



**European Bank**  
for Reconstruction and Development

# The determinants of real exchange rates in transition economies

**Dan Meshulam and Peter Sanfey**

## **Abstract**

Real exchange rates in the transition region have been relatively volatile over the past two decades, with major variation across countries and over time. In most countries, there was a shift between the pre-global crisis period, when the region saw significant real appreciation of currencies, and the post-crisis period during which real exchange rates have been mostly stable or depreciating. In broad terms, real exchange rates have tended to move in line with GDP growth and productivity rates, albeit with important exceptions. Our empirical results show some support for the traditional Balassa-Samuelson hypothesis, according to which real appreciation is driven by productivity differentials in the traded goods sector. Other factors, including government consumption, terms of trade, and capital inflows, do not seem to be significant drivers of real exchange rate movements.

---

Keywords: Real exchange rates, Balassa-Samuelson, transition economies

JEL Classification Number: F31, P2

Contact details: Dan Meshulam, EBRD, One Exchange Square, London EC2A 2JN, United Kingdom

Phone: +44 20 7338 6271; Email: [MeshulaD@ebrd.com](mailto:MeshulaD@ebrd.com)

Peter Sanfey, EBRD, One Exchange Square, London EC2A 2JN, United Kingdom

Phone +44 20 7338 6227; Email [SanfeyP@ebrd.com](mailto:SanfeyP@ebrd.com).

Dan Meshulam is intern and Peter Sanfey Deputy Director of Country Economics and Policy in the Department of Economics, Policy and Governance at the EBRD.

---

The authors thank Sanja Borkovic, Dimitris Georgiou, Heather Gibson, Hans Holzacker, Roger Kelly, Zsoka Koczan, Philipp Paetzold, Alexander Plekhanov and Mateusz Szczurek for helpful comments and suggestions.

|   |
|---|
| <p>The working paper series has been produced to stimulate debate on economic transition and development. Views presented are those of the authors and not necessarily of the EBRD.</p> |
|---|

## 1. Introduction

The real exchange rate of a country is an important macroeconomic variable that contains valuable information on competitiveness and economic performance. How should it be measured, and what are the main drivers of differences across countries and movements over time? There is a vast literature that addresses these questions for advanced economies, and a growing literature for emerging market economies. To date, however, little has been published on real exchange rate developments in the transition region. Empirical tests have been hampered by the relatively short time series of liberalised, market-driven prices and exchange rates. But transition has been under way for more than 25 years in most former socialist countries of central and eastern Europe and the former Soviet Union. The time is ripe, therefore, to take a close look at real exchange rate movements over time in the region and to estimate empirically the extent to which these fluctuations are driven by other macroeconomic variables.

The real exchange rate is defined as the relative price of domestic products in terms of foreign products. It is calculated by multiplying the nominal exchange rate by the ratio between price levels in two countries, commonly measured by the CPI index based in the same year. That is, the real exchange rate (RER) is calculated by taking the nominal exchange rate (the price of one unit of foreign currency in the domestic currency,  $NER_{d/f}$ ) and multiplying by the foreign price level ( $P^f$ ) divided by the domestic price level ( $P^d$ ):

$$RER = NER_{d/f} * \frac{P^f}{P^d} \quad (1)$$

In theory, if two countries trade freely with no transportation costs or other trade barriers, the prices of identical goods in the domestic and foreign economies should be equal, stated in their own currencies. As a result, the nominal exchange rate would be the ratio of price levels between the two economies, and the real exchange rate would be equal to one. But factors such as trade barriers, transportation costs, changing government policies and others can cause sometimes large changes in real exchange rates.

Real exchange rate movements can also be driven by differences in productivity growth across countries. A standard theory in international economics links changes in real exchange rates with technological progress and productivity increases, using a distinction between tradable and non-tradable goods. Commonly known as the Balassa-Samuelson effect, the theory states that low income countries that are converging towards more advanced economies will see their currencies appreciating in real terms.<sup>1</sup> The reason is that the catching up process is driven mainly by technological innovation and productivity gains (from low levels) that mostly occur in the tradable sector. Growing prosperity then spills over to the non-tradable sector through wage growth and other price rises, causing inflation and/or nominal exchange rate appreciation in the whole economy above that of partner countries.

A glance at the data in the transition region provides some *a priori* support for the Balassa-Samuelson hypothesis. The years leading up to the global crisis in 2008-09 were marked by strong productivity gains associated with the wholesale restructuring of economies from being state-run to a system based much more on market principles.<sup>2</sup> Real exchange rates appreciated significantly over this period in most cases. In central Europe and the Baltic

---

<sup>1</sup> See Balassa (1964) and Samuelson (1964).

<sup>2</sup> Growth in the transition region prior to the global crisis was predominantly driven by productivity gains, in contrast with other emerging market regions – see EBRD (2013).

states (CEB), average real appreciation over the period 1997-2008 was 40 per cent, and in south-eastern Europe (SEE) it was 41 per cent. The picture was more mixed elsewhere in the region, with real appreciation in some countries but depreciation in others. The global crisis brought these trends to an end. Productivity gains have been greatly reduced since then and currencies have largely remained flat or declining in real terms, albeit with some exceptions.

We use panel data econometrics to test the Balassa-Samuelson hypothesis more formally in 37 countries, covering both the transition region and countries in the Southern and Eastern Mediterranean (SEMED) where the European Bank for Reconstruction and Development (EBRD) currently operates. Using sectoral and aggregate data, we find some support in CEB and SEE countries for the theory that real exchange rate appreciation is driven by productivity differentials, relative to the OECD average, in the traded goods sectors. In Eastern Europe and the Caucasus (EEC), central Asia and SEMED, however, it is difficult to see a clear link between productivity and real exchange rates, probably because many of these countries have seen large movements in the nominal exchange rate in certain years. We test the impact of demand variables such as government consumption, terms of trade and capital inflows, but in all regions we find it to be limited or non-existent.

## 2. Measuring the real exchange rate

A country's real exchange rate index can be calculated in different ways. A crude measure is simply to multiply the country's nominal exchange rate vis-à-vis a major currency (the euro or the dollar, say) by the price ratio between the country's CPI and that of the eurozone or US.<sup>3</sup> This is a useful rule of thumb measure but has the obvious drawback that it does not take into account the trading relationships an individual country has with others. A more sophisticated measure, therefore, is the real *effective* exchange rate (REER), which is the average value of bilateral RER's, weighted by the trade share between a given country and each of its trade partners. In this paper, we measure the REER for all countries in the EBRD region with the exception of Kosovo, for which appropriate trade data from the usual sources are limited or non-existent.

