, Portugal, Slovenia, Slovak Republic, panel model, productivity differential, wages.

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1. Introduction

Since Greece entered the European Union (EU) in 1981, the country has gone through several periods of economic development. These included Greece's integration into the EU; its preparation for euro introduction; buoyant inflows of capital to the Greek economy preceding and following introduction of the euro; and finally, since 2007, a prolonged financial and economic crisis triggered by the reversal of private capital flows. Whereas per capita income remained fairly stable in the early years after EU accession, it increased by about 50% per capita income (at constant prices) from the mid-1990s up to the onset of the crisis.

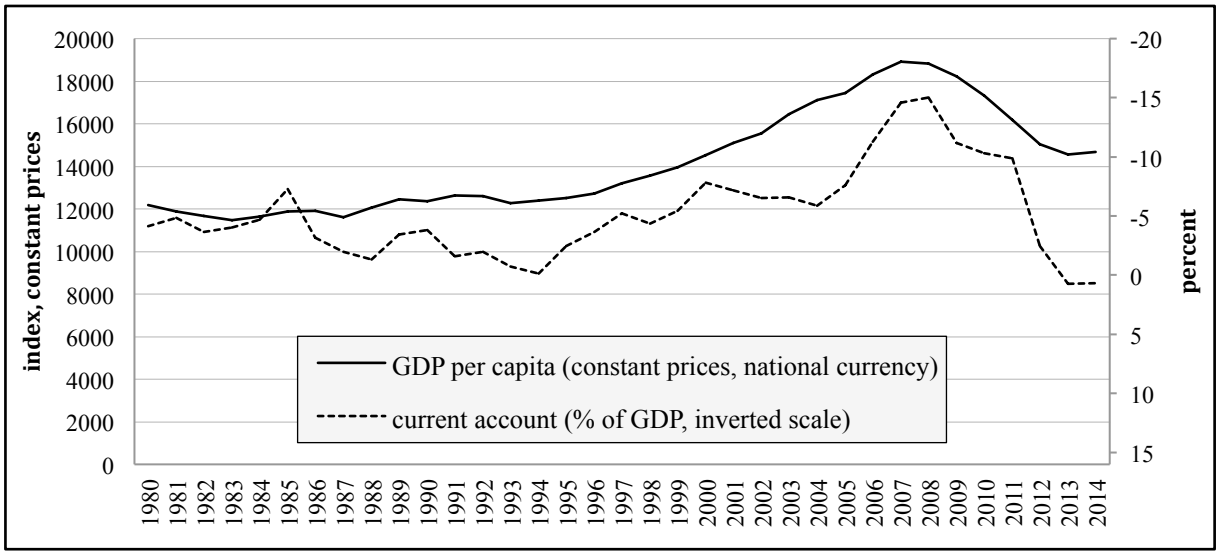
This substantial increase of the standard of living in Greece was accompanied by rising capital inflows as a source of real wage increases. Figure 1 shows the development of GDP per capita (constant prices in national currency) since 1980 and the current account balances as a proxy for net capital inflows. GDP per capita started to increase in the mid-1990s and continued up to the start of the crisis in 2007. It has declined since then.

Over most of the observation period, the current account as a percent of GDP has been negative. Current account deficits and net capital inflows increased from the mid-1990s until the start of the crisis, which suggests a correlation between capital inflows and rising income levels. Since then, a declining current account deficit has been linked to declining GDP per capita. A similar observation can be made for many countries at the periphery of the European (Monetary) Union, where, starting more or less around the turn of the millennium, capital inflows became the source of accelerating increases of wages and income, accompanied by rising government expenditure as well as real estate and stock market booms (Holinski et al. 2012).

This catching-up of income goes beyond the seminal Balassa-Samuelson effect, whose proponents have usually interpreted the economic catch-up process as a dynamic equilibrium

phenomenon in closed economies (Balassa, 1964 and Samuelson, 1964).[1] Domestic saving and capital formation have been regarded as the basis for relative productivity and real wage increases. Implicitly, real wage increases and the resulting real appreciation of the domestic currency leave international competitiveness and the current account balances unchanged, as they are underpinned by the respective productivity increases. However, in Europe, from the mid-1990s on, capital inflows increasingly became the source of substantial relative real wage increases and rising current account deficits (Belke and Dreger 2013). Whereas international credit could have alternatively been used for high-yield investment (which would have ensured credit repayment), rising international debt was instead funnelled ever more frequently into real wage increases that exceeded productivity increases, as well as into speculation in real estate and stock markets.

Figure 1: Income per Capita and Current Account Balance in Greece



Source: IMF: WEO.

After severe crisis revealed the catch-up processes to be unsustainable, new interpretations and extensions of the Balassa-Samuelson effect emerged. According to the seminal Balassa-

[1] According to the Balassa effect, currencies of developing countries tend to be undervalued. The Samuelson effect in turn implies that the economic catch-up process in developing countries and emerging market economies leads to higher inflation rates than in industrial countries.

