Clamoring for Greenbacks:
Explaining the Resurgence of the U.S. Dollar in International Debt

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Abstract

This paper characterizes trends of the shares of the U.S. dollar, the euro, and total foreign currencies in international debt denomination over the last two decades. We find that countries with high output growth trend, greater financial development, better fiscal conditions, and more investment opportunities tend to decrease the extent of reliance on the dollar, but increase that on the euro, while their dependency on total foreign currencies remain unaffected. Stronger trade ties with the U.S. (the euro area) contribute to a higher dollar (euro) share in the currency denomination of international debt securities. We also find that absent the Global Financial Crisis (GFC), the dollar (euro) share in debt denomination would have been higher (lower) than the observed shares in the post-crisis period. That suggests that the outbreak of the GFC increased the demand for the dollar as a safe haven.

Keywords: International debt, currency composition, financial openness, emerging economies

JEL Classification: F02, F34, F41, G15

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1. Introduction

Since the end of World War II, the U.S. dollar has clearly been the most dominant international currency. Roughly, half of international trade in goods and services and a large proportion of foreign exchange turnover (88% out of 200% as of 2019) are conducted with the dollar as the currency of denomination.[1] Based on the data from the Bank for International Settlements (BIS), more than 47% of internationally issued debt is denominated in the dollar as of 2019, while, according to the International Monetary Fund (IMF), 60-65% of foreign reserves have been held in the dollar for the last two decades among central banks in the world. In each type of transactions, the comparable shares of the euro, the second largest international currency, are less than half of those of the dollar, while the shares of other currencies are even smaller. Obviously, no other currency provides as massive, deep, and liquid financial markets as the dollar does.[2] With the currency's dominancy, its issuer, the U.S. Federal Reserve, has been acting as a de facto global lender of last resort.

However, for the last decade, the dollar-centric international monetary system has faced several challenges. For one, the Global Financial Crisis (GFC) of 2008 revealed that the current dollar-centric system weakens the fiscal discipline of the U.S. government by allowing its profligacy to become perennial. Some economists argue that low-cost financing from international financial markets may have fueled the housing bubble of the mid-2000s in the U.S., thereby causing its consequential burst. Unless this profligacy is corrected, they contend, not just the U.S. but the global economy would remain prone to boom-bust cycles and financial crises.

The dollar supremacy is far from being threatened by the second largest international currency, the euro. The euro debt crisis in the early 2010s cast doubt on the stability, credibility, and even viability of the currency which was once seen as challenging and even replacing the dollar (Chinn and Frankel, 2007). Eichengreen (2010) argues that a multi-currency international monetary system based on the dollar, the euro, and the Chinese renminbi (RMB) would lend stability to the world economy, as the key currency issuers would check each other's fiscal conditions, eventually providing fiscal discipline among the major currency issuers. From this view, the weakened credibility of the euro could contribute to greater instability in the world economy, leaving the supremacy of the dollar unchallenged or even strengthened.

Against this backdrop, we reexamine questions related to what accounts for international currency by focusing on the determinants of currency denomination in international debt

securities. More specifically, we investigate the following questions. First, how dominant is the dollar as a currency of denomination for international debt securities? Second, what factors affect the shares of the dollar and the euro in denomination of international debt? Finally, what impacts did the GFC have on the shares of the dollar and the euro in the post-crisis period? Many scholars have pointed out that in the post-GFC period, international debt securities have been increasing their importance as a major driver of international capital flows.[3] Additionally, the literature has been increasingly focusing on the role of foreign currency credit, especially the U.S. dollar credit to emerging market economies.[4] We believe that identifying the factors that affect the currency composition of international debt would help us to have a better understanding of the characteristics of global liquidity and international monetary systems.

The rest of the paper is organized as follows. In Section 2, we present summary statistics of the shares of major currencies in outstanding international debt. In Section 3, we explain the methodology for our empirical investigation on the determinants of the shares of the dollar, the euro, and total foreign currencies. In Section 4, we discuss the empirical findings. In Section 5, we perform a counterfactual analysis of how the shares of the dollar and the euro would have evolved had the GFC not occurred. We make concluding remarks in Section 6.

2. Stylized Facts of Foreign Currency Shares in International Debt

While prevalence of the use of international currency can be observed in many markets or purposes such as trade invoicing, reserve holding, foreign exchange market transactions, and bank loans, we focus on the use of major currencies, particularly the dollar and the euro, for currency denomination in international debt securities.

Many researchers have examined the inability of countries to issue local currency debt internationally (Calvo and Reinhart, 2002; Eichengreen et al., 2002; Ize and Levy-Yeyati, 2003; and Chang and Velasco, 2006). Issuing debt in foreign currencies can make a country more vulnerable to external shocks due to potential currency mismatch. This inevitable financial instability from overreliance on hard currencies comprises part of the "original sin." This paper focuses on the high degree of dependence on issuing debt in the foreign hard currency in international markets.[5]

We use a dataset compiled by the BIS on international debt securities (IDS) that contains information on the shares of individual currencies – not just domestic vs. foreign currencies but

the breakdowns of individual currencies in debt denomination. The data are available for 88 countries (78 developing and 10 developed economies) over the period 1995 through 2015.

While the domestically-issued debt securities market is bigger than international debt securities and domestic currency plays an important role in the former (Figure 1), we focus on examining what factors affect the composition of individual currencies in international debt denomination.[6] That cannot be done in the data for domestically-issued debt securities.[7] In that sense, our study is one of the first to look into the use of individual currencies for international debt denomination.[8]

Furthermore, we believe that using international debt securities data is appropriate for our study because they should be more market driven than domestic debt securities. In domestic debt markets, government authorities occasionally intervene in the market to influence pricing and market formation of the debt securities through regulatory controls or arbitrary actions.

For the data on international debt, we only look at the outstanding volumes of international debt instead of the issuance volumes. Considering that the outstanding volumes of international debt tend to be highly correlated with the volumes of international debt issuance, and that currency choice for debt denomination does not change too drastically in a short time period, this should not pose any major problems.

As another caution, we must also note that, throughout the paper, international debt securities issued by the U.S., countries that use the U.S. dollar as legal tender, and the euro member countries are not included in the data for our analysis. The U.S. is excluded because of its unique status as the issuer of the most dominant international currency. The euro member countries are excluded because of the difficulty of defining international debt securities – for example, if Belgium holds debt issued by France, should that be counted as international debt though both countries use the same currency, the euro?[9]

In recent years, it has been argued that the degree of reliance on hard currency-denominated debt has fallen among developing countries. Figure 2, however, does not show such a trend for developing countries, though it does for developed countries. The share of major currency-denominated debt was about 100% in 1995 for the group of developing countries, and only declined to 95% by 2015. This finding is consistent with Hausmann and Panizza (2010). Hence, as far as international debt securities are concerned, we do not find evidence consistent with the recent argument of dwindling "original sin."[10]

Despite the relatively stable share of total foreign currencies in international debt denomination, the shares of the dollar and the euro have fluctuated as Figure 3 illustrates. The dollar share, starting with about 70% in 1997, fell to below 60% in 2004 through 2008, then trending up back to about 70% by 2015. The euro share almost mirrors the dollar one, rising from 14% in 1996 to almost 27% by 2006, and declining back to about 15% by the end of the sample period.

