Versailles Redux? Eurozone Competitiveness in a Dynamic Balassa-Samuelson-Penn Framework

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Abstract

Prima facie, competitiveness adjustments in the eurozone, based on unit labor cost developments, appear sensible and in line with what the economic analyst might have predicted and the economic doctor might have ordered. But a broader and arguably better—Balassa-Samuelson-Penn (BSP)—framework for analyzing these adjustments paints a very different picture. Taking advantage of the newly released PPP-based estimates of the International Comparison Program (2011), we identify a causal BSP relationship. We apply this framework to computing more appropriate measures of real competitiveness changes in Europe and other advanced economies in the aftermath of the recent global crises. There has been a deterioration, not improvement, in competitiveness in the periphery countries between 2007 and 2013. Second, the pattern of adjustment within the eurozone has been dramatically perverse, with Germany having improved competitiveness by 9 percent and with Greece's having deteriorated by 9 percent. Third, real competitiveness changes are strongly correlated with nominal exchange rate changes, which suggests the importance of having a flexible (and preferably independent) currency for effecting external adjustments. Fourth, internal devaluation—defined as real competitiveness improvements in excess of nominal exchange rate changes—is possible but seems limited in scope and magnitude. Our results are robust to adjusting the BSP framework to take account of the special circumstances of countries experiencing unemployment. Even if we ignore the BSP effect, the broad pattern of limited and lopsided adjustment in the eurozone remains.

JEL Codes: F31; F41; F42

Keywords: Eurozone, Competitiveness, Exchange Rates, Monetary Unions

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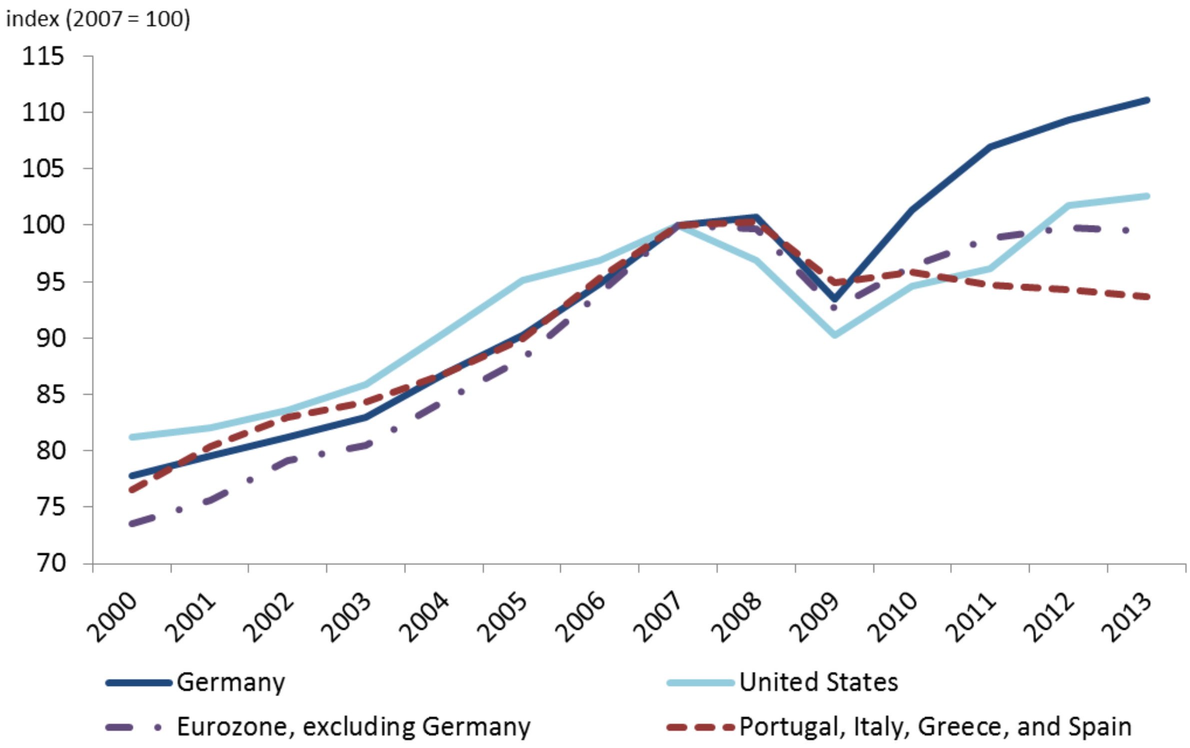
1. INTRODUCTION

Germany has had a pretty good eurozone crisis. Relative to the precrisis peak, its per capita GDP (in purchasing power parity [PPP] terms) has increased by about 11 percent. In contrast, the rest of the eurozone experienced a decline of 0.5 percent, and the four southern Europeans—Portugal, Italy, Greece, and Spain—a decline of 6 percent (figure 1). Thus, relative to the Germanic core, the southern peripherals, which saw some catch-up since 2000, have experienced a dramatic decline in living standards of about 13 percent within the space of six years (figure 2). Living standards have slipped even in the United States—and considerably by about 10 percent—relative to Germany since the onset of the global financial crisis.

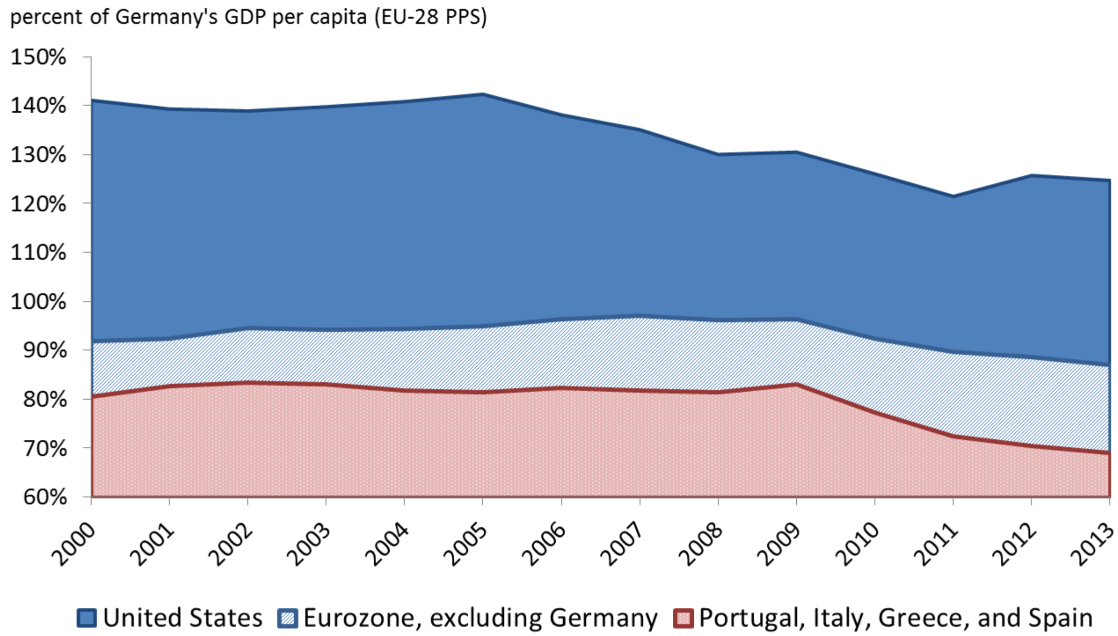
Figure 1. Growth (GDP per capita) performance, Germany and selected countries, 2000 – 2013



Notes: Eurozone consists of all countries that were part of euro currency zone, including those that entered into force in 2000-2013 period. GDP per capita in terms of real expenditure in EU-28 purchasing power standard (PPS) terms.

Source: Eurostat (EU-28 per capita PPS).

Figure 2. Living standards relative to Germany, 2000 – 2013



Notes: Eurozone consists of all countries that were part of Euro currency zone, including those that entered into force in 2000-2013 period. GDP per capita in terms of real expenditure in EU-28 purchasing power standard (PPS) terms.

Source: Eurostat (EU-28 per capita PPS).

Germany knows all too well the current plight of the periphery. In the 1920s it was Germany that, facing added budgetary stress from the postwar reparations, struggled to regain competitiveness against its European peers and engineer improvements in its current account within a fixed exchange regime imposed by the victors at Versailles. Generations later, the Greeks found themselves in a similar situation but this time in the context of constraints imposed by the currency union in Europe.[1]

This paper will deploy the Balassa-Samuelson-Penn (BSP) framework to evaluate how the eurozone has fared in the recent crisis. In particular, this paper has three aims. First is to identify

[1] A more tendentious parallel with Versailles is to see Germany today as the victor and self-serving underwriter of the underlying economic and currency arrangements much as the victors at Versailles who imposed the harsh peace on Germany.

a causal BSP relationship, which relates income growth to real exchange rate changes.[2] This has become possible because of newly available estimates of purchasing power parities produced by the 2011 vintage of the International Comparison Program (ICP) (see section 2). Second is to use this relationship to obtain better measures of competitiveness changes across countries (see section 3). Third is to present some findings for the eurozone and other countries during the recent crisis that help shed light on the question of how and to what extent competitiveness changes/real exchange rate adjustments take place (a) within currency unions and (b) between countries in currency unions (and countries that have relatively hard pegs) and those that have their own, relatively flexible, currencies.

Our results based on the BSP framework are the following. First, there has been a deterioration, not improvement, in competitiveness in the periphery countries. Second, the pattern of adjustment within the eurozone between 2007 and 2013 has been dramatically perverse, with Germany's competitiveness having improved by 9 percent and Greece's having deteriorated by 9 percent. Optimum adjustment within the eurozone required the exact opposite. Third, real competitiveness changes are strongly correlated with nominal exchange rate changes, which suggests the importance of a flexibly independent currency to effect adjustments. Internal devaluation—real competitiveness changes in excess of nominal exchange rate changes—is possible but occurred in few cases and seemed limited in magnitude.

One critique of the BSP framework is that it is not applicable to countries experiencing Keynesian underemployment of resources. While theoretically this argument is valid, our results suggest that the experience of advanced economies suffering unemployment is not inconsistent with the BSP effect. In any case, our results are robust to adjusting the BSP framework to take account of the special circumstances of countries experiencing unemployment. Even if we completely ignore the BSP effect, the broad pattern of limited and lopsided adjustment in the eurozone remains.

Overall, our results suggest that the costs of fixing a currency—via either a currency union or a hard peg—can be considerable, echoing the famously prescient Walters critique (1990) of the eurozone.

2. ESTIMATING THE DYNAMIC BALASSA-SAMUELSON-PENN EFFECT

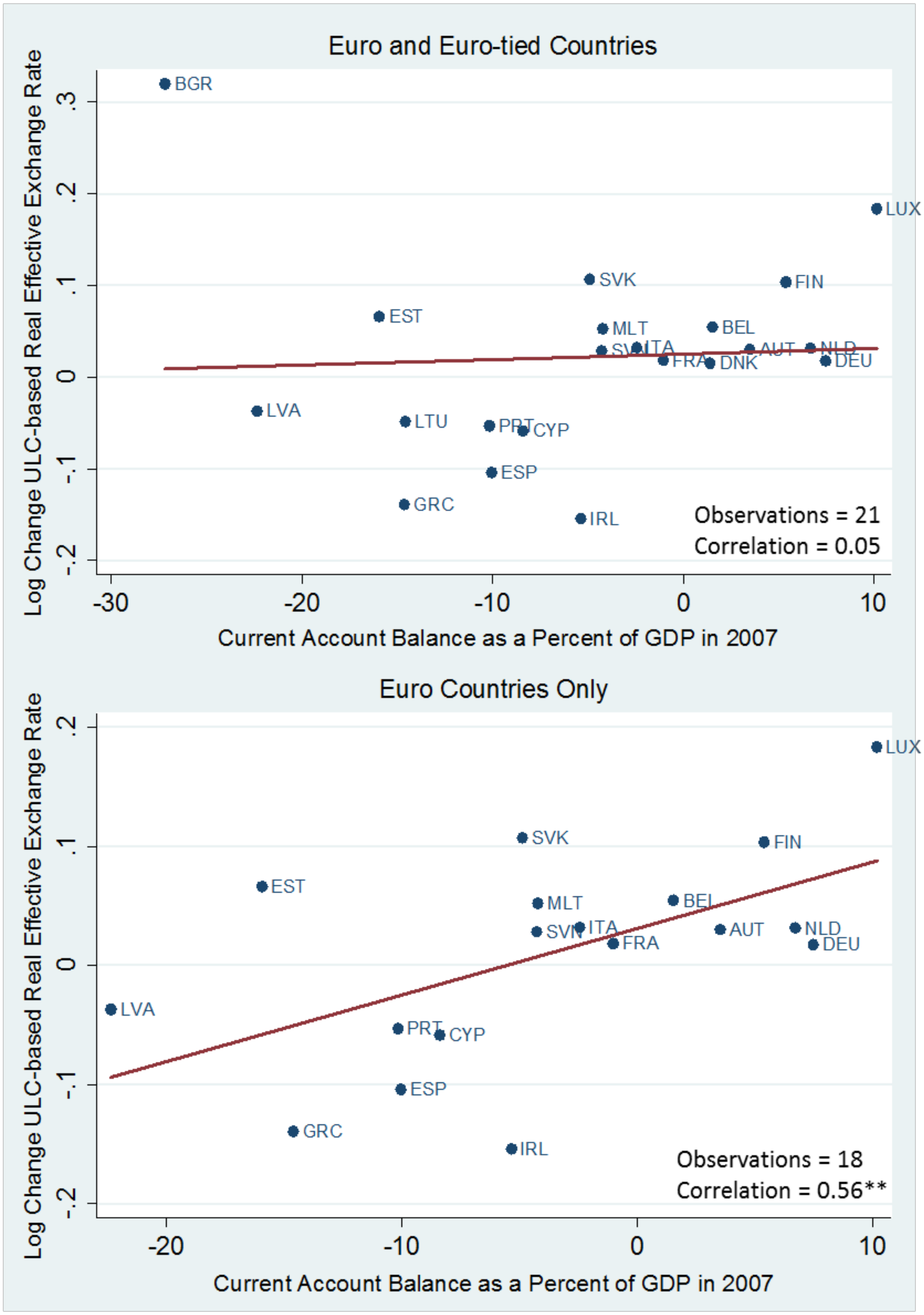
Real exchange rate adjustments can play a useful role in generating more favorable balance of payments outcomes—encompassing exports, imports, and factor payments--(Krugman 1990),

[2] We will refer to the Balassa-Samuelson-Penn (BSP) effect to give credit to the work of the Penn World Tables that put flesh and numbers to the original Balassa-Samuelson theoretical intuition.

and by some measures changes in the eurozone over the crisis period appear to have occurred as might be expected or desired. Consider an often used measure of competitiveness changes of real effective exchange rates based on unit labor cost (ULC) developments. The data are from the European Commission's annual macroeconomic database (AMECO).[3] We plot in figure 3 the changes in this measure of competitiveness between 2007 and 2013 (from the start of the crisis to the most recent period for which data are available) against the initial level of the current account balance.

[3] There are a number of unit labor cost measures to choose from. Specifically we chose the "Real effective exchange rates, based on unit labor costs (total economy): performance relative to the rest of the 37 industrial countries: double export weights; USD: performance relative to the rest of the 36 industrial countries" measure from the European Commission's AMECO database. Data on real effective exchange rates, "Relative unit labor costs 2010 = 100" from the OECD yields broadly similar results in subsequent applications, but we choose the former data source due to wider country availability. It should be noted that the European Central Bank also includes measures of competitiveness indicators based on unit labor costs which take into account a wider range of trading partners, including China, Singapore, and South Korea. However, as we detail below the latest ICP data round is nevertheless far more comprehensive in the number of countries represented.

Figure 3. Pattern of competitiveness changes in the Eurozone based on unit labor costs, 2007 – 13



Note: See key to country abbreviations at the end of the paper. ** p<0.05.
Sources: World Bank (current account balance); European Commission (unit labor cost-based real effective exchange rate).