Samuelson effect, productivity driven real wage increases in the tradable sector lead—via wage arbitrage—to real wage increases in the non-tradable sector. In contrast, Goretti (2008) identifies a process in the Central and Eastern European EU member states a process by which wage increases (driven by capital inflow) in the non-tradable sector are followed (via wage arbitrage) by wage increases in the tradable sector. For Greece, Kyrkilis and Hazakis (2014) identify an "*inverse Balassa-Samuelson*" effect (also called the "*reverse" Balassa Samuelson effect*), in which the non-tradable sector wages seem to have influenced the wages in the tradable sector, eroding the international competitiveness of the Greek tradable sector.[2]

As we will show in this paper, the seminal Balassa-Samuelson effect provides a useful framework to understand wage dynamics in a set of euro-area countries (which before the crisis were considered to be countries that were "catching up") *if it is augmented by capital inflows and the notion of credit-driven real wage increases*. The pre-crisis real appreciation of many currencies inside and outside the euro area was only partially productivity-driven, independent of the direction of causality of wage arbitrage between traded and non-traded goods prices (seminal versus inverse/reverse BS effect). Greek non-tradable prices increased because of strong capital inflows, in particular to the public sector. Non-productivity-based wage increases in the public sector were then transmitted to the private sector, which we call a *"pseudo-Balassa-Samuelson effect*." These overall wage increases were only sustainable as long as capital inflows prevailed.

To put these insights into an analytical framework, we augment the seminal Balassa-Samuelson framework by adding capital markets to assess the determinants of real exchange rate developments in Greece and six other euro-area member countries. Our research builds on estimations of the Balassa-Samuelson effect *for Greece* that have been done in the past without extension by capital flows (for an example, see Gibson and Malley, 2007).

[2] See also Kutasi (2013) for an "inverse" or "reverse" Balassa-Samuelson effect.

2. The Balassa-Samuelson Model and Capital Markets

Previous research has augmented the seminal Balassa-Samuelson supply-side hypothesis (Balassa 1964, Samuelson 1964) by incorporating demand-side effects (Bergstrand 1991) and quality improvements (Égert and Podpiera 2008). The impact of capital inflows has been recently analysed by Belke, Schnabl, and Zemanek (2013), who include capital markets in the model.

2.1 Economic Catch-Up and the Role of Capital Flows

In the seminal Balassa-Samuelson model, productivity increases are explicitly assumed to be exogenous and driven by domestic capital formation. This assumption was realistic for the period of the Bretton-Woods system, in which international private capital flows were heavily restricted. Current account deficits were financed mainly by public funding and were therefore usually small and unsustainable. But starting in the 1990s at the latest, capital markets took on an increasingly important role in the catch-up process of emerging market economies. In less developed economies, capital markets 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.

Table 1: Sectoral Productivity Growth in Greece (Period Averages)

	(1982-1998)	(1999-2007)	(2008-2013)
Tradable Sector	1.20	4.39	-3.92
Non-Tradable Sector	0.58	1.63	-0.80

Source: Own calculations based on data used in Figure 2. *Note:* Prior to 1995, only services are accounted for in the non-tradable sector; thereafter building and construction is added.

Opening up to international capital markets is equivalent to providing a higher supply of capital at a substantially lower interest rate. Portfolio investment and inflows of bank credit

allow for upgrading of domestic production technologies and investment in new production sites. The inflow of FDI is equivalent to upgrading production technologies. In both cases, labour and overall productivity increase. As experienced, for instance, by many Central and Eastern European countries, international capital inflows have been targeting not only the industrial (tradable goods) sector but also the non-tradable sector, for instance, banking or transport and communication (Mencinger 2003). Capital inflows into the region have contributed to productivity increases in both sectors by providing more efficient production technologies and management knowhow.

Figure 2: Average productivity growth in the tradable and non-tradable sector for seven countries

Source: European Commission. Average for all seven countries in the sample (Estonia, Greece, Latvia, Lithuania, Portugal, Slovenia, and the Slovak Republic).

The assumption of Balassa (1964) and Samuelson (1964) that the potential for productivity increases in the tradable goods (industrial) sector is higher than in the non-tradable goods (services) sector is corroborated by empirical evidence for the Central and Eastern European economies (Belke, Schnabl and Zemanek, 2013). This also applies in large part to Greece, as shown in Table 1: From 1982 to 2007, productivity increases were higher in the tradable

sector than in the non-tradable sector. This changed, however, during (after) the crisis, when the decline in productivity became smaller in the non-tradable goods sector than in the tradable goods sector.[3] In addition, for the arithmetic average of all seven countries in our sample, productivity increases in the tradable sector in most years were higher than in the non-tradable sector (see Figure 2).

2.2 Capital-Inflow-Induced Productivity Growth in a Balassa-Samuelson Framework

The seminal Balassa-Samuelson two-country model (Balassa 1964, Samuelson 1964) assumed perfect competition in the tradable goods and national labour markets as represented by purchasing power parity and perfect mobility in national labour markets, but with no international labour mobility. Furthermore, competition between the non-tradable goods sectors of the two countries and between the tradable and non-tradable goods sectors in domestic markets was supposed to be absent. We recall the model augmented with capital-flow-induced productivity increases, as described by Belke, Schnabl and Zemanek (2013).