Interestingly, the GFC of 2008 and the following euro debt crisis seem to have contributed to the dollar's resurgence while putting a dent in the euro share. The resurgence of the dollar share must reflect the high demand for the dollar as a safe haven, and the declining demand for the euro is attributed to uncertainty over its stability or even viability.[11]

Figure 4-(a) makes it clear that the dollar plays a dominant role. In this figure, which plots the dollar share in international debt denomination against the share of the U.S. as the export destination, most countries are scattered above the 45 degree line, indicating that countries denominate their international debt in the dollar more than their trading linkages with the U.S. would suggest. In Figure 4-(b), a comparable figure for the euro, shows many countries scattered around the 45 degree line, which suggests that the degree of reliance on the euro for debt denomination is more or less a reflection of their trading linkages with the euro area. In other words, the euro plays the role of a regional currency at most.

Taking Figures 3 and 4 together, we suspect that the outbreak of the GFC of 2008 led to a resurgence of the dollar, reflecting its special role as the most dominant international currency.

3. Empirical Investigation on the Determinants of Currency Shares in International Debt Denomination

3.1 Estimation Model

With the stylized facts in hand, we now investigate the determinants of the shares of the dollar, the euro, and total foreign currencies in international debt denomination. For the estimation, following Mehl and Reynaud (2010), we employ a Tobit model to incorporate the fact that the share variables are bounded between zero and one. Since unobservable country effects in the panel data could bias the estimates in a standard Tobit model, we also control for random effects as specified below:

$$y_{it}^{C} = \beta_1^{C} + \beta_2^{C} X_{it}^{C} + \beta_3^{C} D_{it}^{C} + u_i^{C} + v_{it}^{C} \qquad (1)$$

$$\text{with } y_{it}^{C} = \begin{cases} 1 & \text{if } y_{it}^{*C} > 1 \\ y_{it}^{*C} & \text{if } 0 \le y_{it}^{*C} \le 1 \\ 0 & \text{if } y_{it}^{*C} < 0 \end{cases}$$

where y_{it}^{C} refers to the share of either dollar- or euro-denominated debt, or of the total of foreign currencies-denominated debt in total international debt outstanding for country *i* in year *t.* y_{it}^{*C} denotes the share before getting censored at both zero and one. We repeat the same estimation for each of the three dependent variables.

The choice of the explanatory variables is based on the past literature. X_{it}^{C} is a vector of variables representing the characteristics of the sample countries, such as the economic size of economy *i*, the growth trend of real output (in local currency), domestic saving as a share of GDP, inflation volatility, financial development, and a variable for "fiscal space" which is defined as gross public debt measured as a proportion of tax revenues. The vector also includes the share of country *i*'s exports to the U.S. or the euro area in its total exports when *C* is either the dollar or the euro, respectively. This variable refers to country *i*'s exports share in total world exports when we estimate the share of total foreign currencies-denominated debt.

Vector D_{it}^{C} includes the dummies pertaining to country *i*'s exchange rate arrangements, such as pegs to the dollar or the euro, and to whether or not country *i* participates in the European Union (EU_i).The dummy for EU membership is assigned for the entire sample period regardless of the year of entry to the union (i.e., it is time-invariant).[12] Furthermore, we include the regional dummies for Asia and Latin America because these two areas have distinct preferences for the dollar in international debt securities.[13]

Finally, u_i^{C} refers to unobserved country effects, which are *i.i.d.* N(0, σ^2_u) and v_{it}^{C} to panel level effects, which are *i.i.d.* N(0, σ^2_v). The estimation model also includes time fixed effects to control for global common shocks. To assess whether a random-effects Tobit model is adequate, we calculate the ρ-statistic, which represents the percent contribution to the total variance of the panel-level variance component.[14]

3.2 Empirical Findings

Tables 1 through 3 report the results from the estimation on the shares of the dollar, the euro, and total foreign currencies (i.e., the reciprocal of the domestic currency), respectively, in international debt denomination. The finding that the ρ-statistic is significantly positive in all the three specifications confirm that our choice of the random-effects Tobit model is preferable to the standard Tobit estimation.[15]

The three tables suggest that a larger economy is less likely to denominate its international debt in either the dollar or the euro, but more likely to issue its debt in its own currency, indicating a larger economy tends to have more bargaining power in its debt issuance.

An economy with faster trend growth tends to denominate its international debt less in the dollar and more in the euro, though it does not necessarily change the proportion of international debt in its domestic currency.

This pattern of the estimates' signs and statistical significance across the three estimations is also found in the impact of financial development; its estimate is significantly negative in the dollar share estimation, significantly positive in the euro estimation, and insignificant in the estimation for the share of total foreign currencies. These findings indicate that countries with higher economic growth potentials or more developed financial markets could switch from solely relying on the dollar for international debt issuance to increasing the use of the euro as another potential currency to denominate for debt issuance, while not necessarily increasing the use of its own currency.

The estimate of financial openness takes similar patterns of the signs and statistical significance. However, unlike the previous two variables, the effect on financial openness in the total foreign currencies share is significantly negative. That is, while a country with more open financial markets tend to have a lower dollar share and a higher euro share in its international debt denomination, overall, greater financial openness would help *increase* the share of the domestic currency in international debt denomination. This bolsters the idea that financial liberalization is an important factor to reduce the extent of overall reliance on foreign currencies for international debt issuance.[16]

Not surprisingly, the more exports to the U.S. or the euro area a country has, the more likely it is for the country to denominate its international debt in the dollar or the euro, respectively. For developing countries, however, this factor becomes much weaker statistically for both currencies. Compared to the dollar share estimation, the magnitude of the trade volume

variable is generally higher in the euro share estimation, suggesting that the euro share in international debt denomination is more responsive to the intensity of trade with the euro area. In the estimation for the share of total foreign currencies, we see that the greater trade presence a country has, the less reliant on foreign currencies, i.e., more reliant on the domestic currency for debt denomination.

Interestingly, the effect of institutional development is significantly negative for both the euro share and total foreign currency share estimations although it is never significant in the dollar share estimation. These findings imply that developing institutions and legal systems could help countries to issue more debt in their own currencies.

"Fiscal space" is also an important factor to reduce the share of foreign currency-denominated debt. The better fiscal conditions a country has (i.e., a decline in the fiscal space variable), the more international debt it tends to denominate in its own currency. That is, a more indebted country would face higher expected inflation and more currency depreciation pressure, which makes it more expensive to issue its debt in local currency. In such a case, issuing debt in major currencies would be a more viable choice so that investors can avoid exchange rate risk.[17]

These results are in line with the arguments made by Calvo and Guidotti (1990) and Corsetti and Mackowiak (2002), both of which argue that an economy with serious solvency problems tend not to issue debt in the domestic currency. Neither fiscal space nor institutional quality matters for the dollar share.

Overall, when we restrict our sample to include only developing countries, the estimation results are intact, except for the variables for growth potential and the share of exports to the U.S. Both the magnitude and statistical significance of the growth potential variable rise, though the level of significance varies across different estimation models. The lack of statistical significance for the share of exports to the U.S. is consistent with what we found in Figure 4 (a).

In Table 4, in order to assess the economic significance of the results for developing countries from the three currency share estimations, we examine the impacts of a one-standard deviation change in each of the explanatory variables in terms of the numbers of standard deviations (Column (1)) and of the percentage points of the share (Column (2)).[18]

Overall, we find that financial openness has the most significant economic impact on the currency shares in international debt denomination. A one standard deviation increase in the variable for financial openness would reduce the dollar share in international debt denomination

by 7.4 percentage points (or 0.4 standard deviations), increase the euro share by 8.3 percentage points (0.3 standard deviations), and reduce the share of total currencies by 1.4 percentage points (0.2 standard deviations). Again, financial liberalization seems to switch the currency of denomination from the U.S. dollar to the euro and to a lesser degree encourage countries to issue international debt more in their own domestic currencies.