The relationship should be strongly positive because countries with high initial deficits should see the largest improvement in their competitiveness. If we leave aside the case of

Bulgaria, which is an outlier, we do see in the second panel such a positive relationship. High current account deficit countries such as Greece, Spain, and Ireland witnessed a real depreciation (based on unit labor costs) of 14, 10, and 15 percent, respectively, facilitating the process of adjustment. In contrast surplus countries such as Luxembourg witnessed a sharp appreciation. And six European countries—Greece, Ireland, Latvia, Lithuania, Portugal, and Spain—did achieve internal devaluation defined as declines in relative unit labor costs in excess of the nominal depreciation.

But several reasons caution against any sanguineness or complacency about the adjustment process in the eurozone. First, look closer at figure 3; the relationship does not look as strong as it should be (a correlation of 0.56). Worrying, in particular, is the fact that Germany, the core country, the anchor of the eurozone, and the one with the largest surplus to begin with, witnessed very little real appreciation.

Second, note that there is one major problem with ULC–based measures relative to the PPP price-based measures. These ULC estimates are derived only for a sample of industrial countries. By definition, therefore, they will fail to take account of competitiveness developments in partner countries outside the Organization for Economic Cooperation and Development (OECD). Thus, China, India, Brazil, and a number of other emerging-market countries that are in actual or potential competition with OECD countries, and that today are major players in the world economy, are ignored.

Third, at the heart of the debate between the Keynesians and the austerians is downward wage rigidity and the welfare costs of adjustment through internal devaluation versus adjustment via exchange rates (Krugman 2012, Wolf 2014). Therefore, from a welfare perspective, it is arguable whether unit labor costs are the better measure of adjustment compared with exchange rate–based measures. At least, it is important to check how competitiveness changes have fared when they are based on exchange rates.

Finally, raw unit labor cost measures obscure a potentially important development associated with the eurozone crisis. There have been sharp output changes as well and the issue arises whether these must be taken into account in assessing the magnitude of adjustment. Greece has lost about 25 percent of its per capita output since 2007. Should that not necessitate an even greater adjustment/competitiveness response compared with Germany, which has seen its output rise during the crisis?

There is an alternate framework for assessing competitiveness changes that takes account of all these concerns with simple unit labor cost measures. With a view to better compare standards of living across countries, the ICP has been collecting disaggregated data across countries since 1970. There have been eight such rounds, with the most recent relating to the price collection exercise in 2011, resulting in the publication in April 2014 of PPP–based estimates of GDP across countries.[4]

Based on work first done by Kravis, Heston, and Summers (1978) and drawing upon the ICP data, the Penn World Tables (PWT) project has been publishing internationally comparable estimates of GDP. The innovation and great contribution of the PWT was to convert national measures of GDP and income into internationally comparable PPP estimates. This is done—in principle—by collecting prices for the same or similar goods in different countries and deriving price indices that can be used to compare what people can actually buy. The PWT obtains local currency data from the national income accounts of countries. Then, based on international price comparisons, it converts these local currency data into PPP-based figures, which are comparable across countries.

But PPP-based estimates have value beyond comparisons of standards of living. Intrinsic to these estimates is the notion of the real exchange rate. Rogoff (1996) highlighted that, when deflated by the market exchange rate, the PPP exchange rate for a country that emerges from the ICP exercise is really a measure of the price level in any country relative to the numeraire country, the United States, and hence a measure of that country's real exchange rate.

Thus for any country:

$$P = \frac{PPP}{MER} \qquad (1)$$

where *P* is the price level of GDP, *PPP* is the purchasing power parity exchange rate relative to the dollar, and *MER* is the market exchange rate relative to the dollar. This price level is conceptually the (inverse) of the real exchange rate: The higher the prices in any country, the more appreciated its currency is in real terms.

Rogoff (1996) then discussed the BSP effect, namely that countries with higher per capita GDP tended to have higher price levels (or more appreciated real exchange rates). The BSP effect was in effect a reason why purchasing power parity did not hold, which was the central focus of Rogoff (1996).

The BSP effect in turn could arise for two reasons. Balassa (1964) and Samuelson (1964) argued that compared with poor countries, rich countries tended to be relatively more productive in their traded good sector. Via labor market equilibrium, higher productivity would entail higher wages in the economy and hence higher prices for nontraded goods. The price level, which is a

[4] See Deaton (2014) and Johnson et al. (2013) for a brief history of the ICP project and the Penn World Tables.

weighted average of traded and nontraded goods prices, should therefore be higher in richer countries.

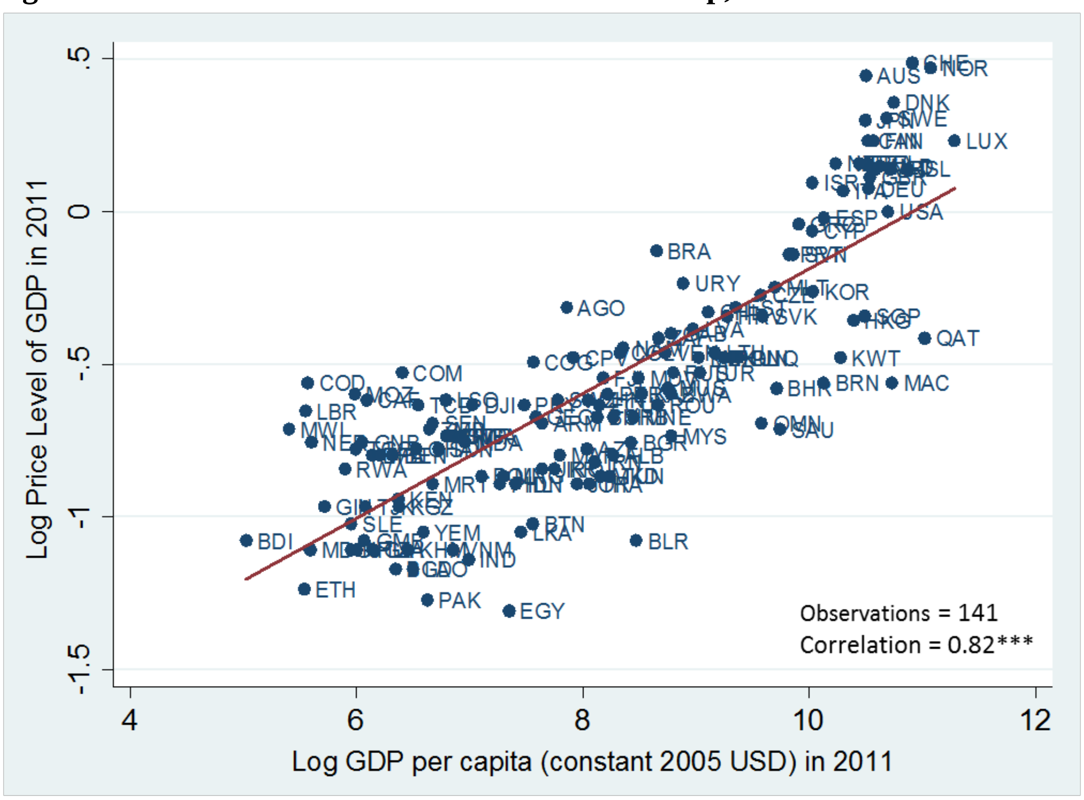
A second reason for the BSP effect is due to Kravis and Lipsey (1983) and Bhagwati (1984). They suggested that capital-labor ratios are likely to be higher in rich countries (because of imperfect capital mobility). Combined with the fact that services are more labor-intensive, high capital-labor ratio would mean that services would be cheaper in poorer countries and hence the overall price level lower. This BSP effect is a static one, comparing countries at a point in time.

Thus, following Rogoff (1996), the static BSP effect can be represented as:

$$\ln P = \alpha + \beta \ln Y \qquad (2)$$

where P is the price level of GDP and Y is the per capita GDP of a country relative to the United States.

Figure 4. Static Balassa-Samuelson-Penn relationship, 2011



Coefficient: 0.204, Standard error: 0.14 , R-squared: 0.67

Note: See key to country abbreviations at the end of the paper. *** p<0.01.
Sources: World Bank (GDP per capita); International Comparison Program (price level of GDP).

Figure 4 shows the static BSP effect for 2011. The relationship is a strong one with the income coefficient significant at the 1 percent confidence level. A country that is 1 percent richer has a price level that is, on average, 0.2 percent higher.[5]

Ravallion (2013, 2014), among others, has argued in favor of a dynamic version of the BSP effect, analogous to the static version.[6] If productivity growth in manufacturing rises, but if prices of manufactured (traded) goods are fixed internationally, wages will have to rise to create the real wage gains to match productivity improvements. But if services productivity has not risen, then to retain labor in the services sector, prices of services will have to rise. Thus, overall prices will increase—and the real exchange rate will appreciate—when traded goods productivity increases.

Ravallion (2013) estimates a dynamic version of equation 2 above:

$$\Delta \ln P = \alpha_1 + \beta_1 \Delta \ln Y \qquad (3)$$

where $\Delta \ln P$ is the log change in price level between two time periods and $\Delta \ln Y$ is the growth rate in per capita GDP.[7]

Estimating the dynamic BSP effect raises a number of issues. First, its meaningful estimation has only now become possible with the release of the ICP 2011 estimates. Although there have now been eight ICP rounds, only the last two have provided estimates of the price level that are sufficiently broad in coverage and use reasonable and consistent methodologies (see Johnson et al. 2013). The first five rounds were limited in coverage: Even the fifth round in 1985 covered only 62 countries, mostly advanced. The sixth round in 1993–96 had more countries (115) but was seriously criticized for its organization and meager resources (United Nations 1998). A substantial improvement occurred with the 2005 ICP round with significantly expanded coverage (146 countries) and improved methodology (Deaton 2014). For example, China was not part of any of the ICP rounds prior to 2005. And India did not participate in the ICP round until just before 2005 (the 1993–96 round). The 2005 and 2011 rounds are the most

[5] The static Penn effect is actually better captured by a quadratic specification consistent with Hassan (2014).

[6] The focus of Ravallion (2013, 2014) is less to identify the causal BSP relationship and more to see whether it can help improve forecasts of the PPPs beyond the ICP benchmark years. Cheung, Chinn, and Fujii (2009) estimate a pooled cross-section equation that is more like a static than a dynamic version of the BSP effect. Recently, Berka, Devereux, and Engel (2014) estimate real exchange rates and sectoral productivity in the eurozone but with a different focus.

[7] In equations (2) and (3), the income/growth variable can be measured at PPP or market exchange rates. The former will create mechanical statistical complications because the PPPs will appear on both sides of the equation. Hence we prefer to use the latter.

reliable and consistent in their methodology and broad in their country coverage, implying that, for the first time, it becomes possible to estimate reliable dynamic BSP effects.[8]

Second, the dynamic BSP effect is not a correlation but a causal relationship going from rising traded goods productivity to appreciating real exchange rates. If the effect is to be reliably estimated ("identified" in the jargon), equation 3 will have to take account of the reverse causation from the real exchange rate changes back to GDP growth. And this channel of reverse causation is potentially significant. A number of recent papers, notably Rodrik (2009) and Prasad, Rajan, and Subramanian (2008), estimate strong effects from an undervalued exchange rate to growth. A stronger real exchange rate could actually stifle growth by inhibiting the allocation of resources to the more productive tradable sector.

Identifying the true BSP effect, therefore, requires a plausible instrument. Since, we are estimating the equation over the 2005–11 period (the two points for which price level data are available from the ICP), we need an instrument that captures or explains short-run growth (the right hand side variable). This stipulation rules out instruments such as institutional quality because they better explain long-run growth and levels of income (Acemoglu, Johnson, and Robinson 2001).[9]

But the instrument must also plausibly satisfy the exclusion restriction. That is, it must explain changes in the real exchange rate (the left hand side variable) only through its effects on growth in per capita GDP (the right hand side variable). The instrument must not directly affect the real exchange rate. Put differently, the instrument must, to the maximum extent possible, be neutral between tradables and nontradables because otherwise it is more likely to affect the relative price of these two sectors, which is the real exchange rate. This consideration would rule out instruments such as trade, trade costs, or geography variables that disproportionately affect the costs and/or profitability in traded goods production.

Intuitively, plausible instruments are inputs into production that are themselves not tradable and that are not clearly more intensively used in tradables relative to nontradables. One input that might possibly satisfy these requirements even if imperfectly—and the one we chose in this paper—is electricity. Specifically, we use per capita electricity consumption growth as our instrument. We work with two variants. The first is overall electricity consumption growth

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[8] In our study, we use 142 countries that were covered in both the 2005 and 2011 ICP rounds, minus Zimbabwe, which experienced hyperinflation during this period.

[9] Tellingly, we attempted instrumenting GDP growth with institutional measurements from the World Bank's Worldwide Governance Indicators. While all appeared to be statistically strong instruments in first-stage estimation, the coefficients were negative, implying that higher institutional governance levels between 2005 and 2011 actually led to lower income growth!

measured over the same period as per capita GDP growth. We think of electricity use in production as being similar between tradables and nontradables. The second variant is residential electricity, which is a consumption-based measure and hence less biased toward either tradables or nontradables production.[10] Both variants are tested to check the robustness of our results, but we ultimately instrument with the more general measure of total electricity consumption in final specifications due to wider data availability.[11]

Data and Samples

We use a number of data sources. Data on real per capita GDP growth in constant US dollars is taken from the World Bank's *World Development Indicators* (WDI) and, in a handful of cases, the International Monetary Fund's (IMF) *World Economic Outlook* (WEO) database.[12] Data on per capita GDP growth in PPP is taken from the Penn World Tables.[13] When we apply our estimation methodology to European exchange rates (beyond the period covered by the ICP), we integrate price level estimates for the 2011–13 and 2005–07 periods for all available country

[10] One potential problem with the instrument is that it might not pass the exclusion restriction in that per capita electricity consumption growth might affect the real exchange rate directly because electricity might have a disproportionately greater effect on tradables production. To test this, we obtained data from the World Bank on "Manufacturing, value added (% of GDP)" and "Services, etc., value added (% of GDP)" as a rough proxy for tradable and non-tradable output, respectively. We then checked for the correlation between growth in manufacturing share in GDP and growth in per capital electricity consumption growth. We found a mild positive correlation with manufacturing growth (0.22) from 2005-2011 for our "core sample" (see Table 1.1), whereas we uncovered no correlation with services growth. However, when removing the outlier countries--Tajikistan and Moldova (see Table 2.1)--no significant correlation was found for either manufacturing or services share growth. We found the same results when regressing log electricity growth on log manufacturing growth. From this exercise, we concluded that electricity growth may be more tightly associated with a country's manufacturing sector growth – and hence tradables – over generally non-tradable services, but this relationship is weak.

[11] Electricity consumption is by no means a perfect instrument for income growth. A country's level of electricity consumption is a complex outcome of private sector demand and public policy decisions, prompting reverse endogeneity concerns within the instrument itself: Does electricity consumption lead to growth, or does growth lead to more electricity consumption? This is of particular relevance when considering residential electricity consumption which intuitively would work only in the latter direction, and another reason we do not use this measure in our final specifications. Our preferred measure is more akin to electricity production which is less prone to this reverse endogeneity problem because it is an input to growth, and not caused by growth, at least in principle. Despite these salient points, the high T-values in first stage estimations illustrate that both instruments used as a statistical tool to separate the causal mechanisms between income growth and the real exchange rate, appear to be an effective first take at identifying a causal BSP framework.

[12] The World Bank does not report GDP per capita values for Taiwan and, as of September 2014, has not yet provided 2013 values for Cyprus, Hungary, Latvia, Lithuania, Malta, Serbia, the Slovak Republic, and Slovenia. Where necessary, for these countries we substitute per capita GDP log change values in constant national currency from IMF's WEO database.

[13] We use output-side real GDP at current PPPs in millions of 2005 dollars (cgdpo) from the Penn World Tables 8.0 and divide it by the PWT-reported population to obtain our PPP GDP per capita values.

observations from Eurostat. The key data on the price level of GDP for 2011 are from the recent ICP round.