The first decision required when calculating the real exchange rate is the choice of price deflator. The popularity of the CPI is mainly due to its wide availability, yet its use as a measure of competitiveness in foreign trade is sometimes questioned. Changes in CPI differentials are mainly affected by variations in prices in the non-traded goods sector, with which the domestic economy does not compete internationally. An alternative is to use unit labour costs (ULC) as the price deflator to better reflect changes in the competitive stance of the economy, as real appreciation based on this measure would directly match an increase in local production costs. The main problem with ULC and other price measures, however, is missing data for many countries, especially in our regions of interest. For this reason, in this paper we will use the CPI as our measure of price deflator, as is done in most studies in this area.

Calculating the REER requires making additional important decisions with regard to the weighting methodology. We need to identify the major trade partners for each country, establish the weighting scheme, and allow for changes in trade patterns throughout the

---

<sup>3</sup> An alternative definition, which we will not use in this paper, looks at the "domestic" real exchange rate, as the ratio between the price levels of tradable to non-tradable goods within the economy. This ratio reflects the RER if the law of one price holds for tradable goods.

period. In this paper we proceed as follows: for each country, we first draw up a list of its main trade partners, using trade flow data from the International Monetary Fund (IMF). The list comprises all countries with a share of over one per cent of total trade with that country, based on total trade figures which aggregate both imports and exports. In general, for all EBRD countries of operations, the countries on the trade-partners list represent 70 to 90 per cent of total trade. The weights are then calculated as the share of each trade partner within each country's sample.

We then allow for the fact that the weights change each year. However, in order to smooth the changes in trade volumes and avoid large variation between two periods, the trade shares between countries are calculated as a moving average of the previous three years.<sup>4</sup> We also treat the Euro area, which is the dominant trade partner for many of the countries in the region, as one entity, which is given a weight based on each country's aggregate share of trade with all euro area countries, and using the average eurozone inflation figures.

The nominal exchange rates are taken from Bloomberg, with each bilateral exchange rate calculated versus the main trade partners. In those cases where data from Bloomberg were not available we use the exchange rate against the US dollar as a bridge between every pair of currencies. Exchange rates are calculated as yearly averages. IMF data on annual average inflation are used as the measure of price changes in all countries. The real exchange rate index is then derived using equation (1) above, and normalised to 100 in the year 1997, the first year of our sample.<sup>5</sup> The real effective exchange rates are calculated as a geometric weighted average of the bilateral RER's. When moving between periods, we use a "chain-linking" method to ensure that the change in the index reflects actual changes in the RER and not merely changes in weights.<sup>6</sup>

### **3. Real exchange rate developments in the transition region**

A glance at the data shows the wide variation in the real exchange rate, both across countries and, within each country, across time. Summary regional charts are discussed below; individual country charts are in Annex 1.<sup>7</sup> Note that the country charts in the annex also include, where available, REERs calculated by other institutions such as the IMF and Bank for International Settlements (BIS). Reassuringly, the alternative measures are in all cases very similar to the ones we calculate and use in this paper.

Looking first at the entire sample period, between the years 1997 and 2017, the EBRD regions can generally be divided into two broad groups. In central Europe and the Baltic states (CEB) and in south-eastern Europe (SEE), there was an overall average cumulative real appreciation of 31 and 34 per cent (chart 1), respectively, where the regional average is weighted by total global trade volume. Out of these countries, the largest appreciation was in the Slovak Republic, of 75 per cent, in Bulgaria (60 per cent) and in Albania and Estonia, where real cumulative appreciation in both cases was 57 per cent. Latvia, Lithuania and

---

<sup>4</sup> The Bank for International Settlements uses a slightly different approach and assigns three-year average trade weights. See Klau and Fung (2006) for details of this methodology.

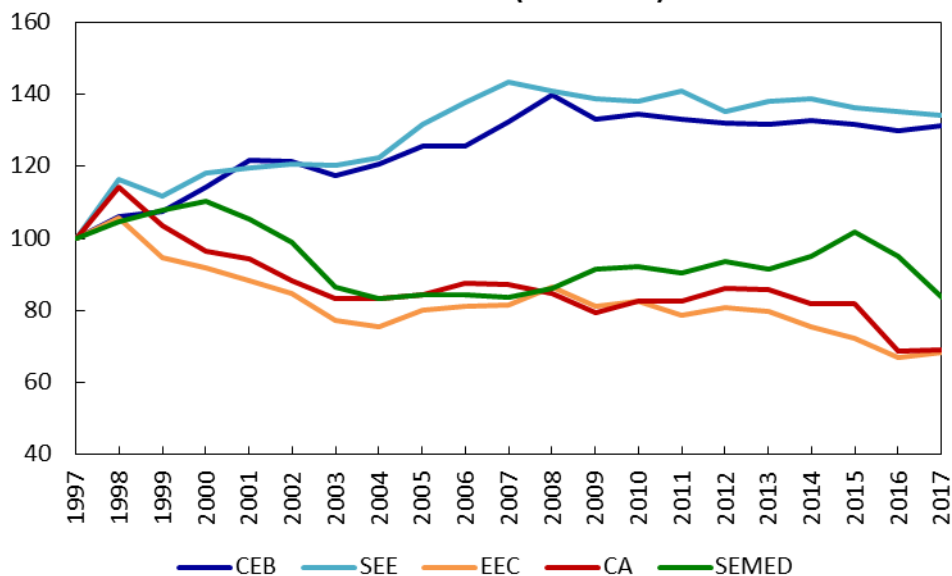
<sup>5</sup> We do not go further back than 1997, as the first years of transition were marked by major structural changes, which contributed to high volatility in exchange rates and productivity.

<sup>6</sup> See Ellis (2001) for details of this methodology.

<sup>7</sup> In the following charts and analysis, an increase in the REER index marks real appreciation

Romania also experienced overall real appreciation of over 40 per cent during this time period.