As far as the estimation on the dollar share is concerned, the impact of domestic saving, our proxy for potentials for further financial development, is even greater. A one standard deviation increase in domestic saving can lead to an 8.2 percentage points (or a 0.4 standard deviations) decrease in the dollar share, though it does not affect either the euro or total currency share.

Panel (c) of the table also makes it clear that in order to increase the share of domestic currency-denominated international debt, it is important for a developing country to be a great exporter, have more open financial markets and more developed institutions, and have better fiscal conditions.

As far as we are aware, few other studies have looked into the determinants of the use of individual currencies for international debt denomination. The lack of comparative studies leads us to compare our findings with past studies in the "original sin" literature in which researchers examine the determinants of reliance on foreign currencies as an aggregate.

In that sense, Hausmann and Panizza (2003) and Bobba et al. (2007) also find that larger economies or economies with greater global trade presence tend to rely less on foreign currencies, i.e., more on their domestic currencies for international debt issuance. Hausmann and Panizza (2003) find that imposing capital controls would increase the share of the domestic currency in domestic debt, thereby lowering the degree of "original sin", which is in line with our finding. Mehl and Reynaud (2010), however, find no significant impact of financial openness on foreign currency denomination in domestic government debt. According to Claessens et al. (2007), foreign investors are more likely to invest in a country's bonds denominated in a foreign currency when its economy experiences low inflation or has its financial markets more open. They also find that country size, the size of the banking system, lower quality institutions, and flexible exchange rates are negatively correlated with the share of foreign currency denominated government bonds.

3.3 Robustness Checks

The sort of empirical exercise we have done thus far entails the risk of getting biased estimates because of missing variables or misspecification of the estimation model. To test the robustness of the main results, we have also conducted a large number of additional tests by examining other candidate explanatory variables and also using other estimation models.

In Appendix B, we present the results from the robustness checks, looking into the impacts of currency and debt crises, different measures of financial openness and linkages, currency weights, trade invoicing, and interest and exchange rates. We also test with a seemingly unrelated regression specification to incorporate the possibility that the error terms are correlated between the estimations for the dollar and euro shares.

Overall, we find that the results are indeed robust. The reader is referred to Appendix B for more details and the summaries of the findings.[19]

4 Counterfactual Analyses

Given its significance, the GFC of 2008 may have caused structural changes in currency choice for debt denomination for both developed and developing economies. We argue that had it not been for the GFC in 2008, the trends of the declining dollar share and the rising euro share would have continued. Chinn and Frankel (2007) predicted such trends for the two currencies in terms of foreign reserve holdings. In retrospect, the onset of the GFC may have contributed significantly to altering such predictions.

We now conduct a counterfactual analysis to examine how the shares of the dollar and the euro in international debt denomination would have evolved if it had not been for the GFC. If the impact of the crisis is significant, the counterfactual predictions based on the pre-crisis data should not only differ from the actual development of the shares, but also reflect the pre-crisis trends of declining dollar shares and rising euro shares as Chinn and Frankel (2007) show.

For this scenario analysis, we first re-run each of the three share estimations by using the data up to 2007.[20] Then, we make out-of-sample predictions for the post-GFC years by applying the actual data from 2008-2015 to the estimates obtained based on the data up to 2007. The out-of-sample predictions should reflect the pre-GFC trend if the crisis acted as a structural break.[21]

Figure 5 (a) presents the country group averages of the out-of-sample forecasts of the shares of the dollar and the euro for the subsample of developing countries. For the sake of

comparison, we also show the in-sample predictions using the data of the whole sample period in Figure 5-(b).

The out-of-sample predictions look consistent with our priors. In the years after 2007, the predicted share of the dollar using the pre-crisis estimates is lower than the actual share, while that of euro is higher.

Among developing countries, without the GFC, the dollar share could have fallen to 61% by 2015 while in actuality it rose up again to 77%, slightly below around the level of the late 1990s. The in-sample prediction also under-predicts the observed dollar share marking 67%, suggesting the rise in the dollar share was unexpected. The euro share could have continued on a moderate rising trend, reaching around 23% by 2015 in the no-GFC scenario. However, in fact, after hitting its peak around 20% in 2006, the share declined to around 10%. These results suggest that the crisis helped strengthen the dominant role of the dollar in international debt denomination while weakening the position of the euro as the second large currency.

We repeat the same exercise for the share of total foreign currency denomination. Figures 6 (a) and 6 (b) illustrate the observed shares along with the out-of-sample predictions and the in-sample predictions, respectively, for the developing countries sample. The figures show that the average share of foreign currency-denominated debt would have moderately declined without the crisis (shown in whether in- or out-of-sample predictions). By 2015, the share of foreign-currency denominated debt in the no-crisis situation would have been smaller by about 5 percentage points.

Interestingly, comparing these results with the ones for the full sample (not reported), we can see that most of the difference between the observed share series and the out-of-sample predictions is driven by the developing country group, suggesting that the impact of the crisis on the extent of foreign currency debt denomination is larger for this group of countries. These results are not only consistent with our priors but also suggestive that a “redemption from original sin” might have happened if the crisis had not occurred.

5 Concluding Remarks

In this study, we have characterized the recent trends in the shares of the dollar, the euro, and total foreign currencies in international debt denomination over the last two decades, and empirically investigated the determinants of the shares. Using the estimation results, we also

conducted counterfactual analyses, focusing on how the currency shares in international debt denomination would have developed if the GFC had not occurred. In these analyses, we obtain several interesting results.

First, we find that the extent of fall in the degree of reliance on foreign currencies for international debt – one of the key aspects of the original sin for developing countries – has been quite modest. This finding is consistent with Hausmann and Panizza (2010). However, the shares of the dollar and the euro in international debt denomination have been changing more substantially in the last two decades.

Before the GFC of 2008, the share of the dollar had been on a declining trend, while that of the euro on a steadily rising trend. After the crisis, however, the dollar share rebounded while the euro share fell, reflecting investors' flight to safety and liquidity, both of which can be provided by the world's most dominant currency, the dollar. In fact, while the use of the euro is more or less proportional to the share of the euro economies in the total export destination, the use of the dollar for debt denomination is disproportionally higher than the share of the U.S. as an export destination suggests.

Our estimation results show that countries with high economic prospects, greater financial development, and more investment opportunities tend to decrease the extent of reliance on the dollar but increase that on the euro, though they do not necessarily change their dependency on foreign currencies in general. These findings suggest that financial openness or development could lead to less reliance on the dollar but that would also provide countries with more currency choices for denomination, including the euro or the domestic currency.

Interestingly, countries with greater "fiscal space" tend to denominate debt less in foreign currencies in general. This result suggests that a country with better fiscal conditions can afford to issue debt more in its own domestic currency in the international financial markets.

Large players in international trade are less reliant on foreign currency debt issuance. Having stronger trade ties with the U.S. or the euro area contributes to currency choice for international debt issuance. However, this is not the case for developing countries. Thus, in their case, the extent of reliance on the dollar or the euro for international debt issuance can be affected by other factors than just trade relations.

From the out-of-sample predictions for the post-GFC period using the data up to 2007, we see that had the trend of the share of dollar denomination in international debt continued after

2008, the currency share would have been lower—around 61%, rather than the actual share of 77% as of 2015. The share of the euro would have been around 23% instead of the actual 10% and the share of total foreign currencies would have been 89% instead of 94%. These findings indicate that the outbreak of the GFC increased the demand for the dollar as a safe haven and significantly affected the determination of currency choice for international debt issuance, suggesting that the dollar is, and will most likely continue to be, the currency that can provide a safe haven in the current international monetary system (Prasad, 2014).