Our data for the price level of GDP for 2005 are from two sources: ICP 2005 itself and adjusted 2005 estimates from Inklaar and Rao (2014). Why the latter? The methodology and coverage in ICP 2005 were far superior to those in previous ICP rounds, but ICP 2005 suffered from two shortcomings. Deaton and Heston (2010) have elaborated that the price level estimates for China were upward biased because of the selective nature of sampling (urban) for prices. A second problem related to “ringing”, a procedure used to make price level estimates comparable across regions. Deaton and Aten (2014) and Inklaar (2014) discuss this in great detail and argue for reestimating the ICP 2005 estimates that better “rings” the regions.

Inklaar and Rao (2014) implement these suggestions and produces newly adjusted price level estimates for 2005. These estimates appear to be superior to the original ICP estimates because they produce more plausible estimates for China consistent with Deaton and Heston (2010) and consistent with those in version 8 of the Penn World Tables. They also produce estimates that, when projected to 2011, are less biased and less variable compared with the estimates from projecting the original ICP 2005 data. For these two reasons, in our baseline estimation of the dynamic BSP effect, we use Inklaar and Rao (2014) adjusted ICP 2005 estimates, though we also test nonadjusted values for model robustness.

We estimate the dynamic BSP equation for a number of samples. PPP-based estimates are not in general very reliable for oil-exporting countries or for very small economies. So, we drop these two groups of countries from our analysis.[14] In other variants, we drop primary commodity exporters (besides oil), sub-Saharan African (SSA) countries, and former Soviet Union countries and restrict the sample only to advanced economies.[15]

[14] We define oil exporters as countries where oil was on average over 50 percent of total exports in the 2005–12 period; we define small countries as those with a population less than one million in 2011.

[15] Primary commodity exporters defined as countries where primary commodities (excluding oil) on average account for over 50 percent of total exports in the 2005–12 period; sub-Saharan African countries and advanced economies are defined by IMF’s WEO database.

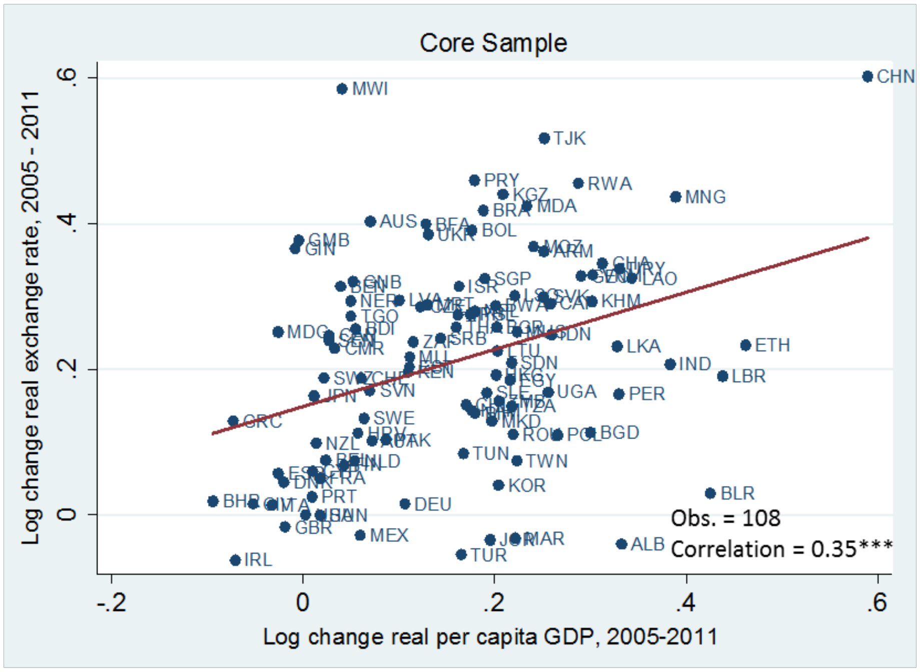
Table 1. Estimating the dynamic Balassa-Samuelson-Penn relationship (ordinary least squares [OLS])

Real exchange rate change on change GDP per capita (constant US dollars), 2005-11				
	Coefficient	**Standard error**	**Observations**	**R-squared**
1.1 Core sample	0.392***	(0.114)	108	0.123
1.2 Drop other commodity exporters	0.433***	(0.135)	81	0.161
1.3 Drop Sub-Saharan Africa	0.587***	(0.123)	76	0.250
1.4 Drop former Soviet States	0.398***	(0.112)	98	0.136
1.5 Only advanced economies	0.722***	(0.230)	31	0.280

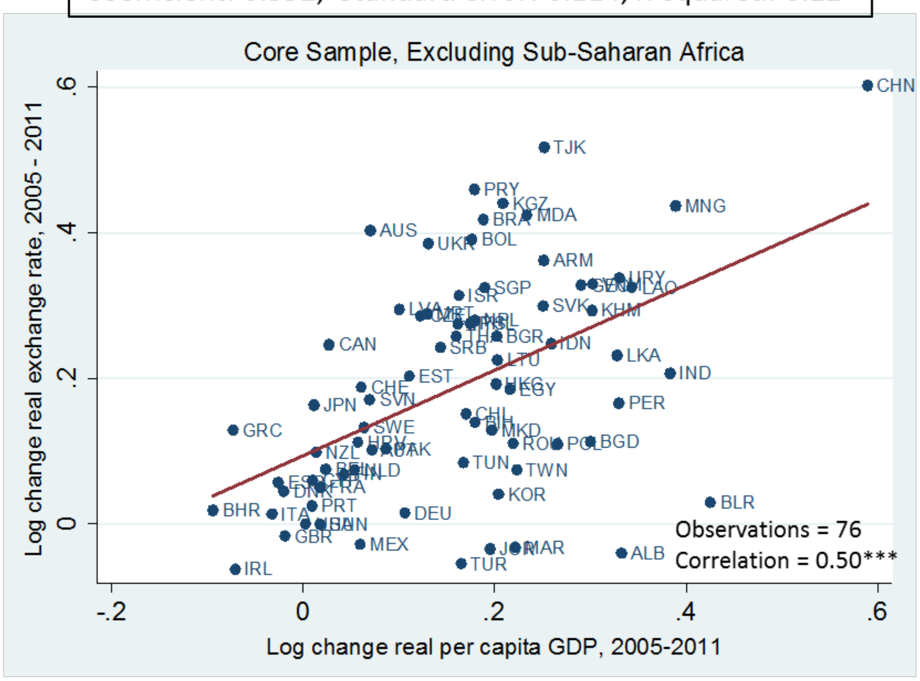
Notes: *** p<0.01. All regressions estimated with a constant, though the coefficient is not reported. "Core sample" excludes oil exporters and countries with populations less than 1 million as of 2011.
Sources: World Bank (GDP per capita); International Comparison Program (real exchange rate).

We first estimate the dynamic BSP equation using ordinary least squares (OLS) (i.e., without instrumenting for growth in per capita GDP). The results are in table 1. In all cases, the BSP coefficient is significantly different from zero at the 1 percent level of confidence. The coefficient estimate varies from 0.39 in the core sample to 0.72 in the advanced country–only sample. The fit is generally good in the cases where we drop SSA countries or only include advanced economies, with approximately 12 to 28 percent of the variation in real exchange rate changes accounted for in all regressions shown. The core results for the core sample (1.1) and that without SSA countries (1.3) are depicted in figure 5.

Figure 5. Dynamic Balassa-Samuelson-Penn relationship (OLS), 2005 – 11



Coefficient: 0.392, Standard error: 0.114, R-squared: 0.12



Coefficient: 0.587, Standard error: 0.123 , R-squared: 0.25

Notes: All standard errors reported as heteroskedastistically robust. All regressions estimated with a constant, though the coefficient is not reported. "Core sample" excludes oil exporters and countries with populations less than 1 million as of 2011. See key to country abbreviations at the end of the paper. *** p<0.01.

Sources: World Bank (GDP per capita); International Comparison Program (real exchange rate).

We test the robustness of these estimates in a number of ways (see appendix table A.1). First, we use per capita GDP growth (in PPP) from the PWT instead of the WDI (combinations B and C). Second we use the original nonadjusted ICP 2005 estimates instead of Inklaar's ICP estimates and find that the equation is only weakly estimated in the former case.

Table 2. Estimating the dynamic Balassa-Samuelson-Penn relationship (instrumental variable [IV])

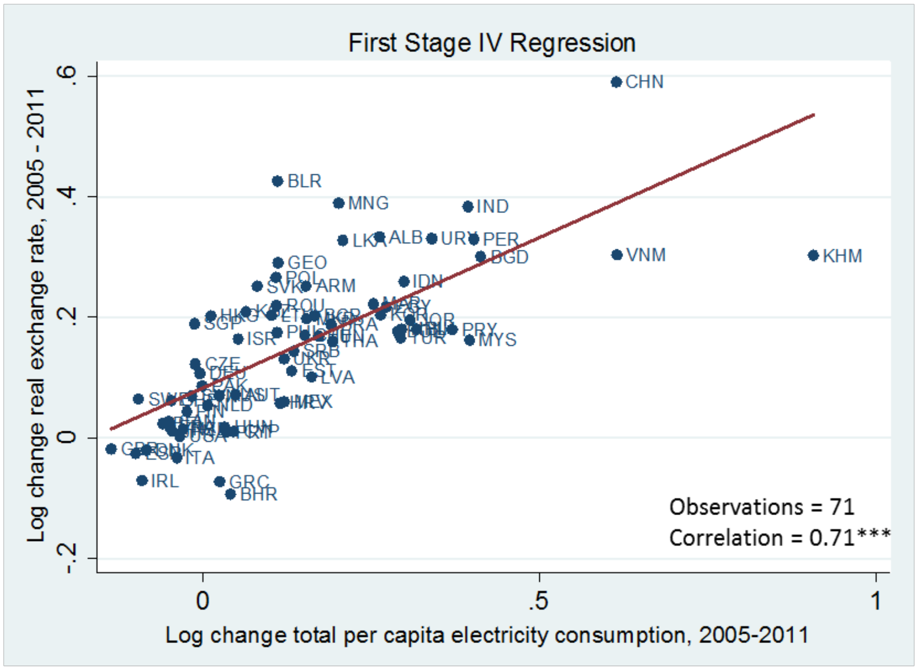
Real exchange rate change on change GDP per capita (constant US dollars), instrumented by total per capita electricity consumption					
	Stage	**Coefficient**	**Standard error**	**Observations**	**R-squared**
2.1 Core sample	*1*	0.441***	(0.058)	84	0.412
	2	0.580***	(0.133)		0.239
2.2 Drop other commodity exporters	*1*	0.433***	(0.059)	70	0.438
	2	0.569***	(0.145)		0.201
2.3 Drop Sub-Saharan Africa	*1*	0.499***	(0.059)	71	0.509
	2	0.602***	(0.138)		0.244
2.4 Drop former Soviet States	*1*	0.450***	(0.056)	76	0.464
	2	0.592***	(0.130)		0.300
2.5 Only advanced economies	*1*	0.588***	(0.151)	30	0.352
	2	0.771	(0.543)		0.354

Notes: *** $p<0.01$. All regressions estimated with a constant, though the coefficient is not reported. "Core sample" excludes oil exporters, countries with populations less than 1 million as of 2011, Tajikistan, and Moldova.

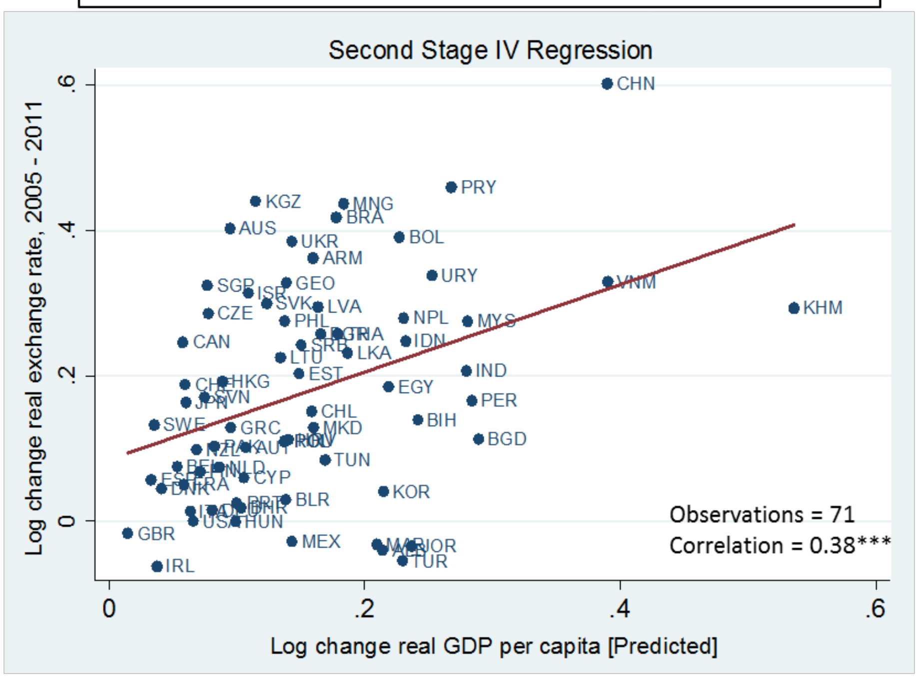
Sources: World Bank (GDP per capita, electricity consumption); International Comparison Program (real exchange rate).

We next estimate the dynamic BSP equation using our instrumental variables (IV). In table 2 we present results of the first and second stage results when total per capita electricity consumption is used as our instrument. The first stage results for our chosen sample (core, excluding SSA countries) are shown in figure 6. The instrument is significant with a t-statistic of 7.6 in the core sample and 8.5 in the sample without SSA countries, which far exceeds the threshold of 3 suggested by Stock and Yogo (2005) for strong instruments. The R-square in the first stage is also high. We thus appear to have very strong instruments.

Figure 6. Dynamic Balassa-Samuelson-Penn relationship (IV), 2005 – 11



Coefficient: 0.499, Standard error: 0.059, R-squared: 0.51



Coefficient: 0.602, Standard error: 0.138, R-squared: 0.24

Notes: Standard errors reported as heteroskedastistically robust. Regression excludes oil exporters, countries with populations less than 1 million as of 2011, Sub-Saharan African countries, and Moldova and Tajikistan. See key to country abbreviations at the end of the paper.
*** p<0.01.

Sources: World Bank (GDP per capita, electricity consumption); International Comparison Program (real exchange rate).

The second stage results shown in figure 6 and table 2 are also plausible. Compared with the OLS results, the coefficients are greater and the R-squares are higher. The fact that the IV estimates are greater than the corresponding OLS estimates is consistent with negative reverse causation from exchange rate changes to growth. Negative reverse causation tends to pull down the OLS estimate. Once this is accounted for the pure BSP effect is greater. Our OLS and especially our IV estimates appear to be substantially greater than those in Ravallion (2013) and Inklaar (2014). Our magnitudes range from 0.4 to 0.7 for OLS results and 0.6 to 0.8 for instrumented coefficients compared with about 0.3 in these other papers. Accounting for reverse causation explains part of the difference while different samples could account for the rest.[16]

To check the robustness of our results, we try a few data variations, which are documented in appendix table A.2. In combinations A and C, we substitute real GDP per capita growth in constant US dollars with PPP income growth, which in general makes the coefficients even higher. In combinations B and C, we instrument income growth with per capita residential electricity consumption. In every case but the advanced country–only sample, coefficients are significant at least at the 5 percent level and not substantially different in magnitude, generally staying in the 0.5 – 0.8 range. For our small sample of advanced countries, coefficients are mostly significant without Korea, which is an outlier, but insignificant if we include Korea.[17]

3. APPLYING AND VALIDATING THE DYNAMIC BSP EQUATION

Frankel (2006) was amongst the first to propose that the BSP equation could be used to assess exchange rates, namely to check for undervaluation and overvaluation. Since then, this method has been used by several authors including Cheung, Chinn, and Fujii (2009) and Subramanian (2010). Measures of undervaluation and overvaluation are obtained as residuals from the static version of the BSP equation.