**Chart 1**  
**Average real effective exchange rate developments,**  
**1997 to 2017 (1997=100)**



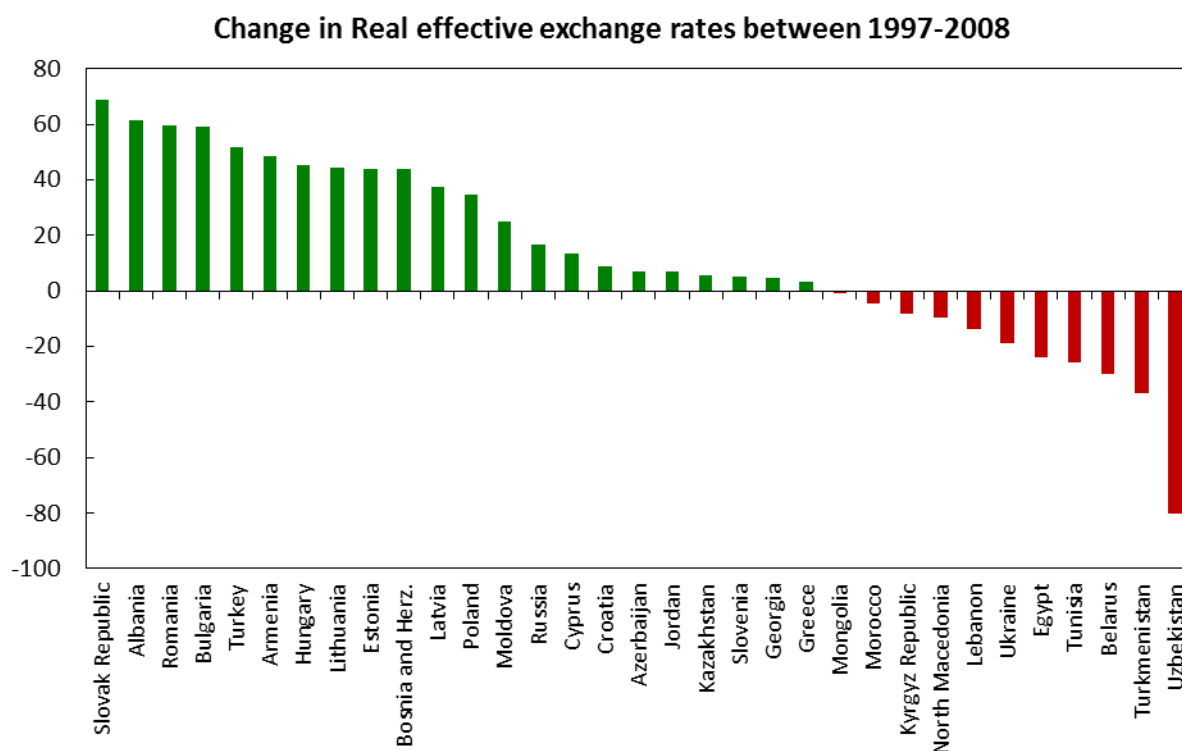
Source: Bloomberg, International Monetary Fund and authors' calculations.

Note: Serbia and Montenegro are not included in the regional average due to incomplete data.

In contrast, the group comprising eastern Europe and the Caucasus (EEC), Central Asia, and the southern and eastern Mediterranean (SEMED) saw average real depreciation of 15-30 per cent during the same time period. However, there were notable differences within this group of countries. While Ukraine, Belarus and Uzbekistan's currencies depreciated in real terms by 43, 49 and 86 per cent respectively, Armenia and Moldova experienced real appreciation of 45 and 42 per cent respectively. Data on several central Asian countries must be treated with caution because of the wide divergence over many years between the official and the market exchange rate. Variation between countries was also significant in SEMED: Egypt had real depreciation of 45 per cent and Tunisia of 37 per cent, while Jordan's currency appreciated in real terms by 20 per cent.

An examination of developments through time reveals two distinctive patterns. In the years leading up to the global financial crisis (1997-2008), almost all countries outside the SEMED region saw real appreciation (chart 2). On average, CEB countries appreciated during these years by 40 per cent and SEE by 41 per cent. Much of the appreciation took place in the last three years of the 1990s. In EEC and Central Asia the regional averages are largely affected by significant depreciations in Uzbekistan, Turkmenistan and Belarus. Yet some of the countries in these regions, such as Armenia and Moldova, also saw sizeable appreciation in the first decade of our period. Smaller appreciations took place in Azerbaijan, Georgia and Kazakhstan. In SEMED during those years, average real depreciation was 20 per cent, driven mainly by Egypt, Tunisia and Lebanon. Turkey's real exchange rate rose by 50 per cent between 1997 and 2008, despite a major nominal devaluation in February 2001.

Chart 2

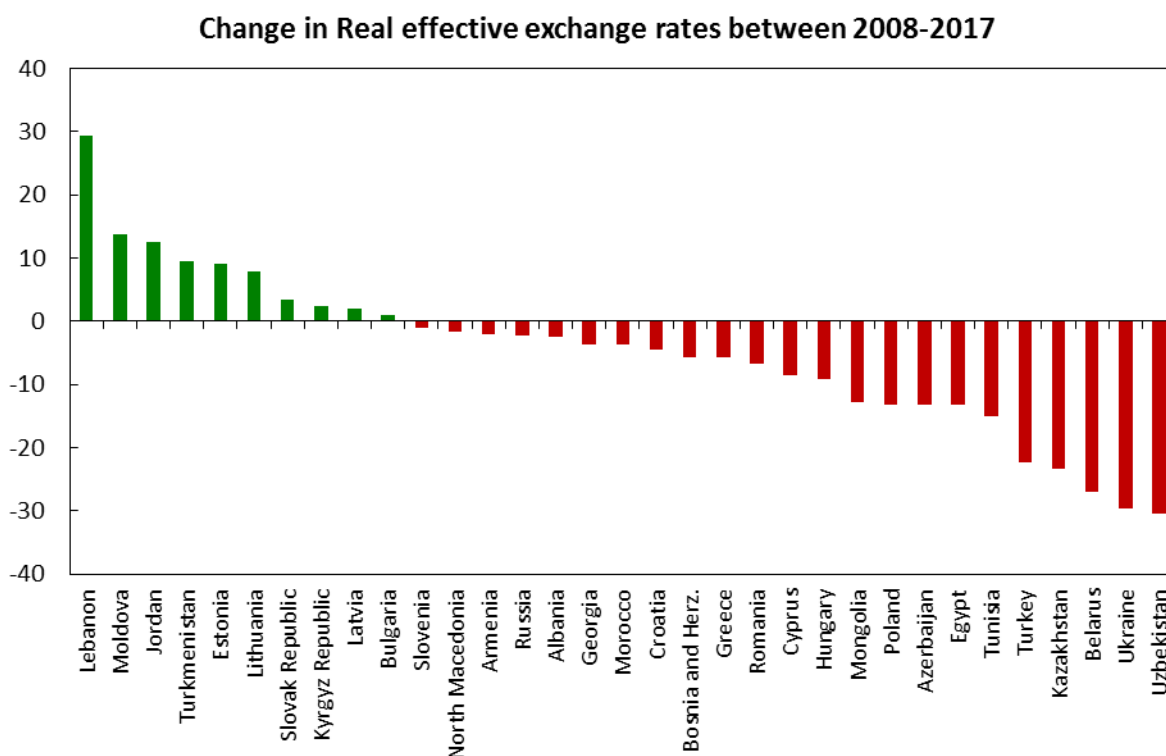


Source: Bloomberg, International Monetary Fund and authors' calculations.

In the years that followed the crisis, real appreciation levels were much lower, and many countries faced sizeable depreciation (chart 3). The largest depreciations were in eastern Europe, the Caucasus, Central Asia and Turkey, where real effective exchange rates decreased by around 20 per cent on average. Real appreciation continued during that time in Estonia, Lithuania and Moldova, but at much less significant levels than pre-crisis, and the regional averages of the index in CEB and SEE countries ended up in 2017 at close to their 2009 levels.