References

Aldasoro, I. and T. Ehlers. 2018. Global Liquidity: Changing Instrument and Currency Patterns. *BIS Quarterly Review*, September 2018. Bank for International Settlements.

Avdjiev, S., V. Bruno, K. Coch, & H.S. Shin. 2018. The Dollar Exchange Rate as a Global Risk Factor: Evidence from Investment. BIS Working Paper #695.

Avdjiev, S., M. Chui, & H. Shin. 2014. Non-financial Corporations from Emerging Market Economies and Capital Flows. *BIS Quarterly Review*. Basel: Bank for International Settlements.

Avdjiev, S., L. Gambacorta, L. Goldberg, & S. Schiaffi. 2017. The Shifting Drivers of Global Liquidity. Staff Report No. 819, New York: Federal Reserve Bank of New York.

Bank of International Settlements. 2019. *Triennial Central Bank Survey of Foreign Exchange and Over-the-Counter (OTC) Derivative Markets in 2019*. Basel, Switzerland.

Bobba, M, G. Della Corte and A. Powell. 2007. On the Determinants of International Currency Choice: Will the Euro Dominate the World? Working Paper #611, Inter-American Development Bank.

Calvo, G. and Guidotti, P. 1990. Indexation and the Maturity of Government Bonds: An Exploratory Model. In Dornbusch, R, Draghi, M. (Eds.), *Public Debt Management: Theory and History*. Cambridge University Press, 52-82.

Calvo, G. and Reinhart, C., 2002. Fear of floating. *Quarterly Journal of Economics* 98(2), 379–408.

Chang, R. and A. Velasco. 2006. Currency mismatches and monetary policy: A tale of two equilibria, *Journal of International Economics*, 69, 1, 150-175.

Chinn, M. D., and J. A. Frankel. 2007. Will the Euro Eventually Surpass the Dollar as Leading International Reserve Currency? In *G7 Current Account Imbalances: Sustainability and Adjustment*, edited by R. Clarida. University of Chicago Press.

Chui, M., I. Fender, & V. Sushko. 2014. Risks related to EME Corporate Balance Sheets: the Role of Leverage and Currency Mismatch. *BIS Quarterly Review*. Basel: Bank for International Settlements.

Claessens, S., D. Klingebiel, and S. Schmukler. 2007. Government Bonds in Domestic and Foreign Currency: The Role of Institutional and Macroeconomic Factors. *Review of International Economics*, 15, 2: 370-413.

Cohen, B.H., 2005. Currency choice in international bond issuance1. *BIS Quarterly Review*, p.53.

Corsetti, G. and B. Mackowiak. 2002. Nominal Debt and Currency Crises. Yale University, Unpublished manuscript.

Du, W. and J. Schreger. 2016. Local currency sovereign risk. *The Journal of Finance*, 71(3), 1027-1070.

Eichengreen, B. 2010. Managing a Multiple Reserve Currency World. The 21st Century International Monetary System, ed. Wing Thye Woo (Asian Development Bank).

Eichengreen, B., Hausmann, R., and Panizza U., 2002. Original Sin, The Pain, The Mystery and The Road to Redemption. Harvard University and UC Berkeley, Unpublished manuscript

Gruic, B. and P. Wooldridge 2013. Who is Issuing International Bonds Denominated in Emerging Market Currencies? *BIS Quarterly Review*, December, 22-23.

Habib, M.M. and M. Joy. 2010. Foreign-currency bonds: Currency choice and the role of uncovered and covered interest parity. *Applied Financial Economics*, 20(8), 601-626.

Hausmann, R. and U. Panizza. 2003. On the determinants of Original Sin: an empirical investigation. *Journal of International Money and Finance* 22(7), 957-990.

———. 2010. Redemption or Abstinence? Original Sin, Currency Mismatches and Counter-Cyclical Policies in the New Millennium, Center for International Development Working Paper #194. Harvard University.

Ito, H. and M. Chinn. 2015. "The Rise of the 'Redback' and China's Capital Account Liberalization: An Empirical Analysis on the Determinants of Invoicing Currencies." In Eichengreen, B. and M. Kawai, eds., *Renminbi Internationalization: Achievements, Prospects, and Challenges* (January 2015).

Ito, H. and Robert McCauley. 2019. A Key Currency View of Global Imbalances, *Journal of International Money and Finance*, vol 94, pp 97-115.

Ito, H. and M. Kawai. 2016. Trade Invoicing in Major Currencies in the 1970s-1990s: Lessons for Renminbi Internationalization. *Journal of the Japanese and International Economies*, 42, December, 123–145.

Ize, A. and Levy-Yeyati, E., 2003. Financial Dollarization. *Journal of International Economics* 59(2), 323– 347.

McCauley, R., P. McGuire., & V. Sushko. 2015. Global dollar credit: links to US monetary policy and leverage. *Economic Policy*, vol 30, no 82, pp 187-229.

Mehl, A. and Reynaud, J., 2010. Risky public domestic debt composition in emerging economies. *Journal of International Money and Finance*, 29(1), 1-18.

Prasad, E. 2014. *The Dollar Trap: How the U.S. Dollar Tightened Its Grip on Global Finance.* Princeton University Press.

Shin H.S. 2014. The Second Phase of Global Liquidity and Its Impact on Emerging Economies. In: Chung K., Kim S., Park H., Choi C., Shin H.S. (eds) *Volatile Capital Flows in Korea*. Palgrave Macmillan, New York.

Tovar, C and T Nor. 2018. Reserve currency blocs: a changing international monetary system? IMF Working Papers #18/20.

Tarashev, N., S. Avdjiev, & B. Cohen. 2016. International Capital Flows and Financial Vulnerabilities in Emerging Market Economies: Analysis and Data Gaps. Bank for International Settlements.

Siegfried, N., E. Simeonova, and C. Vespro. 2007. “Choice of currency in bond issuance and the international role of currencies”, European Central Bank Working Paper #814.