Thus for each country:

$$V = \ln P - \ln \hat{P} = \ln P - \left(\hat{\alpha} + \hat{\beta} \ln Y\right) \qquad (4)$$

[16] Ravallion (2013, 2014) and Inklaar (2014) do not instrument for per capita GDP growth and do not drop oil exporters and small economies from their sample. We also drop observations from Tajikistan and Moldova in all instrumented models, as these countries were found to be significant outliers. If we reestimate the dynamic BSP effect using a completely unrestricted sample, the OLS coefficient is 0.32 and the IV coefficient is 0.27, although only the OLS result is significant at acceptable levels. These coefficients are more in line with previous findings.

[17] For the small sample of 30 advanced countries, coefficients on log income per capita were found to be significant in table 2 (specification 2.5) and appendix table A.2 if we also drop South Korea, but insignificant if we include it.

where V represents the valuation of a country's currency, with positive (negative) values indicating overvaluation (undervaluation); and $\hat{\alpha}$ and $\hat{\beta}$ are the coefficients of the BSP equation (2) estimated using OLS.

It is just a logical step to extend this approach to currency valuation to a dynamic context. Thus:

$$\Delta V = \Delta \ln P - \Delta \ln \widehat{P} = \Delta \ln P - \left(\widehat{\alpha}_1 + \widehat{\beta}_1 \Delta \ln Y\right) \tag{5}$$

where the coefficients are from the BSP equation (3) estimated using our instrumental variables. A positive (negative) value of ΔV represents a decline (improvement) in competitiveness.

ΔV thus measures how much a currency's competitiveness has changed taking account of the fact that some change in the real exchange rate is "natural" and related to economic growth (i.e., some real exchange rate change is an equilibrium phenomenon stemming from the BSP effect). Thus ΔV is arguably a measure of the "true" change in competitiveness. Based on the above we can measure and compare three measures of competitiveness changes across countries summarized in table 3, along with the shorthand reference terms we use for each throughout the rest of the paper.

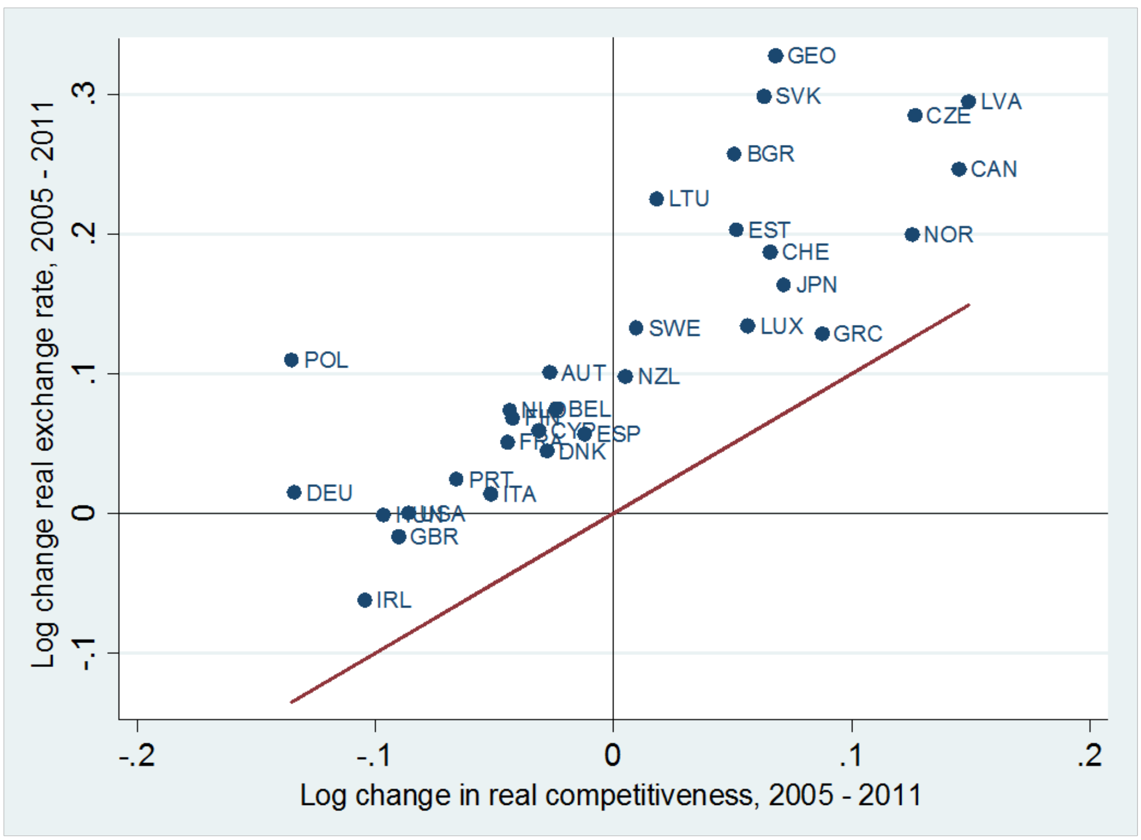
Table 3. Three measures of competitiveness changes

Measure	Reference term	Formula	Remarks
1.Change in real exchange rate	"Change in Real Exchange Rate"	$\Delta \ln P = \ln P_{2011} - \ln P\_adj_{2005}$	Raw number
2.Change in real exchange rate adjusted for "noncausal" BSP effect	"Change in Real Competitiveness [OLS Residual]"	$\Delta \ln P - \Delta \ln \hat{P} = \Delta \ln P - (\hat{a} + \hat{\beta} \Delta \ln Y)$	Residual from OLS regression
3.Change in real exchange rate adjusted for "causal" BSP effect	"Change in Real Competitiveness [IV Residual]"	$\Delta \ln P - \Delta \ln \hat{P} = \Delta \ln P - (\widehat{a_1} + \widehat{\beta_1} \Delta \ln Y)$	Residual from IV regression

OLS = ordinary least squares; IV = instrumental variable

One important point is inadequately appreciated. Like the IMF's Consultative Group on Exchange Rate Issues (CGER) model described in Lee et al. (2008) and unlike the approach in Cline and Williamson (2008) or the unit labor cost measures produced by the OECD, PPP-based approaches to assessing exchange rates such as in the ICP methodology have the virtue of being general equilibrium in spirit, where the price level of GDP for all countries is determined simultaneously based on the detailed and disaggregated price data (see technical appendix 1 in Johnson et al. 2013). Thus, exchange rates are determined simultaneously, ensuring some degree of consistency across estimates for countries (for example, not all countries can simultaneously have undervalued or overvalued exchange rates). This is one advantage of PPP-based real exchange rate measures over the traditional macroeconomic ones computed by the IMF (the nominal and real effective exchange rate series) and a number of investment banks.

Figure 7. Changes in real exchange rate and in real competitiveness for advanced economies, 2005 – 11



Notes: Positive (negative) values on y-axis denote an appreciation (depreciation) in the real exchange rate, positive (negative) vales on x-axis denote loss (gain) in real competitiveness. Thick diagonal line represents 45 degree partition between x- and y-axis. log real change in competitiveness is the residual of IV regression in table 2, specification 2.3. See key to country abbreviations at the end of the paper.

Sources: World Bank (GDP per capita, electricity consumption); International Comparison Program (real exchange rate).

Before we present the main results, we want to validate our framework, notably the usefulness of accounting for the BSP effect, which is illustrated in figure 7. We plot the simple change in the real exchange rate (measure 1 in table 3) on the y-axis and the change in competitiveness based on accounting for the BSP effect (measure 3 in table 3 on the x-axis for select eurozone, euro-tied, and industrialized-country comparators. The 45 degree line is also shown in this figure. Every point in the figure is above the 45 degree line, suggesting that the simple real exchange rate can be a systematically misleading measure of the change in real competitiveness.

For some countries, both measures show deteriorating competitiveness (Japan, Switzerland, Greece, Latvia, Canada, etc.), but the simple measure overstates the deterioration and in some cases substantially (Estonia, Latvia, and the Czech Republic).

For a second set of countries, the two measures move in the opposite direction, with the real exchange rate showing deterioration while the BSP-adjusted measure showing an improvement (Austria, Poland, etc.). Finally, for a third set of countries, both measures show an improvement in competitiveness but the simple measure understates the improvement (United Kingdom, Ireland). Germany's price level of GDP increased (the real exchange rate appreciated) very slightly by 1.5 percent between 2005 and 2011. But once account is taken of Germany's growth rate and the resulting equilibrium real exchange rate appreciation, the real improvement in competitiveness was close to 13.4 percent.

Table 4. Measures of external adjustment in advanced countries, 2005 – 11

Country	Log change in nominal exchange rate against SDR	Log change in real exchange rate	Log change in real competitiveness
Eurozone group			
Austria	0.05	0.10	-0.027
Belgium	0.05	0.07	-0.024
Cyprus	n/a	0.06	-0.031
Estonia	n/a	0.20	0.051
Finland	0.05	0.07	-0.042
France	0.05	0.05	-0.044
Germany	0.05	0.01	-0.134
Greece	0.05	0.13	0.088
Ireland	0.05	-0.06	-0.104
Italy	0.05	0.01	-0.052
Latvia	0.05	0.29	0.149
Luxembourg	0.05	0.13	0.056

Netherlands	0.05	0.07	-0.044
Portugal	0.05	0.02	-0.066
Slovak Republic	n/a	0.30	0.063
Spain	0.05	0.06	-0.012
"Euro-tied" group			
Bulgaria	0.05	0.26	0.051
Denmark	0.04	0.04	-0.028
Lithuania	0.05	0.22	0.018
"Own currency" group			
Canada	0.14	0.246	0.145
Czech Republic	0.24	0.285	0.126
Hungary	-0.07	0.00	-0.097
Iceland	-0.68	-0.26	-0.317
Japan	0.26	0.163	0.072
Poland	0.02	0.11	-0.135
Sweden	0.07	0.13	0.010
Switzerland	0.27	0.187	0.066
United Kingdom	-0.19	-0.017	-0.090
United States	-0.07	0.000	-0.086

n.a. = data not available; SDR = special drawing rights

Notes: Positive (negative) values for log change nominal exchange rate and real exchange rate imply the currency appreciated (depreciated). Positive (negative) values for log change in real competitiveness imply a deterioration (improvement) in competitiveness. Eurozone group consists of all countries in eurozone as of 2014.

Sources: World Bank (GDP per capita, electricity consumption); International Comparison Program (real exchange rate); International Monetary Fund (nominal SDR exchange rate).

Table 4 presents the results for all three measures of changes in competitiveness for three groups of countries—eurozone countries, countries with their own currencies but that closely track the euro, and countries with their own currencies that are relatively flexible.

As a robustness exercise, we show in table 5, similar results for a group of emerging-market currencies. This table suggests that all the estimates are plausible. We also find that the estimates based on the OLS version of the BSP equation are quite close to those based on the IV version of the equation (see the correlations in table 6). In other words, although the IV version produces a marginally larger dynamic BSP coefficient than its OLS counterpart, the residuals do not change substantially.[18]

Table 5. Measures of external adjustment in selected emerging-market countries, 2005-11

Country	Log change in nominal exchange rate against SDR	Log change in real exchange rate	Log change in real competitiveness
Brazil	0.31	0.418	0.220
China	0.17	0.602	0.163
India	-0.12	0.206	-0.109
Indonesia	0.03	0.247	0.006
Mexico	-0.20	-0.029	-0.149
Russia	-0.10	0.368	0.153
South Africa	-0.20	0.238	0.084
Turkey	-0.29	-0.055	-0.239

Note: Positive (negative) values for log change nominal exchange rate imply the currency appreciated (depreciated) against special drawing rights (SDR).

Sources: World Bank (GDP per capita, electricity consumption); International Comparison Program (real exchange rate); International Monetary Fund (nominal SDR exchange rate).

Finally, we report in table 6 a series of correlation coefficients to explore the extent to which our various measures of exchange rate and competitiveness changes move together. We can see that during 2005–11 the change in the real exchange rate is highly correlated with both the OLS and IV-derived changes in competitiveness, as well as the residual averaged over our various robustness-check regressions.

[18] Specifically, we are comparing the residuals derived from table 1, specification 1.3 (OLS) and table 2, specification 2.3 (IV).

Table 6. Correlation between measures of external adjustment, 2005 – 11

Measure	Log change in real exchange rate	Log change in nominal effective exchange rate	Log change in real effective exchange rate	Log change in nominal exchange rate to SDR	Log change in competitiveness [OLS]	Log change in competitiveness [IV]	Average log change in competitiveness [OLS]
Log change in real exchange rate	1						
Log change in nominal effective exchange rate	0.4409	1					
Log change in real effective exchange rate	0.8168	0.6483	1				
Log change in nominal exchange rate to SDR	0.3013	0.9767	0.5908	1			
Log change in competitiveness [OLS]	0.8529	0.4346	0.7298	0.4522	1		
Log change in competitiveness [IV]	0.8448	0.4327	0.7241	0.4546	0.9999	1	
Average log change in competitiveness [OLS]	0.9262	0.4588	0.7617	0.4467	0.9766	0.9738	1
Average log change in competitiveness [IV]	0.8400	0.4541	0.6991	0.4990	0.9817	0.9815	0.9824

OLS = ordinary least squares; IV = instrumental variable

Notes: "Average log change in competitiveness [OLS/IV]" is the average value of the residual for eight different combinations of the OLS/IV regressions. All correlations exclude small countries, oil producers, Sub-Saharan African countries, and Tajikistan and Moldova. Correlations are pairwise, meaning that sample sizes may differ.

Sources: World Bank (GDP per capita, electricity consumption); International Comparison Program (real exchange rate); International Monetary Fund (nominal special drawing rights [SDR] exchange rate, nominal effective exchange rate, real effective exchange rate).

Two correlations are worth highlighting. The PPP-based measure of the real exchange rate and the IMF's real effective exchange rate are highly but not perfectly correlated (0.82). Our preferred measure of real competitiveness (adjusted for the BSP effect) is even less tightly correlated with the IMF's real effective exchange rate (0.72). Thus, PPP-based measures that we estimate here contain different information from the conventional (IMF) measure of real exchange rates.

4. COMPETITIVENESS CHANGES IN THE EUROZONE AND BEYOND AND LESSONS FOR EXCHANGE RATE REGIMES

In principle, this framework can be applied to assessing the exchange rate of any country; the Chinese currency has been the principal target for this framework (Frankel 2006, Cheung et al. 2009, and Subramanian 2013). We chose instead to focus on the eurozone (and other industrial economies) because of the seriousness of the crisis and the raging policy debates around exchange rate regimes and the role they have played in the aftermath of the crisis.[19] A number of papers have discussed adjustment in the eurozone (Tressel et al. 2014, IMF 2012, Shambaugh 2012) but none have adopted our approach.

Since our policy focus is the crisis period, we need estimates that both are more recent than 2011 and begin not in 2005 but at the start of the crisis, 2007.[20] We cannot replicate the BSP equation for any period other than 2005–11 because that is the period of the ICP estimates. But for Europe we can extend the estimates to 2013 because Eurostat and the OECD compile PPP estimates for European and other advanced countries more frequently and more quickly. By the same token, we can calculate estimates for 2007 (even though there are no ICP estimates for that year).

The appendix discusses how and under what assumptions we can compute estimates for Europe and the advanced countries for the period 2007–13. These estimates are presented in table 7.

A few key points stand out.

Limited and Lopsided Adjustments

First, properly measured (i.e., accounting for the BSP effect), there has been little improvement in competitiveness in the euro periphery (table 7). Between 2007 and 2013, the adjustment has been in the wrong direction in Greece, Spain, and Italy with *appreciations* of 9, 1.5, and 1.5, respectively. In Portugal, the improvement has been relatively minor.

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[19] Since our focus is on Europe, all our estimates are based on the sample that excludes SSA countries.

