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The Effect of Exchange Rate Regimes on Business Cycle Synchronization: A Robust Analysis

Jia Hou* and Jakub Knaze†

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Abstract

In contrast to the widely recognized importance of exchange rate regimes, evidence on their effect on business cycle synchronization focuses almost exclusively on the role of currency unions, thus implicitly ignoring potential effect of other exchange rate regimes. In this paper we use a new dataset on *bilateral de-facto* exchange rate regimes for the period 1973-2016 to study the effect of seven types of regimes on business cycle synchronization. Using the Extreme Bound Analysis (EBA) methodology, we find that the exchange rate regime is a robust determinant of business cycle synchronization. Compared to country pairs with freely floating arrangements, we find that: (i) the correlation coefficient measuring business cycle synchronization is higher by around 0.12 points in countries with no separate legal tenders; (ii) other hard pegs such as currency board arrangements and de-facto pegs have also significantly more synchronised business cycles, but the size of the correlation coefficient is halved compared to countries with no separate legal tenders; (iii) the effect is not always linearly decreasing with the increasing exchange rate regime flexibility, since crawling pegs and crawling bands turn out to be insignificant, whereas the effect of moving bands as a more flexible type of exchange rate regimes is positive and significant; (iv) the effect is stronger for countries with high degree of financial openness and good institutional quality.

Keywords: Exchange rate regimes · Currency unions · Business cycles synchronization
JEL codes: E32, E52, F33, F42

1 Introduction

Exchange rate regimes have been shown to significantly affect international trade, foreign direct investment, economic growth and other macroeconomic variables.[1] Although many studies have also investigated the effect of *currency unions* on business cycles synchronization, the empirical evidence on the potential effect of remaining exchange rate regimes remains scarce. In this paper we argue that the seemingly exaggerated focus on currency unions arises due to the difficulty with proper identification of *bilateral* exchange rate regimes other than currency unions. The traditional unilateral exchange rate regimes classifications are suitable to analyse unilateral

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[1]See for example Klein and Shambaugh (2006) for the effect of exchange rate regimes on international trade, Harms and Knaze (2018) for the effect on FDI or Ghosh et al. (2014) for the effect on inflation. Further, exchange rate regimes have been found to significantly affect GDP growth (Levy-Yeyati and Sturzenegger, 2003), terms of trade (Broda, 2004) or other policy variables (e.g. Obstfeld et al., 2005, on monetary policy).

outcome variables, but they are not suitable for bilateral outcome variables such as business cycles synchronization.

In this paper we use the new dataset on *bilateral de-facto* exchange rate regimes constructed by Harms and Knaze (2018), which allows us to analyse the effect of exchange rate regimes on business cycle synchronization over the past 44 years. Thus, we investigate the effect *various* exchange rate regimes - rather than just currency unions - have on business cycle synchronization. Various theoretical models indicate different channels through which the exchange rate regimes might matter for business cycle synchronization. The models' predictions on the direction of the effect usually depend on the interaction of exchange rate regimes with other policy variables. For example, one implication from the classical Mundell-Flemming model (Fleming, 1962; Mundell, 1963) is that exchange rate regimes strengthen or neutralise the effects of monetary and fiscal policies aimed at income and employment stabilisation. The overall strength of the effect, and how this effect is transmitted across countries, depends on which type of the underlying shocks is more pronounced.

There are also potential indirect channels through other variables by which exchange rate regimes can affect business cycle synchronization. For example, less flexible regimes are expected to foster a higher degree of financial integration (McKinnon, 2004) or more trade between countries (Klein and Shambaugh, 2006). Through these indirect channels, exchange rate regimes are expected to influence the degree of synchronization between countries. To analyse the effect of the exchange rate regimes seems thus of high policy relevance. If the exchange rate regimes insulate or amplify effects of various policy tools, one must be careful when analysing the effects of various policy variables.

The main contribution of this paper is to provide empirical evidence on the effect of exchange rate regimes on business cycle synchronization. We follow Inklaar et al. (2008) and conduct the Extreme Bound Analysis (EBA) as proposed by Leamer (1983) and modified by Sala-I-Martin (1997) as our main empirical strategy. The method allows us to address potential bias caused by omitted variables. The basic idea of EBA is to run a set of multiple regressions at once. Among this set of regressions, all possible combinations of potential determinants for a given outcome variable are tested to find EBA-robust determinants of the dependent variable. We collect data on 38 different variables as potential determinants of business cycle synchronization as mentioned by previous literature. We run several thousand regressions with all possible combinations of all 38 variables to obtain the "robust" determinants of business cycle synchronization.

In further analysis, we employ OLS by including all EBA-robust variables. To ensure that our empirical evidence is not sensitive to biases caused by measurement errors or empirical specifications, we run several robustness tests. For example, our investigation uses 5 distinctive correlation periods, with the exchange rate regime measured both at the beginning and middle of each respective period to make sure that the results are not driven by changes in the exchange rate regimes *within* periods. Importantly, our results remain robust to the use of both *de-facto* and *de-jure* regime classifications.

Also, country and country-time fixed effects are used to control for any unobserved heterogeneity. Given that the exchange rate regimes change only slowly, Klein and Shambaugh (2010) argue that using country or country-pair fixed effects seems to address adequately concerns with endogeneity. Importantly, we address the potential reverse causality problem concerning the choice of exchange rate regimes on business cycle synchronization by including only country pairs that are linked indirectly through a common anchor currency. These tests should account for the fact that countries might decide on adoption of the exchange rate regime based on high degree of trade intensity, financial integration or observed business cycle co-movement.

Our empirical investigation provides evidence that less flexible regimes are associated with more synchronised business cycles, but the magnitude of the coefficients varies depending on

the individual regime type. More specifically, country pairs with no separate legal tenders are associated with a correlation coefficient of business cycle synchronization higher by around 0.12 points, compared to country pairs with freely floating regimes. Thus, no separate legal tenders are indeed significantly, positively related to business cycle correlation when considered in isolation. This effect is stronger for participants of a currency union, as compared to the case when a foreign currency circulates as the sole legal tender. We also find strong positive effects for other regimes with low exchange rate flexibility, such as currency board arrangements and de-facto pegs. When moving to the more flexible regimes, we find that the effect for country pairs with soft pegs is more heterogeneous. Comparing to the most flexible (freely floating) regimes, crawling pegs and crawling bands turn out to be insignificant. However, moving bands are found to be positive and significant, although they are more flexible than crawling bands. Overall, our results imply that there is no regime having *less* synchronised business cycles than the country pairs with freely floating regimes.

The rest of the paper is structured as follows: Section 2 briefly reviews the previous empirical findings and summarizes relevant theories on the role of exchange rate regimes for business cycle synchronization. Section 3 describes the data and outlines our empirical methodology. Section 4 reports the benchmark results on the effect of bilateral exchange rate regimes on business cycle synchronization. Section 5 investigates the robustness of the results and section 6 concludes.

2 Literature review

Our study is nested in the literature of determinants of business cycle synchronization and it is closest to the study of Inklaar et al. (2008), which investigates an exhaustive set of possible determinants of business cycle synchronization among 21 OECD countries for the period 1970-2003. The relevant determinants of business cycle synchronization such as trade intensity, trade specialisation or similarity in financial infrastructure were identified in earlier studies by Baxter and Kouparitsas (2005), Imbs (2004) and Kalemli-Ozcan et al. (2001).

2.1 Empirical evidence

2.1.1 Relevant determinants of business cycle synchronization

While individual studies focus on many different determinants of business cycle synchronization, there is a range of commonly recognised factors that are found to affect the comovement. Among them, bilateral trade and trade structure have been identified as a key determinant in most empirical studies. As documented by Anderson et al. (1999) and Calderon et al. (2007), country pairs with more intense trade relationships have more synchronised business cycles. As the latter study shows, the impact of trade *intensity* on business cycle synchronization is smaller for developing countries than for developed countries. To further disentangle the effect of trade on business cycle comovement, studies of Kalemli-Ozcan et al. (2001), Burstein et al. (2008) and Arkolakis and Ramanarayanan (2009) address the role of trade *specialisation*. The strength of the effect depends also on the type of international trade linkages used in production (Di Giovanni and Levchenko, 2010).

Other determinants of business cycle synchronization that were frequently examined by the literature include the degree of financial integration (e.g. Kalemli-Ozcan et al., 2013) and transmission of monetary policy shocks (see e.g. Ehrmann and Fratzscher, 2009; Rey, 2016). Whereas the studies mentioned investigate the effect of individual factors, Imbs (2004) provide one of the earliest studies to consider possible determinants of business cycle synchronization simultaneously in the context of a system of simultaneous equations. The subsequent studies

of Baxter and Kouparitsas (2005) and Inklaar et al. (2008) use the approach of Leamer (1983) to find "robust" variables explaining the comovement. These studies consider in particular trade intensity, specialisation, financial, fiscal and monetary policy integration as common determinants of business cycle synchronization.

2.1.2 The role of exchange rate regimes as a determinant of business cycle synchronization

There is a large number of studies investigating the effect of currency unions – in particular of the European Monetary Union (EMU) – on business cycle synchronization. The number of studies is large enough such that Campos et al. (2018) performed a meta-analysis. The authors analyse 63 studies on business cycle correlations between European countries. synchronization was found to increase from about 0.4 to 0.6 following introduction of the Euro. To our knowledge, nobody has yet extended this analysis to the role of other exchange rate regimes.

Even if the role of exchange rate regimes was not investigated as determinant of synchronization, regimes were found to affect many other variables (such as international trade). If these variables make business cycles more synchronised, we could observe an indirect channel of exchange rate regimes on business cycles. There are many studies on the consequences of an exchange rate regimes choice. Fixing an exchange rate was found to promote international trade as shown by Klein and Shambaugh (2006) or Dorn and Egger (2015). Broda (2004) shows how the real shocks (measured by changes in terms-of-trade) affect the changes in real GDP. He finds that the real shocks are significantly smoother in floats than in pegs. Further studies show the relevance of exchange rate regimes on other common determinants: Taylor (2001) and Obstfeld et al. (2005) on monetary policy; Chang and Velasco (2000) on interaction between regimes, banking system and financial stability. Other studies also consider the effect exchange rate regimes have on economic growth, inflation and fiscal policy (e.g. Levy-Yeyati and Sturzenegger, 2003).

2.2 Related theoretical frameworks

There is no theory that incorporates exchange rate regimes *directly* as a driver of business cycle synchronization. Nevertheless, already the Mundell-Fleming model shows how monetary and fiscal policies affect the real economy under fixed versus floating exchange rate regimes (Fleming, 1962; Mundell, 1963). One implication of the Mundell-Fleming framework is that, given free capital movement, the monetary policy of an economy that fixes its exchange rate regime should be more convergent with monetary policy in the anchor country. As monetary integration has been empirically found by earlier studies to increase business cycle synchronization, we can also expect the latter to be higher under fixed exchange rate regime. The Mundell-Fleming framework thus gives us one possible channel for the exchange rate regimes to affect business cycle synchronization. Nevertheless, other defining features of exchange rate regimes such as behaviour of foreign exchange reserves or official announcements can also play a role.

Another strand of the theoretical literature related to our topic focuses on the other determinants of international business cycles. For example, Canova and Dellas (1993) provides a general equilibrium model that analyses the contribution of trade interdependence to international business cycles. Further theoretical studies on relevant determinants of comovement include Kehoe and Perri (2002) on frictions in international finance, Cravino and Levchenko (2017) on the role of multinational firms or De Grauwe and Ji (2017) on the role of internationally correlated behavioural changes. We find the macroeconomic model developed by De Grauwe and Ji (2017) to be the most relevant for our investigation. Their model studies the transmission of shocks across countries under two cases, monetary union and monetary independence. This framework indicates that more fixed exchange rate regimes are associated

with more synchronised business cycles. Although the authors analyse only these two extreme cases, they inspire us to empirically investigate different types of exchange rate regimes using a finer classification.