We assume that the production of tradable and non-tradable goods is based on two Cobb-Douglas production functions for the tradable goods sector *T* and the non-tradable goods sector *NT*. In equation (1) Y^i is the (real) output; A^i represents technology; K^i stands for domestic capital; and L^i is the labour force employed in sector *i*.[4] Θ is a factor which indicates foreign capital invested in the country. An Θ that is larger (smaller) than unity indicates capital inflows (outflows). Therefore, $K^i\Theta^i$ is the overall productive capital stock in sector *i*. In both sectors, output is generated by combining technology, overall capital and labour:

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

[3] In general, over the business cycle, the fluctuations of productivity in the tradable goods sector tend to be larger than in the non-tradable goods sector.

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

Assuming competitive markets and profit maximization, the marginal productivity of labour $\left(1-\gamma^i\right)\frac{Y^i}{L^i}$ 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:

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

By assuming $\tilde{Y}^i=A^i\left(K^i\right)^{\gamma^i}\left(L^i\right)^{1-\gamma^i}$ with $\tilde{Y}^i$ being generated by the domestic capital stock ($\Theta=1$), equation (2) is equivalent to:

$$\left(1-\gamma^i\right)\frac{\widetilde{Y^i}(\Theta^i)^{\gamma^i}}{L^i}=\frac{W^i}{P^i} \tag{3}$$

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

$$c\,\frac{Q^T(\Theta^T)^{\gamma^T}}{Q^{NT}(\Theta^{NT})^{\gamma^{NT}}}=\frac{P^{NT}}{P^T} \tag{4}$$

where $Q^i\left(\Theta^i\right)^{\gamma^i}$ represents the labour productivities in the respective sectors $\left(\frac{\widetilde{Y^i}(\Theta^i)^{\gamma^i}}{L^i}\right)$ and c is a positive[5] constant depending on the weights of tradable and non-tradable goods $\left(\frac{1-\gamma^T}{1-\gamma^{NT}}\right)$ and contingent on capital flows. Taking the first derivation of logs with respect to time, changes in the productivity differential between the tradable and non-tradable goods sectors determine relative price changes between non-tradable and tradable goods. In contrast to Balassa (1964) and Samuelson (1964), in our model, overall relative productivity growth

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

depends not only on productivity growth driven by domestic capital formation $(q^T - q^{NT})$ but also on the productivity growth driven by the change in foreign capital used for production and given the partial production elasticity of capital in the tradable and non-tradable sector $(\gamma^T\theta^T - \gamma^{NT}\theta^{NT})$. The latter term captures the effect of capital inflows on labour productivity. We maintain the assumption that productivity growth is larger in the tradable than in the non-tradable goods sector.

Assuming that overall inflation is a composite of tradable and non-tradable goods with the weights α and $(1-\alpha)$ $(\hat{p} = \alpha\hat{p}^T + (1-\alpha)\hat{p}^{NT})$ the domestic price level is a function of the domestically traded goods price level and the overall productivity growth differential between the tradable and non-tradable goods sectors (based on the domestic capital stock and the change of foreign capital). The impact of prices on international goods markets can be modelled based on the assumption that purchasing power parity holds in goods markets, that is, 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 $\hat{e}$: $(\hat{p}^T = \hat{p}^T_{EA} + \hat{e})$.

This yields equation (5), which can be interpreted as an equation to determine supply-driven inflation, taking into account international goods markets, the exchange rate, and foreign capital inflows. The term $(1-\alpha)$ is a positive constant depending on the weights of tradable and non-tradable goods in the economy and the consumer price index.

$$\hat{p} = \hat{p}^T_{EA} + \hat{e} + (1-\alpha)\lfloor(q^T + \gamma^T\theta) - (q^{NT} + \gamma^{NT}\theta^{NT})\rfloor \qquad (5)$$

According to equation (5), inflation in countries in the process of catching up economically is driven by inflation in the euro-area tradable goods sector (as the main reference market for European countries), exchange rate changes against the euro, and the differential of productivity gains between the tradeable and non-tradable goods sectors. Thereby, overall productivity growth depends on (i) domestically driven productivity growth $\left(q^i\right)$ and (ii)

productivity growth induced by foreign capital inflows (θ^i) such as FDI and investment financed through international bank lending.

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

$$-(\hat{e} - \hat{p}) = (1 - \alpha)[(q^T + \gamma^T\theta) - (q^{NT} + \gamma^{NT}\theta^{NT})] \qquad (6)$$

Based on equation (6), two corner solutions of exchange rate regimes can be distinguished. Under a fixed exchange rate regime $(\hat{e} = 0)$, 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.

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 (6) is driven by the catch-up in productivity. As shown by De Grauwe and Schnabl (2005), this real appreciation can be achieved either by a nominal appreciation of the exchange rate $(-\hat{e})$ or by price increases relative to the euro area $(+\hat{p}\ )$ as assumed by Balassa (1964) and Samuelson (1964). In both cases the current account balance would be unchanged. The real appreciation would be a steady process that reflects relative productivity catch-up but not changes in international competitiveness or in the current account position. Adding international capital markets implies an accelerated steady real appreciation path in the face of capital inflows.