[20] In principle, we could also make 2008 the starting point. It turns out that the results are generally similar except for one extreme case, Iceland, where the real exchange rate plummeted between 2007 and 2008. To accommodate Iceland, which was an importantly different policy experiment, we therefore chose 2007 as the starting point for our analysis. All country-specific comparisons of results for 2008–13 and 2007–13 can be found in appendix table A.3.

Table 7. Measures of external adjustment in advanced countries, 2007 - 13

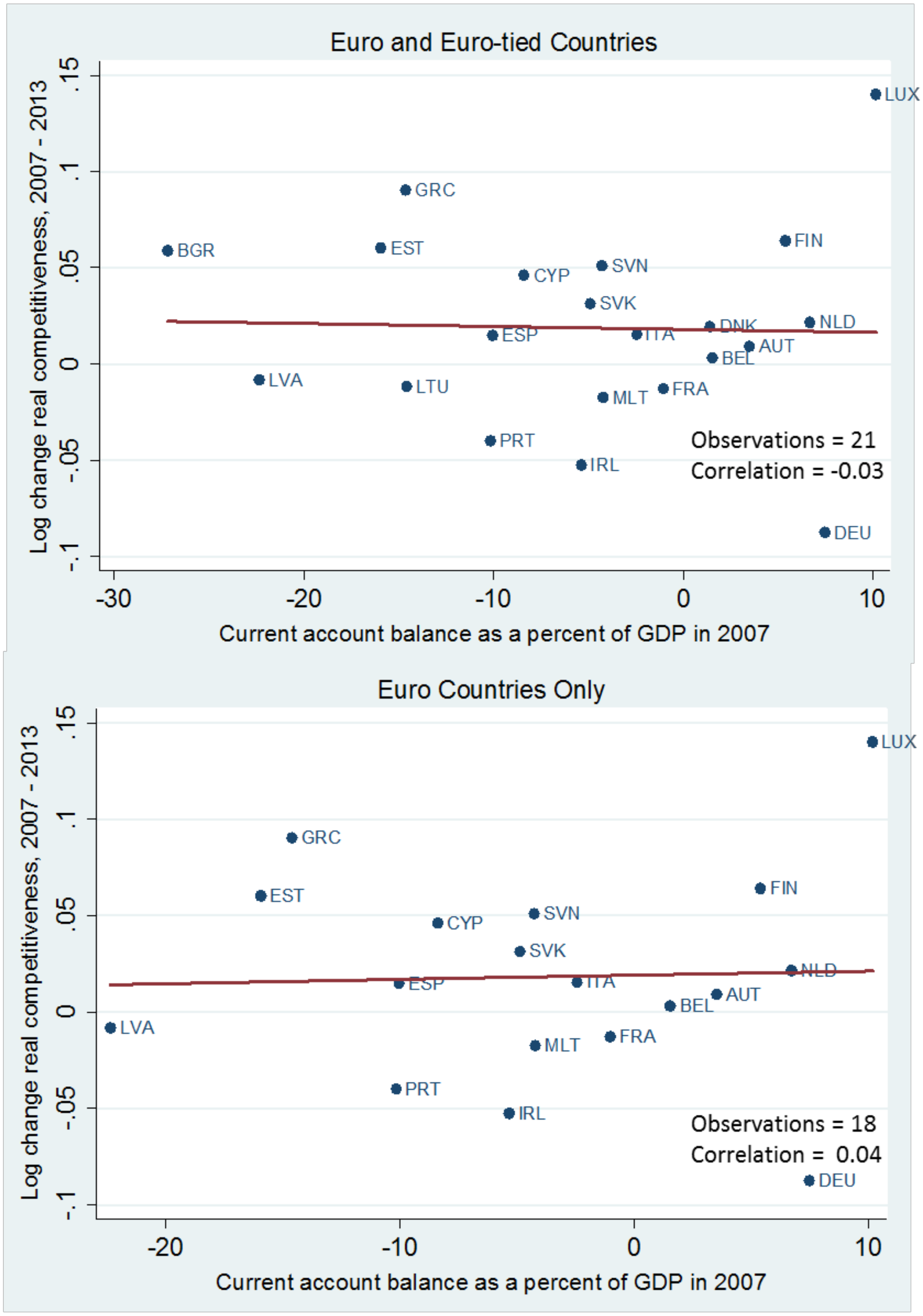
Country	Log change in nominal SDR exchange rate	Log change in real exchange rate	Log change in real competitiveness
Eurozone group			
Austria	-0.02	0.101	0.009
Belgium	-0.02	0.070	0.003
Cyprus	n/a	0.023	0.046
Estonia	n/a	0.133	0.060
Finland	-0.02	0.102	0.064
France	-0.02	0.057	-0.013
Germany	-0.02	0.034	-0.087
Greece	-0.02	0.020	0.090
Ireland	-0.02	-0.041	-0.052
Italy	-0.02	0.032	0.015
Latvia	-0.02	0.069	-0.008
Luxembourg	-0.02	0.153	0.140
Netherlands	-0.02	0.081	0.022
Portugal	-0.02	0.007	-0.040
Slovak Republic	n/a	0.177	0.031
Spain	-0.02	0.044	0.015
"Euro-tied" group			
Bulgaria	-0.02	0.191	0.059
Denmark	-0.02	0.063	0.019
Lithuania	-0.02	0.130	-0.012
"Own currency" group			
Czech Republic	0.04	0.161	0.085
Hungary	-0.19	-0.061	-0.133
Iceland	-0.64	-0.276	-0.324
Japan	0.19	0.180	0.091
Poland	-0.13	0.016	-0.173
Sweden	0.04	0.186	0.094
Switzerland	0.27	0.267	0.176
United Kingdom	-0.24	-0.041	-0.091
United States	0.01	0.117	0.026
Eurozone average	**n/a**	**0.066**	**0.018**
PIGS average	**n/a**	**0.026**	**0.020**

n.a. = data not available; SDR = special drawing rights

Notes: Positive (negative) values for log change nominal exchange rate imply the currency appreciated (depreciated) against the SDR. Cyprus, Estonia, and Slovak Republic joined euro in 2007-13, so nominal exchange rate change not shown. PIGS comprise Portugal, Italy, Greece, and Spain.
Sources: World Bank (GDP per capita, electricity consumption); International Comparison Program (real exchange rate); International Monetary Fund (SDR exchange rate).

Second, and related, figure 8 illustrates how lopsidedly inadequate (even perverse) the pattern of adjustment within the eurozone has been. The figure plots the current account balance (on the x-axis at the beginning of the crisis period in 2007) against the real competitiveness change that has occurred since (on the y-axis). Ideally, the line should have been strongly and significantly upward sloping because adjustment requires competitiveness improvements (moving down on the y-axis) in deficit countries and appreciations (moving up on the y-axis) in surplus countries. But the line of best fit is essentially flat for both the eurozone and euro-tied country samples, with statistically insignificant correlation coefficients of -0.03 and 0.04, respectively. These results contrast sharply with results that assess competitiveness based on unit labor costs (see figure 3).

Figure 8. Limited and lopsided pattern of adjustment accounting for Balassa-Samuelson-Penn effect, 2007 – 13



Notes: Log real change in competitiveness plugs GDP and real exchange rate values from 2007-13 into coefficient and intercept from regressions obtained in 2005-11 samples. Positive (negative) values on y-axis denote loss (gain) in real competitiveness. See key to country abbreviations at the end of the paper.

Sources: World Bank (GDP per capita, electricity consumption, current account balance); International Comparison Program (real exchange rate); Eurostat (real exchange rate).

The periphery countries with deficits (Greece, Spain, Portugal, and Italy) have witnessed deteriorating competitiveness while Germany has witnessed the biggest improvement in competitiveness of about 9 percent (other core countries such as Austria and Belgium with surpluses also witness essentially no differences in competitiveness). The differential between Germany, which needed to reduce its current account surplus, and Greece, which needed to improve its current account deficit, has been a whopping 18 percent but in exactly the wrong direction.

Importance of Nominal Flexibility

As figure 9 illustrates there is a strong relationship between changes in real competitiveness and nominal changes in the exchange rate (measured against special drawing rights [SDR]).[21] The correlation is 0.83, which in a rough way indicates that the passthrough is very low.[22] Thus, on average, an independent flexible currency is more conducive to real competitiveness adjustments. The countries that took advantage of floating were Iceland, Poland, Hungary, Turkey, Romania, and the United Kingdom, where substantial nominal depreciations were accompanied by real competitiveness improvements.

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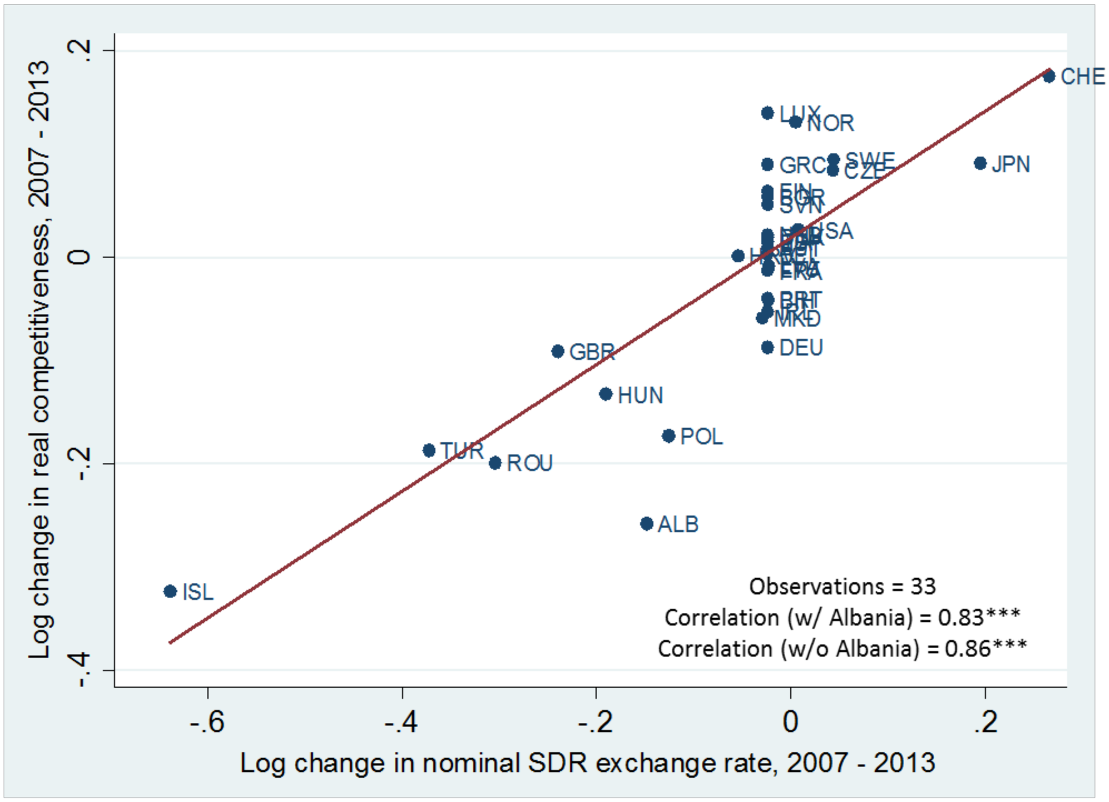
[21] National currency per SDR (annual average) is taken from IMF's *International Financial Statistics* browser. However, SDR values for the euro have been taken from the IMF's Exchange Rate Query Tool. The arithmetic average of all daily euro/SDR rates within a given year is then substituted for all eurozone countries. For Cyprus, Estonia, Malta, the Slovak Republic, and Slovenia, which joined the euro within the 2005–13 period under study, SDR values are typically left blank from the year they switched currencies.

[22] Nominal exchange rate changes can be measured in three ways: bilateral against the dollar; fully multilateral using the IMF's nominal effective exchange rate series; or quasi-multilateral against the SDR. Each has its strengths and shortcomings. The bilateral rate has the virtue that it captures as identical the common shock faced by all eurozone countries. The advantage of the nominal effective series is that it captures the trade and pricing consequences of the common shock. We chose, as a compromise, the rate against the SDR because it is identical across all eurozone countries and by including more than one country can reflect, if not fully capture, the trade and pricing consequences of the exchange rate shock. In any case, our results are very similar even if we use the IMF's nominal effective exchange rate instead of the SDR rate (appendix figure A.1, for example, is the counterpart of figure 9; the correlation coefficient between the two nominal rates is close to 0.98).

Figure 9. Importance of flexibility: Correlation between nominal exchange rate and real competitiveness



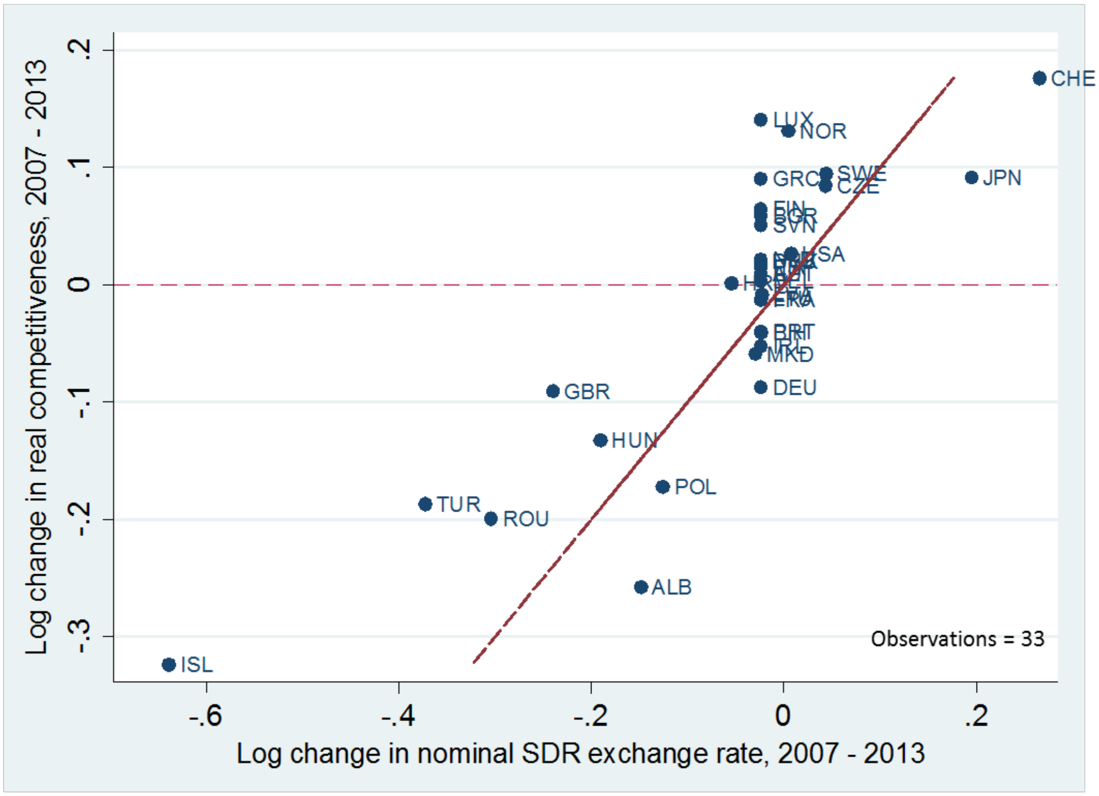
Notes: Log real change in competitiveness plugs GDP and real exchange rate values from 2007-13 into coefficient and intercept from regressions obtained in 2005 - 2011 samples. Positive (negative) values on x-axis denote an appreciation (depreciation) in the nominal SDR exchange rate, positive (negative) vales on y-axis denote loss (gain) in real competitiveness. Cyprus, Estonia, Malta, and Slovak Republic not included because they enter eurozone in 2007-13 period, Serbia and Montenegro special drawing rights (SDR) exchange rate value missing. See key to country abbreviations at the end of the paper. *** p<0.01.

Sources: World Bank (GDP per capita, electricity consumption); International Comparison Program (real exchange rate); International Monetary Fund (SDR exchange rate); Eurostat (real exchange rate).

