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SUMMARY.* There are several theoretical arguments for why the adoption of a common currency (either a currency board or an outright currency union) may reduce exchange rate pass-through (ERPT). Common currencies might cause "trade creation" among participants and "trade diversion"away from non-participants. Common currencies might affect the invoicing decisions of outside exporters to the common currency area. Common currencies tend to reduce both the level and the persistence of inflation in adopting countries. This paper examines a broad panel of 101 countries over the period 1976-2006 and finds that ERPT indeed tends to decline in countries sharing a common currency. In particular, there has been a strong reduction in pass-through in the twelve members of the European Monetary Union since the launch of the euro. Currency boards do not appear to be different from currency unions - both reduce the pass-through from depreciation to inflation. The negative impact of common currencies on ERPT appears to be increasing with per capita incomes and increasing over time.

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Introduction

In the last fifteen years, many countries around the world have chosen to abandon the independence of their national currencies and the ability to run a discretionary monetary policy. Some countries established currency board arrangements (CBAs) – Argentina in 1991, Estonia in 1992, Lithuania in 1994, Bulgaria and Bosnia and Herzegovina in 1997. Others chose to dollarize unilaterally – Ecuador in 2000 and El Salvador in 2001. Still others – twelve EU members – entered into a fully-fledged monetary union.

The euro formally came into existence in January 1999, but for the next three years it only existed as a unit of account. It made its physical debut in January 2002 when it became the official currency of twelve member states of the European Union. In the run-up to the euro's debut, its proponents and opponents advanced various arguments regarding the potential benefits and drawbacks of the euro, and of common currency arrangements in general. Enough time has passed to allow some of these claims to be checked against data.

Perhaps the most popular news headline surrounding the euro's arrival was the claim that it caused a temporary inflationary blip, perhaps because when retailers converted their prices from the legacy currencies into euros, they routinely rounded *up* instead of *down*, and that created an avalanche of price increases across the 12 nations adopting the euro. A careful look at the euro area-wide Harmonized Index of Consumer Prices (HICP) as well as the individual CPIs of the twelve member countries shows this effect to be anywhere between miniscule and non-existent.[1] However, there exists solid evidence that in some sectors of the economy, there were, in fact, abnormal price increases in the first few months after January 2002 – restaurants, cafés, and hairdressers, in particular. Hobijn, Ravenna, and Tambalotti (2006) offers an interesting theoretical explanation of this phenomenon stressing the role played by menu costs and staggered price setting.

As another example, common currencies in general are expected to boost trade integration among participating countries. Frankel and Rose (2002) used the gravity model of trade to show that common currency arrangements around the world tend to triple trade among participants.[2] However, according to Baldwin (2006), the "trade creation" effects for the euro area countries have been rather modest so far – trade among them has increased by perhaps 9 per cent. Interestingly, Baldwin finds that there has

[1]See Hobijn et al (2006) for the evidence.

[2]Interestingly, they found no distinction between currency boards and currency unions, at least as far as their role in promoting trade openness is concerned.

been no "trade diversion" – exports to the euro area by Britain, Sweden and Denmark (the only three of the older cohort of 15 EU members who stayed out of the euro) have gone up by almost as much, approximately 7 per cent.

Third, common currencies in general are supposed to reduce the dispersion of prices of identical products around the common currency area, by making those prices more transparent and easier to compare. Unfortunately, Engel and Rogers (2004) finds that there has been no discernible tendency for price convergence in the euro area after 1999. By some measures, price dispersion in the euro area is still about twice as large as that in the United States, another common currency area which serves as a natural benchmark for comparison.[3]

Yet another, less sensational, claim about common currencies is that they insulate participants from external shocks. In particular, domestic inflation is supposed to become less sensitive to exchange rate fluctuations. In other words, a common currency is expected to reduce exchange rate pass-through (ERPT), defined as the percentage change in the domestic consumer price index (CPI) resulting from a one percent change in a country's nominal effective exchange rate (NEER). This is the claim that this paper will focus on.

The next section surveys the recent literature on exchange rate pass-through, while Section 3 discusses the theoretical arguments for why common currencies might reduce ERPT. The main contribution of the paper is in Section 4 which examines a broad panel of 101 countries over the period 1976–2006, and finds that ERPT indeed tends to decline in countries sharing a common currency. In particular, there has been a strong reduction in pass-through in the twelve members of the European Monetary Union since the launch of the euro. Furthermore, currency boards do not appear to be different from currency unions – both reduce the pass-through from depreciation to inflation. The negative impact of common currencies on exchange rate pass-through appears to be increasing with per capita incomes and increasing over time. Section 5 concludes.

These results are important and exciting for several reasons. First, a fall in ERPT is an added benefit of participating in a common currency arrangement. It tilts the balance of costs and benefits away from having a flexible exchange rate, and toward a currency board or a currency union.

Second, on the issue of ERPT under the euro, several previous studies were inconclusive, while the results here are fairly strong. Lower pass-through reduces the volatility of domestic inflation and makes it easier to achieve

[3]See The Economist (2003) which cites a related study by Dresdner Kleinwort Wasserstein (DKW).

monetary stability inside the euro area. Low pass-through means that inflation forecasts should place a lower weight on exchange rate fluctuations. A decline in pass-through means that policymakers at the European Central Bank (ECB) should pay less attention to volatility in the euro's external value because its capacity to affect the euro area's macro-economy has diminished. Inflation targeting by the ECB should become somewhat easier if central bankers can shift their attention away from the exchange rate.

Third, this study sheds new light on inflation dynamics in the three new EU member countries with currency boards in place (Bulgaria, Estonia, and Lithuania). In particular, it turns out that currency boards mimic currency unions, as far as their impact on ERPT is concerned. My results indicate that the three new EU members with currency board arrangements have already enjoyed the insulation benefits of the European Monetary Union (EMU). The pass-through from depreciation to inflation in those countries is lower than in the remaining seven countries in Central and Eastern Europe (CEE). One might argue that Bulgaria, Estonia, and Lithuania have already taken the EMU out for a "test drive". Therefore, this study would be of special interest to policymakers at CEE central banks who have been planning for joining the ERM II and ultimately for adopting the euro.

Fourth, exchange rate pass-through connects the nominal exchange rate to the real economy. Lower pass-through reduces the real effects of nominal exchange rate volatility by reducing its expenditure-switching effects. Due to lower ERPT, exchange rate swings have a smaller impact on the relative prices of domestic and foreign goods, and thus, on the trade balance and the current account.

Finally, as pointed out by Taylor (2000), lower ERPT rotates the Phillips Curve – the cost for any reduction in the unemployment rate in terms of extra inflation is lower than before.

Literature Review

The recent empirical literature has recorded a broad-based decline in exchange rate pass-through over the past 15 years or so. McCarthy (2000) and Gagnon and Ihrig (2004) were the first two papers to uncover a decline in ERPT for rich industrialized countries.[4] Frankel, Parsley, and Wei (2005) have extended this finding to developing countries as well – as the authors put it, "slow and incomplete pass-through is no longer exclusively a luxury of

[4]Both papers were first circulated around 1999.

industrial countries".[5] Several reasons have been given for the decline in ERPT around the world, and BIS (2005) offers a nice summary. First, international competition in goods markets has increased, especially with the integration of China and India into the global economy. Such increased competition reduces the "pricing power of firms" – their ability to pass along cost increases to consumers. Instead, profit margins along the distribution chain act as shock-absorbers. Second, labor markets have become more competitive as well, especially in rich industrialized countries. Labor unions have become less powerful and more quiescent.

Third, monetary authorities around the world have become more aggressive in keeping inflation down – the 1990s went on record as the decade with the lowest global inflation in recent memory. Aggressive monetary policy anchors inflationary expectations. Economic agents are prone to see any shocks to costs and prices (exchange rate shocks, for example) as likely to be targeted by monetary policy, and therefore as temporary. Taylor (2000) was the first paper to discuss this last channel. In essence, Taylor describes a virtuous cycle under which lower inflation leads to lower ERPT, but lower ERPT in turn helps keep inflation low and stable. The key idea of the paper is that a low level of inflation is associated with low inflation persistence. That means any cost shocks are less likely to be permanent. Hence, firms reduce the extent to which they pass through such costs shocks to their retail prices.

Fourth, Burstein, Eichenbaum, and Rebelo (2002) have found that pass-through has been unusually low in the aftermath of several recent large devaluations in developing countries. The authors explain this finding with substitution away from foreign goods toward lower-quality domestically produced alternatives.

The worldwide decline in ERPT might be explained by the proliferation of currency unions and currency boards in the last 15 years. Several authors have already studied exchange rate pass-through under currency unions, with a special focus on the European Monetary Union, but their results have been weak or inconclusive – see Kieler (2001), Hüfner and Schröder (2003), and Campa, Goldberg, and Gonzalez–Minguez (2005). Campa *et al* (2005) is the most recent and most comprehensive investigation into the existence of a potential structural break in ERPT in the euro area following the euro's launch. Their paper looks at monthly price aggregates across 11 member countries

[5]Note, however, that Frankel, Parsley, and Wei (2005) use price data of very narrowly defined brand commodities. The policy implications of their study are unclear, given that monetary authorities typically focus on broad price indices, such as the CPI.

and 9 industries. The authors estimate a simple equation in first differences using OLS for a sample period ending in May 2004. They find weak statistical evidence that ERPT *might* have declined following the euro's arrival. While most of their regression coefficients are not statistically significant, they do point toward a reduction in pass-through. The authors conclude that "a wider decline in pass-through might be taking place" but it is "too early" to be sure.

As should be obvious from the quotation above, the main obstacle for all these studies is data availability. Not enough time has elapsed since the euro's launch to give empirical researchers enough observations to allow them to draw conclusions about the impact of EMU on exchange rate pass-through. My paper differs from this and the other papers cited above in three important dimensions. First, I tackle the obstacle of insufficient data by changing the focus slightly – I analyze "common currency arrangements" (defined to include both currency unions and currency boards) in the context of a broad panel of 101 countries over three decades. My dataset includes 32 countries which have participated in a currency union or a currency board over the past three decades.[6] The remaining 69 countries will serve as a control group. Therefore, my research question is: does ERPT decline in countries with common currencies, *relative to* all other countries? Figuratively speaking, I put all my money on building a dataset which would give the greatest possible amount of statistical power. To the extent that there are compromises in my empirical methodology, they are driven by the need to collect data for as many countries and for as long a period of time as possible. The number of variables for which I can find data for 101 countries in the world is not terribly long.

Second, my data extend until the first quarter of 2006, while the sample in Campa *et al* (2005) ends in May 2004. Third, Campa *et al* (2005) focuses on pass-through from shocks to a country's bilateral exchange rate with the US dollar. In this paper, I look at shocks to the overall nominal *effective* exchange rate index for each country.

Why Should Common Currencies Reduce Exchange Rate Pass-through?

I am aware of three *theoretical* explanations for why ERPT can be expected to decline under a common currency (defined as either a currency board arrangement or an outright currency union). First, a common currency

[6]Ireland has done so twice – see Table 1.

might have a strong effect on trade flows. Both Rose (2000) and Frankel and Rose (2002) find that currency unions and boards promote trade openness. A common currency might boost trade among members ("trade creation") by eliminating exchange rate risk and by reducing transaction costs in bilateral trade. A common currency might also reduce trade with outsiders ("trade diversion"). If countries sharing a common currency become less dependent on imports from other countries and less exposed to the relative price swings caused by exchange rate volatility, then it is logical to expect that ERPT will decline. As one example, by replacing twelve national currencies, the euro in effect merged twelve relatively small and open economies into one large and closed economic area. It is logical to expect that exchange rate pass-through has declined as a result.

This argument easily extends to currency boards as well. Figure 1 shows quarterly data on the role of the euro area in Bulgaria's direction of trade since 1995. Since the launching of Bulgaria's currency board in mid-1997, the share of imports from the euro area (out of total imports) has increased from around 30 per cent to around 45 per cent in mid-2004. The euro area's trade share has fallen since then to approximately 38 per cent in mid-2006. It is logical to guess that such a decline is driven by the high world price of crude oil (most of which Bulgaria imports from Russia). However, a more careful look at the data reveals that the euro area's declining share is mostly driven by rapidly expanding imports from other Balkan countries, from Asia, and from the Americas.[7] Nevertheless, a significant increase in the Euro area's share of Bulgarian imports appears to have taken place since mid-1997.

Second, Devereux, Engel, and Tille (2003) have hypothesized, again in the context of the euro, that a currency union will affect the pricing decisions of outside exporters. Let's focus, without loss of too much generality, on a US company exporting to the euro area member countries. Before 1999, the US company typically priced its exports to those twelve countries in dollars. The alternative would have been to price these goods in twelve different currencies, and maintain a dozen hedging operations. The transaction and menu costs would have been too high. As a result, before 1999 US exports to the euro area were overwhelmingly priced in dollars, and the domestic currency price of these goods in the destination countries adjusted with the dollar exchange rate. Pass-through, in other words, must have been relatively high, while the profit margins of US exporters must have been relatively stable.

[7]Further details are available from the author, upon request. This claim holds regardless of whether we look at total imports or at imports excluding energy sources.

After 1999 (and especially after 2002), a US company would be more likely to price its exports to members of the euro area in euro. This is due to "pricing to market," that is, the attempt to stabilize the price faced by destination market consumers. A US company would engage in pricing to market in order to protect its share in the destination market, as its "pricing power" would be smaller than before. As a result, its profit margins would fluctuate with the dollar/euro exchange rate. However, pass-through would be much lower than before.

Once again, this story extends easily to currency boards. Figure 1 reports quarterly data on the role of the euro in the currency structure of Bulgaria's imports since 1999. The share of imports priced in euros (or the euro's legacy currencies) has increased from around 46 per cent in 1999 to around 59 per cent in mid-2006. Once again, the euro share has fallen slightly over the past two years, and that is probably due to increasing imports from Asia and the Americas which are more likely to be invoiced in US dollars.