3. Deviations from Productivity-Driven Real Appreciation Due to Capital Flows or: the "Pseudo-Balassa-Samuelson Effect"

Balassa (1964) and Samuelson (1964) assumed implicitly that during the economic catch-up process, productivity growth takes place gradually, without changes in the current account position. Productivity increases in the industrial sector are balanced by relative price increases, 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. In several European countries currently in crisis, the growing pre-crisis current account deficits between 2001 and 2007 are now seen as an indication of (un-)sustainable investment booms, eroded competitiveness, and economic turmoil.[6] In the following, changes in international competitiveness are defined as deviations of the real exchange rate from its productivity-driven equilibrium path as modelled in section 2.2. They are linked to rising current account deficits (declining current account surpluses) and cyclical fluctuations in international capital inflows.

3.1 Capital Inflows and Changes in International Competitiveness: the Inverse Balassa-Samuelson Effect

In the seminal Balassa-Samuelson model, price level increases and—given fixed exchange rates—real appreciations originate from labour productivity growth in the tradable sector. Productivity increases allow for real wage increases in the tradable sector. These real wage increases are translated into wage increases in the non-tradable goods sector via wage competition among sectors. However, empirical evidence shows that the direction of wage and productivity adjustment may change. For instance, Goretti (2008) observed that wage increases in Central and Eastern Europe originated in the non-tradable goods sector and were followed by wage increases in the tradable goods sector. Kutasi (2013) describes this phenomenon, examined in a set of European countries, as a "reverse Balassa-Samuelson

[6] Current account deficits may also indicate inter-temporal consumption smoothing or growth differentials.

effect."

Kyrkilis and Hazakis (2014) identify an "inverse" Balassa-Samuelson effect. They find that in Greece during the run-up to the current crisis, wage increases were initiated in the non-tradable public sector and then transmitted to the tradable sector through wage competition. As productivity in the tradable sector did not increase sufficiently, inflation rose beyond what would have been justified by a catch-up in productivity. The outcome was a real appreciation of the "Greek euro", a rising current account deficit, and, finally, crisis. What is more, Kykilis and Hazakis (2014) see capital inflows as the origin of non-productivity based wage increases.[7]

Goretti (2008) argues that in the Central and Eastern European countries during the pre-2007 period, capital inflows were reflected in privatization receipts as public enterprises were sold to international investors. The privatization receipts allowed for public sector wage increases, which contributed to wage adjustments in the other parts of the non-tradable goods sector and in the tradable goods sector. The wage increase in the tradable goods sectors would then—given constant world market prices—have necessitated productivity increases to maintain international competitiveness. As these productivity increases were not sufficiently implemented, current account positions deteriorated as one step on the way to the current crisis.

Accordingly, capital inflows - that is, international credit-financed spending - can be seen as the main transmission channel for unsustainable wage policies, real appreciation, and rising current account deficits. For instance, as international borrowing allowed the Greek government to pay higher wages in the public (non-tradable goods) sector, the unsustainable wage increases were transmitted to the private sector. Buoyant capital inflows and declining interest rates -particularly in the run-up to the adoption the euro and the period that followed -

[7] See also Grafe and Wyplosz (2007).

triggered quickly rising private indebtedness, particularly through consumption of both tradable goods and non-tradable services. This latter impact raised the wage demands in the local non-tradable sector, which spilled over to the tradable (export) sector. Thus, export competitiveness deteriorated while at the same time local inflation rose, driven by the higher wage costs (Mongelli and Wyplosz 2008).

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 (2), that trade unions in the tradable goods sector of countries in the economic catch-up process do not negotiate wage increases that would exceed productivity increases and world market inflation. In this way, they help to maintain the competitiveness of the domestic export industry (and therefore prevent rising unemployment). In contrast, as shown above, in Greece, wage growth was larger than domestic productivity increases in Greece and other European periphery countries, driven by capital inflows (i.e., through easily available, low-cost public debt issuance on euro capital markets). This is equivalent to a relaxation of the tight closed-economy budget constraint for enterprises, which is constituted by maintaining competitiveness in international markets.

Based on equation (6), the outcome would be that—assuming constant prices for tradable and non-tradable goods in the euro area—the real appreciation of the Greek euro and other European periphery "currencies" is likely to have gone beyond what would be indicated by relative productivity gains.

$$-(\hat{e} - \hat{p}) > (1-\alpha)\lfloor(q^T + \gamma^T\theta^T) - (q^{NT} + \gamma^{NT}\theta^{NT})\rfloor \qquad (7)$$

The consequence of a real appreciation beyond what would be justified by relative productivity increases is deteriorated competitiveness and increasing current account deficits, which have been fuelled by capital inflows.