The theory also suggests that exchange rate regimes have a potential to weaken or strengthen the effects of other economic variables. We expect that the strength of this effect crucially depends on the degree of financial openness. For example, Mundell (1973) assumes perfect capital mobility. This can be interpreted in light of a well-known "impossible trinity" argument, which states that an economy cannot adopt *monetary independence*, *fixed exchange rate regime* and *free capital mobility* at the same time. One implication is that if we have free movement of capital, the monetary policy of an economy in fixed exchange rate regime should be more convergent with policy of an anchor country. For example, Obstfeld et al. (2005) argue that monetary policy for countries with fixed exchange rate regimes is more constrained if there are no *capital controls* in place. Rey (2016) argues that floating regimes are not the only necessary condition that guarantees monetary autonomy under large *capital flows*. The strength of the potential exchange rate regime effect thus depends crucially on the level of countries' financial openness. One can on average expect the effect of regimes to be larger if capital can move freely across countries.

3 Data and Methodology

3.1 Data on dependent variable

Our dependent variable of business cycle synchronization is a correlation coefficient of the business cycle component of GDP growth data. We use either yearly or quarterly GDP growth data for the period 1973-2016. The yearly data is retrieved from the World Bank and the quarterly data is taken from the OECD and International Financial Statistics of the IMF. We use the Baxter-King filter to identify the business cycle components. We use the default filtering option which passes through the components with fluctuations between 2 and 8 years for yearly data. The thresholds for quarterly data are 6 and 32 quarters, respectively. We use both yearly and quarterly data since both have their own advantages: with yearly data we have a large country coverage. Quarterly data are more often used in practice for detrending (Christiano and Fitzgerald, 2003), but such data are available mainly for the limited group of OECD countries.

We compute the correlation of the business cycle components over 5 distinctive time intervals: 1973-1983, 1982-1992, 1991-2000, 1999-2008 and 2007-2016. We include 2 years overlap between two neighbouring intervals as a natural split in the data for two reasons. First, the fourth interval starting in the year 1999 is intentionally chosen such that it reflects a substantial change in the regimes structure brought by the introduction of the Euro. The fourth interval until the year 2008 was also not affected by the global financial crisis and subsequent worldwide declines in real GDP growth rates in the year 2009. Second, we need a sufficiently large time span to obtain a reliable measure of correlation coefficient for each country-pair. Intervals with the duration of at least 10 years seem to be sufficiently large to achieve this goal.

Table 1 presents the summary statistics of our dependent variables for each interval. The sample of *yearly* data covers countries across the whole world with observations number ranging from 12,432 in the first periods to over 31,000 in the last two periods as new countries became independent and data for more countries became available. The mean correlation coefficient for the business cycle synchronization was close to zero in the first three intervals but it increased to almost 0.3 in the last two intervals. The sample of *quarterly* data contains substantially less country-pairs observations since the quarterly data are reported mainly for developed countries.

Table 1: Summary statistics for the business cycle synchronization variable

	(1)	(2)	(3)	(4)	(5)
Interval	1973-1983	1982-1992	1991-2000	1999-2008	2007-2016
Yearly Data					
Mean	.072	.034	.054	.284	.287
Standard Deviation	.373	.357	.372	.380	.449
Observations	12,432	18,632	26,732	31,506	31,152
Quarterly Data					
Mean	.357	.261	.208	.678	.648
Standard Deviation	.295	.341	.429	.186	.242
Observations	600	600	992	2,550	2,756

Note: Business cycle synchronization is measured by the correlation of the business cycle components of the real GDP growth rates.

The mean correlation coefficient for the quarterly data ranges from around 0.2 to 0.7. It is not surprising that the quarterly data show higher business cycle synchronization since the developed countries included in the quarterly sample are likely to be more closely integrated compared to the worldwide average.

Inklaar et al. (2008) argue that there is a possible problem with using the original correlation data, because the error terms in a regression model are unlikely to be normally distributed. Therefore, we follow the authors by transforming our measure of business cycle synchronization by constructing the Fisher's Z-transformation as $C'_t = \frac{1}{2}ln(\frac{1+C_t}{1-C_t})$, with C_t being an original correlation coefficient computed over each time interval t. Figure 1 displays the original and transformed correlations of the business cycle synchronization coefficients. We can see from the left panels in blue that both yearly and quarterly data are far from being normally distributed. In particular, the distribution for *quarterly* data correlations is strongly skewed due to the large degree of integration in those countries covered by the quarterly data. The transformed coefficients ensure that the distribution for both yearly and quarterly data is normally distributed.

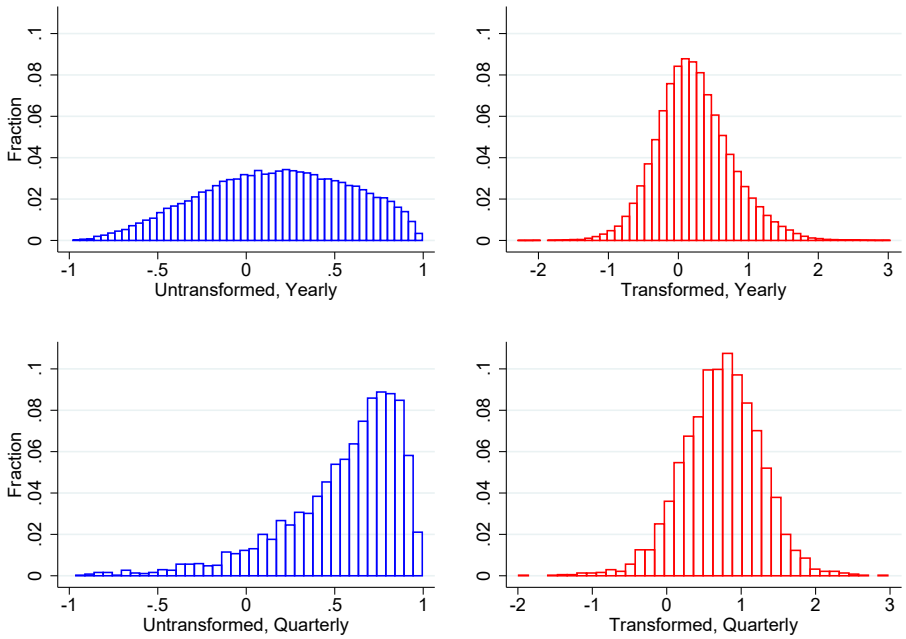
3.2 Data on bilateral exchange rate regimes and other variables

Our key independent variable is the bilateral de-facto exchange rate regime. Data we use is taken from the new dataset provided by Harms and Knaze (2018)[2]. The main feature of the dataset is that the data is at country-pair – bilateral – level for the cross-section dimension, which is transformed from unilateral exchange rate regimes data, with the unilateral exchange rate regimes data retrieved from Ilzetzki et al. (2017). The classification of the bilateral *de-facto* exchange rate regimes is shown in Table A1 in Appendix A, with exchange rate regimes ranging from least flexible (no separate legal tender including currency union) to freely floating. We follow Harms and Knaze (2018) by defining exchange rate regime as integers ranging from 1 (least flexible) to 13 (freely floating). Unless otherwise specified, we pool them to a coarser set of 7 dummy variables denoted $Regime_k$ with k ranging from 1 (least flexible) to 7 (freely floating).[3]

[2]The dataset with further description is available at: `https://www.international.economics.uni-mainz.de/data-on-bilateral-exchange-rate-regimes/`

[3]In some part of the analysis, we also test the specification by including the $Regime_{FF}$ dummy that takes a value of one if at least one country from a given country pair had a freely falling exchange rate regime at a given period.

Figure 1: Distribution of *untransformed* and *transformed* coefficients of business cycle synchronization



Note: The transformed correlation is based on the Fisher's z-transformation function: $C' = \frac{1}{2}ln(\frac{1+C}{1-C})$. *The distribution is drawn from observations for the five intervals 1973-1983, 1982-1992, 1991-2000, 1999-2008 and 2007-2016.*

Another feature of the data relevant for our analysis is that we can differentiate whether the bilateral regime between a country pair is direct or indirect. For example, Ecuador has a no separate legal tender against US dollar, thus U.S. and Ecuador are directly linked. Another direct US pegger (Hong Kong) is therefore indirectly pegged to Ecuador. Note that this can act as an important instrument to address the endogeneity concern of exchange rate regimes. It is plausible to assume that the decision of the Ecuador to peg to the U.S. dollar is independent of the decision of Hong Kong to peg to the U.S. dollar. We can then expect that an indirect peg of Honk Kong against Ecuador is less likely to be endogenous. We will use this information in robustness tests in Section 5.3.[4]

Data on bilateral exchange rate regimes is constructed at yearly intervals. Figure 2 shows the number of year-to-year changes in exchange rate regimes. It provides information on the variance of our key independent variable. We can see that there have been more changes in bilateral exchange rate regimes before 1990 and the time around 1999, when the EMU was formed. The upper part of Figure 2 also plots the 5 intervals over which we compute the business cycle synchronization. We use data of exchange rate regimes at the beginning (BOP) or in the middle (MOP) of each time period. For example, for the first interval 1973-1983, we test the results using the exchange rate regimes in the year 1973 (BOP) and year 1978 (MOP). Our analysis requires that exchange rate regime coefficients are properly measured and the consideration of both BOP and MOP ensures that the results are not driven by *within-period* variation. Given the low variability in exchange rate regimes over time, consistent results between the BOP and MOP measures should be enough to ensure that the exchange rate regime in a given interval is properly measured.[5]

[4]Figure A2 in Appendix A displays the distribution of de-facto regimes split by direct and indirect links.

[5]Another approach would be to use an average value of the exchange rate regime measure for each period. However, taking averages would leave us with non-integer values. For example, if a country had a crawling peg

Figure 2: A number of year-to-year changes in the exchange rate regimes

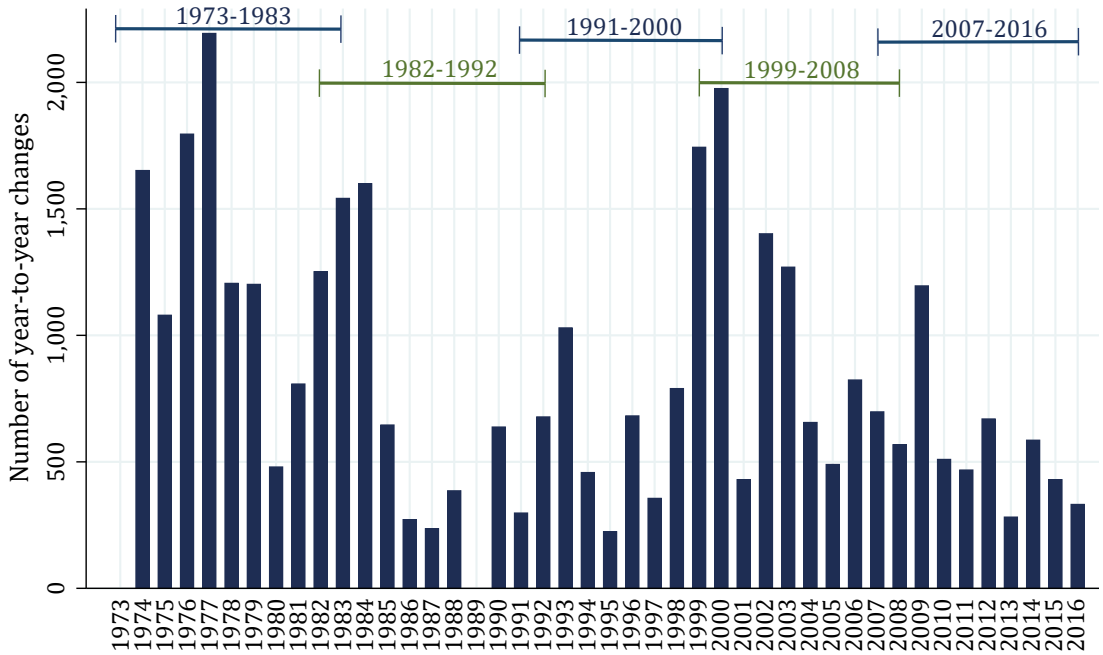
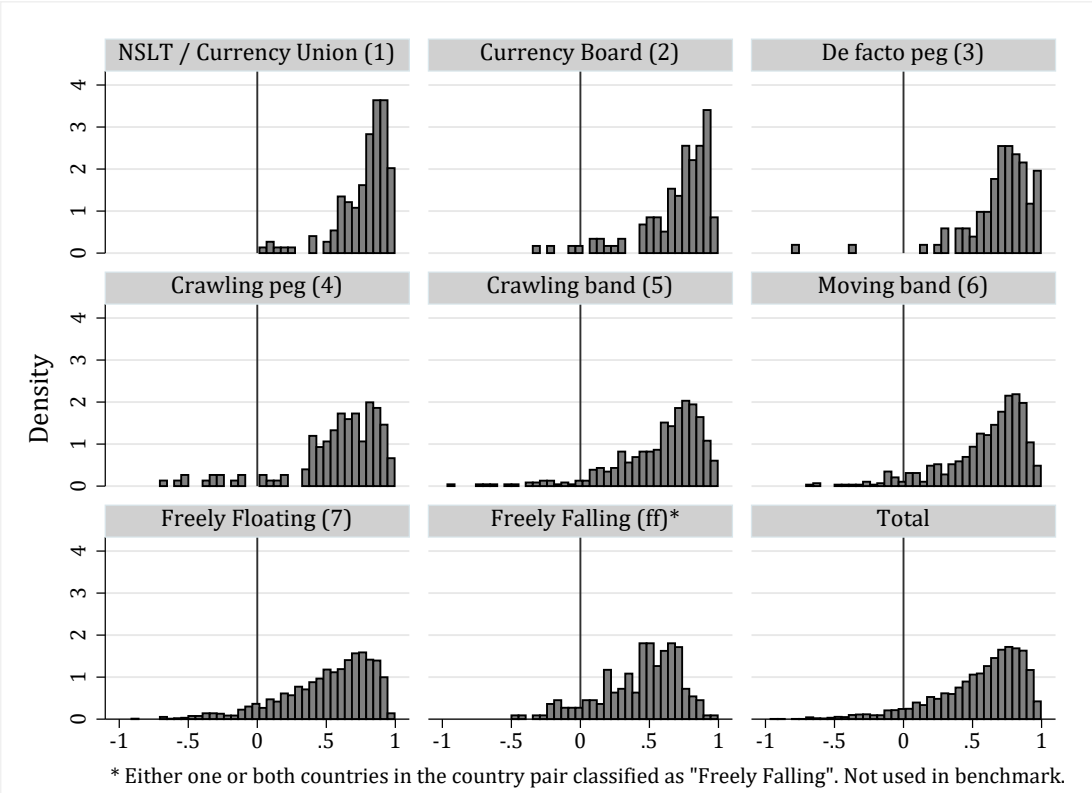