Limited Scope for Internal Devaluation

One qualification to the strong positive relationship between nominal changes and real changes relates to the eurozone itself. Figure 10 is identical to figure 9, except that we draw a 45 degree line instead of the line of best fit. It illustrates that a given nominal depreciation of 2 percent (of the euro against the SDR) has sustained a large variation in real competitiveness changes, ranging from a deterioration of 9 percent for Greece (14 percent for Luxembourg and 5 percent for Cyprus) to an improvement of 1 percent for Latvia, 5 percent for Ireland, and 9 percent for Germany. In other words, a common 2 percent nominal depreciation has sustained a variation of almost 23 percent in real competitiveness changes.

Figure 10. Limited scope for internal devaluation: Correlation between nominal and real competitiveness changes in advanced countries, 2007 – 13



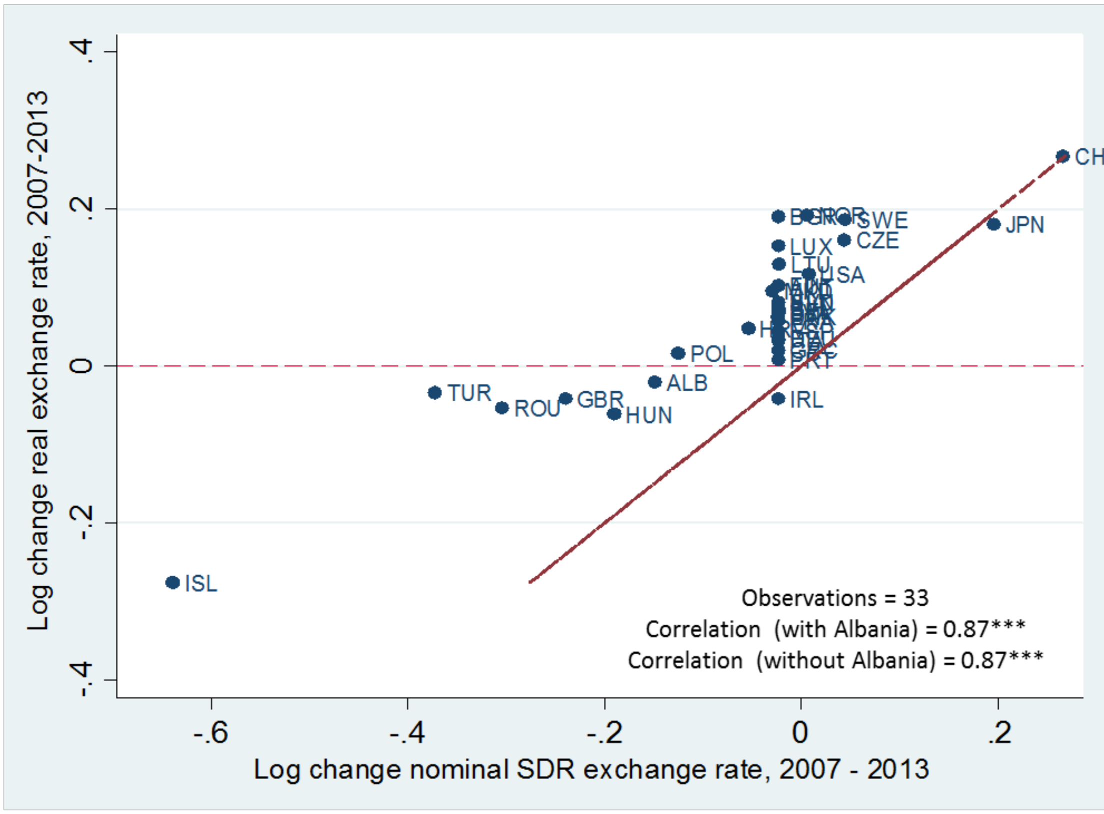
Notes: Log real change in competitiveness plugs GDP and real exchange rate values from 2007-13 into coefficient and intercept from regressions obtain in 2005-11 samples;. Positive (negative) values on x-axis denote an appreciation (depreciation) in the nominal special drawing rights (SDR) exchange rate, positive (negative) vales onydenote loss (gain) in real competitiveness. Thick diagonal line represents 45 degree partition between x- and y-axis values. See key to country abbreviations at the end of the paper.

Sources: World Bank (GDP per capita, electricity consumption); International Comparison Program (real exchange rate); International Monetary Fund (SDR exchange rate); Eurostat (real exchange rate).

What should one make of this dramatically large variation in country-specific responses to a common nominal exchange rate shock? Two issues are important here. The first relates to internal devaluation and the scope for it in a currency zone. Figures 10 and 11 shed light on this issue. In figure 11, we show the zone of internal devaluation, which we define as comprising cases where there has been a real exchange rate depreciation (measure 1) and one exceeding an equivalent nominal depreciation.[23]

[23] We do not focus on cases where real competitiveness deteriorations are more muted than nominal appreciations because such cases involve wage *increases*. Internal devaluation, on the other hand, requires downward wage flexibility, which is what we want to assess.

Figure 11. Limited scope for internal devaluation: Correlation between nominal and real exchange rate changes in advanced countries, 2007 – 13



Notes: Positive (negative) values on x/y-axis denote an appreciation (depreciation) in the nominal special drawing rights (SDR) or real exchange rate. Thick diagonal line represents 45 degree partition between x- and y-axis values. See key to country abbreviations at the end of the paper. *** p<0.01.

Sources: International Comparison Program (real exchange rate); International Monetary Fund (SDR exchange rate); Eurostat (real exchange rate).

We see that internal devaluation was achieved in only Ireland, one out of 33 countries in our sample. In Ireland, the same nominal depreciation resulted in a real depreciation of 4 percent. The scope for internal devaluation thus seems limited.

In figure 10, we show the zone of internal devaluation, which we define as comprising cases where there has been a real competitiveness improvement (measure 3, which accounts for the BSP effect) and one exceeding an equivalent nominal depreciation. If we assess internal devaluation based on achieving such real competitiveness improvements, then seven out of 33 countries achieved internal devaluation. They are Albania, Bosnia, Germany, Ireland, Macedonia, Poland, and Portugal. And for these countries, the real competitiveness changes in excess of the nominal exchange rate change was 4.5 percent on average. Overall, the scope for internal devaluation does not seem limitless.

The Curse of Local Exorbitant Privileges

The perverse nature of adjustment between the reserve currency country Germany (and even France) relative to the periphery highlights a possible structural or intrinsic flaw in the make-up of a currency union.

Germany enjoys two related "local exorbitant privileges:" lower interest rates as capital flees from the periphery to the core but without suffering the consequent appreciation because of being yoked to the weak periphery (see Subramanian 2013).[24] These local exorbitant privileges allow it to have more expansionary aggregate demand, which during depressed times leads to higher output and employment. In contrast, the periphery endures austerity, which is limited in its ability to deliver the required "internal devaluation."

5. LIMITATIONS AND ROBUSTNESS

While our results are striking, they encounter one important objection. The BSP effect is a medium-term structural phenomenon, stemming from differential productivity growth in tradables and is only validly estimated and applied under conditions of full or close to full employment of resources. Under these circumstances, the BSP relationship could break down for a number of reasons. Demand-induced changes in output could have no effect on the relative productivity performance of tradables and nontradables, which is a key driver of the BSP effect. Even if there are relative productivity shifts, unemployment and excess supply of labor could come in the way of labor market arbitrage between the tradables and nontradables sectors, which is a key transmission mechanism for the BSP effect.

In this view, our results are susceptible to two critiques: Our BSP regression estimates could be off because they cover a period (2005–11) when some of the advanced countries experienced high unemployment especially from 2009 to 2011; further, the use of the BSP framework as the benchmark for measuring competitiveness changes is also misguided because an equilibrium phenomenon (the BSP framework) cannot be a benchmark for measurement under conditions of severe Keynesian disequilibrium. Put simply, these two critiques suggest that the regression coefficients are flawed as our measures of real competitiveness changes.

Ideally, we would like to estimate the dynamic BSP effect for a period that was not characterized by severe unemployment. But the binding constraint here is data. The full-fledged multilateral estimation of PPP-based prices by the ICP is only available for 2005 and 2011, limiting us to a single window in time. But we can attempt to address this critique. We can check

[24] We use the term "local" to distinguish Germany, which enjoys the benefits within Europe that the United States enjoys globally as the issuer of the most coveted reserve currency. And we would emphasize the plural because the US government enjoys the exorbitant privilege of being able to secure cheap financing but the US economy experiences an attendant cost of experiencing a correspondingly stronger currency.

if those advanced countries that had high rates of unemployment are outliers in relation to the BSP effect. The idea here is to see if the BSP effect breaks down as an empirical matter for those countries that experienced disequilibrium in labor markets.

We undertake a series of diagnostic tests. We identify all the countries in the advanced country sample that experienced large unemployment shocks defined as 30 percent (or higher) increases in the average unemployment rate between 2000–08 and 2009–11.[25] We then introduce a dummy for this group of countries (15 in number) in our IV and OLS regressions and interact this dummy with the income term in the BSP regressions. As the results in table 8 show, this income interaction effect is statistically insignificant, suggesting that at least empirically, as revealed in the data, the BSP effect continues to hold for countries with high unemployment; or strictly speaking that the BSP effect is no different for this group compared with all the other countries in the sample that did not experience this underemployment of resources.

Table 8. Balassa-Samuelson-Penn relationship accounting for unemployment shocks, 2005 - 11

Dependent variable: Log real exchange rate change, 2005-11	**Log per capita income change**	**Employment shock country income interaction**	**Employment shock country dummy**	**Observations**	**R-squared**
IV regressions					
8.1 Top-15 unemployment interaction	0.487**	0.737	-0.0663*	71	0.265
	(0.193)	(0.503)	(0.0397)		
(Excluding Latvia)	0.487**	0.323	-0.0668*	70	0.278
	(0.193)	(0.468)	(0.0396)		
8.2 Top-10 unemployment interaction	0.521***	0.736	-0.0703**	71	0.277
	(0.168)	(0.579)	(0.0338)		
(Excluding Latvia)	0.521***	0.116	-0.0786**	70	0.283
	(0.168)	(0.600)	(0.0337)		
8.3 Top-5 unemployment interaction	0.553***	1.406***	-0.0383	71	0.270
	(0.157)	(0.393)	(0.0339)		
(Excluding Latvia)	0.553***	-0.227	-0.0828***	70	0.267
	(0.157)	(0.739)	(0.0273)		

[25] These countries are, in order of unemployment shock severity: Ireland, Spain, United States, Portugal, Latvia, Mexico, Estonia, Hungary, Denmark, Cyprus, United Kingdom, Lithuania, New Zealand, Greece, and Sweden. Note that we do not include low-income countries (Uganda, Bhutan), countries where we do not have ICP data (Guatemala, UAE, etc.), and countries already excluded from our model (Iceland) on the list.

OLS regressions					
8.4 Top-15 unemployment interaction	0.467***	0.481	-0.0712*	76	0.272
	(0.163)	(0.324)	(0.0369)		
(Excluding Latvia)	0.467***	0.308	-0.0781**	75	0.282
	(0.163)	(0.302)	(0.0361)		
8.5 Top-10 unemployment interaction	0.491***	0.958**	-0.0869***	76	0.281
	(0.144)	(0.446)	(0.0307)		
(Excluding Latvia)	0.491***	0.464	-0.0948***	75	0.288
	(0.145)	(0.482)	(0.0297)		
8.6 Top-5 unemployment interaction	0.543***	1.463***	-0.0473	76	0.272
	(0.135)	(0.306)	(0.0309)		
(Excluding Latvia)	0.543***	0.349	-0.0797***	75	0.271
	(0.135)	(0.372)	(0.0277)		

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. All regressions estimated with a constant though the coefficients are not reported. All regressions exclude oil producers, countries with populations less than 1 million as of 2011, and Sub Saharan African countries; IV regressions also exclude Moldova and Tajikistan. Top-5: Iceland, Spain, United States, Portugal, Latvia; Top-10: Top 5, plus Mexico, Estonia, Hungary, Denmark, Cyprus; Top-15: Top 10, plus United Kingdom, Lithuania, New Zealand, Greece, and Sweden.

Sources: World Bank (GDP per capita, electricity consumption, unemployment rate); International Comparison Program (real exchange rate).

To further test the robustness of this result, we create two other groups, comprising, respectively, the 5 and 10 countries that experienced the largest shocks to their unemployment rates. We interact the dummy for each of these groups with the income term in the BSP equations. In our core IV specification the income interaction effect is either insignificant or where it is significant, it is because of being driven by one outlier, namely Latvia.[26] In fact, dropping Latvia makes all the interaction coefficients insignificant. So, at least in terms of data-revealed-preference, the dynamic BSP framework does not seem inappropriate for assessing currency valuations during the recent eurozone crisis.[27]

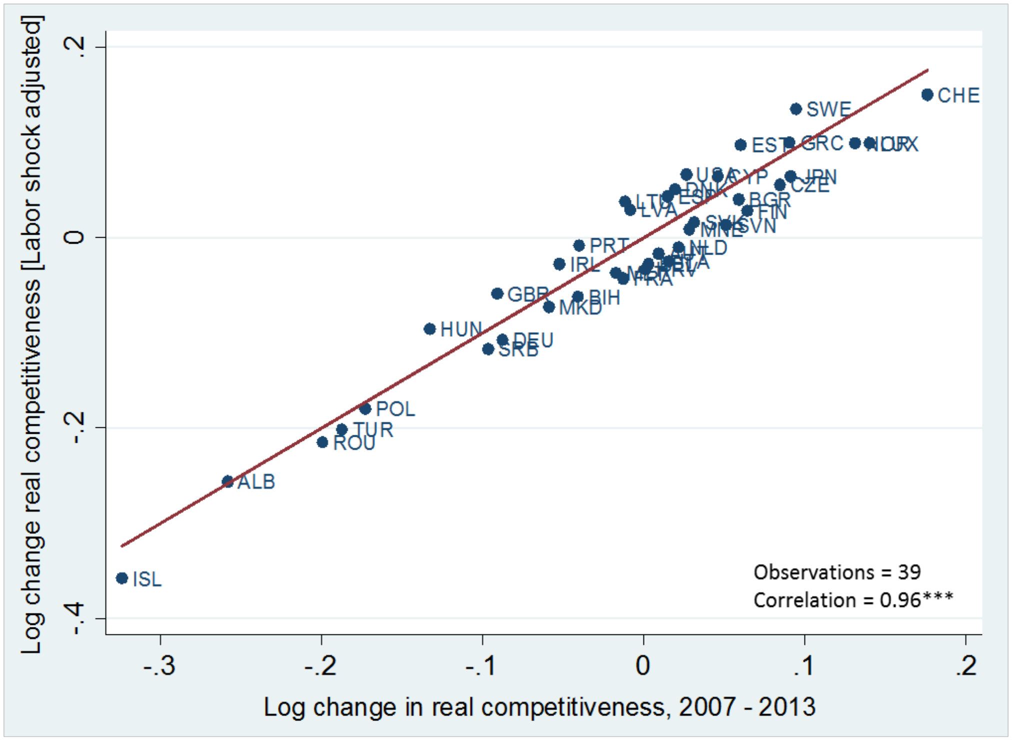
[26] Note that the inclusion of Latvia serves to reinforce, not dilute, the BSP effect reflected in the fact that the income interaction effect is positive.

[27] A salient point arises as to whether this finding belies economic theory on the BSP effect. Theory states that the BSP effect should hold in the long run, but it does not say that it *shouldn't* hold in the short run. Our finding is that, for countries at or close to full employment (alternately the long run) the BSP effect holds. Our additional finding is that the BSP effect also holds under conditions of less-than-full employment. The latter does not contradict theory.

Note, however, that the unemployment dummy in table 8 (without the interaction dummy) is itself significant, indicating that on average high unemployment countries experienced a decline in real exchange rates relative to the average country in the sample. In order to account for this significant intercept dummy but insignificant interaction dummy, we recompute our estimates for real competitiveness changes based on reestimating the BSP relationship, including the value of the intercept dummy, just barely significant at the 10 percent level, and considering the insignificant income interaction dummy no different from zero. In a sense, this could be considered the "true BSP relationship," which takes full account of the situation of countries that were faced with slack resources.