3.2 Cyclical Fluctuations in Competitiveness

A deviation of the productivity-driven real appreciation path cannot go on forever, as either the underlying investment would turn out to have low or negative profitability or borrowers would start to fear default. Capital inflows that feed wage increases without productivity increases are reversed and competitiveness would have to be restored through 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 international capital markets, buoyant international capital inflows contribute to brisk monetary expansion, fast-rising credit growth, and malinvestment (Schnabl and Hoffmann 2008). In particular, if international capital markets in emerging market economies and euro-area periphery countries are underdeveloped or small, domestic credit conditions can change dramatically when economic sentiment changes and capital flows revert. Then, euphoric investment booms, wage hikes, and real appreciation are followed by severe recessions, real wage cuts, and forced real depreciation. Inflation in Greece not only tended to be higher than in the euro area (as assumed by the Balassa-Samuelson hypothesis) before the crisis, it has also been strongly depressed during the ongoing crisis.[8]

The seminal monetary overinvestment theories by Hayek (1929) and Wicksell (1898) and more recent research by Saxena and Wong (2002) provide theoretical frameworks suitable to explaining capital-market-driven fluctuations in inflation, wages, asset prices, 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

[8] The high weight of volatile items (food, regulated prices) in the consumer basket or indirect tax changes are additional sources of volatile inflation.

between "good" investment, which yields returns above a "natural" equilibrium interest rate,[9] and low-return (speculative) investment, which is induced by an interest rate below the equilibrium (I>S). The profitability of investment is also influenced by wage policies. Real wage increases above the productivity increases ceteris paribus deteriorate the profitability of investment. This contributes to the economic turnaround.

According to the seminal Austrian business cycle theories, malinvestment is triggered when the central bank (Wicksell 1898) or the banking sector (Hayek 1929) keep interest rates below the equilibrium interest rate during an economic upswing. In a financially globalized world, in small economies, capital inflows from highly liquid, low-yield developed capital markets can lead to a decline in interest rates below the equilibrium level. Malinvestment is induced during the economic upswing (boom), for instance, because (international) financial institutions (for instance, in the euro area) compete for borrowing to countries with a high consumption preference, such as Greece and Portugal after the turn of the millennium.

Alternatively, fast-growing investment in real estate or financial sectors may emerge, as it did in Spain and Ireland. Together with declining refinancing costs for banks and lower lending rates for enterprises, the (expected) profitability of the realized investment projects decreases. 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, Pesenti, and Roubini 1999).[10] In this case, domestic financial institutions tend to lend 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, as was the case in Greece and Portugal. The positive economic

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

[10] The IMF and the European Institutions became lenders of last resort in some Central and Eastern European as well as the southern European countries during the current crisis.

expectations can well be transmitted to asset markets, where speculation may set in (Schumpeter 1912) (as was also the case in Spain, Ireland, and many Central and Eastern European countries).[11] With credit growth becoming speculative (as seems to have happened in many European periphery countries), productivity increases slow down. The marginal return of investment is undermined by real wage increases beyond productivity increases (as shown in Figure 1). Finally, consumer price inflation accelerates, which usually also reflects fast-rising wages.

Such boom-and-bust cycles have been observed frequently in emerging markets since the mid-1990s. In practice, although malinvestment may be difficult to identify ex ante, it can be linked to buoyant capital inflows. Inflation and wages rise above levels that are justified by productivity growth, as observed in Greece before the recent crisis. Moreover, Lane and Perotti (1998), Beetsma, Giuliodori, and Klaassen (2008), and Benetrix and Lane (2009) find that the increasing public spending in the euro-zone countries shifted the demand towards the non-tradable sectors, which contributed to wage increases. When the crisis hit, the reversal of capital flows triggered the dismantling of investment projects as well as nominal exchange rate depreciations and/or wage austerity, that is, internal depreciation.

This implies a cyclical movement of inflation, wage increases, and thereby of the real exchange. During the boom, wages increase beyond productivity increases, driven by international credit. This leads to real appreciation, which erodes international competitiveness. The outcome is rising current account deficits (as an indicator of unsustainable credit-financed wage policies). In this context, the direction of wage transmission from the tradable to the non-tradable sector can be reverted. When the crisis hits, the reversal of capital flows forces countries such as Greece into real wage cuts (possibly below productivity levels). This results in declining inflation and a real depreciation of the

[11] Given underdeveloped capital markets in many European periphery countries, the speculation activities are focused on the real estate market.

currency. The current account balances improve, as observed in many European crisis countries (including Greece and Portugal) since the outbreak of the crisis in 2007/2008. This adjustment process during the crisis may be attenuated by the substitution of private capital inflows by public capital inflows (i.e., rescue packages).

4. Empirical Analysis

In sections 2 and 3 we have argued that relative productivity changes during the economic catch-up process may originate in domestic capital formation as well as in capital inflows. Previous empirical research on the Balassa-Samuelson effect—for instance, in Central and Eastern Europe—has focused mainly on the seminal goods-market-based model. We aim to extend this research by controlling for capital inflows with a focus on Greece.

4.1 Data and Estimation Framework

We empirically test our model as formulated in equation (5), which explains consumer price inflation in European periphery countries by inflation in the euro-area tradable goods sector, variations of the nominal exchange rate, relative productivity changes in the tradable and non-tradable sectors, as well as capital inflows. We base our empirical analysis on a dynamic panel of annual data for seven euro-area member countries (Estonia, Greece, Latvia, Lithuania, Portugal, Slovenia, and the Slovak Republic) in the context of real convergence and crisis, with a specific focus on Greece. Our data set covers the period from 1995 to 2013 based on yearly data. The data prior to the year 1995 are fragmented or distorted by crisis. We are aware of the fact that the degrees of freedom are low, but quarterly data are not available for sectoral productivities.