If Figure 1 is not convincing enough, Figure 2 reports results from a simple data transformation. Essentially, I divided one of the shares displayed in Figure 1 by the other. The resulting ratio shown in Figure 2 is the ratio of trade in euro to trade with the euro area. Imports priced in euro were 1.07 of imports from the euro area in 1999, and the ratio has increased monotonically to 1.55 in 2006. Today, imports priced in euro exceed by 55 per cent imports from the euro area. Obviously then, more and more third-country companies choose to price their exports to the Bulgarian market in euro.

Third, maintaining a currency board has reduced dramatically inflation rates in the adopting countries. A similar effect has occurred under monetary union, for example, in the peripheral countries of the euro area (Portugal, Spain, Italy, Greece). While all of these countries had a long earlier history of high and persistent inflation, under the euro inflation rates have gone down to the levels enjoyed by Germany.

Taylor (2000) has argued that exchange rate pass-through depends on the anticipated persistence of an exchange rate shock – the more persistent the shock is expected to be, the faster and higher the adjustment in prices. Joining a currency union (or a currency board) should reduce the persistence of exchange rate shocks. ERPT should decline as a result. Obviously, the inflationary expectations of firms and households and the credibility of the monetary authority play a key role here. As one illustration of Taylor's argument, in many (primarily developing) countries, monetary policy lacks transparency. In those countries the private sector cannot easily observe the true stance of monetary policy. However, the exchange rate is easily observable, and exchange rate changes might be interpreted by the private sector as signals about the policy stance of the central bank. If the currency depreciates, firms and households might conclude that the central bank is rapidly expanding the money supply. The private sector will expect higher inflation and will incorporate those inflationary expectations in their price- and wage-setting decisions. Pass-through from depreciation to inflation will be high, as a result.

Currency unions and currency boards illustrate the mirror image of this argument. In a currency board, the central bank's behavior is completely transparent, and is guided by a simple rule. Any fluctuations in the nominal (effective) exchange rate are completely exogenous, in the sense that the NEER is completely outside the control of the monetary authority. Under a currency board, the private sector interprets NEER fluctuations not as a signal about the stance of monetary policy, but as a foreign shock hitting the economy.[8] Exchange rate pass-through should be lower then.

The Empirical Model

In general, the degree of ERPT depends on the share of imports in the CPI – in a more open economy, domestic inflation is more sensitive to exchange rate shocks. This is because imported goods enter directly into the computation of the CPI, and also because imported inputs might be important in the production of domestic goods (both traded and non–traded). In the canonical Mundell–Fleming model of the small open economy, pass-through is assumed to be unitary – a 10 per cent depreciation of the domestic currency leads ultimately to a 10 per cent increase in the domestic price of imports and in all other domestic prices (because the economy is small). Empirical evidence indeed suggests that ERPT is high (though not quite unitary) for real-world small open economies. On the contrary, ERPT is ultimately incomplete for a large closed economy like the United States.

Exchange rate pass-through further depends on the pricing decisions of firms, and the extent to which they adjust their profit margins in response to exchange rate volatility. Campa and Goldberg (2006) argue that profit margins typically drop during depreciation episodes and this decline may dampen ERPT. Campa and Goldberg (2006) also emphasize the role played by fixed distribution costs in reducing exchange rate pass-through.

Previous studies find that ERPT also depends on the degree of real exchange rate misalignment in a particular country. In countries with undervalued currencies, pass-through would be higher since higher inflation

[8] This point is due to Dabusinskas (2003).

in response to depreciation would help return the real exchange rate to its equilibrium path.

The empirical model estimated in this section incorporates the factors mentioned above, and is closest to the ones in Goldfajn and Werlang (2000), Choudhri and Hakura (2001), and Frankel *et al* (2005). All three papers estimate a simple markup pricing equation for a broad panel (consisting of at least 70 countries over 10 years or more).

Model setup

The pricing equation underlying the empirical estimation is as follows:

$$P_{i,t} = \left(P^*_{i,t}\right)^{\beta_2} \left(E_{i,t}\right)^{\beta_3} \mu_{i,t} \vec{Z}_{i,t}, \qquad (1)$$

where $P_{i,t}$ denotes the domestic price level in country *i* in period *t*, $P^*_{i,t}$ denotes the foreign price level, $E_{i,t}$ denotes the nominal exchange rate (in units of domestic currency *per one* unit of foreign currency). $\mu_{i,t}$ denotes the markup firms charge on marginal cost. Finally, $\vec{Z}_{i,t}$ denotes a vector of other controls, such as trade openness (exports and imports as a percentage of GDP), the degree of real exchange rate (RER) misalignment, as well as interaction terms. I do not impose the restriction that $\beta_2 = \beta_3$; in other words, shocks to foreign prices and shocks to the exchange rate might have a different impact on domestic prices. Taking natural logs of equation (1), we get:

$$\ln(P_{i,t}) = \beta_2 \ln\left(P^*_{i,t}\right) + \beta_3 \ln\left(E_{i,t}\right) + \ln(\mu_{i,t}) + \ln(\vec{Z}_{i,t}) \qquad (2)$$

I estimate the following differenced stochastic version of equation (2):

$$\pi_{i,t} = \beta_0 + \beta_1\pi_{i,t-4} + \beta_2\pi^*_{i,t} + \beta_3\varepsilon_{i,t} + \beta_4 Output\_gap_{i,t-4} + \beta_5 Openness_{i,t-4} + \\ +\beta_6 RER\_misalignment_{i,t-4} + \beta_7(Output\_gap_{i,t-4}{}^*\varepsilon_{i,t}) + \beta_8(Openness_{i,t-4}{}^*\varepsilon_{i,t}) + \\ + \beta_9(RER\_misalignment_{i,t-4}{}^*\varepsilon_{i,t}) + \beta_{10} Common\_currency_{t-4} + \\ + \beta_{11}(common\_currency_{t-4}{}^*\varepsilon_{i,t}) + u_{i,t} \qquad (3)$$

where $\pi_{i,t} \equiv \ln\left(\frac{P_{i,t}}{P_{i,t-4}}\right)$ denotes the domestic rate of inflation over the past four quarters in country *i* in period t, $\pi^*_{i,t} \equiv \ln\left(\frac{P^*_{i,t}}{P^*_{i,t-4}}\right)$ the foreign rate of inflation over the past four quarters, and $\varepsilon_{i,t} \equiv \ln\left(\frac{E_{i,t}}{E_{i,t-4}}\right)$ is the rate of depreciation of the nominal exchange rate over the same time horizon. For all three variables, I am looking at the percentage change over the past four quarters because many earlier studies have noted that exchange rate pass-through tends to peak and level off in approximately one year – see Ross (1998), Goldfajn and Werlang (2000), Hüfner and Schröder (2003), Anderton (2003), Gueorguiev (2003), and Faruqee (2004). Since I look at percentage changes over the last four quarters, seasonality in the data is not an issue.

Exchange rate pass-through is captured by the β_3 coefficient, while β_2 measures the pass-through from shocks to foreign inflation to domestic inflation. β_1 captures the degree of autocorrelation in domestic inflation, that is, the extent to which domestic inflation over the last four quarters is explained, in a statistical sense, by inflation over the preceding four quarters. One can think of it as a measure of inflation persistence.

$Output\_gap_{i,t}$ is the deviation of the real GDP of country *i* in period *t* from its potential level. As in Hristov and Mihaylov (2003), it proxies for the markup $\mu_{i,t}$ on marginal cost. Earlier empirical research has shown that markups are procyclical. I expect β_4 to turn up positive – higher markups should filter into higher inflation. $Openness_{i,t}$ denotes exports and imports as a percentage of *GDP*. There is no theoretical presumption about the sign of β_5 – higher trade openness might be associated with higher or lower inflation. $RER\_misalignment_{i,t}$ stands for the deviation of the real exchange rate from some "fundamental" level. I expect β_6 to turn up positive: the extent of RER misalignment should be positively associated with inflation. Countries with undervalued currencies (in other words, with real exchange rates above some "benchmark" level) should tend to have higher inflation rates, simply because those would bring the real exchange rate back down to its "normal" level. In a sense, the RER misalignment term substitutes for the lack of an error-correction term in my regression equation.

I also include three interaction terms – of the output gap, trade openness, and RER misalignment with the depreciation rate $\varepsilon_{i,t}$ – in order to measure the impact of these three variables on exchange rate pass-through. I expect β_7, β_8, and β_9 to be all positive. The output gap can be thought of as a proxy for demand shocks, and ERPT should be greater during cyclical upturns since firms should be finding it easier to pass through cost increases. Trade openness should increase pass-through, since greater openness makes domestic markets more sensitive to foreign shocks of any kind. Finally, RER misalignment should be positively associated with ERPT. If the real exchange rate is already undervalued, further nominal depreciation would take the real exchange rate even further above its "equilibrium" level. Under such conditions, a nominal depreciation is more likely to cause higher inflation, which would bring the real exchange rate back down.

Note that the output gap, trade openness, and the degree of RER misalignment all enter equation (3) with a four-quarter lag. We are interested in how the *initial* values of these three variables influence both inflation and exchange rate pass-through over the next four quarters. Finally, the constant and the error term are denoted by β_0 and $u_{i,t}$, respectively.

In order to measure the impact of common currencies, equation (3) is modified by adding a dummy variable (*Common_currency*) which is set to equal unity for each country *i* during each period *t* in which the country participated in a common currency arrangement, defined as either a currency union or a currency board. The regression equation then becomes:

$$\pi_{i,t} = \beta_0 + \beta_1\pi_{i,t-4} + \beta_2\pi^*_{i,t} + \beta_3\varepsilon i,t + \beta_4 Output\_gap_{i,t-4} + \beta_5 Openness_{i,t-4} + \\ + \beta_6 RER\_misalignment_{i,t-4} + \beta_7(Output\_gap_{i,t-4}{}^*\varepsilon_{i,t}) + \beta_8(Openness_{i,t-4}{}^*\varepsilon_{i,t}) + \\ + \beta_9(RER\_misalignment_{i,t-4}{}^*\varepsilon_{i,t}) + \beta_{10} Common\_currency_{t-4} + \\ + \beta_{11}(common\_currency_{t-4}{}^*\varepsilon_{i,t}) + u_{i,t} \qquad (4)$$

Preliminary data analysis

The time frequency of the data is quarterly. My dataset runs from Q1 of 1976 to Q1 of 2006 and has 101 countries – see the Appendix for the country list. For domestic inflation I used the CPI (IFS, line 64), since the CPI is the price index most relevant for monetary policy. The data source is the IMF's International Financial Statistics. For the rate of depreciation of the nominal exchange rate and for the RER misalignment variable, I used nominal and real effective exchange rate (NEER and REER) indices. For most countries, the data come from the IFS (lines *neu, nec,* and *rec*). Other sources of NEER and REER data include the European Commission's Price and Cost Competitiveness Report,[9] Eurostat,[10] and the Bank for International Settlements (BIS).[11] REER indices from all four sources are computed based on relative consumer prices. All NEER and REER indices had to be inverted, so that an increase in the inverted index denotes a (real or nominal) *depreciation*.

To construct a measure of real exchange rate misalignment, I applied the Hodrick–Prescott (HP) filter to the (logged) REER index for each country, and took the deviations from the HP-filtered series as a measure of RER misalignment. This is obviously a somewhat informal approach, given the huge literature on equilibrium real exchange rates. However, there is no consensus in that literature on the proper methodology for computing

[9] For Brazil, Estonia, Latvia, Lithuania, and Slovenia.

[10] For Greece, Mexico, and Turkey.

[11] For Argentina, Hong Kong, India, Indonesia, South Korea, and Thailand.

equilibrium RERs. In fact, there exists a veritable zoo of equilibrium concepts with catchy acronyms such as *CHEER, BEER, PEER, DEER, FEER,* and so forth. Given the lack of consensus, using the HP filter to obtain a simple measure of *RER* misalignment is probably not a too far off base. Furthermore, the regression coefficients on the RER misalignment variable in Table 2 work out exactly according to theory. This indicates that my simple measure of RER misalignment is probably highly correlated with the true degree of misalignment.

For foreign inflation, I constructed an index of foreign effective prices for each country by combining its *CPI*, its *NEER* index, and its *REER* index. I manipulated the definition of the real exchange rate as follows:

$$Q_1 = \frac{E_t P_i^*}{P_i} \Leftrightarrow P_t^* \frac{Q_t P_t}{E_t}$$

where I plugged the *REER* index for Q_t, the *CPI* for P_t, and the *NEER* index for E_t. Campa and Goldberg (2006) is another recent paper which employs the same trick.

For trade openness, I used data from the World Bank's *World Development Indicators* (WDI) database on total trade (exports plus imports) as a percentage of the GDP for each country. The WDI data are annual. Therefore, I had to convert the series from an annual to a quarterly frequency by linear interpolation.

For the output gap, I obtained real GDP data from the WDI, then used the HP filter to construct a measure of potential GDP, and took the deviations from the (logged and) HP-filtered series as a measure of the output gap. Once again, WDI data are annual, so I converted them to a quarterly frequency by interpolating exponentially.

While less than a perfect solution, the interpolation of openness and real GDP data should not create significant problems, given that we are interested in the *level* of trade openness, and in the *deviation* of real GDP from its potential value. These probably do not fluctuate too much over the course of a short time horizon of 2–3 quarters.[12]

Table 1 summarizes the 57 different episodes in which 56 different countries have participated in a common currency arrangement over the past three decades. The episodes are reasonably spread out through time – see Figure 3. Due to missing values, the typical actual sample size is 8784 data points, or 74 per cent of the theoretical maximum of 11817 (101 countries* 117 quarters between Q1:1977 and Q1:2006).

[12]It would have been nice to include a wage variable in the pricing equation as well. However, I could not find consistent wage data on all 101 countries in my dataset. The IFS has wage data for only about 40 of the 101 countries in my dataset.

Because the dataset is really a panel, I estimate the model using "fixed effects" ("within") and "random effects" (GLS), in addition to OLS. The "fixed effects" approach assumes that differences across the cross-section units (the 101 countries) are captured by different intercept terms. In other words, each country has its own unique β_0. One can think of the "fixed effects" as capturing all the omitted variables which might be driving inflation in a particular country over a particular four-quarter period.