It turns out that accounting for the special situation of "high unemployment" countries does not affect our results. In figure 12, we plot the real competitiveness changes for the two cases and find very little difference in the results.[28]

Figure 12. Comparing real competitiveness changes with and without accounting for "special" situation of high unemployment countries



Note: Thick diagonal line represents 45 degree partition between x- and y-axis values. See key to country abbreviations at the end of the paper. *** p<0.01.

Sources: International Comparison Program (real exchange rate); Eurostat (real exchange rate); World Bank (GDP per capita, electricity consumption, unemployment rate).

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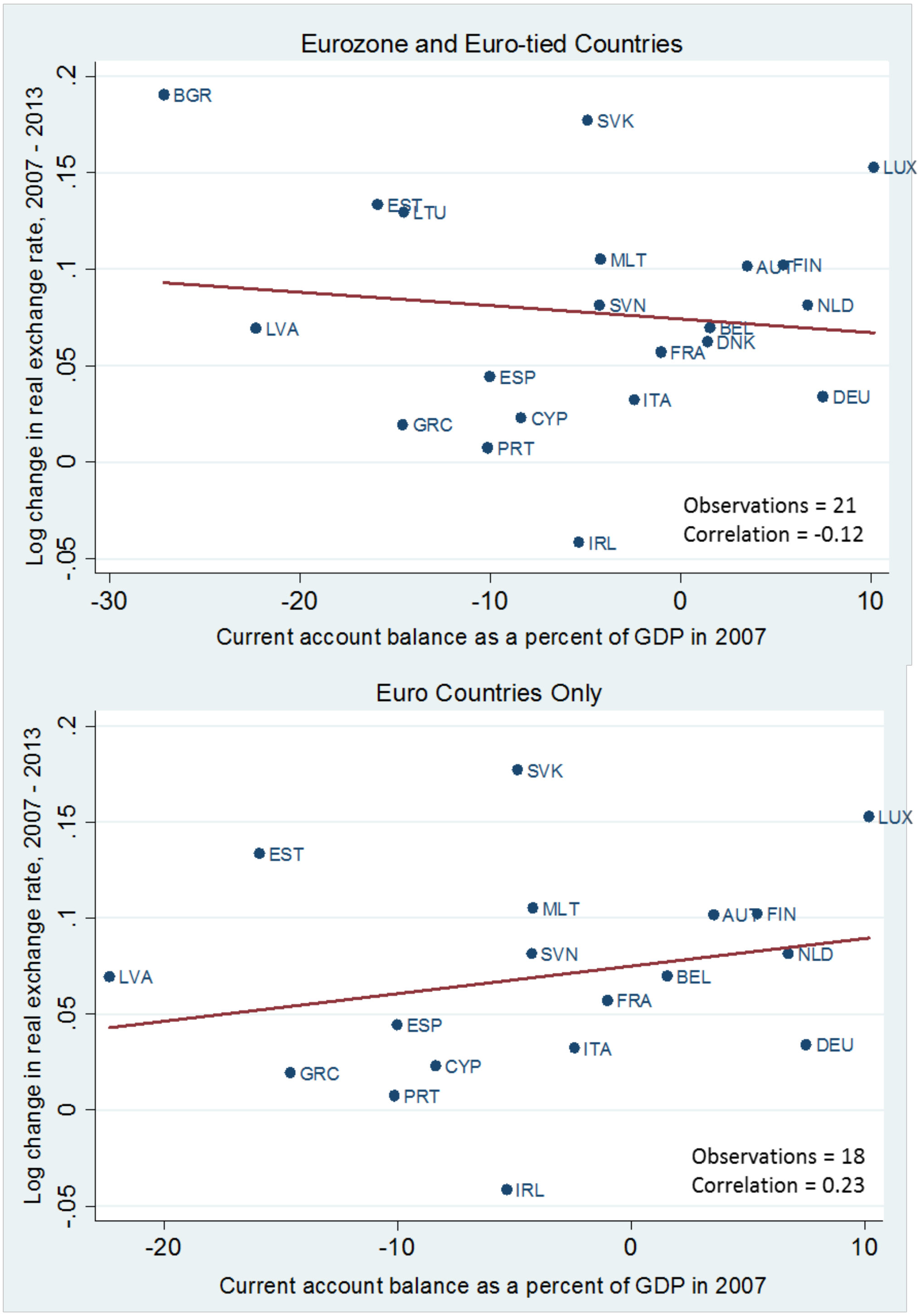
[28] Specifically, on the x-axis we have the results based on the IV equation shown in table 2 and on the y-axis the results based on the IV equation in table 8.

Suppose, and notwithstanding these empirical results and their robustness, there is still a theoretical basis for rejecting the BSP framework for assessing competitiveness changes during the eurozone crisis. In this case, we can simply look at PPP-based real exchange rate changes without taking account of the BSP effect. (This is measure 2 in table 3.) The results are shown in figures 13 and 11.

Figure 13. Limited and lopsided pattern of adjustment, ignoring Balassa-Samuelson-Penn effect, 2007 – 13



Note: See key to country abbreviations at the end of the paper.

Sources: World Bank (current account balance); International Comparison Program (real exchange rate); Eurostat (real exchange rate).

The three broad patterns that we discussed earlier seem to hold. Adjustment continues to be limited. For example, incorporating Inklaar and Rao's (2014) new adjustments Greece actually experienced a real exchange rate increase of 2 percent, Portugal a decline of 0.7 percent, and Ireland of 4 percent.[29] Contrast these with Iceland during the crisis, which experienced a real exchange rate change of 28 percent. And consider too that in the Asian financial crisis, Thailand, Indonesia, and Korea experienced real depreciations of 21, 35, and 13 percent, respectively.[30]

And adjustment continues to be lopsided (although less so compared with the BSP-adjusted measure). For example, the relationship in figure 13 is still not upward-sloping as it should be in the eurozone and euro-tied panels with a statistically insignificant –0.12 correlation. If we remove euro-tied countries, including the outlier Bulgaria, the relationship becomes weakly positive with a correlation coefficient of 0.23, but again not to accepted levels of statistical significance. Germany experienced a depreciation and the Spanish real exchange rate actually appreciated in this period.

Similarly, it continues to be the case that nominal depreciations are strongly correlated with real depreciations and that the number of countries that experienced internal devaluation is limited only to Ireland (figure 11).

6. CONCLUSIONS

Prima facie, competitiveness adjustments in the eurozone, based on unit labor cost developments, appear sensible and in line with what the economic analyst might have predicted and the economic doctor might have ordered. But a broader and arguably better—Balassa-Samuelson-Penn—framework for analyzing these adjustments paints a very different picture.

Taking advantage of the newly released PPP-based estimates of the ICP (2011) project, we identify a causal Balassa-Samuelson-Penn relationship. We apply this framework to computing more appropriate measures of real competitiveness changes in Europe and other advanced economies in the aftermath of the recent global crises.

Our results are the following. First, insofar as the BSP framework is valid, there has been a deterioration, not improvement, in competitiveness in the periphery countries between 2007 and 2013. Second, the pattern of adjustment within the eurozone has been dramatically perverse, with Germany having improved competitiveness by 9 percent and with Greece's having deteriorated by 9 percent. The economic doctor would have ordered the exact opposite. Third, real

[29] Without adjustment (i.e., taking the raw Eurostat values), Greece's real exchange rate declined 3.3 percent, Portugal's 0.1 percent, and Ireland's 7.4 percent. For discussion on using adjusted versus nonadjusted 2007–13 estimates, see appendix A.

[30] This is based on the real effective exchange rate that is not based on PPPs.

competitiveness changes are strongly correlated with nominal exchange rate changes, which suggests the importance of having a flexible (and preferably independent) currency for effecting external adjustments. Fourth, internal devaluation—defined as real competitiveness improvements in excess of nominal exchange rate changes—is possible but seems limited in scope and magnitude.

One critique of the BSP framework is that it is not applicable to countries experiencing Keynesian underemployment of resources. While theoretically this argument is valid, our results suggest that the experience of advanced economies suffering unemployment is not inconsistent with the BSP effect. In any case, our results are robust to adjusting the BSP framework to take account of the special circumstances of countries experiencing unemployment. Even if we completely ignore the BSP effect, the broad pattern of limited and lopsided adjustment in the eurozone remains.

Overall, our results suggest that the costs of fixing a currency—either via a currency union or a hard peg—can be considerable, a point made by several commentators, including Krugman (2012) and Wolf (2014), and made in a more extreme form by Walters (1990). Especially within a currency zone, if the core country (Germany, for example) enjoys local exorbitant privileges, the costs could take the form of substantially large and lopsided adjustment, with weak countries experiencing a deterioration in or insufficient improvement in competitiveness and core countries experiencing improvement or little appreciation. It is a damning indictment that Germany, the anchor of the system, which entered the crisis with a large account surplus either experienced a massive real depreciation (on our preferred measure) or at best no appreciation. Under these circumstances, sustaining the underlying currency union will pose formidable challenges.

Overall, it is hard to rule out the possibility that the present currency arrangements are not just a case of Versailles redux but also Versailles reversed with Germany no longer the punished victim, but the self-serving underwriter of the underlying economic and currency arrangements.

APPENDIX A

EXTENDING THE BSP FRAMEWORK TO MEASURING COMPETITIVENESS CHANGES IN EUROPE AND THE ADVANCED ECONOMIES FOR NON-ICP YEARS

How and under what assumptions can we compute estimates for Europe and the advanced countries for the period 2007–13? To do so, we need to make a few—not unreasonable—assumptions. First, we need to assume that the BSP relationship estimated for the period 2005–11 from the global ICP sample is a stable one, remaining valid from 2011 to 2013 as well. Since the time horizons are sufficiently close, this assumption is not unreasonable.

Second, the really important assumption underlying the extension exercise relates to the way ICP estimates are computed. Recall that under the ringing procedure employed by ICP, each region compiles PPP estimates for countries within the region.[31] In a second step, the ICP procedure computes the adjustments that need to be made across regions via ringing. A key point here is that ringing across regions preserves the relativity of estimates *within* regions. Thus, estimates for Europe and advanced countries based on prices collected by Eurostat beyond 2011 are plausibly valid for comparisons *within* the advanced countries because even the ICP would have preserved those intra-advanced country relativities. Comparisons of log change results for both data sources in the 2005–11 period exhibit a very tight correlation.[32] Thus, we use the parameters estimated from BSP relationship estimated for all countries for 2005–11 to estimate and compare changes in Europe and advanced countries for the period 2007–13.

Thus for every country:

$$\ln P_{2013} - \ln P_{2007} = [\ln ICP_{2011} - \ln ICP_{adj_{2005}}] + [\ln EURO_{2013} - \ln EURO_{2011}] + [\ln EURO_{2005} - \ln EURO_{2007}] \qquad (6)$$

where "ICP" designates real exchange rate data drawn from the latest ICP rounds, "ICP_adj" refers to the Inklaar and Rao (2014) adjusted ICP values for 2005, and "EURO" designates real exchange rate data taken from Eurostat.

From the BSP equation, this is equal to:

$$\hat{\alpha}_1 + \hat{\beta}_1\{\ln Y_{2013} - \ln Y_{2007}\} \qquad (7)$$

The parameters $\hat{\alpha}_1$ and $\hat{\beta}_1$ are derived from the estimates in table 2 (corresponding to coefficients in 2.3) while Y for the years 2013 and 2007 can be obtained from the WDI and, in a handful of cases, IMF's WEO database.

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[31] There are five ICP regions: Africa, Asia, Commonwealth of Independent States, Eurostat/OECD, Latin America, and Western Asia.

[32] We test the similarity of our data sources by comparing the log change value of 39 countries that have data reported in both Eurostat and ICP for the 2005–11 period. Results exhibit an extremely tight correlation of 0.98, with neither source systematically understating or overstating results. Only Albania, Luxembourg, Montenegro, and Serbia and Turkey show an absolute discrepancy of +/– 3 percent or greater between data sources, though it must be noted that Albania's is significant. Eurostat reports Albania's 2005–11 real exchange rate appreciating 2.8 percent, while ICP reports it depreciating 7.2 percent. Note that we are comparing the nonadjusted 2005 values here.

Subtracting (7) from (6) gives the BSP-adjusted competitiveness change measures for the period 2007–13. The parameters $\widehat{\alpha}_1$ and $\widehat{\beta}_1$ are from the IV specification and yield the measures in the third column of table 7.

A final point is that our log change values estimated by equation (6) now take into account the Inklaar and Rao (2014)-adjusted real exchange rate for 2005. In general, the adjusted values for this 39-country sample yield slightly lower price indices than what is reported by the ICP in 2005. If we conclude that extending the Inklaar and Rao (2014) adjustments to the 2007–13 period is invalid, and instead use the raw price level index values as reported by Eurostat to calculate our real change in competitiveness, our story holds. However, it must be noted that the "lop-sided" adjustment is somewhat lessened. For example, Germany exhibits a similar 10.4 percent gain in competitiveness, while Greece's loss in competitiveness has been reduced to only 3.7 percent.

Table A1. The dynamic Balassa-Samuelson-Penn relationship (OLS): Robustness checks, 2005 – 11

Combination A: Nonadjusted real exchange rate and GDP per capita (constant US dollars)				
	Coefficient	**Standard error**	**Observations**	**R-squared**
A.1 Core sample	0.178*	(0.0933)	108	0.025
A.2 Drop other commodity exporters	0.132	(0.107)	81	0.015
A.3 Drop Sub-Saharan Africa	0.242**	(0.116)	76	0.039
A.4 Drop former Soviet States	0.158*	(0.0912)	98	0.022
A.5 Only advanced economies	0.296	(0.307)	31	0.045
Combination B: Nonadjusted real exchange rate and GDP per capita (PPP)				
	Coefficient	**Standard error**	**Observations**	**R-squared**
B.1 Core sample	0.255***	(0.0947)	108	0.071
B.2 Drop other commodity exporters	0.197*	(0.106)	81	0.042
B.3 Drop Sub-Saharan Africa	0.302***	(0.113)	76	0.085
B.4 Drop former Soviet States	0.204**	(0.0910)	98	0.048
B.5 Only advanced economies	0.304	(0.252)	31	0.044
Combination C: Real exchange rate and GDP per capita (PPP)				
	Coefficient	**Standard error**	**Observations**	**R-squared**

C.1 Core sample	0.348***	(0.0973)	108	0.135
C.2 Drop other commodity exporters	0.334***	(0.116)	81	0.122
C.3 Drop Sub-Saharan Africa	0.455***	(0.113)	76	0.212
C.4 Drop former Soviet States	0.336***	(0.0955)	98	0.127
C.5 Only advanced economies	0.506**	(0.233)	31	0.128

Combination D: Real exchange rate and GDP per capita (constant US dollars), Tajikistan and Moldova removed

	Coefficient	Standard error	Observations	R-squared
D.1 Core sample	0.368***	(0.115)	106	0.115
D.2 Drop other commodity exporters	0.419***	(0.136)	80	0.155
D.3 Drop Sub-Saharan Africa	0.553***	(0.124)	74	0.243
D.4 Drop former Soviet States	0.398***	(0.112)	98	0.136
D.5 Only advanced economies	0.722***	(0.230)	31	0.280

Notes: Robust standard errors in parentheses,*** p<0.01, ** p<0.05, * p<0.1. All regressions estimated with a constant, though the coefficient is not reported. "Core sample" excludes oil exporters and countries with populations less than 1 million as of 2011.

Sources: World Bank (GDP per capita); International Comparison Program (real exchange rate).