Main data sources are the IMF-IFS Database, the AMECO Database of the European Commission, and Eurostat. Annual consumer price inflation data is taken from the IMF-IFS database. For euro-area tradable goods inflation, we use producer price inflation (PPI) of the

euro area as a proxy. For our exchange rate variable, we obtained for each country the nominal effective exchange rate based on 42 trading partners. Given eq. (5), we expect that a nominal appreciation (depreciation) lowers (increases) domestic inflation in the countries in our sample.

We construct productivity growth data for the tradable and non-tradable goods sectors from sectoral data on gross value added per person employed at constant prices (provided by the European Commission's AMECO database). The sectors agriculture, forestry, and fishery products and industry excluding building and construction are merged with the tradable goods sector by weighting them by the share of people employed in each sector. The non-tradable goods sector consists of the employment-weighted sectors services and building and construction. Then changes (growth rates) over time are computed.

To control for the impact of capital inflows on inflation, we use several proxies for capital inflows: the financial account balance as percent of GDP, the current account balance as percent of GDP (as proxy of recorded and unrecorded private and public capital flows), FDI inflows in percent of GDP, changes in foreign claims of domestic banks[12], and real interest rate changes.[13]

We base our empirical estimation on the theoretical framework as summarized in equation (5). We are not able to distinguish between domestically-driven and capital-inflow-induced productivity growth. Additionally to the inflation equation (5), we account for inflation persistence by including an autoregressive term with the coefficient β_1. The inflation persistence term accounts for rigid prices (see, e.g., Cuestas and Harrison 2010, Égert 2010). Further, we control for additional determinants of inflation indicated by the vector Γ, which

[12] BIS data on consolidated foreign claims of a country's reporting banks.

[13] As capital flows in, real interest rates are expected to fall. Real exchange rates are determined by inflation, which is our dependent variable. However, correlation between inflation and change of real interest rates is moderate with a correlation coefficient of 0.45.

includes commodity prices[14] and real GDP growth. The coefficient β_2 captures the impact of euro-area tradable goods prices on inflation, whereas β_3 measures the influence of exchange rate movements. The coefficient β_4 captures the seminal Balassa-Samuelson effect on inflation, based on overall productivity growth as proxy for relative productivity growth. The capital inflow proxy *K* is added as a separate variable and controls for inflation, which is purely driven by capital inflows without being backed by productivity growth (β_5).

We use equation (8) for our panel estimation, where *t* indicates the time index, while the index *i* refers to the respective country. Variable γ_i represents the country-specific fixed effect to account for structural country differences and $\mu_{i,t}$ is the white noise error term:

$$\hat{p}_{i,t} = \beta_1 \hat{p}_{i,t-1} + \beta_2 \hat{p}^T_{i,t} + \beta_3 \hat{e}_{i,t} + \beta_4 (q^T - q^{NT})_{i,t} + \beta_5 K_{i,t} + \beta_\Gamma \Gamma + \gamma_i + \mu_{i,t} \quad (8)$$

The seminal Balassa-Samuelson effect (increasing productivity) is contrasted with "solely inflation-increasing capital inflows" (real wage increases in excess of productivity increases, pseudo-Balassa-Samuelson effect). If the coefficient β_4 is significant, there is evidence for the (seminal) Balassa-Samuelson effect, (which can be caused either by domestic capital accumulation or capital inflows). If only the coefficient β_5 is significant, inflation is simply driven by capital inflows (pseudo-Balassa-Samuelson effect) and the seminal productivity-based Balassa-Samuelson effect does not exist. Notably, for Greece, the seminal Balassa-Samuelson effect effect (β_4) is expected to turn out to be insignificant and capital inflows should be significantly linked to inflation (β_5). However, we cannot estimate a Greece-specific single equation, because data are annual and nearly 20 data points are not sufficient due to a severe lack of degrees of freedom. Hence, in the panel context: if Greece is excluded from the panel and the results for the remaining cross-sections shift towards significance of of

[14] We use the change in an overall commodity index (DJ UBS-Future Commodity) as well as crude oil prices (Crude Oil-Brent FOB).

β_4 and non-significance of β_5 the pseudo-Balassa-Samuelson effect is assumed to be confirmed for Greece.

As we include a lagged dependent variable in our panel estimation, we have to account for the Nickell bias, which appears in dynamic panels with a short time dimension (Nickell 1981). The standard approach is to use an estimation method based on Arellano and Bond (1991). We, furthermore, account for our small number of cross-sections and use the bias-corrected fixed effect least square dummy variable (LSDVC) estimator. The bias is approximated by an iteration method (Bruno 2005), which is based on the standard Arellano-Bond estimator (Arellano and Bond 1991). Panel unit-root tests do, in general, reject non-stationarity of the levels of our time series.