The "random effects" approach assumes that each cross-section unit has an intercept β_0 which is randomly drawn from a common distribution. The correct estimator to use here is generalized least squares (GLS) since the error terms in the regression are clustered by country and therefore correlated.

In order to estimate the model in equations (3) and (4), we first need to ensure that the included variables are stationary. If we estimate regression equations with non-stationary data, we run the risk of obtaining spurious results. Traditional unit root tests have a well-known problem – their statistical power is quite low in short samples of 2–3 decades. Instead, I report results from panel unit root tests. These have greater statistical power, because they exploit the greater number of degrees of freedom and the panel structure of the dataset. Appendix Tables A1 thru A6 report the results from panel unit root tests on the six variables in the model: domestic and foreign inflation, the rate of exchange rate depreciation, trade openness, RER misalignment, and the output gap. Each table reports the results from six different panel unit root tests. Five of those test the null hypothesis of a unit root: the Levin, Lin, and Chu (LLC), Breitung (B), Im, Pesaran, and Shin (IPS), Augmented Dickey–Fuller (ADF) – Fisher, and Phillips–Perron (PP) – Fisher tests. The Hadri (H) tests the null hypothesis of stationarity against a non-stationary alternative. Three of the six tests (the IPS, ADF–Fisher, and PP–Fisher tests) allow for individual unit root processes for each cross-section unit, while the other three restrict all countries in the panel to a common unit root process. I run three variations of each of the six tests: with a constant and a linear time trend, with a constant only, and including no exogenous variables at all (if possible). The optimal number of lags is selected based on the Schwarz Information Criterion (SIC).

The results from the panel unit root tests for the degree of RER misalignment and the output gap are clear-cut. See Appendix Tables A5 and A6. In all the variants of the five tests where the null hypothesis is that of a unit root, the null is rejected at significance levels of 1 per cent or better. The Hadri test fails to reject the null hypothesis of stationarity. Therefore, we can say with a high degree of confidence that both series are stationary. These results are unsurprising since both series were obtained by using the Hodrick–Prescott filter to de-trend the real GDPs and REER indices of the countries in my panel. Deviations from the HP-filtered series are stationary almost by construction.

For the remaining four series, the results are somewhat ambiguous. See Tables A1 thru A4. If we take the domestic rate of inflation as an example (Table A1), the five tests testing the null of a unit root reject that null hypothesis strongly, with only two exceptions: the LLC tests with a constant, and with a constant and a linear time trend. However, the Hadri test also rejects strongly the null hypothesis of stationarity.

A similar pattern holds for the other three variables as well: the tests find it quite easy to reject both null hypotheses. Given the inconclusive results here and given that the literature is dominated by estimations of models in first log-differences, I assume tentatively that domestic and foreign inflation rates, the rate of exchange rate depreciation, and trade openness are stationary, and proceed to estimate equations (3) and (4) with that assumption. One alternative would have been to use the first differences of π, π^*, and ε, but that would have obscured the economic content behind the regression analysis: the regression coefficients could no longer be interpreted as measures of pass-through. A further argument in favor of the chosen estimation approach is that panels in general are less prone to generating spurious estimates. Spurious results in time series regressions are due to the covariance between a non-stationary regressor and a non-stationary error term. This is less of a problem in panel data due to the fact that regressors and error terms are averaged across independent cross-section units.[13]

Results

Table 2 reports results from estimating equation (3), using three different estimation techniques, and dropping the interaction terms, as a robustness check. The overall fit of the model is quite good – the R^2 ranges from 0.83 to 0.86. Most regression coefficients reported in that table are statistically significant. Looking across the last three columns of Table 2, note that the coefficients estimates appear to be fairly robust to the estimation techniques used. The exchange rate pass-through coefficient β_3 ranges between 0.51 and 0.53. Pass-through from foreign inflation shocks to domestic inflation (β_2) ranges between 0.73 and 0.74. This pass-through coefficient is higher than the ERPT coefficient – which is consistent with results reported in McCarthy (2000), Hahn (2003), and Warmedinger (2004).[14]

[13]This argument is due to Anderton (2003).

[14]However, Frankel et al (2005) finds the opposite – pass-through from exchange rate shocks exceeds the one from shocks to foreign inflation. Finally, Anderton (2003) cannot reject the null hypothesis that these two pass-through coefficients are equal.

Intuitively, one might explain the finding that $\beta_2 > \beta_3$ with the different degree of anticipated persistence for the two shocks. Nominal prices are typically quite sticky. Thus, any shock to foreign inflation will be perceived by domestic firms and households as more likely to be permanent. As a result, pass-through to domestic prices will be relatively high. On the contrary, exchange rates are notorious for their volatility. Therefore, exchange rate shocks will be perceived as less likely to be permanent, and ERPT will be somewhat lower than pass-through from shocks to foreign inflation.

In the last three columns of Table 2, the inflation persistence parameter ranges from 0.18 to 0.21. Given that β_2 and β_3 only measure pass-through over a four–quarter horizon, combining these two with β_1 would allow us to measure the long-run (infinite-horizon) pass-through. For shocks to foreign inflation and to the exchange rate, the long-run pass-through coefficients would be given by $\frac{\beta_2}{1-\beta_1}$ and $\frac{\beta_3}{1-\beta_1}$, respectively. Using the numbers in columns (4)–(6), long-run pass through ranges from 0.90 to 0.92 for shocks to foreign inflation, and between 0.62 and 0.67 for shocks to the nominal effective exchange rate. These are only slightly higher than the four-quarter pass-through coefficients reported in columns (4) thru (6), thus confirming the empirical findings of many other authors (cited earlier) that most of the pass-through of foreign shocks to domestic inflation occurs within the first four quarters following the shock.

The coefficients on *Openness* are small, mostly insignificant, and their sign flips between positive and negative. As hypothesized earlier, there does not appear to be a robust relationship between trade openness and inflation. However, the coefficient on the interaction between openness and the rate of depreciation is positive, highly statistically significant (for the most part), and large in economic terms (around 0.21). As expected, a higher degree of trade openness is associated with higher exchange rate pass-through.

The extent of RER misalignment is positively associated with inflation. Countries with undervalued currencies (in other words, with real exchange rates above some "benchmark" level) tend to have higher inflation rates, simply because that would bring the real exchange rate back down to its "normal" level. Furthermore, RER misalignment raises ERPT, as the coefficients on the interaction term in Table 2 show. This is also an intuitive result – if the real exchange rate is already depreciated, further nominal depreciations would take the RER even further away from its "normal" level. Therefore, nominal depreciations are more likely to cause higher inflation, which brings the real exchange rate back down.

Finally, the output gap is positively associated with inflation. Countries experiencing cyclical upturns tend to have higher inflation rates. Surprisingly, the coefficient on the interaction between the output gap and the rate of depreciation is negative, large, and highly statistically significant. I will discuss the intuition behind this result later.

Table 3 reports the results from estimating equation (4). The regression coefficients on all the variables which carried over from equation (3) are essentially unchanged, compared to Table 2. The coefficient on the *Common_currency* dummy variable is always negative and typically (in five out of six estimates) statistically significant. Participating in a common currency area (a currency union or a currency board) reduces trend inflation (the constant in both regression equations) by about 1 per cent.

More interestingly, the coefficient on the interaction between the *Common_currency* dummy variable and shocks to the NEER is negative, highly statistically significant (when all interaction terms are included), and reasonably large in economic terms. Participation in a common currency cuts ERPT in half – from 0.50 to about 0.25. This is the central result of this paper.

As a robustness check, Table 4 reports estimates of equation (4) at the eight-quarter time horizon. That is, I look at domestic and foreign inflation and exchange rate depreciation over the latest eight quarters. And I also look at trade openness, the output gap, the degree of RER misalignment, and participation in a common currency at the beginning of the eight-quarter period. The estimates reported in Table 4 are consistent with those in Table 3, taking into account the longer time horizon.

The long-run (infinite-horizon) pass-through coefficients implied by Table 4 range from 0.84 to 0.87 for shocks to foreign inflation, and between 0.63 and 0.69 for shocks to the nominal effective exchange rate. These are almost identical to the estimates based on Table 3.

Next, I slice the dataset in various ways to see if the impact of common currencies on exchange rate pass-through differs for various subsamples. First, I zoom in on the European Monetary Union. Several authors have already studied ERPT in the euro area and have tried to find a structural break in pass-through following the introduction of the euro – papers include Kieler (2001), Hüfner and Schröder (2003), and Campa, Goldberg, and Gonzalez–Minguez (2005). However, their results have been weak or inconclusive. In contrast, in my dataset I find a sizeable reduction in ERPT in the member countries of the euro area after 1999.

To show this, I split the *Common_currency* dummy into two dummy variables: *EMU* and *Non_EMU_common_currency*. *Non_EMU_common_currency* covers all common currency arrangements outside of the *EMU*. Each dummy covers 12 and 20 countries, respectively. Results are reported in Table 5. The first three columns report regressions with the full sample of 101 countries. Of most interest are the last two rows of the table which report the coefficients of the interactions of the two dummy variables *Non_EMU_common_currency* and EMU with $\varepsilon_{i,t}$. Being a member of a common currency outside of the EMU reduces exchange rate pass-through by about 0.25, and the effect is significant in the panel regressions. Membership in the euro area reduces pass-through by a lot more, and the effect is significant at the 1 per cent level in all three specifications. Essentially, it appears that if you belong to the EMU, exchange rate pass-through falls off to approximately zero (taking into account the large standard errors on the interaction term between *EMU* and $\varepsilon_{i,t}$).

Columns (4) thru (6) report results from a sample restricted to the 30 member countries in the Organization for Economic Cooperation and Development (OECD). All twelve EMU members belong to the OECD. The OECD members outside the euro area provide a control group of countries with a similar institutional framework and a similar level of economic development.[15] My research question then becomes: is there a significant difference in ERPT under the euro, relative to the control group? The answer is yes, although the reduction in pass-through is not as large as it was in the full sample. Of course, the control group is different now.

Columns (7) thru (9) report results from estimating equation (4) for a subsample consisting of the 27 member countries of the European Union (including Bulgaria and Romania). So this time, the 15 countries which belong to the EU but do not participate in the EMU provide a control group.[16] Once again, belonging to the euro area is statistically associated with a large and significant reduction in the sensitivity of domestic inflation to exchange rate shocks.

Interestingly, the coefficient on *Output_gap* in the last three columns of Table 5 is substantially smaller than in the full sample. Perhaps EU member countries tend to run a more credible monetary policy and cyclical upturns do not create inflationary pressures to the same extent as in non-EU countries. Another interesting result here is that the coefficient on (*output_gap** $\varepsilon_{i,t}$) is positive, large, and significant. A positive output gap (real GDP above potential) is associated with higher pass-through, perhaps because firms find it easier to pass through cost increases when the economy is booming.

As a next step, I study the impact of common currencies on exchange rate pass-through in the ten countries of Central and Eastern Europe (CEE) which recently joined the European Union (including Romania and Bulgaria). Of those countries,

[15] Of course, pre–1999 observations from the 12 Euro area countries are also part of that control group.

[16] See the previous footnote.

Estonia, Lithuania, and Bulgaria have maintained currency boards since 1992, 1994, and 1997, respectively. I split the *Common_currency* dummy into two dummies whose names should be self-explanatory: *Non_CEE_common_currency* and *CEE_common_currency*. The split here is fairly asymmetric: each variable covers 29 and 3 countries, respectively. Results are reported in Table 6.

The first three columns report estimates from the full sample, while the last three columns limit the sample to the 10 CEE countries only. The two coefficients involving the *Non_CEE_common_currency* dummy variable turn out to be quite similar to those reported in Table 3, as expected. It turns out that the reduction in pass-through among the three CEE currency boards is much stronger than in the typical common currency arrangement – around 0.36. This result survives in the last three columns of the table where I look at the very small subsample of the 10 CEE countries.

As a further step, I explore whether currency unions differ from currency boards in their impact on ERPT. So far, the two monetary arrangements were lumped together. However, there are important differences between the two. Arguably, currency unions are a more transparent and also more credible institutional arrangement than currency boards. On the other hand, Frankel and Rose (2002) tested for a difference in the trade-creating effects of the two arrangements and found none. I replace *Common_currency* with two dummy variables: *Currency_union* and *Currency_board*, covering 20 and 12 countries, respectively. As reported in Table 7, membership in both currency unions and currency boards is associated with lower inflation and with lower pass-through. If anything, the reduction in pass-through under currency boards might even be a bit larger than under currency unions. However, the difference between the two coefficient estimates appears too small to be statistically significant in all three columns of the table. The results here match those in Frankel and Rose (2002): we find no difference between currency unions and currency boards, at least as far as their impact on ERPT is concerned.

In the next table (Table 8), I explore whether common currency arrangements work differently on different continents. I look at common currencies in Africa, the Western Hemisphere, and Europe. There are 7 such arrangements in Africa, 9 in the Western Hemisphere, and 15 in Europe.[17] Judging by the results in Table 7, there is strong evidence that common currencies reduce the level of inflation in Africa. The evidence is also strong that common currencies reduce the pass-through from depreciation to

[17] The only one not covered is the currency board in Hong Kong.

inflation on all three continents. The reduction in ERPT is stronger in the Western Hemisphere than it is in Africa, and it appears to be strongest in Europe. Such a ranking correlates with per capita incomes: Africa is the poorest continent of the three, while Europe is by far the richest.

Therefore, it makes sense to investigate if the impact of common currencies is different at different levels of economic development. For that purpose, I divide the 101 countries in my dataset into two groups: those whose per capita GDP was above $10,000 in the year 2005, and those below that threshold. I ended up with 50 relatively high-income countries and 51 relatively low-income countries (see Table 9).[18] Furthermore, I split the *Common_currency* dummy into 2 separate dummy variables. *Common_currency_Rich* equals unity for each high-income country during each quarter in which that country participated in a common currency. *Common_currency_Poor* is defined symmetrically. Of the 32 countries which have participated in a common currency arrangement, 18 were high-income countries in 2005, while 14 were low-income countries.