In SEMED, however, developments were different, and the REER was apparently less affected by the financial crisis. Egypt faced sizeable depreciation in the first four years of the last decade, followed by continuous appreciation which lasted until 2015, before giving way to further real exchange rate decreases after the nominal devaluation in November 2016. Jordan and Lebanon have experienced significant appreciation since 2011, while Morocco and Tunisia faced ongoing depreciations throughout most of the period.

Chart 3



Source: Bloomberg, International Monetary Fund and authors' calculations.

In Russia, Azerbaijan and, to some extent, Kazakhstan, real appreciation continued well after the financial crisis, until large depreciation started in 2014, most likely related to the sharp decrease in oil prices.

In summary, the developments in real exchange rates over time in CEB and SEE, and in particular the shifting patterns between the pre- and post-crisis periods, are broadly consistent with the view that they are at least partly driven by productivity improvements and economic growth. Elsewhere, the picture is more mixed and it is difficult to see a clear pattern linking the real exchange rate with productivity. The following sections report rigorous tests of the relationship between real exchange rates and productivity movements, and examine whether other factors are also influencing the real exchange rate in a systematic way.

#### 4. The Determinants of Real Exchange Rates

##### *Productivity differentials*

As noted earlier, one of the most common explanations for real exchange rate movements is the Balassa-Samuelson effect, which highlights the link between productivity in the tradable sector and real appreciation. According to the simplifying assumptions of this theory, the local economy produces two types of goods – tradables and non-tradables. While prices of tradable goods are determined in the international markets, local demand factors determine the supply of non-tradables. Other important assumptions of the theory are: equal wages

between the two sectors, a frictionless labour market which enables workers to move freely between them, an internationally-determined interest rate and free movement of capital between countries.

Given these assumptions, real appreciation is the result of the following dynamics. Productivity gains in the production of tradable goods increase the wages in this sector, as firms cannot adjust the prices of goods which are determined by international factors only. Due to the characteristics of the labour market, wages will then increase in the non-tradable sector as well, which will cause higher prices of non-tradables and in turn bring real appreciation.

A couple of important insights arise from the basic model. First, free movements of workers between the sectors and the fact that tradable goods prices are determined externally imply that only the tradable sector is relevant in determining real appreciation. As a productivity increase in the production of non-tradables cannot bring higher wages, the resulting lower prices of non-tradable goods would theoretically cause real depreciation rather than appreciation. Another implication of the model is that local demand does not affect real exchange rates, as the non-tradable sector faces capital and labour costs which are given by either the external markets or the tradable sector. Any change in demand will therefore directly affect the supply of non-tradables but will not change prices.

In this paper we test whether productivity increases positively affect real appreciation. We use the World Bank's estimate of sectoral value-added per worker from the World Development Indicators (WDI) as the measure for labour productivity. A clear distinction between the tradable and non-tradable sectors is not available. One approach is to assume the industry sector reflects the tradable sector while services are non-tradable.<sup>8</sup> We also include the agriculture sector and assume that goods in this sector are also tradable. The productivity measures are calculated relatively to a benchmark of the advanced economies, in this case represented by the OECD-members value added aggregates. For each country  $i$ , the productivity  $A$  of sector  $s$  in time  $t$  is:

$$A_{i,t}^s = \frac{VA_{i,t}^s}{VA_{OECD,t}^s} \quad (2)$$

where  $VA_{i,t}^s$  represents value added per worker in that sector, measured in constant 2010 US dollars, and that country in time  $t$ , divided by the same measure for OECD countries. As a result, the productivity measures are usually between zero and one, with higher values of  $A$  implying productivity levels close to the OECD standard.

Despite being commonly used, this approach has limitations. Trade in services is not uncommon, and sometimes reaches up to a third of total trade, according to the latest WDI figures. It can also be argued that the industry sector does not necessarily contain tradable goods only. As a somewhat crude alternative, we also estimate the effect of total productivity, proxied by GDP per capita, also measured in constant 2010 US dollars, on real exchange rates. As in the value-added measures, this measure is also calculated relative to the OECD aggregate. Using GDP as a measure of productivity is very common in papers aimed at understanding the scope of the Balassa-Samuelson effect. It does imply, however, that the productivity catch-up reflected by this measure takes place mainly in the traded sector, while the productivity differentials in the non-traded sector remain relatively constant.

---

<sup>8</sup> Peltonen and Sager (2009), Égert et al. (2002), Coricelli and Jazbec (2001) and Fischer (2002) use this approach.



### *Other factors*

Our main focus is on the Balassa-Samuelson effect and the impact of productivity gains on the RER. If real appreciation of a country's currency can be attributed to technological catch-up and a narrowing productivity gap against trade partners, its competitiveness is not damaged. But, in addition to the drawbacks noted above, the theory also relies on a couple of assumptions that are very unlikely to hold in any economy, and even more so in the transition or SEMED regions. First, the theory assumes free trade to the extent that the law of one price holds in the tradable goods sector. And second, the theory relies on the existence of frictionless labour and capital markets which, among other things, implies that demand factors are irrelevant to exchange rate movements. Easing these assumptions suggests that there are other factors that might have an important impact on currency values in real terms.

### **Trade openness**

The degree of trade openness may be relevant to a country's real exchange rate, but the direction is unclear *a priori*. On the one hand, trade restrictions reduce the volume of imports and in turn cause higher prices of tradable goods and hence real appreciation. Trade liberalization could therefore lead to real depreciation due to foreign competition in the tradable sector. On the other hand there is a large literature pointing to the beneficial impact of trade openness on productivity and growth.<sup>9</sup> Greater competition from abroad can spur domestic innovation and efficiencies, with positive spillovers for wages and prices in the non-tradable sector. In our regressions we include a measure of trade openness, namely, the ratio of the WDI measure of total trade (aggregating both imports and exports of goods and services) to GDP.

### **Capital inflows**

There is evidence to suggest that only part of the sizeable appreciation experienced by new EU member states in the early years of accession was the result of productivity gains.<sup>10</sup> The real appreciation occurred in the context of large capital inflows to the region that continued up until the financial crisis. These flows allowed for higher investment and consumption at the same time, increasing wages and causing real appreciation mainly through higher demand for non-tradables. In general, the extent and direction of these effects could depend on the type of flows and the way they are utilized. For example, to the extent the funds are invested in higher production capacity for traded goods, real appreciation will occur in a way similar to the Balassa-Samuelson dynamics.<sup>11</sup> As for demand increases, if they are focused towards traded goods, they would be absorbed in greater trade deficits, with little impact on inflation. However, since the increased demand falls at least partially on the non-traded sector, these flows could cause inflationary pressures that lead to real appreciation.