Recall that our country sample comprises seven countries (Estonia, Greece, Latvia, Lithuania, Portugal, Slovenia, and the Slovak Republic). The panel estimation equations include a trend and a crisis dummy (1 for 2008 to 2013, 0 otherwise) as explanatory variables. Based on annual data, our estimation period ranges from 1995 to 2013. We also experiment with an interaction variable, interacting the crisis and the BS effect. We employ, alternatively, five different proxies of capital inflows.

4.2 Estimation Results

Table 2 displays the results for a sequence of LSDVC baseline estimations based on different specifications of the variable set, but without controlling for capital flows, using weighted relative productivity growth and not taking the financial crisis into account. The econometric evidence in favour of the seminal Balassa-Samuelson effect as formulated in equation (5) turns out to be weak, as the coefficient β_4 is not statistically significant. The estimated coefficients of inflation persistence (β_1) and of EMU producer price inflation (PPI) (β_2) are significant at the common levels and have the expected signs. The

coefficients of PPI are smaller than unity, indicating an incomplete pass-through from tradable prices to domestic prices. Commodity prices are significant with the expected sign only in specification (1). [15] The coefficient for expected exchange rate changes β_3 has the expected sign, but remains insignificant. GDP growth and changes of the effective exchange rate do, on average, not have a significant impact on inflation. Furthermore, we have specified a normal and a quadratic time trend as well as a crisis dummy, which is equal to 1 for the period 2008 – 2013, to control for potential time and crisis effects on inflation.

Table 2: Results Estimated with a Corrected Least Squares Dummy Variable Estimator

Dependent variable: Inflation							
		1	2	3	4	5	6
Inflation (t-1)	$ß_1$	0.592***	0.588***	0.587***	0.611***	0.614***	0.612***
		(0.035)	(0.051)	(0.050)	(0.048)	(0.047)	(0.046)
GDP growth	$ß_{\Gamma,1}$	0.018		-0.011		0.020	0.009
		(0.045)		(0.043)		(0.045)	(0.044)
Commodity price inflation	$ß_{\Gamma,2}$	0.025***		0.005			0.006
		(0.004)		(0.004)			(0.004)
EMU producer price inflation	$ß_2$		0.506***	0.438***	0.536***	0.525***	0.446***
			(0.082)	(0.087)	(0.078)	(0.083)	(0.086)
Effective exchange rate changes	$ß_3$		0.014	0.011	0.018	0.014	0.012
			(0.026)	(0.025)	(0.032)	(0.030)	(0.030)
Relative productivity growth	$ß_4$				0.104	0.105	0.108
					(0.075)	(0.077)	(0.078)
Observations		126	126	126	126	126	126
Countries		7	7	7	7	7	7

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Bootstrapped standard errors in parentheses. A normal and quadratic trend is included to control for time effects. To control for the effects of the crisis on inflation, a crisis dummy equal to one from 2008 onwards is included.

In a second step, we add the different proxies for capital inflows. The respective results are provided in Table 3. The standard Balassa-Samuelson effect remains insignificant throughout all specifications. The results concerning the impact of PPI, exchange rate changes, GDP growth and commodity price inflation remain widely unchanged. The results for the capital inflow proxies are mixed. Capital flows approximated by the current account balance and financial account balance show an inflation-increasing effect, while FDI inflows relative to

[15] Using oil prices instead of a commodity price index produces similar results.

GDP, foreign liabilities of banks, and real interest rate changes remain insignificant. Thus, the estimations provide partial evidence in favour of capital-inflow-driven inflation.

Table 3: Capital Inflows as Additional Inflation Determinants

		Dependent variable: Inflation				
		1	2	3	4	5
Inflation (t-1)	$ß_1$	0.610***	0.587***	0.637***	0.622***	0.601***
		(0.043)	(0.047)	(0.053)	(0.040)	(0.049)
GDP Growth	$ß_{\Gamma,1}$	0.002	-0.039	0.030	0.018	-0.026
		(0.015)	(0.039)	(0.116)	(0.051)	(0.113)
Commodity price inflation	$ß_{\Gamma,2}$	0.006*	0.008**	0.006	0.006	0.008
		(0.004)	(0.004)	(0.009)	(0.004)	(0.010)
EMU producer price inflation	$ß_2$	0.445***	0.378***	0.437**	0.451***	0.433*
		(0.085)	(0.086)	(0.196)	(0.085)	(0.222)
Effective exchange rate changes	$ß_3$	0.012	0.018	0.020	0.008	0.026
		(0.029)	(0.029)	(0.067)	(0.032)	(0.089)
Relative productivity growth	$ß_4$	0.105	0.099	0.107	0.113	0.085
		(0.078)	(0.075)	(0.093)	(0.083)	(0.054)
(- 1) * Current account balance	$ß_5$	0.063***				
		(0.015)				
Financial account balance	$ß_5$		0.125***			
			(0.019)			
FDI inflows relative to GDP	$ß_5$			0.005		
				(0.087)		
Change of foreign claims of domestic banks	$ß_5$				-0.005	
					(0.011)	
Real interest rate changes	$ß_5$					-0.043
						(0.078)
Observations		126	126	122	126	112
Countries		7	7	7	7	7

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Bootstrapped standard errors in parentheses. A normal and quadratic trend is included to control for time effects. To control for the effects of the crisis on inflation, a crisis dummy equal to one from 2008 onwards is included.