Table A2. The dynamic Balassa-Samuelson-Penn relationship (IV): Robustness checks, 2005 – 11

Combination A: Real exchange rate and GDP per capita (PPP), instrumented by total per capita electricity consumption

	Stage	Coefficient	Standard error	Observations
A.1 Core sample	*1*	0.421***	(0.078)	84
	2	0.608***	(0.175)	
A.2 Drop other commodity exporters	*1*	0.444***	(0.075)	70
	2	0.556***	(0.171)	
A.3 Drop Sub-Saharan Africa	*1*	0.518***	(0.077)	71
	2	0.579***	(0.162)	
A.4 Drop former Soviet States	*1*	0.433***	(0.075)	76
	2	0.615***	(0.169)	
A.5 Advanced economies only	*1*	0.577***	(0.158)	30
	2	0.786*	(0.427)	

Combination B: Real exchange rate and GDP per capita (constant US dollars), instrumented by household per capita electricity consumption				
	Stage	**Coefficient**	**Standard error**	**Observations**
B.1 Core sample	*1*	0.352***	(0.067)	70
	2	0.600***	(0.225)	
B.2 Drop other commodity exporters	*1*	0.365***	(0.067)	60
	2	0.751***	(0.256)	
B.3 Drop Sub-Saharan Africa	*1*	0.468***	(0.070)	60
	2	0.586**	(0.225)	
B.4 Drop former Soviet States	*1*	0.361***	(0.069)	66
	2	0.536**	(0.220)	
B.5 Advanced economies only	*1*	0.167	(0.146)	30
	2	0.265	(0.875)	
Combination C: Real exchange rate and GDP per capita (PPP), instrumented by household per capita electricity consumption				
	Stage	**Coefficient**	**Standard error**	**Observations**
C.1 Core Sample	*1*	0.347***	(0.071)	70
	2	0.609**	(0.247)	
C.2 Drop other commodity exporters	*1*	0.362***	(0.068)	60
	2	0.758***	(0.283)	
C.3 Drop Sub-Saharan Africa	*1*	0.461***	(0.076)	60
	2	0.594**	(0.254)	
C.4 Drop former Soviet States	*1*	0.336***	(0.073)	66
	2	0.577**	(0.263)	
C.5 Advanced economies only	*1*	0.271**	(0.131)	30
	2	0.164	(0.534)	

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. All regressions estimated with a constant, though the coefficient is not reported. "Core sample" excludes oil exporters, countries with populations less than 1 million as of 2011, Tajikistan, and Moldova.

Sources: World Bank (GDP per capita, electricity consumption); International Comparison Program (real exchange rate).

Table A3. Comparing external adjustment measures

	2008-13			2007-13			
Country	Change in GDP per capita	Change in real exchange rate	Change in real competitiveness	Change in GDP per capita	Change in real exchange rate	Change in real competitiveness	Competitiveness difference
Euro and "euro-tied" countries							
Austria	0.00	0.08	-0.01	0.01	0.10	0.01	0.01
Belgium	-0.03	0.05	-0.02	-0.03	0.07	0.00	0.02
Bulgaria	0.01	0.13	0.03	0.08	0.19	0.06	0.02
Cyprus	-0.19	0.03	0.06	-0.18	0.02	0.05	-0.01
Denmark	-0.06	0.05	0.00	-0.07	0.06	0.02	0.02
Estonia	0.02	0.11	0.01	-0.02	0.13	0.06	0.05
Finland	-0.08	0.09	0.05	-0.08	0.10	0.06	0.01
France	-0.02	0.03	-0.04	-0.02	0.06	-0.01	0.03
Germany	0.05	0.02	-0.09	0.06	0.03	-0.09	0.01
Greece	-0.25	0.01	0.07	-0.26	0.02	0.09	0.02
Ireland	-0.08	-0.07	-0.11	-0.12	-0.04	-0.05	0.06
Italy	-0.09	0.03	0.00	-0.11	0.03	0.02	0.01
Latvia	0.01	-0.01	-0.10	-0.01	0.07	-0.01	0.09
Lithuania	0.06	0.04	-0.08	0.09	0.13	-0.01	0.07
Luxembourg	-0.09	0.13	0.11	-0.12	0.15	0.14	0.03
Malta	0.03	0.08	-0.02	0.06	0.11	-0.02	0.01
Montenegro	0.00	0.09	0.00	0.07	0.15	0.03	0.03
Netherlands	-0.06	0.06	0.01	-0.04	0.08	0.02	0.01
Portugal	-0.06	-0.01	-0.06	-0.06	0.01	-0.04	0.02
Slovak Republic	0.05	0.08	-0.03	0.10	0.18	0.03	0.06
Slovenia	-0.12	0.03	0.02	-0.09	0.08	0.05	0.03
Spain	-0.08	0.02	-0.02	-0.09	0.04	0.01	0.03
Other available countries							
Albania	0.17	-0.05	-0.24	0.25	-0.02	-0.26	-0.02
Bosnia and Herzegovina	0.00	0.00	-0.08	0.05	0.07	-0.04	0.04
Croatia	-0.08	-0.01	-0.04	-0.06	0.05	0.00	0.04
Czech Republic	-0.04	-0.01	-0.07	-0.01	0.16	0.08	0.15
Hungary	-0.03	-0.08	-0.15	-0.02	-0.06	-0.13	0.01
Iceland	-0.05	0.14	0.09	-0.06	-0.28	-0.32	-0.42
Japan	0.02	0.11	0.02	0.01	0.18	0.09	0.07
Macedonia	0.07	0.07	-0.06	0.12	0.10	-0.06	0.00
Norway	-0.03	0.18	0.11	-0.04	0.19	0.13	0.02

Poland	0.12	-0.10	-0.26	0.17	0.02	-0.17	0.09
Romania	0.01	-0.05	-0.14	0.10	-0.05	-0.20	-0.06
Serbia	0.02	-0.02	-0.12	0.06	0.02	-0.10	0.02
Sweden	0.03	0.20	0.10	0.01	0.19	0.09	-0.01
Switzerland	0.00	0.23	0.14	0.01	0.27	0.18	0.03
Turkey	0.12	-0.04	-0.19	0.11	-0.03	-0.19	0.01
United Kingdom	-0.04	0.06	0.00	-0.06	-0.04	-0.09	-0.10
United States	0.02	0.15	0.05	0.01	0.12	0.03	-0.02

Sources: World Bank (GDP per capita, electricity consumption); International Comparison Program (real exchange rate); Eurostat (real exchange rate).

Table A4. Comparing external adjustment measures

	Country	Nominal effective exchange rate	Real exchange rate	Real change in competitiveness	ULC-based real effective exchange rate
1	Albania	n/a	-0.02	-0.26	n/a
2	Austria	-0.01	0.10	0.01	0.03
3	Belgium	0.01	0.07	0.00	0.05
4	Bosnia and Herzegovina	n/a	0.07	-0.04	n/a
5	Bulgaria	0.05	0.19	0.06	0.32
6	Croatia	-0.03	0.05	0.00	-0.02
7	Cyprus	0.04	0.02	0.05	-0.06
8	Czech Republic	0.07	0.16	0.08	0.05
9	Denmark	-0.01	0.06	0.02	0.01
10	Estonia	n/a	0.13	0.06	0.07
11	Finland	-0.01	0.10	0.06	0.10
12	France	-0.01	0.06	-0.01	0.02
13	Germany	-0.01	0.03	-0.09	0.02
14	Greece	0.01	0.02	0.09	-0.14
15	Hungary	-0.16	-0.06	-0.13	-0.12
16	Iceland	-0.64	-0.28	-0.32	n/a
17	Ireland	-0.01	-0.04	-0.05	-0.15
18	Italy	0.00	0.03	0.02	0.03
19	Japan	0.15	0.18	0.09	0.04
20	Latvia	0.03	0.07	-0.01	-0.04
21	Lithuania	n/a	0.13	-0.01	-0.05
22	Luxembourg	0.01	0.15	0.14	0.18
23	Macedonia	0.03	0.10	-0.06	n/a

24	Malta	-0.01	0.11	-0.02	0.05
25	Montenegro	n/a	0.15	0.03	n/a
26	Netherlands	0.00	0.08	0.02	0.03
27	Norway	0.01	0.19	0.13	0.24
28	Poland	-0.10	0.02	-0.17	-0.07
29	Portugal	0.00	0.01	-0.04	-0.05
30	Romania	-0.27	-0.05	-0.20	-0.19
31	Serbia	n/a	0.02	-0.10	n/a
32	Slovak Republic	0.12	0.18	0.03	0.11
33	Slovenia	n/a	0.08	0.05	0.03
34	Spain	0.00	0.04	0.01	-0.10
35	Sweden	0.06	0.19	0.09	0.02
36	Switzerland	0.28	0.27	0.18	0.24
37	Turkey	n/a	-0.03	-0.19	-0.05
38	United Kingdom	-0.24	-0.04	-0.09	-0.17
39	United States	-0.02	0.12	0.03	-0.06

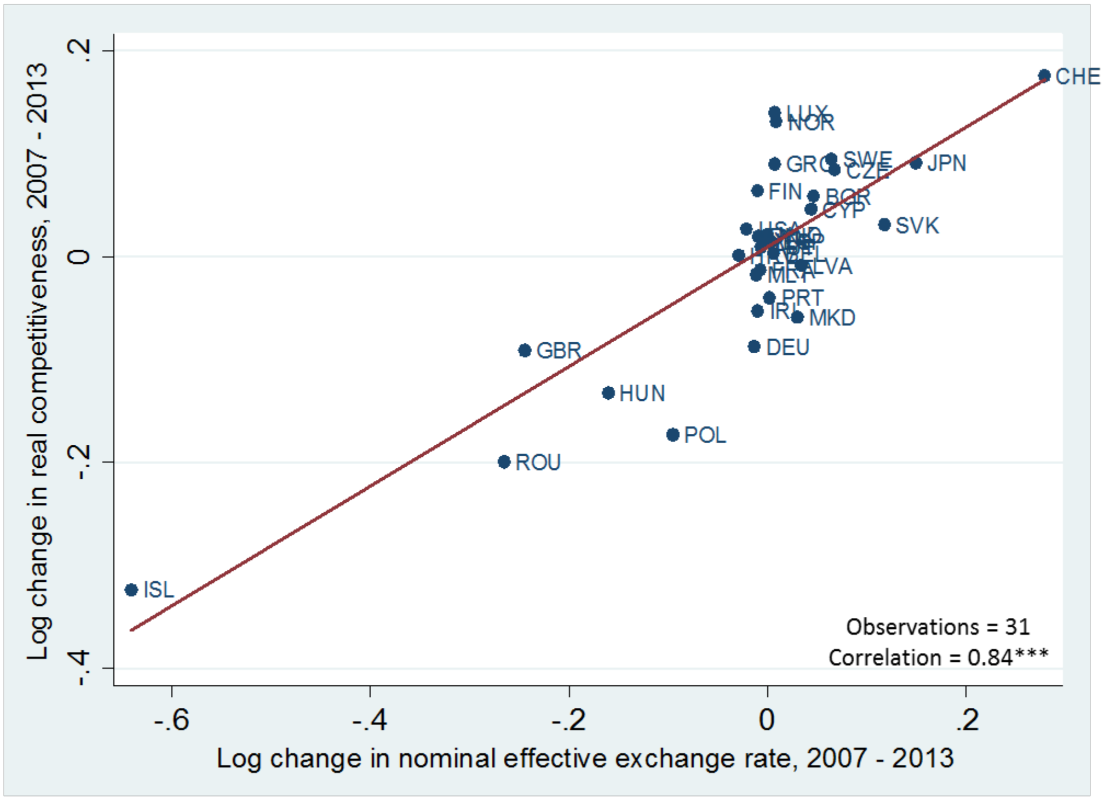
Correlation coefficients	**Nominal effective exchange rate**	**Real exchange rate**	**Real change in competitiveness**	**ULC-based real effective exchange rate**
Nominal effective exchange rate	1			
Real exchange rate	0.8727***	1		
Real change in competitiveness	0.8436***	0.8394***	1	
ULC-based real effective exchange rate	0.6117***	0.8229***	0.6603***	1

ULC = unit labor costs

Notes: All values designate log percent changes between 2007 and 2013. All correlation coefficients significant at the 1 percent level.

Sources: International Monetary Fund (nominal effective exchange rate); World Bank (GDP per capita, total per capita electricity consumption); International Comparison Program (real exchange rate); Eurostat (real exchange rate); European Commission (ULC-based real effective exchange rate).

Figure A1. Correlation between nominal effective exchange rate and real competitiveness



Notes: Log real change in competitiveness plugs GDP and real exchange rate values from 2007-13 into coefficient and intercept from regressions obtained in 2005-11 samples. Positive (negative) vales on y-axis denote loss (gain) in real competitiveness.

Sources: World Bank (GDP per capita, electricity consumption); International Comparison Program (real exchange rate); International Monetary Fund (nominal effective exchange rate); Eurostat (real exchange rate).

Key to country abbreviations

Albania	ALB	Georgia	GEO	New Zealand	NZL
Angola	AGO	Germany	DEU	Niger	NER
Armenia	ARM	Ghana	GHA	Nigeria	NGA
Australia	AUS	Greece	GRC	Norway	NOR
Austria	AUT	Guinea	GIN	Oman	OMN
Azerbaijan	AZE	Guinea-Bissau	GNB	Pakistan	PAK
Bahrain	BHR	Hong Kong SAR, China	HKG	Paraguay	PRY
Bangladesh	BGD	Hungary	HUN	Peru	PER
Belarus	BLR	Iceland	ISL	Philippines	PHL
Belgium	BEL	India	IND	Poland	POL
Benin	BEN	Indonesia	IDN	Portugal	PRT
Bhutan	BTN	Iran	IRN	Qatar	QAT
Bolivia	BOL	Iraq	IRQ	Romania	ROU

Bosnia and Herzegovina	BIH	Ireland	IRL	Russia	RUS
Botswana	BWA	Israel	ISR	Rwanda	RWA
Brazil	BRA	Italy	ITA	Sao Tome and Principe	STP
Brunei Darussalam	BRN	Japan	JPN	Saudi Arabia	SAU
Bulgaria	BGR	Jordan	JOR	Senegal	SEN
Burkina Faso	BFA	Kazakhstan	KAZ	Serbia	SRB
Burundi	BDI	Kenya	KEN	Sierra Leone	SLE
Cabo Verde	CPV	Korea, Republic of	KOR	Singapore	SGP
Cambodia	KHM	Kuwait	KWT	Slovak Republic	SVK
Cameroon	CMR	Kyrgyz Republic	KGZ	Slovenia	SVN
Canada	CAN	Laos	LAO	South Africa	ZAF
Central African Republic	CAF	Latvia	LVA	Spain	ESP
Chad	TCD	Lesotho	LSO	Sri Lanka	LKA
Chile	CHL	Liberia	LBR	Sudan	SDN
China	CHN	Lithuania	LTU	Swaziland	SWZ
Colombia	COL	Luxembourg	LUX	Sweden	SWE
Comoros	COM	Macao SAR, China	MAC	Switzerland	CHE
Congo, Democratic Republic of	COD	Macedonia	MKD	Taiwan	TWN
Congo, Republic of	COG	Madagascar	MDG	Tajikistan	TJK
Cote d'Ivoire	CIV	Malawi	MWI	Tanzania	TZA
Croatia	HRV	Malaysia	MYS	Thailand	THA
Cyprus	CYP	Maldives	MDV	Togo	TGO
Czech Republic	CZE	Mali	MLI	Tunisia	TUN
Denmark	DNK	Malta	MLT	Turkey	TUR
Djibouti	DJI	Mauritania	MRT	Uganda	UGA
Ecuador	ECU	Mauritius	MUS	Ukraine	UKR
Egypt	EGY	Mexico	MEX	United Kingdom	GBR
Equatorial Guinea	GNQ	Moldova	MDA	United States	USA
Estonia	EST	Mongolia	MNG	Uruguay	URY
Ethiopia	ETH	Montenegro	MNE	Venezuela	VEN
Fiji	FJI	Morocco	MAR	Vietnam	VNM
Finland	FIN	Mozambique	MOZ	Yemen	YEM
France	FRA	Namibia	NAM	Zambia	ZMB
Gabon	GAB	Nepal	NPL		
Gambia, The	GMB	Netherlands	NLD		

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