In some transition countries, capital inflows are also associated with real estate price bubbles, fuelling credit booms, further contributing to the pressures for appreciation.<sup>12</sup> It is also worth noting that real exchange rate exposure to capital inflows depend on the type of exchange rate regime. Countries with fixed exchange rates would see inflation-led real appreciation, while a

---

<sup>9</sup> Frankel and Romer (1999) is a widely cited example of this literature.

<sup>10</sup> See Von Hagen and Traistaru (2006).

<sup>11</sup> Cerra, Tekin and Turnovsky (2008), for example, link foreign aid to real appreciation, as long as it leads to productivity gains in the production of traded goods, while productivity increase for non tradables is associated with depreciation.

<sup>12</sup> See Von Hagen and Traistaru (2006).

more flexible regime would allow policy makers to battle inflation, at the price of nominal appreciation.

Given all the factors listed above, different types of capital flows are expected to impact RER in different ways. Most probably, short term portfolio flows should be treated differently than FDI, for example.<sup>13</sup> Yet as this paper focuses on the B-S effect, we will include the financial account balance, relative to countries' GDP, as a measure of the overall net capital inflows to the countries in our sample. We include this variable in a way that a positive value indicates positive capital inflows.

### **Government consumption**

One of the assumptions of the Balassa-Samuelson theory is that demand for non-tradable goods affects only the supply, but not the prices, of non-tradables. This is because non-tradable producing firms face externally-determined costs of both production factors (wages being determined by the export sector, and interest rates by the global markets). As a result, changes in demand should not have any impact on real exchange rates. However, in the real world, these assumptions are unlikely to hold. Frictions in the labour market, for example, could cause an upward-sloping supply curve for non-tradable goods.<sup>14</sup>

If that is the case, increased demand should cause inflation in non-tradable prices and serve as a channel for real appreciation. Higher government consumption is therefore expected to bring real currency appreciation, especially if this consumption is concentrated heavily in the non-tradable sector. We include government consumption in some of our regressions as a robustness check, using an indicator from the WDI measured as the ratio of general government final consumption expenditure to GDP.

### **Net foreign assets**

Net foreign assets (NFAs) are potentially relevant for real exchange rates. A country with negative NFAs faces the need to finance large outflows of interest payments in order to serve its external liabilities to its creditors. This can be achieved by depreciation of real exchange rates. On the other hand, a positive stock of net foreign assets removes the pressure for depreciation and allows countries to maintain their debt whilst still maintaining strong currencies in real terms.

### **Terms of Trade**

The terms of trade is defined as the ratio of country export prices to import prices, and might affect real exchange rate in several different and conflicting ways, which can generally be divided into an income effect and a substitution effect.<sup>15</sup> An increased terms of trade, caused for example by higher export prices, boosts domestic income and spending on both types of products. This creates greater demand, which causes appreciation as long as some of it is spent in the non-tradable sector.

---

<sup>13</sup> Bakardzhieva et al. (2010), using data from a sample of 57 developing countries, find that FDI has no effect on the real exchange rate whereas other types of inflows, including portfolio investments, do lead to real appreciation.

<sup>14</sup> Fischer (2004) presents an extension to the classic model, with an additional production factor – skilled labour that cannot move freely between sectors. In this model, non-tradable sector firms hold an upward-sloping supply curve due to the wages of skilled workers, and the result is sensitivity of the real exchange rate to demand factors.

<sup>15</sup> See Edwards (1988) and Edwards and Van Wijnbergen (1987).

Yet according to the substitution effect, higher export prices reduce international demand for domestic production. This might cause a shift in production to the non-tradable sector, giving way to lower prices and real depreciation. If the increase in terms of trade initially reflects greater demand for domestic production, we might expect the income effect to be greater than the substitution effect. In any case, these effects are linked to the fact that demand factors matter in determining the real exchange rate, in contrast to the basic Balassa-Samuelson assumptions.

For some countries in our region, oil prices are the main factor that contributes to terms of trade developments and their impact on RER. In those countries that rely heavily on oil exports, we can assume that increased oil prices would have a wide income effect that might bring RER appreciation. We include the terms of trade in some of our regressions as a robustness check, using the WDI Net barter terms of trade index.

## **5. Previous literature**

The Balassa-Samuelson effect has received some support in existing studies. Yet there are few papers looking at transition countries in particular, and these mainly examine the first years of the transition period. Before proceeding to the results of our tests, we review briefly some of this earlier literature.

Ricci, Milesi-Ferretti and Lee (2008) focus on a group of 48 countries, consisting of both advanced and emerging economies, over the time period 1980-2004. Productivity differentials are measured using figures on output and employment in several key sectors to reflect the tradable and non-tradable sectors. The impact of other fundamentals, such as net foreign assets, commodity terms of trade, an index for trade restrictions and a measure for price controls, is also tested.

Since an equal increase in the productivity of tradables and non-tradables should theoretically not cause any appreciation according to the model, the paper chooses to focus on the productivity differentials between the sectors to represent the Balassa-Samuelson effect. They find that a 10 per cent increase in the productivity of tradables relative to non-tradables, compared to main trade partners, is associated with an appreciation of the real exchange rate by 2 per cent. A positive impact on REER was also found from net foreign assets, government consumption and the commodity terms of trade.

Another study that was conducted on a wide list of countries is Peltonen and Sager (2009). This paper found no support for the traditional Balassa-Samuelson (B-S) effect. The paper examines a list of 64 countries at different levels of development but, in contrast to Ricci et al. (2008), which focused on the real effective exchange rate, Peltonen and Sagar focus on bilateral RERs only, mainly against the US dollar. They use value added data in the industry and agriculture sectors as proxies for tradables, and services for non-tradables. The main result is that it is the services sector that is linked to real appreciation, contradicting the original hypothesis. Furthermore, they find that, in emerging markets with fixed exchange rates, there is evidence of a reverse B-S effect, indicating that productivity growth in the tradable (industry) sector is actually correlated with real depreciation.

Shifting towards papers that were focused on the transition region, most of this small literature has explored the early years of transition only. De Broeck and Sløk (2001) studied the period between 1991-1998 in a sample of countries consisting of transition economies in central and eastern Europe, the Caucasus and central Asia. They divided their sample into two groups – EU accession countries and others. The paper uses a fixed effects model and a

measure of productivity that assumes the industry sector represents tradable goods and services non-tradables, both calculated relative to the OECD averages. The results show a clear process of productivity-led appreciation in EU accession countries. Results in the rest of the countries were not conclusive. Trade openness and government balance were also found to be relevant to explaining RER movements in accession countries.