Figure 3: Density of the *quarterly* business cycle correlations split by the exchange rate regime dummies



Note that Harms and Knaze (2018) provide *de-facto* exchange rate regimes data based on the dataset of Ilzetzki et al. (2017) as well as *de-jure* data based on the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). Unlike Harms and Knaze (2018), our paper focuses on the *de-facto* data as we are mainly interested in the role of actually implemented exchange rate regimes. The *de-facto* regimes data also has a longer time span starting in 1973, thus having much larger sample size than the *de-jure* data that starts in 2000. However, we use *de-jure* data for one robustness check.

Figure 3 motivates our empirical investigation: here we plot a density of the business cycle correlation coefficients for quarterly data across different exchange rate regimes. Compared to the overall density (box in the lower right corner), we can observe that countries with less flexible regimes (the three boxes in the first row of Figure 3) seem to have more synchronized business cycles than the other regimes. We shall of course be aware of the omitted variable bias between those two variables as countries with less flexible exchange rate regimes are likely to have other common characteristics.[6]

Regarding other potential determinants of business cycle synchronization, we collect an extensive set of all variables mentioned in the previous literature, following mainly Inklaar et al. (2008) and Baxter and Kouparitsas (2005). In particular, we focus on nine groups of determinants: (1) monetary integration; (2) trade intensity; (3) specialization; (4) similarity in governments' net lending / net borrowing; (5) financial integration; (6) financial infrastructure; (7) inflation; (8) gravity variables of distance, dummy for a common colonial history and dummies for a common border, language and religion; (9) other variables such as difference in saving rate and physical capital. The complete data description including data sources and indicators is reported in Table A4 in Appendix A.

3.3 Empirical specification

Our empirical strategy consists of two steps. The first step is to perform Extreme Bound Analysis (EBA) to identify robust determinants from a set of potential determinants of business cycle synchronization. EBA is a methodology based on Leamer (1985) which tests how a dependent variable, in our case business cycle synchronization, is associated with a variety of possible determinants of the synchronization. We use a more flexible version of the EBA introduced by Sala-I-Martin (1997), where we look at an entire distribution of regression coefficients in line with Inklaar et al. (2008).

For each variable of interest, the EBA consists of running n separate regression equations specified as:

$$Y'_{n,ijt} \equiv \underbrace{\frac{1}{2} ln \left(\frac{1 + Y_{n,ijt}}{1 - Y_{n,ijt}} \right)}_{\text{Fisher's } z\text{-transformation}} = \alpha_n + \underbrace{\beta_n I_{n,ijt}}_{\text{Interest}} + \underbrace{\boldsymbol{\delta}_n \boldsymbol{D_{n,ijt}}}_{\text{Potential}} + \boldsymbol{\gamma}_n \boldsymbol{Z_{n,ijt}} + \epsilon_{n,ijt}, \tag{1}$$

where Y'_{ijt} are the transformed yearly (quarterly) business cycle correlations between countries i and j over interval t. Note that the t notation indicates the intervals, which have 5 potential values. For each given t, the dependent variable is a correlation coefficient computed over 10 or 11 years. For simplicity, we omit the notation of ijt in the following description of the equation. I denotes the variable of interest that is being assessed by the EBA and it is therefore always included. Note that $I \in \boldsymbol{X}$, where $\boldsymbol{X}$ is a vector of 38 *potentially* robust bilateral variables between countries. Among variables of interest, our main focus is given on the exchange rate regime variable. $\boldsymbol{D}_n$ consists of unique combinations of up to 3 variables from the set of $\boldsymbol{X}$

(Regime 4) and later on adopted a crawling band (Regime 5).

[6]Please see Figure A3 in Appendix A for business cycle synchronization measured by yearly data.

(excluding I), which differs in each of the n separate regression models. Lastly, $\boldsymbol{Z}$ denotes variables always included in each regression model n. Our vector $\boldsymbol{Z}$ uses a full set of country i and j fixed effects to control for any unobservable country characteristics. A variable is considered to be EBA robust if at least 95 percent of its beta coefficients have the same sign.[7] In addition, at least 90 percent of all beta coefficients must be statistically significant at the 5 percent significance level.

Having determined the EBA robust variables of business cycle synchronization, we use the robust variables in a reduced form equation specified as:

$$Y'_{ijt} = \alpha_0 + \boldsymbol{\beta X_{ijt,robust}} + \alpha_i + \alpha_j + \varepsilon_{ij} \tag{2}$$

where X_{robust} denotes a vector of bilateral variables that are found to be EBA robust determinants of business cycle synchronization. α_i (α_j) denotes source (host) country fixed effects.[8] Standard errors are clustered at country-pair level.

The main challenge of the estimation strategy is the potential endogeneity of business cycles and exchange rate regimes. As indicated among others by Frankel and Rose (1998) following the theory of optimal currency area (OCA) by Mundell (1961), more synchronized business cycles increase the likelihood of two countries adopting the same currency. This is a common issue in most studies on currency unions. However, we argue that it should be of a lesser concern to us because we use not yearly regimes observations but only regimes at selected periods and look at resulting correlation of business cycles. We still account for the endogeneity issue in different ways. For example, we exclude country-pair observations containing countries whose currencies are being frequently adopted as an anchor such as the U.S. or Germany, since the decision on the exchange rate regime involving those countries is more likely to be endogenous, as suggested by Barro and Tenreyro (2007).

4 Empirical Results

4.1 The extreme bound analysis (EBA)

The following section reports the results from estimating equation 1 using the EBA methodology and reports the robust variables. We focus on reporting the EBA results for the exchange rate regimes.[9] In a first step, we construct a flexibility measure using an index ranging from 1 (least flexible regime) to 13 (freely floating) as specified in Table A1. As Harms and Knaze (2018) have shown, it is likely that the regimes effect is non-linear. To take this into account, in a second step we map the measure of 13 regimes into a set of 7 coarser dummy variables. Our variable of interest I becomes a set of six coarser regime dummies, ranging from 1 (no separate legal tender) to 6 (managed floating) as reported in the last column of Table A1. The dummy characterizing bilateral free floats (Regime 7) is excluded, such that the 6 dummies reflect the differential impact of each regime on business cycle synchronization, relative to the case of free floats.[10]

[7] Using the normally distributed cumulative distribution function being at right or left side of zero in at least 95 percent of all cases (CDF (0) test statistics > 0.95).

[8] In one of our robustness checks, we will later replace country-specific variables by *time-variant* country fixed effects in line with Harms and Knaze (2018). Note, however, that we do not include country-pair fixed effects since our main variable of interest — the bilateral de-facto exchange rate regime — exhibits little time variation.

[9] The EBA results for other potential determinants of business cycle synchronization can be found in Table A4 in Appendix A.

[10] Unless otherwise indicated, our analysis for the rest of the empirical part will focus on the effect of individual regime dummies.

Table 2: EBA results with selected coefficients for the exchange rate regimes

	Yearly data			Quarterly data		
	Share of signifficant betas		EBA robust?	Share of signifficant betas		EBA robust?
Bilateral de-facto ERR: BOP* (index)	100.0	%<0	✓	100.0	%<0	✓
Bilateral de-facto ERR: MOP* (index)	100.0	%<0	✓	100.0	%<0	✓
Regime 1, BOP* (NSLT / Currency union)	100.0	%>0	✓	100.0	%>0	✓
Regime 2, BOP* (Currency board)	79.7	%>0	✗	96.6	%>0	✓
Regime 3, BOP* (De facto peg)	97.3	%>0	✓	100.0	%>0	✓
Regime 4, BOP* (Crawling peg)	92.0	%>0	✓	78.2	%>0	✗
Regime 5, BOP* (Crawling band)	46.4	%>0	✗	43.2	%<0	✗
Regime 6, BOP* (Moving band)	100.0	%>0	✓	100.0	%>0	✓

*Note: * BOP denotes beginning of period. MOP denotes middle of period. The share of significant betas refers to the share of coefficients of corresponding exchange rate dummies being significant among the 1781 regressions.*

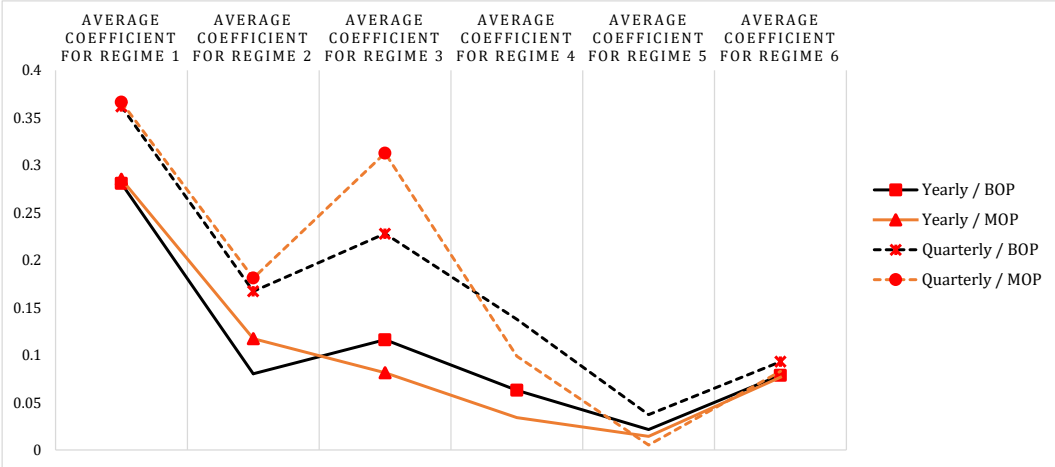
The first two rows in Table 2 report results for the flexibility index. A combination of the exchange rate regimes flexibility index as a variable of interest I with up to three potentially robust variables leads to a total of 1,781 regressions. We find that the regimes coefficient is negative and statistically significant in all 100 percent of cases for both yearly and quarterly GDP data, thus passing the EBA robustness test. The results are identical for both beginning of period (BOP; row 1) and middle of period (MOP; row 2). We conclude that less flexible regimes (having lower value on the index) are on average associated with more synchronised business cycles. The remaining 6 rows of Table 2 show the EBA results when the exchange rate regime dummies are used for each regime type. The large share of positive and significant beta coefficients means that those regimes are found to have significantly more synchronised business cycles than free floats. We find that only regime 1, regime 3 and regime 6 passed the robustness test for both yearly and quarterly data. In addition, we find currency boards (regime 2) to be EBA robust using quarterly data only. For yearly data we find that currency boards have still all betas with positive signs but they are statistically significant only in 1,419 individual regressions (79.7 percent of all regressions we ran).