Results are reported in Table 10. The first three columns of that table report regressions using the full dataset. Splitting participants in common currency arrangements into high-income and low-income countries produces some interesting results. For example, it turns out that *Common_currency_Rich* is not associated with lower inflation, while there is still a strong negative relationship between *Common_currency_Poor* and the inflation rate. Perhaps for relatively low-income countries, participating in a common currency is viewed primarily as a ticket to monetary stability, while for high-income countries giving up monetary sovereignty is not the only path, and there are alternative institutional mechanisms to commit to low inflation.

Furthermore, it turns out that common currencies reduce exchange rate pass-through in rich and poor countries alike – the coefficients on the interactions with $\varepsilon_{i,t}$ are uniformly negative and uniformly statistically significant. However, the reduction in ERPT is significantly larger for relatively high-income countries.

Columns (4) thru (6) report regression results for a subsample limited only to the 50 relatively high-income countries, while columns (7) thru (9) report results for the subsample consisting of the 51 low-income countries. The results on common currency membership reported in columns (4)–(9) are consistent with those in columns (1)–(3).

[18]The data source was the CIA's World Factbook online. Their GDP numbers are adjusted for purchasing power parity (PPP).

Table 11 investigates whether the impact of currency unions and currency boards has evolved over time. I look separately at common currency arrangements over three time periods: 1976–1985, 1986–1995, and 1996–2006.[19] Membership in a common currency reduces exchange rate pass-through in all three periods. However, the effect appears to be getting stronger quantitatively over time.

Finally, let me return to the surprising finding of a strongly negative coefficient sign on the interaction between the output gap and the rate of depreciation ($output\_gap * \varepsilon_{i,t}$). If you look at Tables 5, 6, and 10, the interaction coefficient is always negative when we look at the full sample of 101 countries, or when we look at a subsample dominated by relatively poor and developing countries. But the coefficient is either insignificant, or both positive *and* significant if we look at relatively rich and developed economies. For example, the interaction coefficient is:

- strongly negative in the first three columns of Tables 5, 6, and 10, each covering the full sample of 101 countries;

- strongly negative in the last three columns of Table 10 (covering a sub-sample of 51 relatively poor countries), but mostly insignificant in the middle three columns of that table (analyzing a subsample of 50 relatively rich countries);

- insignificant in the middle three columns of Table 5 (covering 30 OECD countries), and both positive *and* significant in the last three columns (EU–27);

- mostly insignificant in the last three columns of Table 6 (10 CEE countries).

Obviously then, the negative coefficient on ($output\_gap * \varepsilon_{i,t}$) in the full sample of 101 countries is driven by the relatively poor, developing countries in the sample. This might be because in those countries periods of exchange rate depreciation tend to be associated with recessions, and high inflation. And vice versa, economic booms go hand in hand with stronger currencies and lower inflation.

Of course, in relatively rich, developed economies exchange rate depreciations have the classical effect (from undergraduate textbooks) of stimulating aggregate demand and causing a cyclical upturn in output. Thus, in those countries the exchange rate, output, and prices all move up or down together.

Relatively poor, developing countries dominate the full sample of 101 countries because there are more outlier observations among them: periods of very high depreciation combined with deep recessions and high inflation.

[19]See again Figure 3 for the evolution of membership in common currencies over the past three decades.

Concluding remarks

Earlier studies have offered theoretical arguments for why the adoption of a currency board or a currency union might reduce the pass-through from the exchange rate to the domestic price level. Bulgarian data were used to illustrate these theoretical arguments. By analyzing a broad panel of 101 countries over the period 1976–2006, this paper has found that indeed exchange rate pass-through tends to decline in countries participating in a common currency arrangement. In particular, there has been a strong reduction in ERPT in the twelve members of the European Monetary Union since the launch of the euro. Currency boards do not differ from currency unions – both reduce the pass-through from depreciation to inflation. The negative impact of common currencies on exchange rate pass-through appears to be increasing with per capita incomes and increasing over time.

Verifying empirically that ERPT declines under a common currency is important for several reasons. First, lower pass-through is a benefit of participating in a common currency arrangement. It tilts the balance of costs and benefits toward a currency board or a currency union, and away from having a flexible exchange rate.

Second, several previous studies were inconclusive about pass-through under the euro, while the results here are fairly strong. Lower pass-through makes it easier to achieve monetary stability in the euro area. It means that inflation forecasts should place a lower weight on exchange rate fluctuations. It also means that policy-makers at the ECB should pay less attention to volatility in the euro's external value because its capacity to affect the euro area's macroeconomy has diminished. Inflation targeting by the ECB should become somewhat easier if central bankers can shift their attention away from the exchange rate.

Third, this study shows that currency boards mimic currency unions, as far as their impact on ERPT is concerned. My results indicate that the three new EU members with currency board arrangements have already enjoyed the insulation benefits of the European Monetary Union (EMU). The pass-through from depreciation to inflation in those countries is lower than in the remaining seven CEE countries. Bulgaria, Estonia, and Lithuania have already taken the EMU out for a "test drive."

Finally, exchange rate pass-through connects the nominal exchange rate to the real economy. Lower pass-through reduces the real effects of nominal exchange rate volatility by reducing its expenditure-switching effects. Due to lower ERPT, exchange rate swings have a smaller impact on the relative prices of domestic and foreign goods, and thus, on the trade balance and the current account.

Table 1

LIST OF CURRENCY UNIONS AND CURRENCY BOARDS AROUND THE WORLD (IN EXISTENCE IN OR AFTER 1976)

COUNTRY	CURRENCY UNION OR CURRENCY BOARD	START	END
Anguilla	*Currency board with Trinidad, GBP, and USD (switches in 1951 and 1976); Eastern Caribbean Central Bank*	*1935*	*present*
Antigua and Barbuda	**Currency board with Trinidad, GBP, and USD (switches in 1951 and in 1976 or 1983); Eastern Caribbean Central Bank**	**1935**	**present**
Argentina	**Currency board with USD**	**Q3:1991**	**Q4:2001**
Austria	**Currency union (euro area)**	**Q1:1999**	**present**
Belgium	**Currency union (euro area)**	**Q1:1999**	**present**
Belize	**Currency board with USD and GBP (switches in 1949 and 1974)**	**1894**	**1981**
Benin	*Currency union; Colonies Françaises d'Afrique/Central Bank of West African States*	*1976 or earlier*	*present*
Bhutan	*Currency union with Indian Rupee*	*1960 or earlier*	*present*
Bosnia and Herzegovina	*Currency board with DEM, later EUR*	*Q3:1997*	*present*
Botswana	*Currency union with South African Pound/Rand*	*1920*	*Q2:1976*
Brunei Darussalam	*Currency board with Singapore Dollar*	*1967*	*present*
Bulgaria	**Currency board with DEM, later EUR**	**Q3:1997**	**present**
Burkina Faso	*Currency union; Colonies Françaises d'Afrique/Central Bank of West African States*	*1976 or earlier*	*present*
Cameroon	**Currency union; Colonies Françaises d'Afrique/Bank of Central African States**	**1976 or earlier**	**present**
Central African Republic	**Currency union; Colonies Françaises d'Afrique/Bank of Central African States**	**1976 or earlier**	**present**
Chad	*Currency union; Colonies Françaises d'Afrique/Bank of Central African States*	*1976 or earlier*	*present*
Comoros	*Currency board with FFR, later EUR*	*Q1:1980*	*present*
Congo, Republic of	*Currency union; Colonies Françaises d'Afrique/Bank of Central African States*	*1976 or earlier*	*present*
Cote D'Ivoire	**Currency union; Colonies Françaises d'Afrique/Central Bank of West African States**	**1976 or earlier**	**present**
Czech Republic	**Currency union (Czechoslovakia)**	**1976 or earlier**	**Q4:1992**
Djibouti	*Currency board with USD*	*1949*	*present*
Dominica	**Currency board with Trinidad, GBP, and USD (switches in 1951 and 1976); Eastern Caribbean Central Bank**	**1935**	**present**

(continued)

(continued)

COUNTRY	CURRENCY UNION OR CURRENCY BOARD	START	END
Ecuador	**Currency union with USD**	**Q2:2000**	**present**
Equatorial Guinea	**Currency union; Colonies Françaises d'Afrique/Bank of Central African States**	**Q4:1984**	**present**
Estonia	**Currency board with DEM, later EUR**	**Q3:1992**	**present**
Finland	**Currency union (euro area)**	**Q1:1999**	**present**
France	**Currency union (euro area)**	**Q1:1999**	**present**
Gabon	**Currency union; Colonies Françaises d'Afrique/Bank of Central African States**	**1976 or earlier**	**present**
Germany	**Currency union (euro area)**	**Q1:1999**	**present**
Greece	**Currency union (euro area)**	**Q1:2001**	**present**
Grenada	**Currency board with Trinidad, GBP, and USD (switches in 1951 and 1976); Eastern Caribbean Central Bank**	**1935**	**present**
Guinea-Bissau	*Currency union; Colonies Françaises d'Afrique/Central Bank of West African States*	*Q2:1997*	*present*
Hong Kong	**Currency board with USD**	**Q1:1984**	**present**
Ireland	**Currency union (euro area)**	**Q1:1999**	**present**
Ireland	**Currency union with GBP**	**1931**	**Q1:1979**
Italy	**Currency union (euro area)**	**Q1:1999**	**present**
Lesotho	**Currency union with South African Pound/Rand**	**1910**	**Q4:1979**
Liberia	*Currency union with USD*	*1822*	*1988*
Lithuania	**Currency board with USD and EUR (switch in 2002)**	**Q2:1994**	**present**
Luxembourg	**Currency union (euro area)**	**Q1:1999**	**present**
Mali	*Currency union; Colonies Françaises d'Afrique/Central Bank of West African States*	*Q2:1984*	*present*
Micronesia	*Currency union with USD*	*1944 or earlier*	*present*
Montserrat	*Currency board with Trinidad, GBP, and USD (switches in 1951 and 1976); Eastern Caribbean Central Bank*	*1935*	*present*

(continued)

(continued)

COUNTRY	CURRENCY UNION OR CURRENCY BOARD	START	END
Netherlands	**Currency union (euro area)**	**Q1:1999**	**present**
Niger	*Currency union; Colonies Françaises d'Afrique/Central Bank of West African States*	*1976 or earlier*	*present*
Panama	*Currency union with USD*	*1904*	*present*
Portugal	**Currency union (euro Area)**	**Q1:1999**	**present**
El Salvador	*Currency union with USD*	*Q1:2001*	*present*
San Marino	*Currency union with Italian Lira, later Euro*	*1960 or earlier*	*present*
Senegal	*Currency union; Colonies Françaises d'Afrique/Central Bank of West African States*	*1976 or earlier*	*present*
Slovakia	**Currency union (Czechoslovakia)**	**1976 or earlier**	**Q4:1992**
Spain	**Currency union (euro area)**	**Q1:1999**	**present**
St. Kitts and Nevis	**Currency board with Trinidad, GBP, and USD (switches in 1951 and in 1976 or 1983); Eastern Caribbean Central Bank**	**1935**	**present**
St. Lucia	**Currency board with Trinidad, GBP, and USD (switches in 1951 and 1976); Eastern Caribbean Central Bank**	**1935**	**present**
St. Vincent and the Grenadines	**Currency board with Trinidad, GBP, and USD (switches in 1951 and 1976); Eastern Caribbean Central Bank**	**1935**	**present**
Swaziland	*Currency union, then currency board with South African Pound/Rand*	*1920*	*1986*
Togo	**Currency union; Colonies Françaises d'Afrique/Central Bank of West African States**	**1976 or earlier**	**present**

Notes: 1. The table lists only member countries of the International Monetary Fund which participated in a common currency arrangement at some point in or after 1976.

2. Highlighted countries are included in my dataset. Italicized countries are not included in my dataset.

3. According to sources, Belize's currency board ended at some point in 1981. For the purposes of the empirical analysis, I assumed that the regime ended in mid-1981. Thus, Q2 of 1981 was coded as the last quarter with Belize's currency board in place.

Sources: Ghosh, Gulde, and Wolf (2000), Frankel and Rose (2002), Reinhart and Rogoff (2002), Schuler (1992), CIA's The World Factbook, IMF's International Financial Statistics, Wikipedia.

Table 2

BENCHMARK PASS-THROUGH EQUATION

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$
Estimator	**OLS**	**Fixed**	**Random**	**OLS**	**Fixed**	**Random**
Independent variables		**effects (within)**	**effects (GLS)**		**effects (within)**	**effects (GLS)**
Constant	**0.02**	**0.02****	**0.02*****	**0.01**	**-0.01**	**0.01*****
	(0.016)	*(0.008)*	*(0.004)*	*(0.011)*	*(0.008)*	*(0.004)*
$\pi_{i,t-4}$	**0.26*****	**0.22*****	**0.24*****	**0.21*****	**0.18*****	**0.20*****
	(0.056)	*(0.005)*	*(0.005)*	*(0.040)*	*(0.005)*	*(0.005)*
$\pi^*_{i,t}$	**0.66*****	**0.67*****	**0.66*****	**0.73*****	**0.74*****	**0.73*****
	(0.125)	*(0.015)*	*(0.014)*	*(0.094)*	*(0.013)*	*(0.013)*
$\varepsilon_{i,t}$	**0.54*****	**0.52*****	**0.53*****	**0.53*****	**0.51*****	**0.52*****
	(0.116)	*(0.004)*	*(0.004)*	*(0.131)*	*(0.009)*	*(0.009)*
Openness	**-0.01**	**0.00**	**-0.01****	**-0.01**	**0.02****	**-0.01**
	(0.010)	*(0.010)*	*(0.004)*	*(0.007)*	*(0.009)*	*(0.004)*
RER_misalignment	**0.50*****	**0.49*****	**0.50*****	**0.20**	**0.20*****	**0.20*****
	(0.109)	*(0.009)*	*(0.009)*	*(0.199)*	*(0.011)*	*(0.011)*
Output_gap	**0.41*****	**0.37*****	**0.40*****	**0.64*****	**0.61*****	**0.63*****
	(0.114)	*(0.069)*	*(0.070)*	*(0.157)*	*(0.063)*	*(0.064)*
(openness * $\varepsilon_{i,t}$**)**				**0.20**	**0.22*****	**0.20*****
				(0.144)	*(0.016)*	*(0.015)*
(RER_misalignment * $\varepsilon_{i,t}$**)**				**0.03*****	**0.03*****	**0.03*****
				(0.011)	*(0.001)*	*(0.001)*
(output_gap * $\varepsilon_{i,t}$**)**				**-1.93*****	**-2.08*****	**-1.98*****
				(0.429)	*(0.108)*	*(0.108)*
Number of observations	**8784**	**8784**	**8784**	**8784**	**8784**	**8784**
R^2	**0.83**	**0.83**	**0.83**	**0.86**	**0.86**	**0.86**

Note: All regressions estimate equation (3) in the main text of the paper. Regressions using the OLS estimator report standard errors which are heteroscedasticity-consistent, as well as robust to clustering by country. Standard errors are reported in parentheses. ***, ** and *, denote statistical significance at the 1per cent, 5per cent, 10per cent level, respectively. All columns in the table cover the full sample of 101 countries.