As the next step, we exclude Greece from our country sample in order get an impression of the Greece-specific impact on the overall results and re-estimate the specifications contained in Table 3. The results can be found in Table 4. Most importantly, the coefficient measuring the BS effect, β_4 turns positive and significant in all but the last specification and β_5 becomes insignificant in four out of five cases. This provides evidence of a pseudo-Balassa-Samuelson effect being particularly strong in Greece.

On the whole, we thus feel justified in summarizing our results as follows, with the following setting in accordance with the goodness-of-fit indicators. The country sample comprises seven countries (Estonia, Greece, Latvia, Lithuania, Portugal, Slovenia, and the Slovak Republic).

Our estimation period covers the period from 1995 to 2013. The best-fitting panel estimation equations include a trend and a crisis dummy (1 for 2008 to 2013, 0 otherwise) as explanatory variables. We employ, alternatively, five different proxies of capital inflows (we dropped some others such as available credit simply because its time span is too short).

Table 4: Estimations for a Sample Without Greece

		Dependent variable: Inflation				
		1	2	3	4	5
Inflation (t-1)	$ß_1$	0.614***	0.585***	0.638***	0.623***	0.611***
		(0.047)	(0.040)	(0.071)	(0.027)	(0.052)
GDP growth	$ß_{\Gamma,1}$	-0.012	-0.086	0.013	0.002	-0.067
		(0.133)	(0.122)	(0.161)	(0.112)	(0.094)
Commodity price inflation	$ß_{\Gamma,2}$	0.006	0.008	0.006	0.006	0.007
		(0.007)	(0.006)	(0.007)	(0.007)	(0.012)
EMU producer price inflation	$ß_2$	0.522***	0.453***	0.509**	0.526***	0.547***
		(0.126)	(0.130)	(0.228)	(0.126)	(0.206)
Effective exchange rate changes	$ß_3$	0.003	0.017	0.016	-0.000	0.021
		(0.071)	(0.066)	(0.056)	(0.072)	(0.035)
Relative productivity growth	$ß_4$	0.118**	0.104**	0.122***	0.127**	0.089
		(0.053)	(0.051)	(0.046)	(0.052)	(0.060)
(- 1) * Current account balance	$ß_5$	0.069				
		(0.055)				
Financial account balance	$ß_5$		0.145**			
			(0.072)			
FDI inflows relative to GDP	$ß_5$			-0.001		
				(0.083)		
Change of foreign claims of domestic banks	$ß_5$				-0.005	
					(0.014)	
Real interest rate changes	$ß_5$					-0.070
						(0.047)
Observations		108	108	107	108	94
Countries		6	6	6	6	6

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Bootstrapped standard errors in parentheses. A normal and quadratic trend is included to control for time effects. To control for the effects of the crisis on inflation, a crisis dummy equal to one from 2008 onwards is included.

From this exercise, the following main results emerge. In a sample containing all seven countries and basic determinants as GDP growth, exchange rate effects, and other inflation proxies, one does not find the coefficients that would correspond with our main hypotheses as significant. However, if further determinants that capture capital inflows, as shown in Table 3, are added, β_4 is not significant but, at least partially, the capital inflow proxies (β_5). Interestingly, without Greece, the results turn into roughly the opposite: The coefficient measuring the BS effect, β_4 turns significant and positive and β_5 becomes insignificant.

5. Conclusions

A set of peripheral euro-area member countries faced (and still face) the challenges of achieving low inflation and nominal exchange rate stability during their real convergence process. Although the uncertainty concerning the scope and transmission channels of the Balassa-Samuelson effect remains high, the countries under investigation in this paper (Estonia, Greece, Latvia, Lithuania, Portugal, Slovenia, and the Slovak Republic) on average experienced higher inflation than the core euro area before the crisis. As a result - given mostly tight pegs to the euro - all these countries have, up to the crisis, embarked to some extent on real appreciation. From this point of view, the empirical evidence in favour of a Balassa-Samuelson effect and other reinforcing effects appears to be strong.

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

Our empirical analysis confirms the seminal Balassa-Samuelson effect but, if Greece is included, only to the extent that capital inflows are an important determinant of inflation. Generalised for the whole country sample, this impact may cover both capital inflows that contribute to productivity-driven inflation as well as capital inflows that are translated directly into inflation and are not backed by respective productivity gains. Our estimation efforts can be seen as an approach to also capture the cyclical capital inflows that contribute to non-productivity-backed inflation and therefore to a structural loss in competitiveness.

To summarise, our best-fitting panel estimation equations include a trend and a crisis dummy. Including Greece in the country sample, β_4 is not significant but, at least partially, the capital

inflow proxies (β_5) are. Without Greece, the results roughly turn into the opposite: the coefficient measuring the Balassa-Samuelson effect, β_4, turns significant and positive and β_5 becomes insignificant. This finding overall indicates that the pseudo-Balassa-Samuelson effect has been highly significant for Greece.

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