Figure 4 plots the average size of each beta coefficient of different exchange rate regimes from all 1,781 regressions. We weigh each beta using the adjusted R^2 of each estimation. We perform this step to mitigate the possibility that the size of the average coefficient is driven by a handful of estimations with low explanatory power.[11] We report the yearly and quarterly data using solid and dotted lines, respectively. The red markers denote estimations which passed the EBA robustness test.

We can see that the coefficients for the quarterly data are always higher than for yearly data, but display a similar pattern for individual exchange rate regimes. In particular, regime 1 (no separate legal tender) is associated with the strongest positive effect on business cycle synchronization, with both quarterly and yearly data being EBA robust. We also find regime 3 (hard pegs) to be EBA robust, but the average size of the effect is much higher for quarterly than for yearly data. Regime 6 (managed floating) is also strongly EBA robust but the average size of its coefficient is only about a quarter of the effect of regime 1. Finally, the differences in the use of a regime classification at the beginning (BOP) and middle of period (MOP) are negligible. This is not surprising given the overall low variability in bilateral exchange rate

[11] Nevertheless, we find that this is not the case. The unadjusted average of coefficients shows very similar pattern with slightly more outliers. The results are available upon request.

Figure 4: Average effect of the R^2-weighted exchange rate regime dummy coefficients from 1,781 regressions



Note: Red markers denote the EBA robust coefficients. BOP – Beginning of period; MOP – Middle of period. The coefficients show the differential impact of each individual regime on business cycle synchronization - measured as a correlation - relative to the case of free floats.

regimes over time.

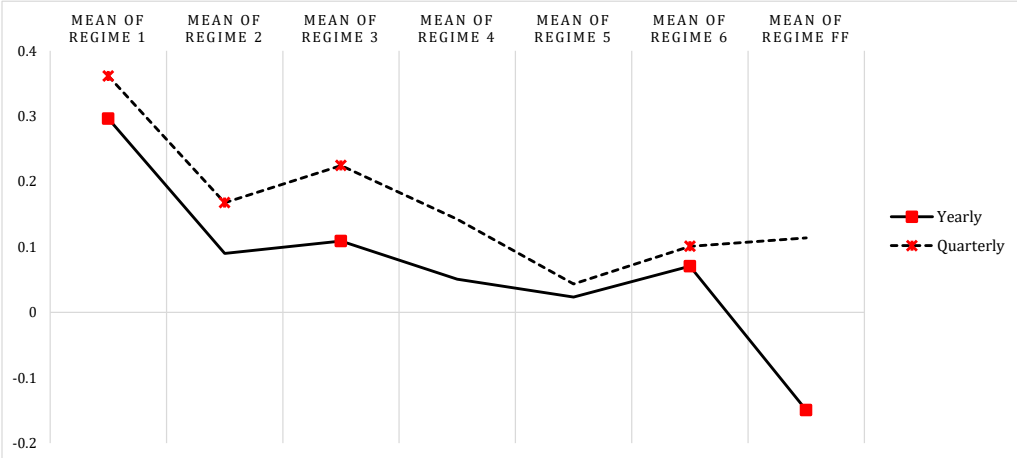
One concern in our estimation is that our results might be driven by countries with currency crises. However, these countries are likely to be already classified as a residual "freely falling" regimes category. The dataset contains a dummy variable $Regime_{FF}$ for freely falling regimes. This takes a value of one for each country pair where *at least one* country was categorized as having a freely falling exchange rate regime by Ilzetzki et al. (2017). We repeat our EBA test using the alternative dummies specification with the $Regime_{FF}$ dummy included. The estimation results are reported in Figure 5.

The results remain similar, with regime 1, regime 3 and regime 6 being most significant. In addition, we find that our dummy variable $Regime_{FF}$ dummy has an EBA robust *negative* coefficient: country pairs where at least one country's regime is classified as freely falling have substantially less synchronised business cycles compared to the country pairs with free floating regimes. This is in line with our intuition: if countries with freely falling exchange rate regime suffer severe financial and economic crisis, then the business cycles get significantly out of synchronization compared to countries that are currently not in crisis. The coefficient for freely falling regimes using quarterly data is not EBA robust, which is not surprising as none but two countries with quarterly GDP data were ever classified as having a freely falling exchange rate regime.[12]

Note that results reported in Figure 5 are estimated with the freely falling regime at the beginning of each correlation interval. However, each of our intervals has a length of at least 10 years. This might be problematic for the interpretation of empirical results if the freely falling regime prevails only for the very short time span. For example, we might misidentify all cases where freely falling regime occurred later than in the first interval. We find that the average duration for countries ever classified as having the "freely falling" regime between years 1973 and 2016 is 7.3 years. This is indeed shorter than the average duration of other exchange rate regimes. Some countries like Turkey, Uruguay, Argentina or Brazil were in this category for

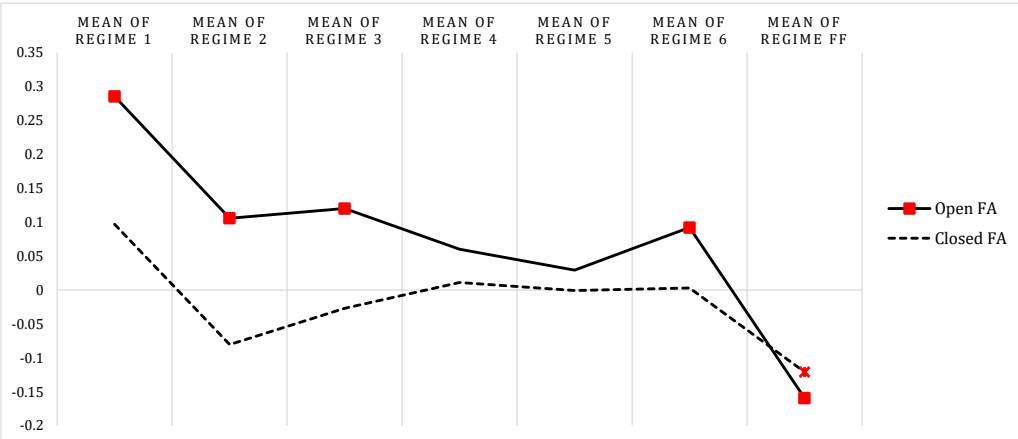
[12]Specifically, for quarterly data we have only 126 country-pair observations with $Regime_{FF}$ dummy being equal to one at the beginning of each period from a full sample of approximately 5000 observations for quarterly data. These observations come from a freely falling regimes being in place in Iceland and Brazil. There are no observations falling into the freely falling category for quarterly data when exchange rate regimes at the middle of period is taken.

Figure 5: Average effect of the R^2-weighted exchange rate regime dummy coefficients from 1,781 regressions: with "Freely Falling Regime (FF)" included



Note: Red markers denote EBA robust coefficients.

Figure 6: Average effect of the R^2-weighted exchange rate regime dummy coefficients from 1,781 regressions: Sample split by the degree of *financial openness*



Note: Red markers denote EBA robust coefficients.

more than 20 years, but most other countries were in this category for significantly shorter time spans. Thus, the "freely falling" regimes coefficients might be biased.

However, this should not affect our results if the exchange rate regime dummies of primary interest (Regimes 1 to 6) remain stable. This is indeed the case as can be seen in Figure 5. This is also the case when we perform further robustness tests by excluding countries that were classified as freely floating during *any* given correlation interval or (even more restrictively) in any year between the 1973 and 2016.[13] Moving on, we treat the "freely falling" regime as a special category used for robustness checks, also because this classification does not fit well into our bilateral structure when only one country within a country pair was classified as a freely falling regime.

Following the discussion on the Mundellian trilemma, we are also concerned about the extent to which regimes interact with countries' levels of financial openness. To account for the importance of capital flows, we do a sample split using a measure of financial openness as in Chinn and Ito (2006). We compute an average of the unilateral measure of financial account openness of each county pair at the beginning of each period. The yearly data for dependent

[13]See Section 5 for extensions and robustness tests.

variable is used.[14] The results reported in Figure 6 show that regimes matter only for country pairs with an open financial account: all regimes except regime 4 and regime 5 are EBA robust. Also, note that the regime 2 (currency boards) that previously failed the EBA robustness test when using the yearly data is now EBA robust as well. We find no robust regimes for countries with a closed financial account.

We proceed with the EBA on all other potential determinants of synchronization. The complete EBA results for all 38 doubtful variables are reported in Table A4 in Appendix A. The robust determinants identified by EBA are very similar to the determinants found by Inklaar et al. (2008). In addition to those determinants found by Inklaar et al. (2008), the correlation of CPI based inflation rates and average trade openness are also robust determinants of synchronization. We take all EBA robust variables and use them in estimating our reduced model as outlined in equation 2.

4.2 Benchmark estimation of the reduced model

Estimation of the reduced model specified in equation 2 is shown in Table 3. Following the EBA exercise, a vector $\boldsymbol{X_{ijt,robust}}$ consists of all EBA robust variables including exchange rate regime dummies. These variables include measures for *trade intensity* (principal component), *trade specialization* (share of intra-industry trade), *fiscal integration*, *inflation correlation* and *average trade openness*. Note that we report the standardized coefficients of non-dummy explanatory variables to make the individual coefficients comparable.[15].

Table 3 shows that all standardized coefficients have the expected sign and are statistically significant. The sample size for yearly data (column 1) is much larger than for quarterly data (column 2), but the size of the standardized coefficients is very similar, further supporting the robustness of our results. The size of the standardized coefficients is also in line with the previous literature. For example, the coefficient for fiscal integration is identical to the findings of Inklaar et al. (2008). The coefficient of *trade intensity* (bilateral trade) is slightly lower (0.02-0.03) compared to Inklaar et al. (2008), which seems to be driven by the fact that we are also including a measure of *aggregate* trade (openness).

Turning to our main coefficients of interest, it can be see in column (1) that coefficients for no separate legal tenders (Regime 1) and de-facto pegs (Regime 3) are positive and strongly statistically significant. As for other soft pegs, only moving bands (Regime 6) are statistically significant. We find that no separate legal tender (Regime 1) has by far the strongest effect on business cycle synchronization compared to the free floating pairs. The size of the effect for regime 3 is only about half as large compared to regime 1. The size of the effect for regime 6 is only about one fourth of the regime 1.

Comparing yearly to quarterly data (column 2), the results turn out to be very consistent. However, the size of the coefficients is always larger when using quarterly data.[16]. Finally, taking the regimes at the middle of the period (see columns 3 and 4) yields very similar results, which is not surprising to us given the low variability in exchange rate regimes over time. Note that currency boards (Regime 2) are significant only for columns (2)-(4) but not for yearly data in column (1). We will show in section 5.2 that the currency boards coefficient is significant only for financially open countries.

We find that the results for exchange rate regimes – especially for hard pegs – are also

[14]The reason is that quarterly data consists of mostly developed countries that all have a relatively high degree of financial openness.

[15]We standardize each variable x_{ijt} by subtracting its mean and dividing by its standard deviation such that $x_{ijt}^{std} = \frac{[x_{ijt} - mean(x_{ijt})]}{sd(x_{ijt})}$. Note that dummies for exchange rate regimes are not standardized.

[16]For completeness, please see Table B2 in Appendix B for the results when observations of "Free Falling" regime is included.