Table 3

THE IMPACT OF COMMON CURRENCIES ON EXCHANGE RATE PASS-THROUGH

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$
Estimator	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**
Independent variables						
Constant	**0.02** (0.016)	**0.02**** (0.008)	**0.02***** (0.004)	**0.02** (0.011)	**0.00** (0.008)	**0.02***** (0.003)
$\pi_{i,t-4}$	**0.25***** (0.056)	**0.22***** (0.005)	**0.24***** (0.005)	**0.20***** (0.040)	**0.18***** (0.005)	**0.20***** (0.005)
$\pi^*_{i,t}$	**0.65***** (0.123)	**0.67***** (0.015)	**0.66***** (0.014)	**0.72***** (0.093)	**0.74***** (0.013)	**0.72***** (0.013)
$\varepsilon_{i,t}$	**0.54***** (0.118)	**0.52***** (0.004)	**0.53***** (0.004)	**0.53***** (0.130)	**0.50***** (0.009)	**0.52***** (0.009)
Openness	**-0.01** (0.009)	**0.00** (0.010)	**-0.01** (0.004)	**-0.01** (0.007)	**0.02** (0.009)	**0.00** (0.004)
RER_misalignment	**0.50***** (0.109)	**0.49***** (0.009)	**0.50***** (0.009)	**0.19** (0.199)	**0.19***** (0.011)	**0.19***** (0.011)
Output_gap	**0.40***** (0.118)	**0.37***** (0.070)	**0.38***** (0.070)	**0.57***** (0.151)	**0.55***** (0.064)	**0.57***** (0.064)
(openness * $\varepsilon_{i,t}$**)**				**0.22** (0.142)	**0.24***** (0.016)	**0.22***** (0.015)
(RER_misalignment * $\varepsilon_{i,t}$**)**				**0.04***** (0.011)	**0.03***** (0.001)	**0.03***** (0.001)
(output_gap * $\varepsilon_{i,t}$**)**				**-1.94***** (0.432)	**-2.08***** (0.108)	**-1.97***** (0.108)
Common_currency	**-0.01**** (0.005)	**-0.01** (0.009)	**-0.01***** (0.005)	**-0.01***** (0.004)	**-0.02*** (0.008)	**-0.01***** (0.004)
(common_currency * $\varepsilon_{i,t}$**)**	**-0.07** (0.091)	**-0.04** (0.031)	**-0.06**** (0.031)	**-0.27***** (0.060)	**-0.24***** (0.028)	**-0.26***** (0.028)
Number of observations	**8784**	**8784**	**8784**	**8784**	**8784**	**8784**
R^2	**0.83**	**0.83**	**0.83**	**0.86**	**0.86**	**0.86**

Note: All regressions estimate equation (4) in the main text of the paper. Regressions using the OLS estimator report standard errors which are heteroscedasticity-consistent, as well as robust to clustering by country. Standard errors are reported in parentheses. ***, ** and * denote statistical significance at the 1 per cent, 5 per cent, 10 per cent level, respectively. All columns in the table cover the full sample of 101 countries.

Table 4

THE IMPACT OF COMMON CURRENCIES ON EXCHANGE RATE PASS-THROUGH AT THE 8-QUARTER HORIZON

	(1)	(2)	(3)
Dependent variable	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$
Estimator	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**
Independent variables			
Constant	**0.03** (0.028)	**-0.01** (0.012)	**0.03*** ** (0.007)
$\pi_{i,t-4}$	**0.10*** ** (0.034)	**0.07*** ** (0.004)	**0.08*** ** (0.004)
$\pi^*_{\iota,\tau}$	**0.78*** ** (0.071)	**0.78*** ** (0.013)	**0.78*** ** (0.012)
$\varepsilon_{\iota,\tau}$	**0.62*** ** (0.148)	**0.59*** ** (0.008)	**0.60*** ** (0.008)
Openness	**-0.01** (0.018)	**0.06*** ** (0.015)	**0.00** (0.008)
RER_misalignment	**0.69*** ** (0.167)	**0.71*** ** (0.018)	**0.70*** ** (0.018)
Output_gap	**0.86*** ** (0.262)	**0.81*** ** (0.096)	**0.83*** ** (0.096)
(**openness** * $\varepsilon_{\iota,\tau}$)	**0.26**** (0.128)	**0.29*** ** (0.015)	**0.29*** ** (0.015)
(**RER_misalignment** * $\varepsilon_{\iota,\tau}$)	**0.01** (0.016)	**0.01*** ** (0.002)	**0.01*** ** (0.002)
(**output_gap** * $\varepsilon_{\iota,\tau\ t}$)	**-1.51*** ** (0.534)	**-1.69*** ** (0.109)	**-1.61*** ** (0.109)
Common_currency	**-0.02*** (0.009)	**-0.02** (0.012)	**-0.02*** (0.008)
(**common_currency** * $\varepsilon_{\iota,\tau}$)	**-0.27*** ** (0.061)	**-0.23*** ** (0.031)	**-0.25*** ** (0.030)
Number of observations	**8275**	**8275**	**8275**
R^2	**0.91**	**0.91**	**0.91**

Note: All regressions estimate equation (4) in the main text of the paper. Regressions using the OLS estimator report standard errors which are heteroscedasticity-consistent, as well as robust to clustering by country. Standard errors are reported in parentheses. ***, ** and * denote statistical significance at the 1 per cent, 5 per cent, 10 per cent level, respectively. All columns in the table cover the full sample of 101 countries.

Table 5

THE IMPACT OF EMU ON EXCHANGE RATE PASS-THROUGH

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$
Estimator **Independent variables**	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**
Constant	**0.02** (0.011)	**0.00** (0.008)	**0.02***** (0.003)	**0.02***** (0.005)	**0.05***** (0.004)	**0.02***** (0.002)	**0.01** (0.005)	**0.02***** (0.007)	**0.01***** (0.002)
$\pi_{i,t-4}$	**0.20***** (0.040)	**0.18***** (0.005)	**0.20***** (0.005)	**0.45***** (0.070)	**0.41***** (0.009)	**0.45***** (0.008)	**0.16**** (0.068)	**0.11***** (0.007)	**0.16***** (0.007)
$\pi^*_{\iota,\tau}$	**0.72***** (0.093)	**0.73***** (0.013)	**0.73***** (0.013)	**0.22***** (0.039)	**0.21***** (0.012)	**0.22***** (0.012)	**0.90***** (0.206)	**0.91***** (0.020)	**0.90***** (0.020)
$\varepsilon_{\iota,\tau}$	**0.53***** (0.130)	**0.50***** (0.009)	**0.52***** (0.009)	**0.58***** (0.088)	**0.55***** (0.013)	**0.58***** (0.012)	**0.71***** (0.089)	**0.63***** (0.027)	**0.71***** (0.026)
Openness	**0.00** (0.007)	**0.02**** (0.009)	**(0.00** (0.009)	**0.00** (0.088)	**-0.04***** (0.013)	**0.00** (0.012)	**0.00** (0.089)	**-0.01** (0.027)	**0.00** (0.026)
RER_misalignment	**0.19** (0.199)	**0.19***** (0.011)	**0.19***** (0.011)	**0.31***** (0.032)	**0.30***** (0.015)	**0.31***** (0.015)	**0.68***** (0.140)	**0.68***** (0.023)	**0.68***** (0.024)
Output_gap	**0.57***** (0.151)	**0.56***** (0.064)	**0.57***** (0.064)	**0.56***** (0.153)	**0.58***** (0.053)	**0.56***** (0.054)	**0.24*** (0.126)	**0.21***** (0.058)	**0.24***** (0.062)
(openness * $\varepsilon_{\iota,\tau}$)	**0.22** (0.142)	**0.24***** (0.016)	**0.22***** (0.015)	**-0.25***** (0.090)	**-0.24***** (0.023)	**-0.25***** (0.022)	**0.11** (0.113)	**0.16***** (0.031)	**0.11***** (0.030)

(continued)

(continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(RER_misalignment * $\varepsilon_{\iota,\tau}$)	**0.04***** *(0.011)*	**0.03***** *(0.001)*	**0.03***** *(0.001)*	**-0.09** *(0.120)*	**-0.10**** *(0.048)*	**-0.09*** *(0.049) -0.29*	**0.60***** *(0.193)*	**0.68***** *(0.055)*	**0.60***** *(0.058)*
(output_gap * $\varepsilon_{\iota,\tau}$)	**-1.95***** *(0.431)*	**-2.09***** *(0.108)*	**-1.98***** *(0.108)*	**-0.29** *(1.144)*	**-0.36** *(0.253)*	**-0.29** *(0.259)*	**1.24*** *(0.666)*	**1.12***** *(0.197)*	**1.24***** *(0.207)*
Non_EMU_common_currency	**-0.01***** *(0.004)*	**-0.03**** *(0.012)*	**-0.01***** *(0.005)*				**0.00** *(0.003)*	**-0.02***** *(0.005)*	**0.00** *(0.004)*
EMU	**-0.01**** *(0.005)*	**-0.02*** *(0.009)*	**-0.01** *(0.008)*	**-0.01***** *(0.003)*	**0.00** *(0.003)*	**-0.01***** *(0.002)*	**-0.01** *(0.004)*	**0.00** *(0.003)*	**-0.01**** *(0.003)*
(non_EMU_common_currency * $\varepsilon_{\iota,\tau}$)	**-0.26***** *(0.060)*	) **-0.24***** *(0.028)*	**-0.26***** *(0.028)*				**-0.32***** *(0.065)*	(**-0.27***** *(0.048)*	**-0.32***** *(0.046)*
(EMU * $\varepsilon_{\iota,\tau}$)	**-0.85***** *(0.120)*	**-0.85***** *(0.261)*	**-0.84***** *(0.261)*	**-0.17*** *(0.083)*	**-0.16**** *(0.074)*	**-0.17**** *(0.075)*	**-0.76***** *(0.095)*	**-0.81***** *(0.086)*	**-0.76***** *(0.091)*
Number of observations	**8784**	**8784**	**8784**	**3046**	**3046**	**3046**	**2346**	**2346**	**2346**
R^2	**0.86**	**0.86**	**0.86**	**0.90**	**0.88**	**0.90**	**0.92**	**0.91**	**0.92**

Note: All regressions estimate an expanded version of equation (4) in the main text of the paper. Regressions using the OLS estimator report standard errors which are heteroscedasticity-consistent, as well as robust to clustering by country. Standard errors are reported in parentheses. ***, ** and *, denote statistical significance at the 1 per cent, 5 per cent, 10 per cent level, respectively. Columns (1)–(3) cover the full sample of 101 countries. Columns (4)–(6) cover a subsample restricted to the 30 member countries of the OECD. Columns (7)–(9) cover a subsample restricted to the 27 members of the European Union (including Bulgaria and Romania).

Table 6

THE IMPACT OF COMMON CURRENCIES ON EXCHANGE RATE PASS-THROUGH IN CENTRAL AND EASTERN EUROPE (CEE)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$
Estimator	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**
Independent variables						
Constant	**0.02**	**0.00**	**0.02*****	**0.04**	**0.02**	**0.04*****
	(0.011)	*(0.008)*	*(0.003)*	*(0.027)*	*(0.021)*	*(0.0121)*
$\pi_{i,t-4}$	**0.20*****	**0.17*****	**0.20*****	**0.09****	**0.07*****	**0.09*****
	(0.040)	*(0.005)*	*(0.005)*	*(0.039)*	*(0.011)*	*(0.010)*
$\pi^*_{i,t}$	**0.72*****	**0.73*****	**0.72*****	**1.17*****	**1.20*****	**1.17*****
	(0.093)	*(0.013)*	*(0.013)*	*(0.119)*	*(0.054)*	*(0.042)*
$\varepsilon_{i,t}$	**0.53*****	**0.50*****	**0.52*****	**0.80*****	**0.75*****	**0.80*****
	(0.131)	*(0.009)*	*(0.009)*	*(0.138)*	*(0.053)*	*(0.046)*
Openness	**-0.01**	**0.02****	**0.00**	**-0.02**	**0.01**	**-0.02**
	(0.007)	*(0.009)*	*(0.004)*	*(0.025)*	*(0.017)*	*(0.010)*
RER_misalignment	**0.191**	**0.19*****	**0.19*****	**0.75*****	**0.74*****	**0.75*****
	(0.200)	*(0.011)*	*(0.011)*	*(0.183)*	*(0.048)*	*(0.050)*
Output_gap	**0.58*****	**0.56*****	**0.57*****	**0.12**	**0.12**	**0.12**
	(0.150)	*(0.063)*	*(0.064)*	*(0.147)*	*(0.133)*	*(0.1323)*
(openness * $\varepsilon_{i,t}$)	**0.22**	**0.23*****	**0.22*****	**0.07**	**0.11***	**0.07**
	(0.142)	*(0.016)*	*(0.015)*	*(0.168)*	*(0.060)*	*(0.052)*
(RER_misalignment * $\varepsilon_{i,t}$)	**0.04*****	**0.03*****	**0.03*****	**0.045****	**0.48*****	**0.45*****
	(0.011)	*(0.001)*	*(0.001)*	*(0.178)*	*(0.089)*	*(0.092)*
(output_gap * $\varepsilon_{i,t}$)	**-1.95*****	**-2.11*****	**-1.97*****	**0.53**	**0.36**	**0.53***
	(0.432)	*(0.108)*	*(0.108)*	*(0.533)*	*(0.303)*	*(0.312)*
Non_CEE_common_currency	**-0.01*****	**0.00**	**-0.01*****			
	(0.004)	*(0.008)*	*(0.004)*			
CEE_common_currency	**0.00**	**-0.20*****	**0.00**	**-0.01**	**-0.04***	**-0.01**
	(0.006)	*(0.034)*	*(0.015)*	*(0.010)*	*(0.022)*	*(0.008)*
(non_CEE_common_currency * $\varepsilon_{i,t}$)	**-0.26*****	**-0.24*****	**-0.26*****			
	(0.060)	*(0.028)*	*(0.029)*			
(CEE_common_currency * $\varepsilon_{i,t}$)	**-0.35****	**-0.36****	**-0.37*****	**-0.21****	**-0.23*****	**-0.21*****
	(0.146)	*(0.145)*	*(0.143)*	*(0.075)*	*(0.076)*	*(0.075)*
Number of observations	**8784**	**8784**	**8784**	**537**	**537**	**537**
R^2	**0.86**	**0.86**	**0.86**	**0.96**	**0.96**	**0.96**

Note: All regressions estimate an expanded version of equation (4) in the main text of the paper. Regressions using the OLS estimator report standard errors which are heteroscedasticityconsistent, as well as robust to clustering by country. Standard errors are reported in parentheses. ***, ** and * denote statistical significance at the 1 per cent, 5 per cent, 10 per cent level, respectively. Columns (1)–(3) cover the full sample of 101 countries. Columns (4)–(6) cover a subsample restricted to the 10 countries in Central and Eastern Europe that recently joined the EU (including Bulgaria and Romania).