Table 1: Determinants of the U.S. Dollar Share in International Debt, 1995-2015

	FULL SAMPLE				DEVELOPING COUNTRIES			
Dep. Var.: % of Dollar	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log (GDP)	-5.963***	-5.229***	-6.382***	-5.588***	-5.797***	-5.626***	-5.967***	-5.927***
	(1.180)	(1.186)	(1.243)	(1.241)	(1.420)	(1.475)	(1.460)	(1.503)
Real GDP growth trend	-0.593**	-0.438	-0.264	-0.142	-0.980***	-0.749**	-0.751**	-0.531
	(0.298)	(0.289)	(0.323)	(0.310)	(0.350)	(0.338)	(0.367)	(0.353)
Domestic savings (% of GDP)	-0.510***	-0.537***	-0.379***	-0.393***	-0.705***	-0.762***	-0.571***	-0.593***
	(0.121)	(0.120)	(0.123)	(0.122)	(0.143)	(0.143)	(0.134)	(0.132)
Inflation volatility	0.487**	0.521***	0.248	0.276	0.470**	0.525**	0.307	0.346
	(0.196)	(0.190)	(0.200)	(0.191)	(0.218)	(0.208)	(0.217)	(0.216)
Fiscal space (reciprocal)	0.725	1.224	1.407	1.803	1.376	1.861	2.320	2.459
	(1.683)	(1.627)	(1.753)	(1.685)	(2.123)	(2.050)	(2.098)	(2.018)
Financial development	-0.077***	-0.068***	-0.064***	-0.055**	-0.173***	-0.129***	-0.147***	-0.093*
	(0.022)	(0.022)	(0.022)	(0.022)	(0.047)	(0.047)	(0.049)	(0.049)
Exports to the U.S. (% of total exp.)	0.156*	0.133	0.222**	0.188**	0.091	0.053	0.085	0.030
	(0.094)	(0.091)	(0.097)	(0.094)	(0.110)	(0.108)	(0.110)	(0.107)
EU dummy	-55.135***	-53.629***	-48.726***	-47.840***	-67.438***	-68.992***	-60.923***	-60.955***
	(8.880)	(8.391)	(9.007)	(8.729)	(10.148)	(9.749)	(10.136)	(9.943)
Quality of institutions		-3.163**		-2.360		-2.060		-2.318
		(1.465)		(1.463)		(1.849)		(1.824)
Financial openness			-19.417***	-20.041***			-19.103***	-21.315***
			(3.957)	(3.811)			(5.172)	(5.108)
σ_u^2	24.818***	22.484***	24.731***	23.167***	24.316***	22.594***	24.046***	22.899***
σ_v^2	12.707***	12.213***	12.227***	11.599***	13.643***	12.962***	13.520***	12.739***
ρ	0.792	0.772	0.804	0.800	0.761	0.752	0.760	0.764
LR test σ_u^2=0	855***	734***	776***	673***	518***	465***	458***	407***
Observations	1,014	955	880	828	785	726	733	678
Countries	84	75	82	73	74	65	72	63

Notes: * p<0.1; ** p<0.05; *** p<0.01. Robust standard errors are presented in parentheses. All specifications control for geographical regions, currencies pegged to the U.S. dollar or the euro, and for the period after the introduction of the euro as a currency as well as year fixed effects and a constant term, but we do not report their estimates to conserve space. The EU dummy is time invariant. See Appendix A for the definitions and constructions of the data. $\sigma_u^2$and σ_v^2 are the panel-level and overall variance components respectively, while ρ is the percent contribution to the total variance of the panel-level variance component. The null hypothesis of the LR test is that the standard Tobit model is better suited than the random-effect Tobit.

Table 2: Determinants of the Euro Share in International Debt, 1995-2015

	FULL SAMPLE				DEVELOPING COUNTRIES			
Dep. Var.: % of euro	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log (GDP)	-2.049*	-3.046***	-2.205*	-3.246***	-2.202	-4.329***	-1.959	-3.802**
	(1.140)	(1.117)	(1.229)	(1.194)	(1.570)	(1.589)	(1.682)	(1.712)
Real GDP growth trend	1.211***	1.351***	0.771**	0.787**	1.571***	1.848***	0.935**	1.094***
	(0.299)	(0.294)	(0.314)	(0.309)	(0.397)	(0.391)	(0.419)	(0.417)
Domestic savings (% of GDP)	0.074	0.010	-0.001	-0.036	0.198	0.142	0.077	0.052
	(0.135)	(0.134)	(0.142)	(0.140)	(0.177)	(0.175)	(0.185)	(0.185)
Inflation volatility	-0.001	-0.103	0.213	0.123	-0.167	-0.300	0.029	-0.095
	(0.223)	(0.218)	(0.218)	(0.214)	(0.270)	(0.264)	(0.259)	(0.257)
Fiscal space (reciprocal)	1.538	1.224	2.759*	2.623	1.940	1.193	3.146	2.410
	(1.639)	(1.583)	(1.650)	(1.602)	(2.411)	(2.355)	(2.426)	(2.416)
Financial development	0.094***	0.103***	0.081***	0.087***	0.065	0.075*	-0.010	0.006
	(0.020)	(0.020)	(0.020)	(0.020)	(0.046)	(0.044)	(0.047)	(0.047)
Exports to the euro area	0.538***	0.463***	0.411***	0.390***	0.451***	0.322*	0.214	0.172
(% of total exp.)	(0.122)	(0.118)	(0.125)	(0.121)	(0.168)	(0.165)	(0.173)	(0.171)
EU dummy	18.019***	21.650***	12.280*	15.900**	32.129***	34.915***	25.027**	26.103**
	(6.394)	(6.126)	(7.165)	(6.747)	(8.815)	(8.700)	(10.031)	(10.250)
Quality of institutions		-5.906***		-6.948***		-6.946***		-6.819***
		(1.217)		(1.236)		(1.924)		(1.943)
Financial openness			21.526***	21.893***			28.836***	26.724***
			(3.130)	(3.035)			(5.236)	(5.184)
σ_u^2	19.640***	17.817***	21.812***	19.307***	20.983***	19.389***	23.802***	22.672***
σ_v^2	11.253***	10.990***	10.527***	10.324***	12.820***	12.456***	11.752***	11.520***
ρ	0.753	0.724	0.811	0.778	0.728	0.708	0.804	0.795
LR test σ_u^2=0	579***	543***	603***	569***	357***	322***	387***	357***
Observations	833	816	745	731	608	591	552	538
Countries	70	67	67	64	60	57	57	54

See the Notes for Table 1.

Table 3: Determinants of the Share of Foreign-Currency Denominated International Debt, 1995-2015

	FULL SAMPLE				DEVELOPING COUNTRIES			
Dep. Var.: % of Foreign-Currency	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log (GDP)	-2.746***	-2.042***	-1.640***	-2.001***	-1.029***	-1.297***	-1.013***	-1.379***
	(0.343)	(0.337)	(0.290)	(0.345)	(0.284)	(0.341)	(0.288)	(0.365)
Real GDP growth trend	-0.050	-0.138	-0.165**	-0.144	-0.126*	-0.101	-0.128	-0.093
	(0.094)	(0.084)	(0.079)	(0.088)	(0.074)	(0.078)	(0.079)	(0.089)
Domestic savings (% of GDP)	-0.005	-0.026	-0.020	-0.023	-0.028	-0.024	-0.021	-0.025
	(0.032)	(0.030)	(0.026)	(0.030)	(0.024)	(0.027)	(0.025)	(0.029)
Inflation volatility	0.035	-0.006	-0.009	-0.014	-0.003	-0.016	-0.006	-0.009
	(0.058)	(0.051)	(0.048)	(0.051)	(0.045)	(0.046)	(0.046)	(0.050)
Fiscal space (reciprocal)	2.601***	1.586***	1.926***	2.127***	0.648	0.412	1.070**	1.165**
	(0.510)	(0.468)	(0.424)	(0.475)	(0.422)	(0.457)	(0.434)	(0.498)
Financial development	0.011	-0.001	-0.004	-0.003	-0.010	-0.003	-0.009	-0.002
	(0.009)	(0.008)	(0.007)	(0.008)	(0.011)	(0.012)	(0.011)	(0.013)
Share of Exports (% of world exp.)	-2.035***	-4.005***	-3.256***	-2.995***	-4.058***	-4.172***	-3.199***	-3.028***
	(0.379)	(0.400)	(0.372)	(0.428)	(0.354)	(0.386)	(0.365)	(0.423)
EU dummy	0.085	-0.364	1.116	1.378	0.968	0.401	2.200	1.988
	(2.435)	(2.103)	(1.960)	(2.097)	(1.970)	(2.145)	(1.917)	(2.152)
Quality of institutions		-1.350**		-1.771***		-2.194***		-2.116***
		(0.592)		(0.571)		(0.559)		(0.578)
Financial openness			-4.341***	-4.593***			-3.646***	-3.877***
			(0.982)	(1.092)			(1.017)	(1.170)
σ_u^2	6.613***	5.570***	5.194***	5.425***	4.510***	4.815***	4.292***	4.695***
σ_v^2	5.480***	4.590***	4.161***	4.251***	4.156***	4.102***	4.010***	4.124***
ρ	0.593	0.596	0.609	0.620	0.541	0.579	0.534	0.564
LR test σ_u^2=0	579***	517***	567***	497***	463***	410***	370***	316***
Observations	1,200	1,046	1,045	912	952	817	829	704
Countries	88	81	86	78	78	71	76	68

See the Notes for Table 1.