Table 3: Effect of exchange rate regimes on business cycle synchronization: *Benchmark results*

	(1)	(2)	(3)	(4)
	Beginning of period		Middle of period	
	Yearly	Quarterly	Yearly	Quarterly
Bilateral Trade (PCA, standardized)	0.027***	0.018***	0.027***	0.020***
	(6.398)	(5.417)	(6.386)	(6.398)
Specialization (standardized)	0.037***	0.037***	0.035***	0.028***
	(11.375)	(5.833)	(10.836)	(4.283)
Fiscal integration (standardized)	0.060***	0.064***	0.066***	0.083***
	(21.368)	(9.171)	(24.275)	(11.450)
Inflation correlation (standardized)	0.044***	0.036***	0.022***	0.002
	(12.337)	(4.266)	(6.657)	(0.176)
Openness (standardized)	0.348***	0.300***	0.366***	0.427***
	(33.648)	(14.540)	(35.406)	(17.678)
Regime 1 (NSLT / Currency union)	0.114***	0.266***	0.115***	0.194***
	(7.229)	(8.068)	(7.970)	(6.155)
Regime 2 (Currency board)	0.022	0.100**	0.040**	0.077**
	(1.134)	(2.334)	(2.320)	(2.089)
Regime 3 (De facto peg)	0.056***	0.182***	0.045***	0.311***
	(2.888)	(4.451)	(2.929)	(8.542)
Regime 4 (Crawling peg)	0.005	0.001	0.004	0.139***
	(0.405)	(0.021)	(0.359)	(2.998)
Regime 5 (Crawling band)	-0.009	-0.014	-0.025**	-0.028
	(-1.013)	(-0.615)	(-2.511)	(-0.885)
Regime 6 (Moving band)	0.032***	0.029*	0.051***	0.060***
	(3.728)	(1.718)	(5.585)	(2.721)
N	29634	5000	32073	5198
R^2	0.47	0.41	0.44	0.40

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. *Standard errors clustered at country-pair level. Country i and country j fixed effects included but not reported. Business cycle synchronization is a dependent variable.*

economically significant. We see this by re-estimating our benchmark results with the untransformed dependent variable instead of using the Fisher's Z-transformation. This specification is easier for interpretation, since the correlation coefficients after the transformation do not range from -1 to 1. For example, we find that the estimated coefficient of regime 1 (NSLT / Currency union) ranges from 0.07 to 0.12, implying that regime 1 increases business cycle correlation by 0.07-0.12, compared to the free floating regimes. We report the complete results when using the *untransformed* dependent variable in Table B1 in Appendix B.[17]

4.3 Focus on the special case of currency unions

The bilateral dataset defines the "no separate legal tender" (NSLT, Regime 1) category as a) countries where a foreign currency circulates as the sole legal tender (frequently also referred to as "dollarization") and b) countries that belong to a monetary or currency union in which the same legal tender is shared by members of the union (Harms and Knaze, 2018). To facilitate the comparison with numerous studies on the effect of currency unions, we split the NSLT category into country pairs within the EMU and pairs that are NSLT but outside of the EMU. The reason is that EMU can be considered as the only currency union that conducts monetary policy based

[17]We note a difficulty in comparing the strength of the effects *between* individual determinants: the dummy coefficients for exchange rate regimes are non-standardized, whereas the other variables have standardized coefficients. Despite the standardization, bilateral variables constructed as bilateral correlations such as trade specialisation are difficult to compare with aggregate measures such as trade openness. Therefore, our paper focuses on the *relative* importance between *individual* exchange rate regimes for business cycles synchronization.

Table 4: Effect of exchange rate regimes on business cycle synchronization: Split of Regime 1 into *currency unions (EMU)* and *no separate legal tenders*

	(1)	(2)	(3)	(4)
	Beginning of period		Middle of period	
	Yearly	Quarterly	Yearly	Quarterly
Currency union (EMU)	0.313***	0.266***	0.260***	0.194***
	(10.307)	(8.068)	(10.128)	(6.155)
Other no separate legal tender	0.034**		0.040***	
	(2.122)		(2.625)	
Regime 2 (Currency board)	0.022	0.100**	0.040**	0.077**
	(1.104)	(2.334)	(2.349)	(2.089)
Regime 3 (De facto peg)	0.056***	0.182***	0.046***	0.311***
	(2.876)	(4.451)	(2.938)	(8.542)
Regime 4 (Crawling peg)	0.004	0.001	0.003	0.139***
	(0.363)	(0.021)	(0.270)	(2.998)
Regime 5 (Crawling band)	-0.008	-0.014	-0.025**	-0.028
	(-0.917)	(-0.615)	(-2.515)	(-0.885)
Regime 6 (Moving band)	0.034***	0.029*	0.052***	0.060***
	(3.875)	(1.718)	(5.648)	(2.721)
N	29634	5000	32073	5198
R^2	0.47	0.41	0.44	0.40

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. *Standard errors clustered at country-pair level. Country i and country j fixed effects included but not reported. Other explanatory variables from vector* $X_{ijt,robust}$ *included but not reported.*

on criteria for the union as a whole. Other currency unions are only implicitly pegging against other currencies. For example, West African Economic and Monetary Union (WAEMU) or Central African Economic and Monetary Community (CAEMC) are pegged against the Euro (before French Franc) and Eastern Carribean Currency Union is pegged against the US dollar.

Table 4 reports the results when the EMU dummy is separated. We can see that both coefficients remain positive and statistically significant, but the coefficient of currency union (0.313, row 1 in column 1) is much higher than for other "dollarized" (NSLT) countries without Eurozone (0.034, row 2 in column 1). This implies that the Eurozone membership is associated with an increase in business cycle synchronization by almost ten times as much compared to the other NSLT countries. Therefore, the role of a common central bank with a monetary policy conducted across all member states seems to be of a particular importance. Further, we can see from column 2 (quarterly data) that the EMU category is almost identical to the coefficient for regime 1 in Table 3, since all countries with available quarterly data are members of the EMU. This partially explains the difference observed between yearly and quarterly coefficients in the previous table.

5 Extensions and Robustness Tests

5.1 Additional controls for time trend

Our benchmark estimation includes country i and j fixed effects. The use of standard *country-year* fixed effects is not possible as our dependent variable is constructed as a correlation over multiple years. We believe that the time-varying unobserved heterogeneity is not an issue to us since we consider 5 very distinctive intervals over long time spans. Nevertheless, to test this possibility we also include country-time fixed effects to account for unobservable country-time varying heterogeneity.

Table 5: Controlling for the time-varying heterogeneity using *country-time* fixed effects

	(1)	(2)	(3)	(4)
	Beginning of period		Middle of period	
	Yearly	Quarterly	Yearly	Quarterly
Regime 1 (NSLT / Currency union)	0.056***	0.158***	0.074***	0.203***
	(3.587)	(5.261)	(5.171)	(7.537)
Regime 2 (Currency board)	-0.009	0.050	0.020	0.090***
	(-0.500)	(1.541)	(1.225)	(3.236)
Regime 3 (De facto peg)	0.060***	0.233***	0.085***	0.378***
	(3.318)	(5.758)	(5.760)	(10.657)
Regime 4 (Crawling peg)	0.027**	0.152***	0.031***	0.143***
	(2.340)	(3.620)	(2.975)	(3.903)
Regime 5 (Crawling band)	0.046***	0.040*	0.074***	0.080**
	(5.467)	(1.878)	(7.744)	(2.554)
Regime 6 (Moving band)	0.035***	0.040**	0.038***	0.116***
	(4.021)	(2.516)	(4.390)	(5.750)
N	29634	5000	32073	5198
R^2	0.62	0.67	0.61	0.69

*t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. Standard errors clustered at country-pair level. Country **i-time** and country **j-time** fixed effects included but not reported. Other explanatory variables from vector $X_{ijt,robust}$ included but not reported. Business cycle synchronization is the dependent variable.*

Table 5 reports the results. We can see that the coefficients are higher for most regimes than in our benchmark results, except for regime 2. Also, regime 4 and regime 5 now are shown to significantly affect synchronization, which has not been the case before. We note that the size of the coefficients for each regime generally falls as the regimes become more flexible. Our results also remain robust when country i, country j and time t fixed effects are controlled (i.e. no country-time dummies but separate time dummies) and when bilateral gravity variables are added to the specification.[18]

5.2 Accounting for the role of financial openness and institutional quality

Our next robustness check consists of splitting the sample by a degree of financial openness based on Chinn and Ito (2006) and by institutional quality as measured by the World Governance Indicators from the World Bank. The intuition to consider financial openness is that the relationship between regimes and monetary autonomy exists only when there is a free movement of capital. The relationship between regimes and synchronization might be stronger when the financial account is open. Moreover, a more open financial account should allow the exchange rate regime to play a larger role in the real economy. An intuition to consider the institutional quality is that countries with high quality governance are expected to perform better at maintaining exchange rate pegs and abandon them less often, as suggested by Alesina and Wagner (2006). Even if a country is committed to a credible exchange rate regime, poor institutional quality is expected to impose more challenges to implement and maintain its policy targets.

The first two columns of Table 6 confirm the EBA results presented in Figure 6, which show that exchange rate regime is a significant determinant of synchronization only if financial account is relatively open.[19] In contrast to EBA, our reduced model also shows positive

[18]Table B3 in Appendix B reports regression results when country i, country j and time t fixed effects are controlled. Table B4 in Appendix B adds bilateral gravity variables.

[19]We perform the sample split by defining a threshold of 0.5 in the range 0 to 1, where countries with an index of 0.5 or higher are understood as having an open financial account.

Table 6: The *sample split* by the levels of financial openness and institutional quality

	(1)	(2)	(3)	(4)
	Openness		Governance quality	
	High	Low	High	Low
Regime 1 (NSLT / Currency union)	0.128***	0.114***	0.133***	0.090***
	(7.368)	(3.660)	(7.306)	(3.335)
Regime 2 (Currency board)	0.052**	-0.047	0.027	-0.000
	(2.350)	(-1.160)	(1.329)	(-0.009)
Regime 3 (De facto peg)	0.077***	0.004	0.080***	0.023
	(3.280)	(0.118)	(3.401)	(0.649)
Regime 4 (Crawling peg)	0.005	0.011	0.019	-0.017
	(0.322)	(0.574)	(1.046)	(-0.889)
Regime 5 (Crawling band)	0.002	-0.039**	-0.018	-0.025
	(0.216)	(-2.499)	(-1.496)	(-1.613)
Regime 6 (Moving band)	0.045***	0.009	0.031***	0.012
	(4.386)	(0.552)	(2.709)	(0.767)
N	20936	8374	17490	12144
R^2	0.50	0.39	0.50	0.42

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. *Standard errors clustered at country-pair level. Country i and country j fixed effects included but not reported. Other explanatory variables from vector* $X_{ijt,robust}$ *included but not reported.* *Note: Institutional quality is represented by the world governance index (WGI). Yearly data is used for this table. Exchange rate regime at the beginning of each period is used. Business cycle synchronization is the dependent variable.*

and significant effect of regime 1 for countries with closed financial account, even though the coefficient is lower than for countries with an open financial account. The last two columns of Table 6 show that the effect of the regimes on synchronization is higher and more significant for countries with higher institution quality.

5.3 Exclusion of observations with possibly endogenous exchange rate regimes and the "freely falling" cases

The concern that an exchange rate regime is not exogenous to the outcome variable under study has been frequently raised in the literature. For example, Klein and Shambaugh (2006) note that the frequent variables of interest such as inflation or economic growth are both *determined* by the peg and *determine* the likelihood to peg. However, the authors argue that the choice to peg is largely related to variables that only change slowly, such that the use of country or country-pair fixed effects seems to address adequately concerns with endogeneity. We also believe that our dependent variable is less prone to the endogeneity problem than variables such as inflation, because it is constructed as a correlation over five independent periods with relatively long time horizon. Nevertheless, to rule out this possibility, we use three rather strict criteria for excluding potentially endogenous exchange rate regimes observations.

The first approach borrows the intuition from Barro and Tenreyro (2007), where the authors propose an approach to address the problem that the decision on exchange rate regime might be endogenous to other macroeconomic variables such as trade, inflation or real GDP co-movement. The intuition runs as follows: suppose that both a country A and a country B peg their currency to an anchor currency of country C. If both countries A and B decide *independently* to keep a close parity with country C's currency, the exchange rate regime between countries A and B would be exogenous to the bilateral trade, co-movement of business cycles or other economic variables between these two countries. Therefore, exchange rate regime that is only *indirectly* linked between countries A and B is assumed to be exogenous. This might not be the case for the exchange rate regimes of countries A and B *directly* pegged to the anchor C.