Table 7

THE IMPACT OF COMMON CURRENCIES ON EXCHANGE RATE PASS-THROUGH: CURRENCY UNIONS VERSUS CURRENCY BOARDS

	(1)	(2)	(3)
Dependent variable	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$
Estimator	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**
Independent variables			
Constant	**0.02**	**0.00**	**0.02*****
	(0.011)	*(0.008)*	*(0.004)*
$\pi_{i,t-4}$	**0.20*****	**0.17*****	**0.20*****
	(0.040)	*(0.005)*	*(0.005)*
$\pi^*_{\iota,\tau}$	**0.72*****	**0.73*****	**0.72*****
	(0.093)	*(0.013)*	*(0.013)*
$\varepsilon_{\iota,\tau}$	**0.53*****	**0.50*****	**0.52*****
	(0.131)	*(0.009)*	*(0.009)*
Openness	**-0.01**	**0.02*****	**-0.01**
	(0.007)	*(0.009)*	*(0.004)*
RER_misalignment	**0.19**	**0.19*****	**0.19*****
	(0.199)	*(0.011)*	*(0.011)*
Output_gap	**0.58*****	**0.56*****	**0.57*****
	(0.151)	*(0.064)*	*(0.064)*
(openness * $\varepsilon_{\iota,\tau}$**)**	**0.22**	**0.23*****	**0.22*****
	(0.142)	*(0.016)*	*(0.015)*
(RER_misalignment * $\varepsilon_{\iota,\tau}$**)**	**0.04*****	**0.03*****	**0.03*****
	(0.011)	*(0.001)*	*(0.001)*
(output_gap * $\varepsilon_{\iota,\tau\ t}$**)**	**-1.95*****	**-2.10*****	**-1.98*****
	(0.430)	*(0.108)*	*(0.108)*
Common_currency	**-0.02*****	**0.00**	**-0.02*****
	(0.005)	*(0.008)*	*(0.005)*
(common_currency * $\varepsilon_{\iota,\tau}$**)**	**-0.01**	**-0.10*****	**-0.01**
	(0.004)	*(0.023)*	*(0.006)*
(common_union * $\varepsilon_{\iota,\tau}$**)**	**-0.24*****	**-0.22*****	**-0.24*****
	(0.070)	*(0.037)*	*(0.037)*
(common_board * $\varepsilon_{\iota,\tau}$**)**	**-0.30*****	**-0.26*****	**-0.29*****
	(0.066)	*(0.042)*	*(0.042)*
Number of observations	**8784**	**8784**	**8784**
R^2	**0.86**	**0.86**	**0.86**

Note: All regressions estimate an expanded version of equation (4) in the main text of the paper. Regressions using the OLS estimator report standard errors which are heteroscedasticityconsistent, as well as robust to clustering by country. Standard errors are reported in parentheses. ***, ** and * denote statistical significance at the 1 per cent, 5 per cent, 10 per cent level, respectively. All columns in the table cover the full sample of 101 countries.

Table 8

THE IMPACT OF COMMON CURRENCIES ON EXCHANGE RATE PASS-THROUGH ON DIFFERENT CONTINENTS

	(1)	(2)	(3)
Dependent variable	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$
Estimator	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**
Independent variables			
Constant	**0.02**	**0.00**	**0.02*** **
	(0.011)	*(0.008)*	*(0.003)*
$\pi_{i,t-4}$	**0.20*** **	**0.18*** **	**0.20*** **
	(0.040)	*(0.005)*	*(0.005)*
$\pi^*_{\iota,\tau}$	**0.72*** **	**0.73*** **	**0.73*** **
	(0.093)	*(0.013)*	*(0.013)*
$\varepsilon_{\iota,\tau}$	**0.53*** **	**0.50*** **	**0.52*** **
	(0.131)	*(0.009)*	*(0.009)*
Openness	**-0.01**	**0.02*** **	**-0.01** **
	(0.007)	*(0.009)*	*(0.004)*
RER_misalignment	**0.19**	**0.19*** **	**0.19*** **
	(0.199)	*(0.011)*	*(0.011)*
Output_gap	**0.58*** **	**0.56*** **	**0.58*** **
	(0.152)	*(0.064)*	*(0.064)*
(openness * $\varepsilon_{\iota,\tau}$)	**0.22**	**0.23*** **	**0.22*** **
	(0.142)	*(0.016)*	*(0.015)*
(RER_misalignment * $\varepsilon_{\iota,\tau}$)	**0.04*** **	**0.03*** **	**0.03*** **
	(0.011)	*(0.001)*	*(0.001)*
(output_gap * $\varepsilon_{\iota,\tau\ t}$)	**-1.95*** **	**-2.08*** **	**-1.98*** **
	(0.429)	*(0.108)*	*(0.108)*
Common_currency_Africa	**-0.03*** **	**-0.04**	**-0.03*** **
	(0.005)	*(0.036)*	*(0.007)*
Common_currency_Western_Hemisphere	**-0.01***	**-0.01**	**-0.01**
	(0.004)	*(0.027)*	*(0.007)*
Common_currency_Europe	**0.00**	**-0.02***	**0.00**
	(0.005)	*(0.09)*	*(0.007)*
Common_currency_Africa * $\varepsilon_{\iota,\tau}$)	**-0.23*** **	**-0.22*** **	**-0.23*** **
	(0.069)	*(0.038)*	*(0.037)*
(common_Western_Hemisphere * $\varepsilon_{\iota,\tau}$)	**-0.26*** **	**-0.23*** **	**-0.26*** **
	(0.060)	*(0.045)*	*(0.045)*
(common_currency_Europe * $\varepsilon_{\iota,\tau}$)	**-0.44*** **	**-0.36*** **	**-0.43*** **
	(0.115)	*(0.128)*	*(0.116)*
Number of observations	**8784**	**8784**	**8784**
R^2	**0.86**	**0.86**	**0.86**

Note: All regressions estimate an expanded version of equation (4) in the main text of the paper. Regressions using the OLS estimator report standard errors which are heteroscedasticityconsistent, as well as robust to clustering by country. Standard errors are reported in parentheses. ***, ** and * denote statistical significance at the 1 per cent, 5 per cent, 10 per cent level, respectively. All columns in the table cover the full sample of 101 countries.

Table 9

A RANKING OF THE 101 COUNTRIES IN THE DATASET BY GDP PER CAPITA (PPP, 2005)

Country	GDP per capita	Country	GDP per capita
LUXEMBOURG	**$55,600**	**BULGARIA**	**$9,600**
EQUATORIAL GUINEA	**$50,200**	URUGUAY	$9,600
NORWAY	$42,300	**ST. KITTS AND NEVIS**	**$8,800**
UNITED STATES	$41,800	BRAZIL	$8,400
IRELAND	**$41,000**	IRAN	$8,300
ICELAND	$35,600	THAILAND	$8,300
DENMARK	$34,600	TUNISIA	$8,300
CANADA	$34,000	ROMANIA	$8,200
HONG KONG	**$32,900**	TURKEY	$8,200
AUSTRIA	**$32,700**	COLOMBIA	$7,900
SWITZERLAND	$32,300	MACEDONIA	$7,800
AUSTRALIA	$31,900	UKRAINE	$7,200
JAPAN	$31,500	DOMINICAN REPUBLIC	$7,000
BELGIUM	**$31,400**	**BELIZE**	**$6,800**
FINLAND	**$30,900**	CHINA	$6,800
NETHERLANDS	**$30,500**	**GABON**	**$6,800**
GERMANY	**$30,400**	VENEZUELA	$6,100
UNITED KINGDOM	$30,300	FIJI	$6,000
FRANCE	**$29,900**	SAMOA	$5,600
SWEDEN	$29,800	**DOMINICA**	**$5,500**
ITALY	**$29,200**	**ST. LUCIA**	**$5,400**
SPAIN	**$25,500**	PHILIPPINES	$5,100
NEW ZEALAND	$25,200	**GRENADA**	**$5,000**
ISRAEL	$24,600	PARAGUAY	$4,900
BAHRAIN	$23,000	GUYANA	$4,600
GREECE	**$22,200**	ARMENIA	$4,500
SLOVENIA	$21,600	**ECUADOR**	**$4,300**
CYPRUS	$21,500	MOROCCO	$4,200
KOREA	$20,400	INDONESIA	$3,600
BAHAMAS	$20,200	INDIA	$3,300
MALTA	$19,900	BOLIVIA	$2,900
CZECH REPUBLIC	**$19,500**	NICARAGUA	$2,900
PORTUGAL	**$19,300**	**ST. VINCENT & THE GRENADINES**	**$2,900**
ESTONIA	**$16,700**	PAPUA NEW GUINEA	$2,600
TRINIDAD AND TOBAGO	$16,700	GHANA	$2,500
HUNGARY	$16,300	**LESOTHO**	**$2,500**
SLOVAKIA	**$16,100**	**CAMEROON**	**$2,400**
LITHUANIA	**$13,700**	PAKISTAN	$2,400
POLAND	$13,300	GAMBIA	$1,900
LATVIA	$13,200	MOLDOVA	$1,800
ARGENTINA	**$13,100**	UGANDA	$1,800
SAUDI ARABIA	$12,800	SOLOMON ISLANDS	$1,700
MALAYSIA	$12,100	**TOGO**	**$1,700**
SOUTH AFRICA	$12,000	**COTE D'IVOIRE**	**$1,600**
CROATIA	$11,600	NIGERIA	$1,400
CHILE	$11,300	**CENTRAL AFRICAN REPUBLIC**	**$1,100**
COSTA RICA	$11,100	ZAMBIA	$900
RUSSIA	$11,100	SIERRA LEONE	$800
ANTIGUA & BARBUDA	**$11,000**	BURUNDI	$700
MEXICO	$10,000	DEMOCRATIC REPUBLIC OF CONGO	$700
		MALAWI	$600

Note: Highlighted countries participated in a common currency at some point in or after 1976.
Sources: CIA's The World Factbook.

Table 10

THE IMPACT OF COMMON CURREN CIES ON EXCHANGE RATE PASS-THROUGH: HIGH-INCOME VS. LOW INCOME COUNTRIES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$
Estimator / **Independent variables**	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**
Constant	**0.02**	**0.00**	**0.02*****	**0.01**	**0.01**	**0.01*****	**0.02**	**0.00**	**0.02*****
	(0.011)	*(0.008)*	*(0.003)*	*(0.005)*	*(0.004)*	*(0.002)*	*(0.021)*	*(0.017)*	*(0.007)*
$\pi_{i,t-4}$	**0.20*****	**0.18*****	**0.20*****	**0.17****	**0.15*****	**0.17*****	**0.21*****	**0.18*****	**0.21*****
	(0.040)	*(0.005)*	*(0.005)*	*(0.071)*	*(0.006)*	*(0.005)*	*(0.041)*	*(0.007)*	*(0.007)*
$\pi^*_{i,t}$	**0.72*****	**0.73*****	**0.73*****	**0.82*****	**0.82*****	**0.82*****	**0.72*****	**0.74*****	**0.72*****
	(0.093)	*(0.013)*	*(0.013)*	*(0.148)*	*(0.010)*	*(0.010)*	*(0.099)*	*(0.022)*	*(0.020)*
$\varepsilon_{\iota,\tau}$	**0.53*****	**0.50*****	**0.52*****	**0.65*****	**0.61*****	**0.65*****	**0.49*****	**0.48*****	**0.49*****
	(0.131)	*(0.009)*	*(0.009)*	*(0.094)*	*(0.014)*	*(0.013)*	*(0.154)*	*(0.015)*	*(0.014)*
Openness	**-0.01**	**0.02****	**-0.01**	**0.00**	**0.00**	**0.00****	**-0.01**	**0.05****	**-0.01**
	0.007)	*(0.009)*	*(0.004)*	*(0.002)*	*(0.005)*	*(0.002)*	*(0.017)*	*(0.021)*	*(0.008)*
RER_misalignment	**0.19**	**0.19*****	**0.19*****	**0.60*****	**0.61*****	**0.60*****	**0.13**	**0.13*****	**0.13*****
	(0.199)	*(0.011)*	*(0.011)*	*(0.075)*	*(0.015)*	*(0.015)*	*(0.212)*	*(0.016)*	*(0.01*
Output_gap	**0.57*****	**0.55*****	**0.57*****	**0.49*****	**0.49*****	**0.49*****	**0.60*****	**0.57*****	**0.60*****
	(0.150)	*(0.064)*	*(0.064)*	*(0.098)*	*(0.044)*	*(0.045)*	*(0.217)*	*(0.107)*	*(0.108)*