Another paper that focuses on the same region in the same years is Coricelli and Jazbec (2001). They examine the impact of structural changes using different variables, including the share of workers in services relative to those in industry, a structural reform index and the level of private sector credit. The results shed a different light on the first five years of transition. During that time, they argue, structural reforms played a significant role in real appreciation. In the years that followed, however, the impact of structural change variables diminished and the role of both productivity and the demand variables increased.

Égert, Drine, Lommatzsch and Rault (2002) agree that the first years of transition were marked with structural changes that affected both productivity and real exchange rates. As a result, they focus their attention on the relatively short period of 1995-2000, in 9 EU accession countries that today consist of the CEB region (including the Czech Republic). They find that a productivity increase in the tradable sector, relative to the non-tradable sector, is responsible for significant inflation in non-tradable prices. Yet this does not fully translate to overall inflation or real appreciation, because of the composition of the CPI index or the presence of regulated prices. When it comes to real exchange rate appreciation, it is affected largely by the prices of tradable goods, rather than the non-tradable sector, as the Balassa-Samuelson hypothesis suggests.

Fischer (2004) analyses the first decade of transition, using data on EU accession countries in the years prior to 2001. Fischer argues that the strict assumptions of the traditional B-S model are implausible. He first presents a modified version of the model in which there are two types of labour: unskilled labour, which can freely move between sectors, and skilled labour which cannot. The addition of another production factor in the non-tradable sector, whose costs are not determined externally, cause an upward-sloping supply curve. The results give a theoretical explanation for the importance of demand variables on real exchange rates. Empirically studying the effect on REER, Fischer finds that around half of real appreciation can be attributed to productivity. Demand for consumption is responsible for another quarter of real appreciation in CEE and Baltic countries, while the rest is attributed to increase demand for investments in the non-tradable sector in those countries.

Mihaljek and Klau (2003) measure the magnitude of the Balassa-Samuelson effect in six central European countries throughout most of the 1990s. In contrast to previous studies, they find mixed evidence of the effect. While in five out of six countries its existence was verified with statistical significance, the magnitude was relatively small – productivity differentials were found to explain only 0.2 to 2 percentage points of inflation differentials between the countries in the study and the euro area. The authors suggest examining other factors, including rising demand fostered by capital inflows, as the leading causes of real appreciation.

Focusing on the possible impact of capital inflows in real exchange rates, Combes, Kinda and Plane (2011) use a sample of emerging markets and low-income countries. They find that total capital inflows are largely associated with real appreciation. As expected, public flows cause more appreciation than private flows, perhaps because the former lead to greater government consumption in the non-traded sector, while the latter increases production

capacity. Within private flows, short term portfolio flows lead to greater appreciation, as these are not linked to productivity improvements and more to demand factors.

## 6. Estimation and results

We use a panel data set consisting of 36 of the EBRD’s countries of operations across all regions on a yearly basis for the years 1997-2017.<sup>16</sup> We included the Czech Republic as well, given its similar characteristics with other central European transition economies, which brings the number of countries in our sample to 37.<sup>17</sup> The dependent variable is the index of real effective exchange rate, which equals 100 in 1997. We use a country fixed effect model to estimate the effect of productivity differentials and other factors on REER.<sup>18</sup>

$$\log(REER_{i,t}) = \beta_0 + \beta_1 \log(A_{i,t}^{agr}) + \beta_2 \log(A_{i,t}^{ind}) + \beta_3 \log(A_{i,t}^{serv}) + \varepsilon \quad (3)$$

The productivity measures ( $A$ ) are included separately for the three sectors: agriculture, industry and services, and are calculated as a proportion of the OECD benchmark. We estimate several variations of the basic model. First, we sometimes use a measure of total productivity rather than sectoral productivity. Second, in order to control for global time-varying factors which affect all countries in a similar way, we include year dummy variables in some of our regressions. Third, we also estimate regressions using a narrower measure of REER, computed using OECD currencies only. In practise, this measure consists largely of the bilateral RERs with the EUR and the USD, as well as smaller weights to other advanced economies currencies such as the JYP, the GBP and others. This eliminates the mismatch between the dependent variable and the explanatory productivity variables, which are based on a comparison with OECD countries. In practice, the mismatch problem is more severe in Eastern Europe, the Caucasus and in central Asia, and much less so in CEB and SEE countries, which carry out most of their trade with OECD countries (mostly with members of the European monetary union).

Lastly, as robustness checks we included several other measures in our regressions, mostly examining demand side variables which, according to the basic Balassa-Samuelson theory, should not have any impact on RER: Trade openness, government consumption, net capital inflows and terms of trade. As discussed above, some of these variables were found in the previous literature to be associated with real exchange rate movements. We take logarithms for all variables except the financial account balance, which is sometimes negative.

The main empirical results for the country-fixed effects regressions featuring all countries in our samples are shown in Table 1. The first two columns in the table present the estimation results based on all 37 countries. These results show no clear link between real exchange rates and total productivity, or with productivity in the industry sector, which theoretically should best represent the production of tradable goods. Although the results do suggest that productivity increases in the agriculture sector are linked with REER appreciation, the large heterogeneity in our sample and the high volatility observed in REER developments in some countries prevent us from inferring any firm conclusions about productivity and its impact on

<sup>16</sup> For some countries, the sample size is shorter because of missing data or the elimination of outliers associated with structural shifts, the elimination of dual exchange rates, or other reasons. Sectoral value added data were only available until 2016, while total productivity were available for 2017 as well.

<sup>17</sup> The Czech Republic graduated from EBRD operations in 2007.

<sup>18</sup> We performed the Hausman specification test (1978) to determine the appropriateness of a fixed effects rather than a random effects model. The test generally confirms that the difference between the coefficients in both models is systematic, and rejects the use of random effects.

real exchange rates. In fact, when splitting the sample into the main sub-regions, only the sub-group consisting of central Europe and the Baltic states, south-eastern Europe and Turkey appears to have a clear connection between the independent and dependent variables. In the next columns of the table, we focus on these countries only.

Columns 3-4 present the effect of total productivity on REER in the smaller 19-country sample. The results suggest a positive and statistically significant effect. A 1 percentage point increase in total productivity (measured as GDP per capita), relative to OECD countries, increases the REER against the OECD countries by 0.17 to 0.42 percentage points.

When splitting the productivity measure to the three sectors – agriculture, industry and services, we again see a significant positive impact of a productivity increase on REER in the CEB, SEE and Turkey region. This connection exists in both models in the industry sector (columns 5-6). These results are in line with the Balassa-Samuelson effect, assuming this sector represents the production of tradable goods. The estimates for the agriculture sector productivity measure seem significant when controlling for time-varying global factors with year dummy variables.