Table 4: Predicted Impacts of a One-standard deviation Change on the Currency Shares for Developing Countries

(a) Dollar Share

Predicted Impact of 1 S.D.	(1)	(2)
	In SDs of Dep. Variable	In Percentage Points
Dom. Savings/GDP***	-0.39	-8.24
Financial Openness***	-0.28	-7.43
Inflation Volatility	0.14	3.61
Financial Development	-0.13	-3.51
Quality of Institutions	-0.08	-2.19
Fiscal Space (reciprocal)*	0.08	2.09
Real GDP growth	-0.06	-1.57
Exports to U.S. (% of total)	0.02	0.57
Log (GDP)***	0.00	-0.10

(b) Euro Share

	(1)	(2)
	In SDs of Dep. Variable	In Percentage Points
Financial Openness***	0.28	8.29
Exports to euro area (% of total)	0.11	3.51
Real GDP growth***	0.09	2.80
Quality of Institutions***	-0.06	-2.01
Fiscal Space (reciprocal)	0.06	1.87
Dom. Savings/GDP	0.02	0.60
Inflation Volatility	-0.01	-0.28
Financial Development	0.01	0.24
Log (GDP)**	0.00	-0.06

(c) Share of Total Foreign Currencies

	(1)	(2)
	In SDs of Dep. Variable	In Percentage Points
Share of Exports in world exp.***	-0.42	-3.12
Financial Openness***	-0.18	-1.36
Quality of Institutions ***	-0.16	-1.21
Fiscal Space (reciprocal)**	0.13	0.97
Dom. Savings/GDP	-0.06	-0.42
Real GDP growth	-0.04	-0.28
Inflation Volatility	-0.01	-0.09
Financial Development	-0.01	-0.07
Log (GDP)***	0.00	-0.02

The table reports the impacts of a one standard deviation change in the explanatory variables on the share of the dollar, the euro, and total foreign currencies in terms of the numbers of standard deviations (1) and of percentage points of the share (2) based on the estimation results reported in Tables 1 through 3. Asterisks correspond to what is reported in the respective tables. * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

[1] Since each transaction in the foreign exchange market involves two currencies, the sum of shares in market turnover for individual currencies totals 200%. The data are based on BIS (2019).

[2] Ito and McCauley (2019) find that in the period of the 1970s through the 2010s, the U.S. dollar zone accounts for a fairly consistent 50-60% of world GDP. Tovar and Nor (2018) also find the share to be 60% while Ilzetzki et al (2019) find that the dollar zone covers 70% in recent years.

[3] For the role of international debt securities in the "second phase of global liquidity" refer to Shin (2013), Avdjiev et al (2014), Chui et al (2014) and Avdjiev et al (2017).

[4] See McCauley et al (2015), Tarashev et al (2016), Aldasoro and Ehlers (2018), and Avdjiev et al (2018).

[5] Strictly speaking, we are dealing with *international* original sin. In contrast, *domestic* original sin refers to the inability of countries to borrow in local currency at long maturities and fixed rates domestically (Mehl and Raynaud, 2010; and Hausmann and Panizza, 2010, 2013).

[6] The discrete change in 2002 in Figure 1 (b) reflects the inclusion of Brazil and Korea in the dataset, for which no data are available before that year. In 2002, the volume of domestic debt securities is $1.63 trillion, rising from $0.65 trillion in 2001. Excluding Brazil and Korea, the comparable figure would be $0.83 trillion. We thank an anonymous referee for this observation.

[7] The domestic debt securities (DDS) dataset from the BIS does not distinguish whether (domestic) debt is issued in local currency or foreign currency. That means that it is not possible to aggregate the DDS with the IDS dataset for the purpose of our paper. Furthermore, other datasets exist and contain domestically-issued data with currency decomposition such as Arslanalp and Tsuda (2014) and the Coordinated Portfolio Investment Survey by the IMF. However, both datasets lack comprehensive country-year coverage. In contrast, international debt data is more consistently available across countries, especially for developing countries.

[8] Previous studies by Cohen (2005), Siegfried et al. (2007), and Habib and Joy (2008) use proprietary bond-level data (Thompson or Dealogic) for corporations in developed countries and analyze the probability of choosing an issuing currency.

[9] To maintain data consistency, we also exclude the euro member countries from the sample even before the introduction of the euro in 1999 (or whenever they became the members).

[10] Du and Schreger (2016) and Gruic and Wooldridge (2013), among others, argue that the ability of emerging markets to borrow abroad in their own currencies has improved in the last decade, particularly, for countries such as Brazil, Colombia, Mexico, South Africa, and Turkey.

[11] Reflecting the high demand for the dollar, compared to the pre-GFC period, the dollar appreciated by 14.8% in nominal terms (11.7% in real terms) by March 2009.

[12] This is due to stylized facts that the behavior of currency denomination tends to differ for EU member countries even before they actually become the members. This is partly because they usually belong to precursor organizations (e.g., the European Community) before the membership and they are geographically proximate to the member countries (e.g., former communist states).

[13] In Appendix A, we provide data descriptions and sources and present the rationales for the choice of variables and the expected signs of their estimates. The appendix also lists the countries included in the analysis.

[14] The ρ-statistic is defined as $\rho = \sigma^2_u/(\sigma^2_v + \sigma^2_u)$, where the overall and panel-level variance components are σ^2_v and σ^2_u, respectively. When ρ is close to zero, the panel-level variance component is unimportant, and the panel estimator is not different from the pooled estimator. In other words, this implies that the random-effects Tobit estimation would not be significantly different from a standard Tobit one. We formally compare the two models with a likelihood-ratio test, where the null hypothesis is that the standard Tobit is better suited than the random-effect Tobit.

[15] While the standard Tobit estimation does not incorporate unobservable country effects, the random-effects Tobit model does.

[16] This result is also consistent with Ito and Chinn (2015) and Ito and Kawai (2016) on currency choice for trade invoicing.

[17] Because the IDS can be disaggregated by the sector, i.e., general government, private financial, and private non-financial, we rerun the estimation of the share of total foreign currencies for each sector and find that the estimate for the *fiscal space* variable is significantly positive for the general government and the private financial sectors. These findings indicate that the results in Table 3 are not exclusively driven by the public sector, and that the private financial sector can also benefit from better fiscal conditions in the government-sector.

[18] We use the estimation results of (8) in Tables 1 through 3. Each panel reports the same set of selected explanatory variables and lists them in the order of their impacts in absolute values.

[19] As an additional robustness check, we also re-estimate the benchmark specification across the three currency shares using a common sample. We find that our main results are unaffected. The results are available upon request.

[20] For the predictions, we use specification (8) of Tables 1 through 3. We also test the coefficient stability over the crisis period and significantly reject the stability of the estimates for all three types of currency share estimations. Furthermore, we perform structural break tests to find out the most significant structural break. These tests reveal that the year of 2008 is the most significant structural break.