(continued)

(continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(openness * $\varepsilon_{\iota,\tau}$)	**0.21**	**0.23*****	**0.22*****	**0.11**	**0.15*****	**0.11*****	**0.30**	**0.28*****	**0.30*****
	(0.143)	(0.016)	(0.015)	(0.102)	(0.016)	(0.015)	(0.208)	(0.028)	(0.027)
(RER_misalignment * $\varepsilon_{\iota,\tau}$)	**0.04*****	**0.03*****	**0.03*****	**0.51****	**0.49*****	**0.51*****	**0.04*****	**0.03*****	**0.04*****
	(0.011)	*(0.001)*	*(0.001)*	*(0.194)*	*(0.042)*	*0.042)*	*(0.012)*	*(0.002)*	*(0.002)*
(output_gap * $\varepsilon_{\iota,\tau}$)	**-1.95*****	**-2.10*****	**-1.98*****	**-0.15**	**-0.60*****	**-0.15**	**-2.16*****	**-2.24*****	**-2.16*****
	(0.432)	*(0.108)*	*(0.108)*	*(0.668)*	*(0.198)*	*(0.196)*	*(0.473)*	*(0.153)*	*(0.154)*
Common_currency_Rich	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**			
	(0.005)	(0.009)	(0.006)	(0.004)	(0.004)	(0.003)			
Common_currency_Poor	**-0.02*****	**-0.08*****	**-0.02*****				**-0.02*****	**-0.07*****	**-0.02*****
	(0.005)	(0.009)	(0.006)				(0.006)	(0.027)	(0.007)
(common_currency_Rich * ?i,t)	**-0.35*****	**-0.31*****	**-0.34*****	**-0.19****	**-0.15*****	**-0.19*****			
	(0.005)	(0.020)	(0.005)	(0.006)	(0.027)	(0.007)			
(common_currency_Poor * ?i,t)	**-0.23*****	**-0.22*****	**-0.23*****				**-0.27*****	**-0.25*****	**-0.27*****
	(0.067)	(0.034)	(0.034)				(0.090)	(0.047)	(0.047)
Number of observations	**8784**	**8784**	**8784**	**4494**	**4494**	**4494**	**4290**	**4290**	**4290**
R2	**0.86**	**0.86**	**0.86**	**0.90**	**0.90**	**0.90**	**0.86**	**0.85**	**0.86**

Note: All regressions estimate an expanded version of equation (4) in the main text of the paper. Regressions using the OLS estimator report standard errors which are heteroscedasticity-consistent, as well as robust to clustering by country. Standard errors are reported in parentheses. ***, ** and * denote statistical significance at the 1 per cent, 5 per cent, 10 per cent level, respectively. Columns (1)–(3) cover the full sample of 101 countries. Columns (4)–(6) cover a subsample restricted to 50 relatively high-income countries. Columns (7)–(9) cover a subsample restricted to 51 relatively low-income countries.

Table 11

THE IMPACT OF COMMON CURRENCIES ON EXCHANGE RATE PASS-THROUGH: DECADE BY DECADE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$	$\pi_{i,t}$
Estimator **Independent variables**	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**	**OLS**	**Fixed effects (within)**	**Random effects (GLS)**
Constant	**0.01** *(0.011)*	**0.00** *(0.008)*	**0.02***** *(0.003)*	**-0.03** *(0.028)*	**0.02** *(0.023)*	**-0.02** *(0.012)*	**0.01** *(0.018)*	**-0.05** *(0.035)*	**0.01** *(0.009)*	**0.01** *(0.006)*	**0.01** *(0.011)*	**0.01**** *(0.003)*
$\pi_{i,t-4}$	**0.20***** *(0.040)*	**0.17***** *(0.005)*	**0.19***** *(0.005)*	**0.48***** *(0.061)*	**0.45***** *(0.021)*	**0.45***** *(0.021)*	**0.18***** *(0.040)*	**0.10***** *(0.009)*	**0.16***** *(0.007)*	**0.21***** *(0.052)*	**0.17***** *(0.008)*	**0.21***** *(0.007)*
$\pi^{*}_{i,t}$	**0.73***** *(0.095)*	**0.74***** *(0.014)*	**0.73***** *(0.013)*	**0.71***** *(0.138)*	**0.71***** *(0.025)*	**0.71***** *(0.024)*	**0.75***** *(0.097)*	**0.70***** *(0.027)*	**0.77***** *(0.022)*	**0.72***** *(0.138)*	**0.70***** *(0.034)*	**0.72***** *(0.031)*
$\varepsilon_{i,t}$	**0.53***** *(0.131)*	**0.51***** *(0.009)*	**0.53***** *(0.009)*	**0.64***** *(0.147)*	**0.61***** *(0.023)-*	**0.61***** *(0.022)*	**0.52***** *(0.146)*	**0.45***** *(0.015)*	**0.49***** *(0.014)*	**0.64***** *(0.114)*	**0.61***** *(0.020)*	**0.64***** *(0.019)*
Openness	**0.00** *(0.007)*	**0.02**** *(0.009)*	**0.00** *(0.004)*	**0.01** *(0.013)*	**-0.06*** *(0.029)*	**0.00** *(0.013)*	**0.00** *(0.014)*	**0.11***** *(0.032)*	**0.00** *(0.010)*	**0.00** *(0.004)*	**0.00** *(0.013)*	**0.00** *(0.003)*
RER_misalignment	**0.19** *(0.199)*	**0.19***** *(0.011)*	**0.19***** *(0.011)*	**0.64***** *(0.056)*	**0.65***** *(0.028)*	**0.64***** *(0.026)*	**0.02** *(0.196)*	**0.06***** *(0.017)*	**0.04**** *(0.017)*	**0.59***** *(0.077)*	**0.58***** *(0.019)*	**0.59***** *(0.018)*
Output_gap	**0.57***** *(0.151)*	**0.55***** *(0.064)*	**0.57***** *(0.064)*	**0.29** *(0.241)*	**0.25***** *(0.085)*	**0.25***** *(0.084)*	**0.69**** *(0.268)*	**0.81***** *(0.144)*	**0.66***** *(0.142)*	**0.48***** *(0.155)*	**0.43***** *(0.065)*	**0.48***** *(0.064)*

(continued)

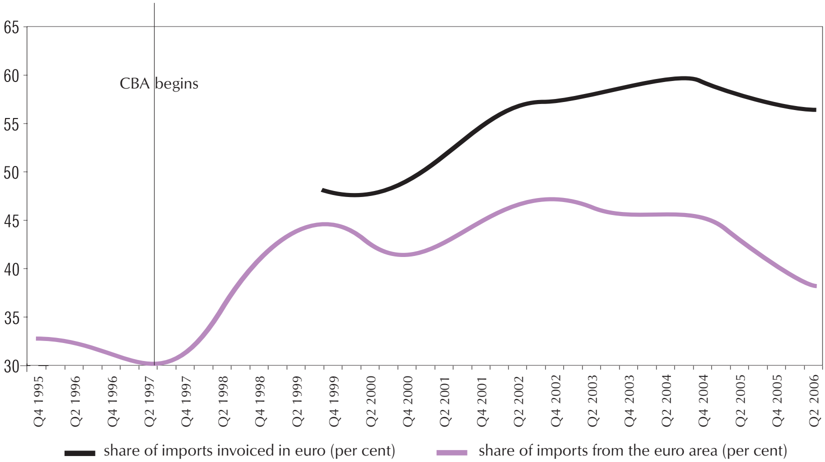
(continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(openness* $\varepsilon_{i,t}$)	**0.21**	**0.23*** **	**0.22*** **	**0.05**	**0.13*** **	**0.13*** **	**0.27**	**0.32*** **	**0.29*** **	**0.05**	**0.07*** **	**0.05** **
	(0.144)	*(0.016)*	*(0.015)*	*(0.137)*	*(0.042)*	*(0.039)*	*(0.199)*	*(0.029)*	*(0.027)*	*(0.185)*	*(0.025)*	*(0.024)*
(RER_misalignment* $\varepsilon_{i,t}$)	**0.04*** **	**0.03*** **	**0.03*** **	**0.06**	**0.06*** **	**0.06*** **	**0.04*** **	**0.03*** **	**0.04*** **	**0.06**	**0.05*** **	**0.06*** **
	(0.011)	*(0.001)*	*(0.001)*	*(0.116)*	*(0.023)*	*(0.023)*	*(0.015)*	*(0.002)*	*(0.002)*	*(0.052)*	*(0.019)*	*(0.019)*
(output_gap* $\varepsilon_{i,t}$)	**-1.97*** **	**-2.11*** **	**-2.00*** **	**-0.62**	**-0.98*** **	**-0.95*** **	**-2.66*** **	**-3.09*** **	**-2.74*** **	**1.11**	**1.08*** **	**1.11*** **
	(0.429)	*(0.108)*	*(0.108)*	*1.521)*	*(0.316)*	*(0.313)*	*(0.407)*	*(0.157)*	*(0.158)*	*1.730)*	*(0.213)*	*(0.210)*
Common_currency_7685	**0.00**	**0.00**	**0.00**	**-0.01**	**0.01**	**0.00**						
	(0.008)	*(0.012)*	*(0.008)*	*(0.008)*	*(0.021)*	*(0.014)*						
Common_currency_8695	**-0.03*** **	**-0.03** **	**-0.03*** **				**-0.03*** **	**-0.01**	**-0.04*** **			
	(0.006)	*(0.011)*	*(0.007)*				*(0.007)*	*(0.143)*	*(0.013)*			
Common_currency_9606	**-0.01** **	**-0.01***	**-0.01***							**0.00**	**0.00**	**0.00**
	(0.004)	*(0.008)*	*(0.005)*							*0.004*	*0.006*	*0.003*
(common_currency_7685* $\varepsilon_{i,t}$)	**-0.11**	**-0.09***	**-0.11***	**-0.09**	**-0.13*** **	**-0.14*** **						
	(0.096)	*(0.056)*	*(0.056)*	*(0.109)*	*(0.051)*	*(0.050)*						
(common_currency_8695* $\varepsilon_{i,t}$)	**-0.30*** **	**-0.28*** **	**-0.30*** **				**-0.38*** **	**-0.31*** **	**-0.36*** **			
	(0.064)	*(0.040)*	*(0.040)*				*(0.087)*	*(0.051)*	*(0.051)*			
(common_currency_9606* $\varepsilon_{i,t}$)	**-0.36*** **	**-0.31*** **	**-0.35*** **							**0.26*** **	**-0.23*** **	**-0.26*** **
	(0.066)	*(0.054)*	*(0.053)*							*(0.073)*	*(0.032)*	*(0.031)*
Number of observations	**8784**	**8784**	**8784**	**1890**	**1890**	**1890**	**3139**	**3139**	**3139**	**3755**	**3755**	**3755**
R2	**0.86**	**0.86**	**0.86**	**0.88**	**0.88**	**0.88**	**0.89**	**0.87**	**0.89**	**0.82**	**0.82**	**0.82**

Note: All regressions estimate an expanded version of equation (4) in the main text of the paper. Regressions using the OLS estimator report standard errors which are heteroscedasticity-consistent, as well as robust to clustering by country. Standard errors are reported in parentheses. ***, ** and * denote statistical significance at the 1 per cent, 5 per cent, 10 per cent level, respectively. Columns (1)–(3) cover the full sample of 101 countries. Columns (4)–(6) cover a subsample restricted to the period 1976–1985. Columns (7)–(9) cover a subsample restricted to the period 1986-1995. Columns (10)–(12) cover a subsample restricted to the period 1996–2005.

Figure 1

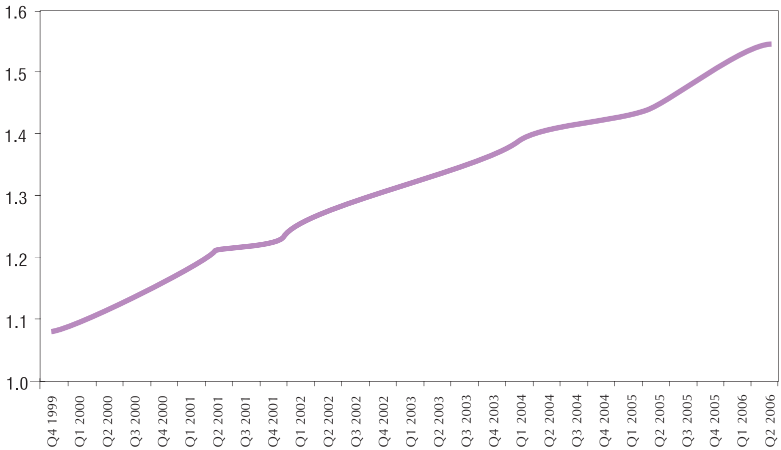
SHARE OF IMPORTS INVOICED IN EURO AND SHARE OF IMPORTS FROM THE EURO AREA FOR BULGARIA, (PER CENT OF TOTAL IMPORTS, Q4:1995–Q2:2006, 4-QUARTER MOVING AVERAGE)



Source: Bulgarian National Bank, through www.bnbg.bg.

Figure 2

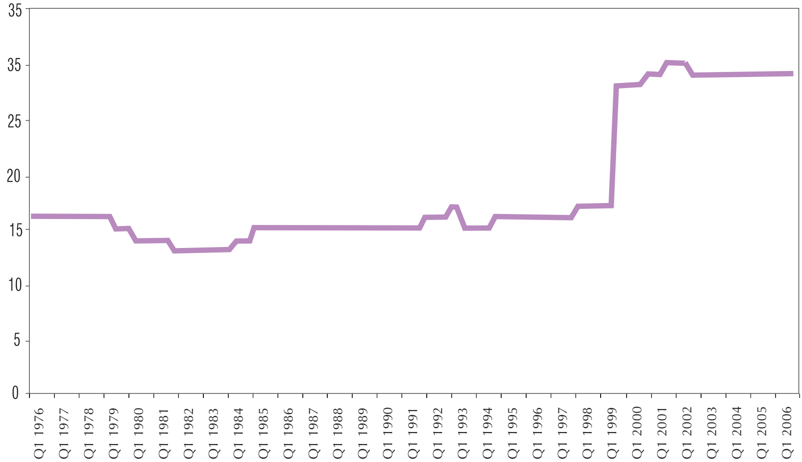
RATIO OF BULGARIAN IMPORTS INVOICED IN EURO TO BULGARIAN IMPORTS FROM THE EURO AREA FOR BULGARIA, (PER CENT OF TOTAL IMPORTS, Q4:1999–Q2:2006, 4-QUARTER MOVING AVERAGE)



Source: Bulgarian National Bank, throught www.bnbg.bg.