This feature can be easily applied to the bilateral exchange rate regimes dataset. We have

Table 7: Exclusion of observations that are prone to endogeneity problem

	(3)	(4)	(5)	(6)	(1)	(2)
	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded
	Direct Links	Direct Links	6 Anchors	6 Anchors	Regime 1	Regime 1
Regime 1 (NSLT / Currency union)	0.174***	0.156***	0.108***	0.055***		
	(6.507)	(5.525)	(6.296)	(3.123)		
Regime 2 (Currency board)	-0.015	-0.029	0.015	-0.012	0.026	-0.004
	(-0.603)	(-1.195)	(0.710)	(-0.620)	(1.311)	(-0.189)
Regime 3 (De facto peg)	0.032	0.046**	0.047**	0.045**	0.060***	0.064***
	(1.390)	(2.176)	(2.182)	(2.297)	(3.089)	(3.514)
Regime 4 (Crawling peg)	-0.014	0.013	0.010	0.026**	0.010	0.033***
	(-1.095)	(1.104)	(0.783)	(2.126)	(0.821)	(2.825)
Regime 5 (Crawling band)	-0.028***	0.037***	-0.001	0.046***	-0.004	0.050***
	(-3.077)	(4.138)	(-0.132)	(5.281)	(-0.471)	(5.944)
Regime 6 (Moving band)	0.015	0.030***	0.034***	0.044***	0.036***	0.039***
	(1.612)	(3.261)	(3.671)	(4.742)	(4.140)	(4.422)
Country Fixed Effects	Yes	No	Yes	No	Yes	No
Country-Time Fixed Effects	No	Yes	No	Yes	No	Yes
Observations (N)	27476	27476	25556	25556	28572	28572
R^2	0.45	0.61	0.47	0.61	0.46	0.62

*t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. Standard errors clustered at country-pair level. Other explanatory variables from vector $X_{ijt,robust}$ included but not reported. Note: Yearly data is used for this table. Business cycle synchronization is the dependent variable.*

data on country pairs that have both *directly* as well as *indirectly* linked exchange rate regimes.[20] *Directly* linked exchange rate regimes consist of connections when a given country adopts the currency of a main anchor country in a "client-anchor" relationship (f.e. Hong-Kong - U.S.), a currency union relationship (f.e. Germany-France) or a "client-currency union" relationship (f.e. Denmark-Eurozone). *Indirect* link dummies distinguishes country pairs that are connected indirectly through common anchor currency as "anchor-anchor" (f.e. Honk-Kong - Jordan) and pairs that are both pegged to a currency union as "anchor-currency union" (f.e. Denmark and Bulgaria). We use the argument of Barro and Tenreyro (2007) that the *directly* linked regimes are more likely to be endogenous and exclude all such observations from the sample.

The results are reported in columns 1 and 2 of Table 7. We see that the effect of regime 1 is almost identical for both country and country-pair fixed effects. Thus, even if all "client-anchor", "client-currency union" observations are excluded the results remain very robust. As for regimes 3 and 6, those regimes remain significant only for country-time fixed effects, which could be driven by the fact that we strongly reduce the number of available observations.[21] An unexpected result shows up for regime 5, when country fixed effects are controlled for. The negatively significant result indicates that country pairs in crawling band have lower synchronization than the freely floating regimes. However, the coefficient turns out to be positive and significant once the country-time fixed effects are used. Combined with the fact that regime 5 was not EBA significant, we tend not to make any inference on the effect of this regime on business cycle synchronization.

In line with the same intuition, the second approach is to exclude observations for countries that are frequently identified as main anchor currencies. The countries identified as major anchor currencies as in by Barro and Tenreyro (2007) are Australia, France, Germany, Japan, the United Kingdom and the United States. We exclude all observations where at least one country from the country-pair belongs to this list. Excluding these countries should eliminate the observations that are most likely to suffer from endogeneity.

Columns 3 and 4 of Table 7 show results when excluding observations involving these 6

[20] See Figure A1 in Appendix B.

[21] Note that from cca. 27.000 observations available, the large majority are the freely floating regimes.

Table 8: Excluding observations classified as *freely falling* or in *crisis*

	(1)	(2)	(3)	(4)	(5)
	Excluded	Excluded	Excluded	Excluded	Excluded
	Freely falling	Freely falling	Banking crises	Currency crises	Debt crises
	(in period)	(all periods)	(in period)	(in period)	(in period)
Regime 1 (NSLT / Currency union)	0.128***	0.123***	0.110***	0.104***	0.120***
	(7.647)	(6.896)	(5.959)	(6.470)	(7.180)
Regime 2 (Currency board)	0.020	0.035	0.025	0.021	0.029
	(0.871)	(1.267)	(1.128)	(1.036)	(1.422)
Regime 3 (De facto peg)	0.062**	0.086***	0.058**	0.075***	0.050**
	(2.576)	(3.249)	(2.571)	(3.346)	(2.492)
Regime 4 (Crawling peg)	0.018	0.022	0.031**	0.013	0.014
	(1.316)	(1.204)	(2.256)	(1.030)	(1.130)
Regime 5 (Crawling band)	-0.025**	-0.034**	0.002	-0.004	-0.013
	(-2.221)	(-2.255)	(0.217)	(-0.367)	(-1.411)
Regime 6 (Moving band)	0.046***	0.066***	-0.018*	0.012	0.038***
	(4.421)	(4.903)	(-1.759)	(1.342)	(4.189)
Observations (N)	19620	12824	20348	24524	27548
R^2	0.51	0.44	0.47	0.50	0.48

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. *Standard errors clustered at country-pair level. Country i and country j fixed effects included but not reported. Other explanatory variables from vector* $X_{ijt,robust}$ *included but not reported. Note: Yearly data is used for this table.*

countries. The positive effect of regimes 1, 3 and 6 is robust in both specifications. In addition, regime 5 shows a significantly positive effect on synchronization when we control for country-time fixed effects. Finally, the third approach is to exclude all observations for regime 1 (No separate legal tenders / currency unions) as they are likely to be subject to the endogeneity issue as well. The results are shown in the last two columns of Table 7. We can see that the results with regime 1 excluded are very similar to our benchmark results.

An additional issue we consider is the occurrence of short-lived exchange rate regimes in any given interval. This is especially the case for the "freely falling" residual category. This could be especially problematic if the regime went from peg to freely falling at any point in time other than the beginning of period (BOP) or the middle of period (MOP). To check for this possibility, Table 8 reports the results when excluding "freely falling" observations even if they were not classified as such at the BOP or MOP. Column 1 excludes observations that had a freely falling regime at any year over a given interval, even if this was in the last year. Column 2 is even more strict such that it excludes observations if they were classified as freely falling at any point in history starting from the year 1973.

These exclusions greatly reduce the number of observations available. Nevertheless, the robustness of the results for regimes 1, 3 and 6 remains. Similarly to the previous table, the non-EBA robust regime 5 turns out to be negative, with the coefficient being barely economically significant. Further, there remains a possibility that an exchange rate regime was not classified as "freely falling" but a country experienced serious banking, currency and debt crises. We control for this possibility by excluding countries that experienced a crisis during our correlation period as specified in Laeven and Valencia (2012). The results are reported in columns 3 to 5 of Table 8. We find that even this exclusion does not significantly alter our results.

5.4 Robustness across samples, periods and regime classifications

Finally, we re-estimate the effect of exchange rate regimes on business cycle synchronization by excluding observations whenever at least one country in a country pair belonged to either: (1) oil-exporting countries with a membership in the Organization of the Petroleum Exporting Countries (OPEC); (2) countries with a population of less than 1 million; (3) tax havens as

Table 9: Exclusion of the selected *country groups* from the sample

	(1) Excluded OPEC	(2) Excluded Small Countries	(3) Excluded Tax Heavens	(4) Excluded Latin America
Regime 1 (NSLT / Currency union)	0.126***	0.108***	0.117***	0.113***
	(6.901)	(6.032)	(6.798)	(6.669)
Regime 2 (Currency board)	0.001	0.006	0.016	0.015
	(0.055)	(0.214)	(0.657)	(0.740)
Regime 3 (De facto peg)	0.075***	0.083***	0.062***	0.060***
	(3.190)	(3.278)	(2.636)	(3.095)
Regime 4 (Crawling peg)	0.025*	0.003	0.011	0.011
	(1.680)	(0.218)	(0.798)	(0.832)
Regime 5 (Crawling band)	-0.017*	-0.002	0.005	0.017*
	(-1.708)	(-0.174)	(0.572)	(1.753)
Regime 6 (Moving band)	0.038***	0.015	0.021**	0.031***
	(3.790)	(1.558)	(2.239)	(3.064)
N	22038	22744	24442	23301
R^2	0.50	0.49	0.48	0.48

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. *Standard errors clustered at country-pair level. Country i and country j fixed effects included but not reported. Other explanatory variables from vector $X_{ijt,robust}$ included but not reported. Note: Yearly data is used for this table.*

classified by the OECD and (4) Latin America countries. We exclude these groups due to their country-specific characteristics that might potentially bias our results. For example, countries in Latin America are excluded as those have been subject to multiple economic or financial crises in recent history. It can be seen from Table 9 that our results remain very robust to our benchmark and do not appear to be driven by any particular country group. Lastly, we confirm that our results are not driven by any specific time period[22] or by the *de-jure* versus *de-facto* dichotomy in regimes classification.[23]

6 Conclusion

The use of a new dataset on *bilateral* exchange rate regimes allows us to move beyond the special case of currency unions and test the effect of various exchange rate regimes on business cycle synchronization. We find that currency unions increase the co-movement of business cycles, which is consistent with the previous literature. The point estimate from our analysis measuring business cycle correlation indicates that – compared to pairs with free floating regimes – countries with no separate legal tenders have more synchronised business cycles by around 0.12 points. This effect is particularly strong for countries within a currency union, as compared to countries with foreign currency as their sole legal tender.

The effect of other exchange rate regimes has not been previously tested empirically. We find that country pairs with other less flexible regimes have more synchronised business cycles. The effect remains positive and significant for both currency boards as well as de-facto pegs. The effect is much stronger for countries with high financial openness. In particular, currency boards are found to lead to more synchronised business cycles only for financially opened countries. The effect of soft pegs is more heterogeneous - with the coefficient not always linearly decreasing with the increasing exchange rate flexibility - such that we must be careful in differentiating between the effects of individual soft pegs. Overall, we find *no* exchange rate regimes with *less* synchronised business cycles than free floats, at least as long as countries do not experience a severe financial crisis.

[22]See Table B5 in Appendix B for split according to periods.
[23]See Table B6 in Appendix B for a comparison of coefficients.