As a robustness check, Table 2 presents the same estimation with a different independent variable – REER based on OECD countries. As explained earlier, this variable more accurately aligns the benchmark countries on both sides of the equation, as productivity differentials are measured against OECD countries as well. The results in all columns are similar to the broad REER estimates. Looking at all countries does not yield any connection between REER and productivity, but looking at a sub-sample of CEB and SEE countries does. Interpreting column 6 in both tables, when adding year dummy variables, implies that a 1 percentage point increase in industry sector productivity, relative to the OECD average, would increase the REER by 0.13 percentage points. A slightly larger but similar relationship exists between productivity in the agriculture sector and the REER.

Further robustness checks do not change the overall picture. Splitting the sample into regions and looking at CEB separately increases the size of the significant coefficients. An interesting sub-sample is the eight countries in the CEB region, plus the Czech Republic, Bulgaria and Romania. These 11 countries were the focus of many real exchange rate studies at the beginning of the last decade. Focusing on these countries, a 1 percentage point increase in productivity differentials in the industry sector relative to OECD average during our sample period, translates to a 0.27 percentage points increase in REER, rather than 0.13 in the broader region. Another robustness check is adding lagged productivity instead of the current measures, on the basis that the B-S dynamics do not take effect in the same period. Adding lags does not change the nature of the results.

Table 3 presents the results when adding four other variables, mostly connected to demand factors which could potentially affect the RER: trade openness, government consumption, capital inflows and terms of trade. The results in this table are based on OECD-based REER and only focus on the region comprising CEB, SEE and Turkey. All columns in the table include year dummy-variables. The results observed in the previous tables generally hold, as in most of the models productivity is significantly linked to real appreciation. When splitting into sectors, the industry and agriculture sectors both appear to impact REER, yet the industry sector is generally more significant and has a slightly larger coefficient.

Interestingly, none of the additional variables themselves is statistically relevant for determining REER. Capital inflows have a statistically significant but *negative* relation to REER when used in the same model as GDP per capita (total productivity), yet this relation

disappears when splitting productivity into specific sectors. These results contradict the idea that real appreciation in many EBRD countries of operations was at least partially the result of capital inflows to the region. However, this can be explained by the fact that the measure we use to represent capital flows do not distinguish between different type of flows and their separate contributions to consumption demand, investments and employment.

Similar results appear also when using the broad-REER measure, and when testing for different sub-samples within the CEB, SEE and Turkey region. Interestingly, when looking only at the CEE-EU members of our sample (the 11 countries consisting of CEB, the Czech Republic, Bulgaria and Romania), the results are more statistically significant and larger in magnitude.

## **7. Conclusion**

The study of real exchange rate movements has been a somewhat neglected issue in the literature on transition economies. Our paper has attempted to fill this gap. We have explored the shifting patterns observed in real exchange rate movements in the transition region, and highlighted the large variations across countries and through time since the mid-1990s. These movements have undoubtedly had important impacts on countries' competitiveness and economic growth rates, and it is important to understand the underlying driving forces.

The main finding of our paper is that productivity in traded goods is a key driver of real exchange rate movements in more advanced transition countries in central and south-eastern Europe. For all its faults and simplifications, the traditional Balassa-Samuelson model still retains some validity as an explanation of changes in the real exchange rate over time. But other factors must also be taken into account, especially in countries further south and east. What the most important ones are is difficult to say, given current data. There is a lot of "noise" in real exchange rate data, and it is hard to identify robust statistical associations between the exchange rate and other macroeconomic factors. Further research will be needed in the coming years to tease out further the principal underlying drivers of real exchange rates in this region.

## References

- Bakardzhieva, Damyana, Sami Ben Naceur, and Bassem Kamar. "The Impact of Capital and Foreign Exchange Flows on the Competitiveness of Developing Countries." IMF Working Paper 10/154 (2010).
- Balassa, Bela, "The purchasing-power parity doctrine: a reappraisal", *Journal of Political Economy* 72.6 (1964): 584-596.
- Cerra, Valerie, Serpil Tekin, and Stephen J. Turnovsky. "Foreign Aid and Real Exchange Rate Adjustments in a Financially Constrained Dependent Economy", IMF Working Paper 08/204 (2008).
- Chinn, Menzie D, "A primer on real effective exchange rates: determinants, overvaluation, trade flows and competitive devaluation", *Open Economies Review* 17.1 (2006): 115-143.
- Combes, Jean-Louis, Patrick Plane, and Mr Tidiane Kinda, "Capital flows, exchange rate flexibility, and the real exchange rate", IMF Working Paper 11/9, (2011).
- Coricelli, Fabrizio, and Boštjan Jazbec, "Real exchange rate dynamics in transition economies", *Structural Change and Economic Dynamics* 15.1 (2004): 83-100.
- De Broeck, Mark, and Torsten Sløk, "Interpreting real exchange rate movements in transition countries", IMF Working Paper 01/56 (2001).
- Edwards, Sebastian, "Temporary terms of trade disturbances, the real exchange rate and the current account", NBER Working Paper No. 2629, (1988).
- Edwards, Sebastian, and Sweder Van Wijnbergen, "Tariffs, the real exchange rate and the terms of trade: on two popular propositions in international economics", NBER Working Paper No. 2365, (1987).
- Égert, Balázs, Imed Drine, Kirsten Lommatzsch, and Christophe Rault, "The Balassa–Samuelson effect in Central and Eastern Europe: myth or reality?", *Journal of Comparative Economics* 31, no. 3 (2003): 552-572.
- Ellis, Luci, "Measuring the real exchange rate: Pitfalls and practicalities", Reserve Bank of Australia, (2001).
- European Bank for Reconstruction and Development, "Transition Report (2013): Stuck in Transition?", EBRD (2013).
- Fischer, Christoph, "Real currency appreciation in accession countries: Balassa-Samuelson and investment demand." *Review of World Economics* 140.2 (2004): 179-210.
- Frankel, Jeffrey A., and David H. Romer, "Does trade cause growth?", *American Economic Review* 89.3 (1999): 379-399.



Hausman, Jerry A., "Specification tests in econometrics." *Econometrica: Journal of the econometric society* (1978): 1251-1271.

Klau, Marc, and San Sau Fung, "The new BIS effective exchange rate indices", *BIS Quarterly Review* (2006).

Klau, Marc, and Dubravko Mihaljek, "The Balassa-Samuelson effect in central Europe: a disaggregated analysis", *BIS Monetary and Economic Department*, (2003).

Peltonen, Tuomas A., and Michael Sager, "Productivity shocks and real exchange rates: a reappraisal", *ECB Working Paper No. 1046* (2009).

Ricci, Luca Antonio, Jaewoo Lee, and Gian-Maria Milesi-Ferretti, "Real exchange rates and fundamentals: A cross-country perspective" *International Monetary Fund* (2008).

Samuelson, Paul A., "Theoretical notes on trade problems", *The Review of Economics and Statistics* (1964): 145-154.