Figure 3

TOTAL NUMBER OF COUNTRIES PARTICIPATING IN A COMMON CURRENCY AREA (Q1:1976–Q1:2006)



LIST OF THE 101 COUNTRIES INCLUDED IN THE DATASET

1. ANTIGUA AND BARBUDA
2. ARGENTINA
3. ARMENIA
4. AUSTRALIA
5. AUSTRIA
6. BAHAMAS
7. BAHRAIN
8. BELGIUM
9. BELIZE
10. BOLIVIA
11. BRAZIL
12. BULGARIA
13. BURUNDI
14. CAMEROON
15. CANADA
16. CENTRAL AFRICAN REPUBLIC
17. CHILE
18. CHINA
19. COLOMBIA
20. DEMOCRATIC REPUBLIC OF CONGO
21. COSTA RICA
22. COTE D'IVOIRE
23. CROATIA
24. CYPRUS
25. CZECH REPUBLIC
26. DENMARK
27. DOMINICA
28. DOMINICAN REPUBLIC
29. ECUADOR
30. EQUATORIAL GUINEA
31. ESTONIA
32. FIJI
33. FINLAND
34. FRANCE
35. GABON
36. GAMBIA
37. GERMANY
38. GHANA
39. GREECE
40. GRENADA
41. GUYANA
42. HONG KONG
43. HUNGARY
44. ICELAND
45. INDIA
46. INDONESIA
47. IRAN
48. IRELAND
49. ISRAEL
50. ITALY
51. JAPAN
52. KOREA
53. LATVIA
54. LESOTHO
55. LITHUANIA
56. LUXEMBOURG
57. MACEDONIA
58. MALAWI
59. MALAYSIA
60. MALTA
61. MEXICO
62. MOLDOVA
63. MOROCCO
64. NETHERLANDS
65. NEW ZEALAND
66. NICARAGUA
67. NIGERIA
68. NORWAY
69. PAKISTAN
70. PAPUA NEW GUINEA
71. PARAGUAY
72. PHILIPPINES
73. POLAND
74. PORTUGAL
75. ROMANIA
76. RUSSIA
77. SAMOA
78. SAUDI ARABIA
79. SIERRA LEONE
80. SLOVAKIA
81. SLOVENIA
82. SOLOMON ISLANDS
83. SOUTH AFRICA
84. SPAIN
85. ST. KITTS AND NEVIS
86. ST. LUCIA
87. ST. VINCENT AND THE GRENADINES
88. SWEDEN
89. SWITZERLAND
90. THAILAND
91. TOGO
92. TRINIDAD AND TOBAGO
93. TUNISIA
94. TURKEY
95. UGANDA
96. UKRAINE
97. UNITED KINGDOM
98. UNITED STATES
99. URUGUAY
100. VENEZUELA
101. ZAMBIA

Appendix table A1

PANEL UNIT ROOT TESTS FOR $\pi_{i,t}$

Test	Exogenous variables	Lags	Cross-sections	Observations	Test statistic	*p*-value
Levin, Lin, and Chu (LLC) H_0: Unit root (common unit root process)	None	0 to 12	101	9974	-16.63	0.000
	constants	0 to 12	101	10002	0.25	0.600
	constants and time trends	0 to 11	101	9999	4.97	1.000
Breitung (B) H_0: Unit root (common unit root process)	none	0 to 12	101	9760	-9.00	0.000
	constants	0 to 12	101	9901	-4.65	0.000
	constants and time trends	0 to 11	101	9898	-3.63	0.000
Im, Pesaran, and Shin (IPS) H_0: Unit root (individual unit root processes)	none	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
	constants	0 to 12	101	10002	-12.75	0.000
	constants and time trends	0 to 11	101	9999	-12.43	0.000
Augmented Dickey – Fuller (ADF) – Fisher H_0: Unit root (individual unit root processes)	none	0 to 12	101	9974	993.60	0.000
	constants	0 to 12	101	10002	625.32	0.000
	constants and time trends	0 to 11	101	9999	576.86	0.000
Phillips-Perron (PP) – Fisher H_0: Unit root (individual unit root processes)	none	0 to 12	101	10455	1216.19	0.000
	constants	0 to 12	101	10455	660.63	0.000
	constants and time trends	0 to 11	101	10455	522.63	0.000
Hadri (H) H_0: No unit root (common unit root process)	none	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
	constants	0 to 12	101	10567	16.73	0.000
	constants and time trends	0 to 11	101	10567	23.05	0.000

Note: Samples run from Q1:1975 to Q1:2006. Selection of the optimal number of lags is based on the Schwarz Information Criterion (SIC). Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix table A2

PANEL UNIT ROOT TESTS FOR $\pi^*_{i,t}$

Test	Exogenous variables	Lags	Cross-sections	Observations	Test statistic	*p*-value
Levin, Lin, and Chu (LLC)	none	0 to 12	101	8862	-19.14	0.000
H_0: Unit root (common unit root process)	constants	0 to 12	101	8875	-12.17	0.000
	constants and time trends	0 to 12	101	8896	-9.62	0.000
Breitung (B)	none	0 to 12	101	8586	-12.93	0.000
H_0: Unit root (common unit root process)	constants	0 to 12	101	8774	-0.91	0.182
	constants and time trends	0 to 12	101	8795	0.62	0.731
Im, Pesaran, and Shin (IPS)	none	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
H_0: Unit root (individual unit root processes)	constants	0 to 12	101	8875	-17.25	0.000
	constants and time trends	0 to 12	101	8896	-16.74	0.000
Augmented Dickey – Fuller (ADF) – Fisher	none	0 to 12	101	8862	1384.18	0.000
H_0: Unit root (individual unit root processes)	constants	0 to 12	101	8875	721.50	0.000
	constants and time trends	0 to 12	101	8896	905.30	0.000
Phillips-Perron (PP) – Fisher	none	0 to 12	101	9329	1525.04	0.000
H_0: Unit root (individual unit root processes)	constants	0 to 12	101	9329	845.21	0.000
	constants and time trends	0 to 12	101	9329	1177.49	0.000
Hadri (H)	none	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
H_0: No unit root (common unit root process)	constants	0 to 12	101	9441	25.74	0.000
	constants and time trends	0 to 12	101	9441	14.46	0.000

Note: Samples run from Q1:1975 to Q1:2006. Selection of the optimal number of lags is based on the Schwarz Information Criterion (SIC). Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix table A3

PANEL UNIT ROOT TESTS FOR $\varepsilon_{\iota,\tau}$

Test	Exogenous variables	Lags	Cross-sections	Observations	Test statistic	*p*-value
Levin, Lin, and Chu (LLC)	none	0 to 12	101	10282	-28.05	0.000
H_0: Unit root (common unit root process)	constants	0 to 12	101	10276	-8.49	0.000
	constants and time trends	0 to 12	101	10248	-1.51	0.066
Breitung (B)	none	0 to 12	101	10181	-21.05	0.000
H_0: Unit root (common unit root process)	constants	0 to 12	101	10175	-8.83	0.000
	constants and time trends	0 to 12	101	10147	-9.19	0.000
Im, Pesaran, and Shin (IPS)	none	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
H_0: Unit root (individual unit root processes)	constants	0 to 12	101	10276	-19.41	0.000
	constants and time trends	0 to 12	101	10248	-14.26	0.000
Augmented Dickey – Fuller (ADF) – Fisher	none	0 to 12	101	10282	1267.56	0.000
H_0: Unit root (individual unit root processes)	constants	0 to 12	101	10276	840.02	0.000
	constants and time trends	0 to 12	101	10248	568.73	0.000
Phillips-Perron (PP) – Fisher	none	0 to 12	101	10821	1532.65	0.000
H_0: Unit root (individual unit root processes)	constants	0 to 12	101	10821	862.28	0.000
	constants and time trends	0 to 12	101	10821	583.21	0.000
Hadri (H)	none	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
H0: No unit root (common unit root process)	constants	0 to 12	101	10922	10.81	0.000
	constants and time trends	0 to 12	101	10922	16.84	0.000

Note: Samples run from Q1:1975 to Q1:2006. Selection of the optimal number of lags is based on the Schwarz Information Criterion (SIC). Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix table A4

PANEL UNIT ROOT TESTS FOR *OPENNESS*

Test	Exogenous variables	Lags	Cross-sections	Observations	Test statistic	*p*-value
Levin, Lin, and Chu (LLC)	none	1 to 9	101	10341	2.84	0.998
H_0: Unit root (common unit root process)	constants	1 to 9	101	10349	-0.61	0.271
	constants and time trends	1 to 9	101	10361	-2.57	0.005
Breitung (B)	none	1 to 9	101	10240	-3.18	0.001
H_0: Unit root (common unit root process)	constants	1 to 9	101	10248	-6.10	0.000
	constants and time trends	1 to 9	101	10260	0.68	0.752
Im, Pesaran, and Shin (IPS)	none	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
H_0: Unit root (individual unit root processes)	constants	1 to 9	101	10349	-2.99	0.001
	constants and time trends	1 to 9	101	10361	-7.28	0.000
Augmented Dickey – Fuller (ADF) – Fisher	none	1 to 9	101	10341	86.43	1.000
H_0: Unit root (individual unit root processes)	constants	1 to 9	101	10349	295.69	0.000
	constants and time trends	1 to 9	101	10361	361.76	0.000
Phillips-Perron (PP) – Fisher	none	1 to 9	101	10764	91.55	1.000
H_0: Unit root (individual unit root processes)	constants	1 to 9	101	10764	184.66	0.804
	constants and time trends	1 to 9	101	10764	182.79	0.830
Hadri (H)	none	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
H_0: No unit root (common unit root process)	constants	1 to 9	101	10867	49.10	0.000
	constants and time trends	1 to 9	101	10867	24.78	0.000

Note: Samples run from Q1:1975 to Q1:2006. Selection of the optimal number of lags is based on the Schwarz Information Criterion (SIC). Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix table A5

PANEL UNIT ROOT TESTS FOR *RER_MISALIGNMENT*

Test	Exogenous variables	Lags	Cross-sections	Observations	Test statistic	*p*-value
Levin, Lin, and Chu (LLC)	none	0 to 8	101	10194	-41.80	0.000
H_0: Unit root (common unit root process)	constants	0 to 8	101	10194	-14.79	0.000
	constants and time trends	0 to 10	101	10185	-11.86	0.000
Breitung (B)	none	0 to 8	101	10093	-36.98	0.000
H_0: Unit root (common unit root process)	constants	0 to 8	101	10093	-21.76	0.000
	constants and time trends	0 to 10	101	10084	-20.73	0.000
Im, Pesaran, and Shin (IPS)	none	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
H_0: Unit root (individual unit root processes)	constants	0 to 8	101	10194	-32.66	0.000
	constants and time trends	0 to 10	101	10185	-27.56	0.000
Augmented Dickey– Fuller (ADF) – Fisher	none	0 to 8	101	10194	2241.98	0.000
H_0: Unit root (individual unit root processes)	constants	0 to 8	101	10194	1517.35	0.000
	constants and time trends	0 to 10	101	10185	1146.93	0.000
Phillips-Perron (PP) – Fisher	none	0 to 8	101	10293	1959.26	0.000
H_0: Unit root (individual unit root processes)	constants	0 to 8	101	10293	1307.87	0.000
	constants and time trends	0 to 10	101	10293	953.42	0.000
Hadri (H)	none	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
H_0: No unit root (common unit root process)	constants	0 to 8	101	10394	-8.85	1.000
	constants and time trends	0 to 10	101	10394	-7.51	1.000

Note: Samples run from Q1:1975 to Q1:2006. Selection of the optimal number of lags is based on the Schwarz Information Criterion (SIC). Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix table A6

PANEL UNIT ROOT TESTS FOR *OUTPUT_GAP*

Test	Exogenous variables	Lags	Cross-sections	Observations	Test statistic	*p*-value
Levin, Lin, and Chu (LLC)	none	1 to 9	101	11197	-43.71	0.000
H_0: Unit root (common unit root process)	constants	1 to 9	101	11197	-13.34	0.000
	constants and time trends	1 to 9	101	11197	-10.99	0.000
Breitung (B)	none	1 to 9	101	11096	-39.80	0.000
H_0: Unit root (common unit root process)	constants	1 to 9	101	11096	-24.35	0.000
	constants and time trends	1 to 9	101	11096	-22.81	0.000
Im, Pesaran, and Shin (IPS)	none	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
H_0: Unit root (individual unit root processes)	constants	1 to 9	101	11197	-34.36	0.000
	constants and time trends	1 to 9	101	11197	-29.64	0.000
Augmented Dickey – Fuller (ADF) – Fisher	none	1 to 9	101	11197	2357.81	0.000
H_0: Unit root (individual unit root processes)	constants	1 to 9	101	11197	1636.52	0.000
	constants and time trends	1 to 9	101	11197	1246.94	0.000
Phillips-Perron (PP) – Fisher	none	1 to 9	101	11462	1360.06	0.000
H_0: Unit root (individual unit root processes)	constants	1 to 9	101	11462	817.16	0.000
	constants and time trends	1 to 9	101	11462	529.49	0.000
Hadri (H)	none	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
H_0: No unit root (common unit root process)	constants	1 to 9	101	11563	-8.09	1.000
	constants and time trends	1 to 9	101	11563	4.81	1.000

Note: Samples run from Q1:1975 to Q1:2006. Selection of the optimal number of lags is based on the Schwarz Information Criterion (SIC). Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

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