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Appendix A: Description of the Data

Table A1: De-facto exchange rate regimes mapping

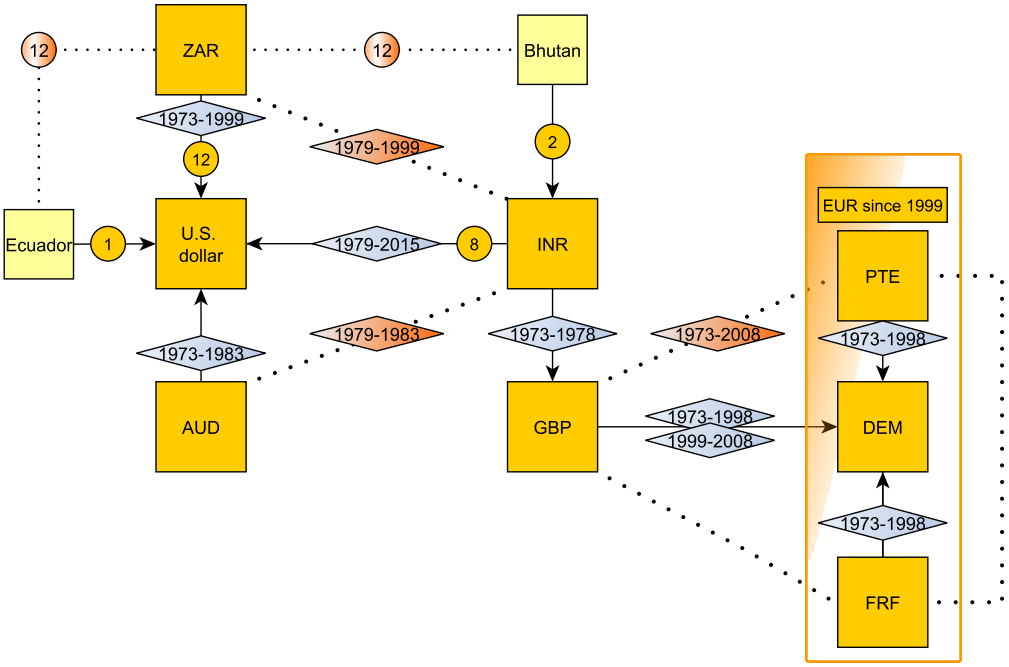
De-facto exchange rate regimes	Exchange rate flexibility (index)	Exchange rate regime
Hard pegs		
No separate legal tender or currency union	1	Regime_1
Pre announced peg or currency board arrangement	2	Regime_2
Soft pegs		
Pre announced horizontal band that is narrower than or equal to +/-2% *	3	-
De facto peg	4	Regime_3
Pre announced crawling peg; de facto moving band narrower than or equal to +/-1%	5	Regime_4
Pre announced crawling band / de facto horizontal band that is narrower than or equal to +/-2%	6	Regime_4
De facto crawling peg	7	Regime_4
De facto crawling band that is narrower than or equal to +/-2%	8	Regime_5
Pre announced crawling band that is wider than or equal to +/-2%	9	Regime_5
De facto crawling band that is narrower than or equal to +/-5%	10	Regime_5
Moving band that is narrower than or equal to +/-2%	11	Regime_6
Floating arrangements		
De facto moving band +/-5%/ Managed floating	12	Regime_6
Freely floating	13	Regime_7
Residuals		
Freely falling **	-	Regime_{FF}
Dual market in which parallel market data is missing **	-	-

* We do not include the category "Pre announced horizontal band that is narrower than or equal to +/-2%" in our specification as we had no observations for this regime in our sample.

** Residuals 'Freely falling' and 'Dual market in which parallel makret data is missing' were dropped in the index.

Note: Table is based on Table A1 from Harms and Knaze (2018).

Figure A1: Example of the bilateral structure of the data



Note: Information on countries' anchor currencies is used to identify country-pairs' exchange rate regimes. For example, taking South African Rand (ZAR) pegged to U.S. dollar and Bulgarian Lev pegged to the Euro, South Africa rand is classified as floating to Bulgarian Lev since U.S. dollar is agains the Euro. Continuing with the example above, South African Rand is connected to the U.S. with a direct link (yellow dot in Figure A1). Since Ecuador is having no separate legal tender to the U.S. dollar, it has a direct link to the U.S. and at the same time an indirect link against South Africa (red dot in Figure A1).

Figure A2: Density distribution of exchange rate regimes with direct and indirect connections

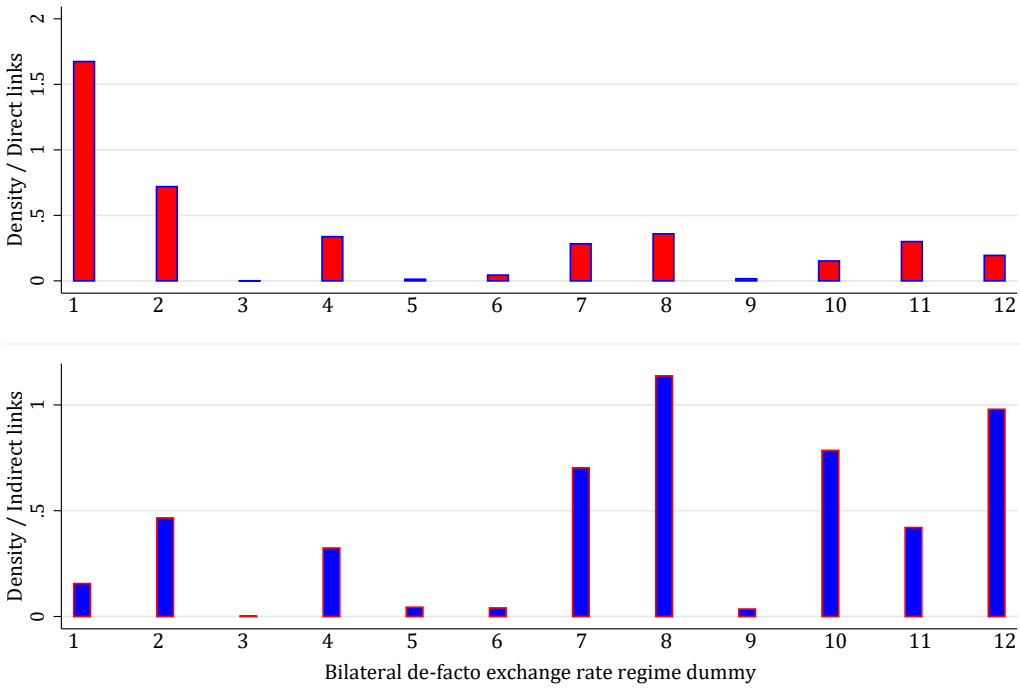


Figure A3: Density of the *yearly* business cycle correlations split by bilateral exchange rate regime dummies

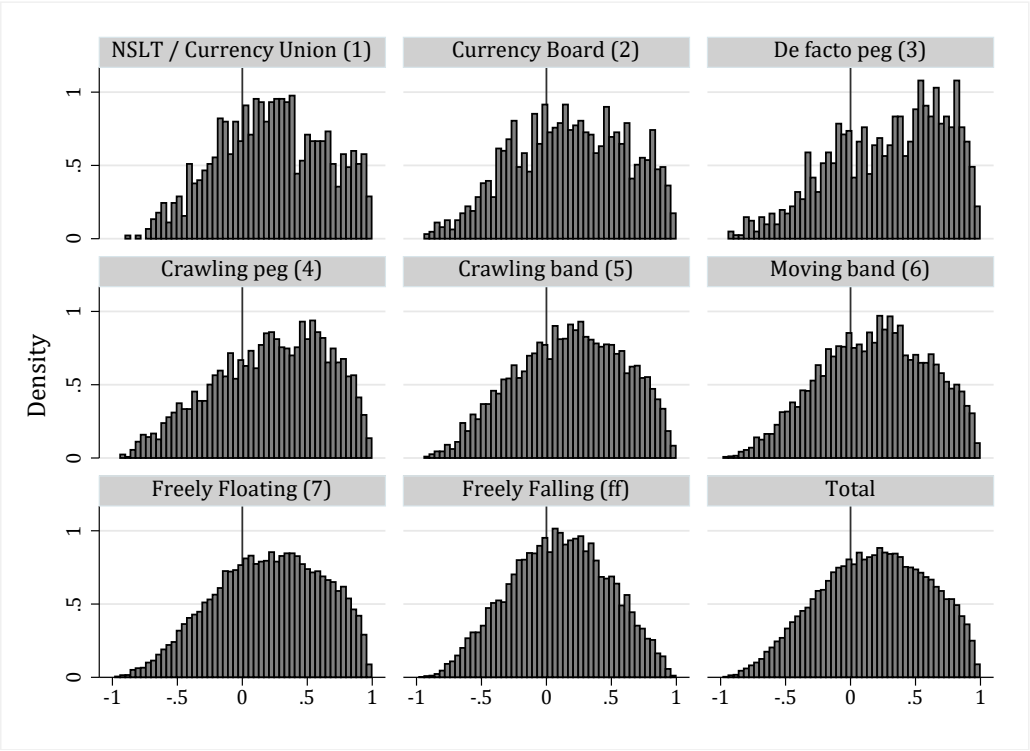


Figure A4: Variables used in the EBA to choose the EBA robust variables

Variable	Source	EBA robust?	
1. Monetary integration			
Bilateral de-facto exchange rate regime (index), BOP*	Harms and Knaze (2018), link: https://www.international.economics.uni-mainz.de/data-on-bilateral-exchange-rate-regimes/	✓	yes
Bilateral de-facto exchange rate regime (index), MOP*		✓	yes
Bilateral de-jure exchange rate regime (index), BOP*		✓	yes
Bilateral de-jure exchange rate regime (index), MOP*		!	yearly only
Nominal Interest rate correlations: Deposit Rate	IMF: International Financial Statistics. Link: http://data.imf.org/IFS	✓	yes
Nominal Interest rate corr.: Government Bond Yield		✓	yes
Nominal Interest rate corr.: Treasury Bill Rate		✓	yes
Nominal Interest Rate corr.: Central Bank Policy Rate		✓	yes
Real Interest rate corr.: Deposit Rate		✓	yes
Real Interest rate corr.: Government Bond Yield		✓	yes
Real Interest rate corr.: Treasury Bill Rate		✓	yes
Real Interest Rate corr.: Central Bank Policy Rate		✓	yes
Bilateral pairs within the EMU (dummy)		✓	yes
Exchange rate variability (mean of monthly changes)		✓	yes
Exchange rate variability (squared)		✓	yes
2. Trade intensity			
Ratio of bilateral trade to the sum of total trade	World Bank, WITS: https://wits.worldbank.org/	✓	yes
Ratio of bilateral trade to the sum of GDP		✓	yes
Maximum of trade intensity		✓	yes
Principal component analysis of the previous variables		✓	yes
3. Specialization			
Export similarity between two countries (abs): extent of trade in similar goods in the same industry	World Bank, WITS: https://wits.worldbank.org/	!	quarterly
Export similarity between two countries (square)		✓	yes
Share of intra-industrial trade		✓	yes
4. Similarity of fiscal policies			
Yearly correlations in general government net lending / borrowing (percent of GDP)	IMF: WEO. Link: https://www.imf.org/external/pubs/ft/weo/2018/01/weodata/index.aspx	✓	yes
5. Financial infrastructure			
Difference in FI (abs, private credit by money banks to % of GDP/stock mkt capitalization to % of GDP)	World Bank: World Development Indicators. Link: https://datacatalog.worldbank.org/dataset/world-development-indicators	!	quarterly
Difference in FI (abs, private credit by deposit banks to % of GDP/stock mkt capitalization to % of GDP)		!	quarterly
Difference in FI (sqr, private credit by money banks to % of GDP/stock mkt capitalization to % of GDP)		✗	no
Difference in FI (sqr, private credit by deposit banks to % of GDP/stock mkt capitalization to % of GDP)		✗	no
6. Financial integration			
Difference in the net foreign assets positions (NFA/GDP)	Lane and Milesi-Ferretti, 2007	✗	no
Overall capital inflows restrictions correlations	IMF: AREAER. Link: https://www.elibrary-areaer.imf.org	✗	no
Overall capital restrictions index correlations	Fernández, Klein, Rebucci, Schindler and Uribe (2016)	✗	no
7. Inflation			
Correlation of CPI based inflation rates	IMF: International Financial Statistics. Link: http://data.imf.org/IFS	✓	yes
Standard deviation of inflation rates differences between two countries		!	quartely
8. Others			
Absolute difference in capital stock per person between country pairs in constant 2011 USD	Penn World Table version 9.0. Link: https://www.rug.nl/ggdc/productivity/pwt/	!	quarterly
Trade openness	World Bank: World Development Indicators	✓	yes
Difference in oil import share (absolute diff or squared)		!	quarterly
Difference in oil import share (squared diff of square)		!	quarterly
Difference in saving rate (absolute diff or squared)	OECD. Link: https://data.oecd.org/natincome/saving-rate.htm	✗	no
Difference in saving rate (squared diff)		✗	no

** Note: BOP denotes "Beginning of the period" and stands for the first year of the respective period. MOP denotes "Middle of the period" and stands for the median year of the respective period.*

Appendix B: Additional Estimation Results

Table B1: Effect of exchange rate regimes on business cycle synchronization as an *untransformed* dependent variable without the Fisher's-Z transformation