Von Hagen, Jürgen, and Iulia Traistaru, "Macroeconomic adjustment in the new EU member states", *SUERF Studies*, (2006).

## Tables

**Table 1: REER based on all trade partners**

| VARIABLES            | (1)<br>All countries | (2)                 | (3)                  | (4)                 | (5)                  | (6)                  |
|----------------------|----------------------|---------------------|----------------------|---------------------|----------------------|----------------------|
|                      |                      |                     | CEB, SEE and Turkey  |                     |                      |                      |
| lnAtotal             | -0.102<br>(0.170)    |                     | 0.424***<br>(0.0828) | 0.166*<br>(0.0876)  |                      |                      |
| lnAgr                |                      | 0.182**<br>(0.0769) |                      |                     | 0.0882<br>(0.0708)   | 0.135**<br>(0.0581)  |
| lnAind               |                      | 0.125<br>(0.0852)   |                      |                     | 0.318***<br>(0.0525) | 0.132***<br>(0.0332) |
| lnAserv              |                      | -0.134<br>(0.0845)  |                      |                     | 0.104<br>(0.0694)    | -0.0616<br>(0.0823)  |
| Constant             | 4.387***<br>(0.358)  | 4.802***<br>(0.205) | 5.337***<br>(0.104)  | 4.837***<br>(0.147) | 5.379***<br>(0.106)  | 4.822***<br>(0.145)  |
| Year dummy variables | Yes                  | Yes                 | No                   | Yes                 | No                   | Yes                  |
| Observations         | 764                  | 693                 | 389                  | 389                 | 364                  | 364                  |
| R-squared            | 0.022                | 0.106               | 0.362                | 0.496               | 0.455                | 0.605                |
| Number of countryID  | 37                   | 37                  | 19                   | 19                  | 19                   | 19                   |

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 2: REER based on OECD countries only**

| VARIABLES            | (1)<br>All countries | (2)                  | (3)                  | (4)                 | (5)                  | (6)                  |
|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|
|                      |                      |                      | CEB, SEE and Turkey  |                     |                      |                      |
| lnAtotal             | 0.00769<br>(0.153)   |                      | 0.532***<br>(0.0813) | 0.192**<br>(0.0854) |                      |                      |
| lnAgr                |                      | 0.195***<br>(0.0689) |                      |                     | 0.0879<br>(0.0711)   | 0.138**<br>(0.0517)  |
| lnAind               |                      | 0.112<br>(0.0776)    |                      |                     | 0.376***<br>(0.0507) | 0.137***<br>(0.0325) |
| lnAserv              |                      | -0.0400<br>(0.0806)  |                      |                     | 0.154*<br>(0.0748)   | -0.0572<br>(0.0759)  |
| Constant             | 4.631***<br>(0.322)  | 4.978***<br>(0.182)  | 5.473***<br>(0.102)  | 4.879***<br>(0.143) | 5.504***<br>(0.112)  | 4.839***<br>(0.123)  |
| Year dummy variables | Yes                  | Yes                  | No                   | Yes                 | No                   | Yes                  |
| Observations         | 764                  | 693                  | 389                  | 389                 | 364                  | 364                  |
| R-squared            | 0.097                | 0.227                | 0.481                | 0.627               | 0.538                | 0.713                |
| Number of countryID  | 37                   | 37                   | 19                   | 19                  | 19                   | 19                   |

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 3: REER in CEB, SEE and Turkey, calculated against OECD members only**

| VARIABLES            | (1)                 | (2)                 | (3)                      | (4)                | (5)                      | (6)                  | (7)                  | (8)                   | (9)                 | (10)                  |
|----------------------|---------------------|---------------------|--------------------------|--------------------|--------------------------|----------------------|----------------------|-----------------------|---------------------|-----------------------|
|                      | Total productivity  |                     |                          |                    |                          | Sector Productivity  |                      |                       |                     |                       |
| InAtotal             | 0.188**<br>(0.0760) | 0.214**<br>(0.0892) | 0.230***<br>(0.0697)     | 0.123<br>(0.102)   | 0.187*<br>(0.0911)       |                      |                      |                       |                     |                       |
| InTopen              | 0.0850<br>(0.0849)  |                     |                          |                    | 0.0597<br>(0.112)        | -0.00539<br>(0.0759) |                      |                       |                     | -0.104<br>(0.103)     |
| InGovCons            |                     | 0.0298<br>(0.0779)  |                          |                    | 0.139<br>(0.0929)        |                      | 0.0751<br>(0.0890)   |                       |                     | -0.0165<br>(0.122)    |
| Kflow                |                     |                     | -0.00367***<br>(0.00125) |                    | -0.00448***<br>(0.00150) |                      |                      | -0.00174<br>(0.00136) |                     | -0.00172<br>(0.00135) |
| InToT                |                     |                     |                          | 0.0640<br>(0.326)  | -0.00212<br>(0.314)      |                      |                      |                       | 0.275<br>(0.272)    | 0.220<br>(0.304)      |
| InAgr                |                     |                     |                          |                    |                          | 0.138**<br>(0.0519)  | 0.138**<br>(0.0520)  | 0.123**<br>(0.0556)   | 0.126**<br>(0.0461) | 0.125**<br>(0.0539)   |
| InAind               |                     |                     |                          |                    |                          | 0.138***<br>(0.0336) | 0.151***<br>(0.0293) | 0.187***<br>(0.0572)  | 0.117<br>(0.0727)   | 0.139**<br>(0.0649)   |
| InAserv              |                     |                     |                          |                    |                          | -0.0566<br>(0.0781)  | -0.0524<br>(0.0769)  | -0.0911<br>(0.148)    | -0.191<br>(0.166)   | -0.179<br>(0.169)     |
| Constant             | 4.501***<br>(0.411) | 4.824***<br>(0.199) | 4.956***<br>(0.113)      | 4.345**<br>(1.630) | 4.084**<br>(1.598)       | 4.865***<br>(0.411)  | 4.651***<br>(0.232)  | 4.873***<br>(0.139)   | 3.257**<br>(1.300)  | 4.094**<br>(1.841)    |
| Year dummy variables | Yes                 | Yes                 | Yes                      | Yes                | Yes                      | Yes                  | Yes                  | Yes                   | Yes                 | Yes                   |
| Observations         | 388                 | 387                 | 374                      | 318                | 317                      | 364                  | 364                  | 350                   | 295                 | 295                   |
| R-squared            | 0.645               | 0.644               | 0.661                    | 0.585              | 0.627                    | 0.713                | 0.715                | 0.725                 | 0.683               | 0.693                 |
| Number of countryID  | 19                  | 19                  | 19                       | 18                 | 18                       | 19                   | 19                   | 19                    | 18                  | 18                    |

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Annex 1: Real effective exchange rates, 1997-2018**