[21] Strictly speaking, for this sort of exercise, we should use the ex-ante (e.g., forecasted or surveyed) data as of 2007 so that the out-of-sample would be more orthogonal of the breakout of the crisis. However, it is not feasible to obtain such ex-ante data for all of the explanatory variables. Hence, our counterfactual predictions are rather conservative in terms of showing the trends of the currency shares in the non-crisis scenario.

Appendix A: Data Descriptions and Country List

PREDICTED SIGNS AND DATA SOURCES

Share of International debt securities denominated in the dollar, the euro, and total foreign currencies – The outstanding international debt securities denominated in the dollar, the euro, and total foreign currencies are divided by the total outstanding international debt securities. The data are extracted from the BIS International Debt Security database (IDS). In the estimation, we do not include the debt securities data for the U.S. or the euro member countries. The data for the euro member countries are excluded even before the introduction of the euro in 1999 or whenever they became the members because we cannot treat the data of these countries in a consistent manner before and after they became the members. For example, debt securities issued in the Deutsche mark in the German market by, say, France are not the same as France's debt securities issued in Germany but denominated in the euro, because, while the former was a foreign currency-denominated debt, the latter is denominated in its own currency. This issue can arise to any debt denominated in other "legacy currencies." Also, euro-denominated debt could mean debt securities issued by a euro member country (e.g., Spain) but held by another euro country (e.g., France), making the issue of what makes "international" or "domestic" complex. To avoid confusion or any inconsistency, we exclude the euro member countries completely from all the three kinds of estimations for the entire sample period.

Economic size – The economic size of a country should affect the choice of currency for debt denomination; a large economy may have more bargaining power in negotiating the terms of the debt, which may allow it to issue its debt more in its own currency. Also, a large economy may be endowed with more economic and physical resources to pay off its debt. However, a large economy can also afford to diversify currencies of debt denomination, which can also mean a non-dollar currency, i.e., the euro can be more used for debt denomination. Hence, we expect the impact of economic size to be negative for the share of the dollar or total foreign currencies, but the impact on the share of the euro is ambiguous. The GDP of each country is converted to U.S. dollars before being expressed in natural log. The data are extracted from the IMF's *World Economic Outlook (WEO)* Database (October 2016).

Growth trend – An economy with higher growth potential may issue more international debt in its own currency because of the higher prospects of repaying its debt. The expected sign of this variable can be similar to that of economic size. Hence, the impact of growth potential is expected to be negative for the share of the dollar or total foreign currencies, but ambiguous for the share of the euro. The five-year (t–4 through t) average of the growth rate of real GDP (in local currency) is used. The original data are from the *WEO*.

Domestic savings – An economy with potential investment opportunities and room for more financial potential may be less reliant on hard currencies for debt issuance. We expect that domestic savings negatively affect the share of the dollar, the euro, or total foreign currencies. Domestic savings as a ratio to GDP is a proxy for investment opportunities or future financial development, included as a share of nominal GDP. The data are extracted from the *WEO*.

Inflation volatility – An unstable macroeconomic environment could make investors shy away from holding assets denominated in the currency with such uncertainty. A country with volatile inflation, a proxy for an unstable macroeconomic environment, tends to rely less on its home currency and more on hard currencies for debt denomination.[1] The expected sign is positive for all the three estimations. The five year average of annual standard deviations based on monthly, year-to-year rates of inflation. The original data are retrieved from the IMF *International Financial Statistics (IFS)*.

Fiscal space – Fiscal sustainability is an important factor for currency choice in debt denomination. The more indebted a country is, the more likely it is to face higher expected inflation and currency depreciation pressure, and the harder it becomes to issue its debt in local currency. In such a case, a more viable choice becomes issuing debt in major currencies so that investors could avoid exchange risk. We measure it with "fiscal space," or public debt measured as a proportion of tax revenues (Aizenman and Jinjarak, 2012). A lower value of this variable indicates more fiscal space. We expect a positive sign for the estimate in all the estimations. "Fiscal space" is measured as the log difference between general government gross debt and the five-year average of tax revenues. Both variables are retrieved from the *WEO*.

Financial development – A currency for which large, liquid, and deep markets exist should face lower transaction costs, and therefore should make debt denominated in the home currency more acceptable or appealing. For all of the three estimations, expect a negative sign for the estimate. It is total private credit as a share of GDP. The original data are extracted from the World Bank's *World Development Indicators (WDI)* database.

Trade with the U.S./the euro area/the World – The more exports bound for the issuer of an international currency a country has, the more likely it is to issue international debt in that currency, because its export proceeds, paid in the currency of the destination country, make it easier to repay the debt. Hence, we should expect a positive estimate for the share of exports to the U.S. or the euro area in the estimation of the share of the dollar or the euro, respectively. For the estimation of the share of total foreign currencies, we use the share of country *i*'s exports in total world exports. In this estimation, the export share variable also represents the sample country's bargaining power. The larger exporter in world trade should be able to invoice its exports more in its own currency. Hence, we expect a positive estimate for this variable as well. The data are from the IMF *Direction of Trade* database.

Dummy for dollar -or euro- peg: If a country pegs its currency to an anchor currency such as the dollar or the euro, it should tend to issue international debt in that currency.[2] The dummy is assigned based on the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).*

British Legal Origin – La Porta et al. (1997) have found that the national legal origin (whether English, French, German, or Scandinavian) strongly affects the regulatory environment for financial transactions and explains cross-country differences in financial development.

[1] The high use of Deutsche mark for both trade invoicing and international debt issuance before the advent of the euro is often attributed to the stability of the currency, backed by Germany's stable monetary policy (Tavlas, 1991).
[2] For the pre-euro period, the dummy is assigned for countries pegging their currencies to the Deutsche mark.

According to them, countries with British (common law) legal origin tend to develop financial systems that are friendlier toward bond markets. This suggests that countries with British legal origin tend to issue debt in their own currencies, making the suggested sign of the estimate negative in all the three estimations. The value of one is assigned to countries whose legal systems have British origin. The original data are from the World Bank's *WDI.*

Quality of Institutions – Countries with more developed legal systems or high-quality institutions can provide protective environments for property owners and therefore make it easier to issue international debt in their own domestic currencies. To capture the level of legal/institutional development, we include the first principal component of measures for law and order, bureaucracy quality, and corruption. As in the case of the British legal origin, we expect a negative estimate. It is the first principal component of law and order, bureaucracy quality, and corruption, all variables from the ICRG database. Higher values of these variables indicate better conditions.

Financial Openness (KAOPEN) by Chinn and Ito (2006) – The currency of a country with more open financial markets could provide more usability and investment opportunities for international investors. Hence, the more open capital account a country has, the more likely it is to issue debt in its own domestic currency, making the expected impact negative. *KAOPEN* is the first principal component of the original variables pertaining to regulatory controls over current or capital account transactions, the existence of multiple exchange rates, and the requirements of surrendering export proceeds, all of which are based on information regarding regulatory restrictions on cross-border capital transactions reported in the *AREAER*. See Chinn and Ito (2006 and 2008). The dataset is available at http://web.pdx.edu/~ito/ .

De Jure Measures of Financial Openness by Fernández, et al. (2015) –Based on the narrative description in the *AREAER*, the authors determine whether there are restrictions on international equity transactions, with 1 representing the presence of a restriction and 0 representing no restriction. The indexes for the aggregated average as well as for capital inflows and outflows are available.