	(1)	(2)	(3)	(4)
	Beginning of period		Middle of period	
	Yearly	Quarterly	Yearly	Quarterly
Bilateral Trade (PCA, standardized)	0.013***	0.004**	0.013***	0.006***
	(6.984)	(2.325)	(6.745)	(3.476)
Specialization (standardized)	0.020***	0.024***	0.020***	0.019***
	(9.465)	(5.915)	(9.221)	(4.382)
Fiscal integration (standardized)	0.040***	0.046***	0.045***	0.060***
	(19.391)	(9.729)	(22.758)	(12.353)
Inflation correlation (standardized)	0.028***	0.022***	0.013***	0.002
	(10.631)	(3.847)	(5.298)	(0.311)
Openness (standardized)	0.238***	0.184***	0.253***	0.266***
	(31.614)	(14.522)	(33.418)	(17.062)
Regime 1 (NSLT / Currency union)	0.069***	0.116***	0.072***	0.081***
	(7.007)	(7.655)	(8.035)	(4.862)
Regime 2 (Currency board)	0.019	0.056**	0.029***	0.042**
	(1.626)	(2.569)	(2.865)	(2.078)
Regime 3 (De facto peg)	0.041***	0.119***	0.028***	0.183***
	(3.094)	(5.796)	(2.591)	(9.484)
Regime 4 (Crawling peg)	0.006	-0.027	0.004	0.091***
	(0.701)	(-0.943)	(0.464)	(3.194)
Regime 5 (Crawling band)	0.002	-0.004	-0.017**	-0.024
	(0.383)	(-0.262)	(-2.365)	(-1.200)
Regime 6 (Moving band)	0.024***	0.027***	0.036***	0.037***
	(3.892)	(2.585)	(5.651)	(2.583)
N	29634	5000	32073	5198
R^2	0.46	0.39	0.42	0.37

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. *Standard errors clustered at country-pair level. Country i and country j fixed effects included but not reported. The transformation does not have any effect on the significance of individual coefficients.*

Table B2: The effect of exchange rate regimes on business cycle synchronization: with "Freely falling" regimes

	(1)	(2)	(3)	(4)
	Beginning of period		Middle of period	
	Yearly	Quarterly	Yearly	Quarterly
Bilateral Trade (PCA, standardized)	0.028***	0.017***	0.028***	0.020***
	(6.485)	(5.295)	(6.539)	(6.398)
Specialization (standardized)	0.035***	0.035***	0.032***	0.028***
	(10.965)	(5.744)	(10.202)	(4.283)
Fiscal integration (standardized)	0.063***	0.070***	0.065***	0.083***
	(23.822)	(10.299)	(24.370)	(11.450)
Inflation correlation (standardized)	0.034***	0.039***	0.024***	0.002
	(10.564)	(4.752)	(7.452)	(0.176)
Openness (standardized)	0.345***	0.305***	0.371***	0.427***
	(34.994)	(14.806)	(37.004)	(17.678)
Regime 1 (NSLT / Currency union)	0.118***	0.271***	0.111***	0.194***
	(7.510)	(8.237)	(7.715)	(6.155)
Regime 2 (Currency board)	0.042**	0.107**	0.050***	0.077**
	(2.143)	(2.502)	(2.940)	(2.089)
Regime 3 (De facto peg)	0.055***	0.188***	0.053***	0.311***
	(2.814)	(4.609)	(3.433)	(8.542)
Regime 4 (Crawling peg)	0.005	0.010	-0.000	0.139***
	(0.438)	(0.195)	(-0.029)	(2.998)
Regime 5 (Crawling band)	-0.000	0.005	-0.026***	-0.028
	(-0.010)	(0.209)	(-2.643)	(-0.885)
Regime 6 (Moving band)	0.025***	0.044***	0.048***	0.060***
	(2.885)	(2.652)	(5.286)	(2.721)
Regime ff (Freely falling)	-0.085***	0.026	-0.207***	0.000
	(-6.733)	(0.543)	(-13.292)	(.)
N	32722	5126	33703	5198
R^2	0.45	0.41	0.43	0.40

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. *Standard errors clustered at country-pair level. Country i and country j fixed effects included but not reported.*

Table B3: Effect of exchange rate regimes on business cycle synchronization: Benchmark with country and period fixed effects

	(1)	(2)	(3)	(4)
	Beginning of period		Middle of period	
	Yearly	Quarterly	Yearly	Quarterly
Regime 1 (NSLT / Currency union)	0.050***	0.058*	0.066***	0.113***
	(3.067)	(1.704)	(4.456)	(3.756)
Regime 2 (Currency board)	0.008	0.030	0.027	0.068**
	(0.397)	(0.839)	(1.616)	(2.188)
Regime 3 (De facto peg)	0.070***	0.198***	0.090***	0.396***
	(3.696)	(5.140)	(5.971)	(11.826)
Regime 4 (Crawling peg)	0.011	0.054	0.025**	0.122***
	(0.973)	(1.305)	(2.347)	(3.402)
Regime 5 (Crawling band)	0.032***	0.046**	0.044***	0.092***
	(3.880)	(2.288)	(4.645)	(3.102)
Regime 6 (Moving band)	0.034***	0.021	0.042***	0.079***
	(4.112)	(1.311)	(4.756)	(3.934)
N	29634	5000	32073	5198
R^2	0.52	0.56	0.49	0.57

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. *Standard errors clustered at country-pair level. Country* ***i****, country* ***j*** *and period* ***t*** *fixed effects included but not reported. Other explanatory variables from vector* $X_{ijt,robust}$ *included but not reported.*

Table B4: Effect of exchange rate regimes on business cycle synchronization: Gravity variables included

	(1)	(2)	(3)	(4)
	Beginning of period		Middle of period	
	Yearly	Quarterly	Yearly	Quarterly
Bilateral Trade (PCA, standardized)	0.024***	0.018***	0.023***	0.019***
	(5.349)	(4.679)	(5.336)	(4.821)
Specialization (standardized)	0.035***	0.021***	0.033***	0.011*
	(11.121)	(3.312)	(10.724)	(1.711)
Fiscal integration (standardized)	0.034***	0.049***	0.037***	0.057***
	(12.674)	(5.686)	(14.381)	(6.646)
Inflation correlation (standardized)	0.042***	0.063***	0.026***	0.050***
	(10.666)	(6.993)	(7.520)	(5.751)
Openness (standardized)	0.083	-2.061***	0.129	-2.081***
	(0.732)	(-3.555)	(1.129)	(-3.722)
Regime 1 (NSLT / Currency union)	0.027*	0.102***	0.045***	0.139***
	(1.673)	(3.171)	(3.083)	(4.726)
Regime 2 (Currency board)	-0.031*	-0.010	-0.001	0.030
	(-1.675)	(-0.289)	(-0.031)	(1.019)
Regime 3 (De facto peg)	0.048**	0.187***	0.070***	0.339***
	(2.571)	(4.554)	(4.493)	(8.766)
Regime 4 (Crawling peg)	0.017	0.110***	0.022**	0.098***
	(1.479)	(2.737)	(2.030)	(2.781)
Regime 5 (Crawling band)	0.037***	-0.004	0.064***	0.034
	(4.408)	(-0.204)	(6.617)	(1.073)
Regime 6 (Moving band)	0.021**	-0.001	0.024***	0.073***
	(2.430)	(-0.066)	(2.803)	(3.361)
Distance	-0.000***	-0.000***	-0.000***	-0.000***
	(-5.689)	(-3.747)	(-5.284)	(-2.625)
Common border	0.033	-0.020	0.033	-0.029
	(1.502)	(-0.571)	(1.608)	(-0.785)
Common language	0.033***	0.081***	0.038***	0.074***
	(3.569)	(3.919)	(4.312)	(3.597)
Colony	-0.086***	-0.073**	-0.092***	-0.043
	(-5.025)	(-2.278)	(-5.465)	(-1.419)
Religion	0.053***	0.267***	0.050***	0.222***
	(7.307)	(6.299)	(7.200)	(5.362)
N	28541	4824	30938	5020
R^2	0.62	0.68	0.61	0.70

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. *Standard errors clustered at country-pair level. Country* $\boldsymbol{i}$ *and country* $\boldsymbol{j}$ *fixed effects included but not reported.*

Table B5: Effect of exchange rate regimes on business cycle synchronization across time periods

	(1) Period [1,4]	(2) Period [1,3]	(3) Period [3,5]	(4) Period [4,5]
Bilateral Trade (PCA, standardized)	0.028***	0.034***	0.028***	0.029***
	(6.434)	(7.587)	(6.152)	(5.566)
Specialization (standardized)	0.039***	0.054***	0.038***	0.040***
	(9.750)	(7.621)	(11.807)	(11.539)
Fiscal integration (standardized)	0.044***	0.028***	0.057***	0.034***
	(12.827)	(5.508)	(19.997)	(11.405)
Inflation correlation (standardized)	0.011**	0.052***	0.044***	0.038***
	(2.489)	(6.900)	(11.917)	(9.790)
Openness (standardized)	0.660***	-0.007	0.334***	0.051***
	(34.942)	(-0.093)	(31.915)	(4.082)
Regime 1 (NSLT / Currency union)	0.096***	0.046	0.102***	0.061***
	(4.876)	(0.886)	(6.524)	(3.732)
Regime 2 (Currency board)	0.031	-0.073	0.012	-0.011
	(1.428)	(-1.209)	(0.638)	(-0.602)
Regime 3 (De facto peg)	0.108***	0.160***	0.053***	0.035
	(4.687)	(4.169)	(2.703)	(1.644)
Regime 4 (Crawling peg)	-0.012	-0.016	0.017	0.021*
	(-0.762)	(-0.550)	(1.449)	(1.704)
Regime 5 (Crawling band)	-0.008	0.096***	-0.003	0.022**
	(-0.876)	(6.029)	(-0.293)	(2.376)
Regime 6 (Moving band)	0.034***	0.062***	0.046***	-0.001
	(2.989)	(3.036)	(5.237)	(-0.153)
N	15784	5578	28736	24056
R^2	0.45	0.27	0.48	0.56

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. *Standard errors clustered at country-pair level. Country* $\boldsymbol{i}$ *and country* $\boldsymbol{j}$ *fixed effects included but not reported.*

Table B6: Effect of exchange rate regimes on business cycle synchronization: *De-jure* versus *de-facto* regimes for periods 4 and 5 only

	(1)	(2)	(3)	(4)
	De-facto regimes		De-jure regimes	
	Yearly	Quarterly	Yearly	Quarterly
Bilateral Trade (PCA, standardized)	0.029***	0.027***	0.025***	0.027***
	(5.566)	(7.010)	(5.240)	(7.025)
Specialization (standardized)	0.040***	0.013**	0.042***	0.011*
	(11.539)	(2.187)	(12.684)	(1.858)
Fiscal integration (standardized)	0.034***	0.033***	0.041***	0.036***
	(11.405)	(5.084)	(13.786)	(5.525)
Inflation correlation (standardized)	0.038***	0.052***	0.030***	0.051***
	(9.790)	(6.378)	(8.680)	(6.471)
Openness (standardized)	0.051***	-0.105***	0.028**	-0.129***
	(4.082)	(-4.708)	(2.168)	(-5.250)
Regime 1 (NSLT / Currency union)	0.061***	0.165***		
	(3.732)	(5.720)		
Regime 2 (Currency board)	-0.011	0.048		
	(-0.602)	(1.456)		
Regime 3 (De facto peg)	0.035	0.193***		
	(1.644)	(3.750)		
Regime 4 (Crawling peg)	0.021*	0.198***		
	(1.704)	(4.747)		
Regime 5 (Crawling band)	0.022**	0.063***		
	(2.376)	(2.997)		
Regime 6 (Moving band)	-0.001	0.031**		
	(-0.153)	(1.961)		
De-jure Regime 1 (NSLT / Curerncy union)			0.232***	0.138***
			(9.495)	(4.702)
De-jure Regime 2 (Currency board)			0.020	-0.044
			(0.856)	(-1.274)
De-jure Regime 3 (Conventional peg)			-0.014	0.154***
			(-1.100)	(3.331)
De-jure Regime 4 (Stabilized and crawling)			-0.036*	-0.186***
			(-1.738)	(-3.512)
De-jure Regime 5 (Horizontal bands and other managed)			0.103***	0.191***
			(5.396)	(6.218)
De-jure Regime 6 (Managed floating)			0.047***	0.067***
			(5.876)	(3.072)
N	24056	3962	24762	4054
R^2	0.56	0.50	0.56	0.49

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, * $p < 0.01$. *Standard errors clustered at country-pair level. Country* ***i*** *and country* ***j*** *fixed effects included but not reported.*