FDI provided by the Center Economies – It is the ratio of the total stock of foreign direct investment from country *C* in country *i* as a share of country *i*'s GDP. We use the *OECD International Direct Investment* database.

Bank lending provided by the Center Economies – It is the ratio of the total bank lending provided by each of the Center Economies to country *i* shown as a share of country *i*'s GDP. We use the BIS database.

Currency weights (CZW) – The weights of the five major currencies (or four after the introduction of the euro in 1999) are estimated following the often used Frankel and Wei (1996) method. The estimates are those estimated in Ito and Kawai (2016). See their paper for more details on the estimation methodology.

Currency crisis dummy by Aizenman and Ito (2013) – To identify currency crisis, Aizenman and Ito (2013) use the exchange market pressure (EMP) index using the exchange rate against the currency of the base country as suggested by Eichengreen et al. (1995, 1996). The EMP index is defined as a weighted average of monthly changes in the nominal exchange rate, the international reserve loss in percentage, and the nominal interest rate.

Debt crisis dummy by Aizenman and Ito (2013) –Aizenman and Ito (2013) identify debt crisis by using the dataset by Reinhart and Rogoff (2011).

Interest rate differential – For the U.S. dollar share regressions, it is the difference between the 3-month Treasury bill of country *i* and the U.S. Treasury bill yield. For the euro share regressions, it is the difference between the 3-month Treasury bill of country *i* and the European Central Bank yield. For the total foreign currencies regressions, it is the difference between the 3-month Treasury Bill of country *i* and the average of the U.S., European Central Bank, Japan, and the U.K Treasury bills yields.

Exchange rate trend – Is the three-year moving average of the rate of growth of the nominal exchange rate in the currency share regressions. For the U.S. dollar or euro share regression, we use the nominal exchange rate of the U.S. dollar or the euro, respectively. For the regression of the share of total foreign currencies, we use the nominal effective exchange rate from the IMF's *International Financial Statistics*. To maintain consistency, we change the nominal exchange rates (against the dollar or the euro) so that higher values mean currency appreciation.

Trade invoicing by Ito and Chinn (2015) and Ito and Kawai (2016) – This measure is the share of exports and imports denominated in U.S. dollars and in euros.

References

Aizenman, J. and Jinjarak, Y., 2012, June. The fiscal stimulus of 2009–2010: trade openness, fiscal space, and exchange rate adjustment. In *NBER international seminar on macroeconomics* (Vol. 8, No. 1, pp. 301-342). Chicago, IL: The University of Chicago Press.

Aizenman, J., and H. Ito. 2013. Living with the Trilemma Constraint: Relative Trilemma Policy Divergence, Crises, and Output Losses for Developing Countries. *Journal of International Money and Finance* 49 p.28-51, (May 2014).

Chinn, M. D., and H. Ito. 2006. What Matters for Financial Development? Capital Controls, Institutions, and Interactions. *Journal of Development Economics* 81(1): 163–192.

———. 2008. A New Measure of Financial Openness. *Journal of Comparative Policy Analysis* 10(3): 309–322.

Eichengreen, B., Rose, A.K. and Wyplosz, C., 1995. Exchange market mayhem: the antecedents and aftermath of speculative attacks. *Economic policy*, *10*(21), pp.249-312.

Eichengreen, B., Rose, A.K. and Wyplosz, C., 1996. *Contagious currency crises* (No. W5681). National bureau of economic research.

Fernández, Andrés, Michael W. Klein, Alessandro Rebucci, Martin Schindler, and Martín Uribe. 2015. "Capital Control Measures: A New Dataset," NBER Working Paper series #20970. Cambridge, MA: National Bureau of Economic Research.

Frankel, J. and S.J. Wei. 1996. Yen Bloc or Dollar Bloc? Exchange Rate Policies in East Asian Economies, In T. Ito and A. Krueger, eds., *Macroeconomic Linkage: Savings, Exchange Rates, and Capital Flows*, University of Chicago Press, pp 295–329.

Ito, H. and M. D. Chinn. 2014. The rise of the 'Redback' and China's Capital Account Liberalization: an Empirical Analysis on the Determinants of Invoicing Currencies, Asian Development Bank Institute Working paper no 473.

Ito, H. and M. Kawai. 2016. Trade Invoicing in Major Currencies in the 1970s-1990s: Lessons for Renminbi Internationalization. *Journal of the Japanese and International Economies*, vol 42, December, pp 123–145.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R.W., 1997. Legal Determinants of External Finance. *Journal of Finance* 52, 1131– 1150.

Reinhart, Carmen M. and Kenneth S. Rogoff. 2011. The Forgotten History of Domestic Debt, *Economic Journal*, Royal Economic Society, vol. 121(552), pages 319-350, 05.

Tavlas, G. S. 1991. On the International Use of Currencies: The Case of the Deutsche Mark. Essays in International Finance 181. Princeton, NJ: Princeton University.

COUNTRY LIST

Albania	Georgia	Mexico	Thailand
Algeria	Ghana	Moldova	Trinidad and Tobago
Australia [A]	Grenada	Morocco	Tunisia
Azerbaijan	Guatemala	Namibia	Turkey
Bahamas, The	Hong Kong SAR, China	New Zealand [A]	Ukraine
Bahrain	Hungary	Nigeria	United Arab Emirates
Barbados	Iceland [A]	Norway [A]	United Kingdom [A]
Belarus	India	Oman	Uruguay
Belize	Indonesia	Pakistan	Venezuela, RB
Bolivia	Iran, Islamic Rep.	Papua New Guinea	Vietnam
Brazil	Iraq	Paraguay	
Bulgaria	Israel	Peru	
Canada [A]	Jamaica	Philippines	
Chile	Japan [A]	Poland	
China	Jordan	Qatar	
Colombia	Kazakhstan	Russian Federation	
Congo, Rep.	Kenya	Saudi Arabia	
Costa Rica	Korea, Rep.	Senegal	
Cote d'Ivoire	Kuwait	Seychelles	
Croatia	Latvia	Singapore	
Czech Republic	Liberia	South Africa	
Denmark [A]	Lithuania	Sri Lanka	
Dominican Republic	Macedonia, FYR	St. Lucia	
Egypt, Arab Rep.	Malaysia	Suriname	
Fiji	Mauritania	Sweden [A]	
Gabon	Mauritius	Switzerland [A]	

Note: The countries included are divided into developing and advanced following the classification used by the IMF's World Economic Outlook. The superscript “A” stands for advanced economies.

Appendix B: Robustness Checks

The empirical exercise like the one we present in the paper entails the risk of getting biased estimates because of missing variables or misspecification of the estimation model. Here, we test the robustness of the main results by conducting a large number of additional tests and discuss the results.

Specifically, we examine the impacts of currency and debt crises, different measures of financial openness and financial linkages, currency weights, and interest and exchange rates. We also test with different estimation techniques such as using a fixed effects model, implementing a seemingly unrelated regression (SUR) specification in order to incorporate the possibility that the error terms are correlated between the estimations for the dollar and euro shares, and including the lags of the independent variable in the estimation.

Generally, we find that the results we present in the text are robust.

B.1 Impact of Financial Crises

Financial crisis may affect the share of a currency in international debt denomination. If the crisis causes an expectation of future devaluation of the crisis economy's currency, the volume of debt denominated in the domestic currency may fall while the volume of debt denominated in hard currencies, such as the dollar and the euro, may rise. We examine the impact of financial crisis by including dummy variables for currency and debt crisis in each of the three estimations, expecting the sign of the estimates of the dummies to be positive for all three currency shares.[1]

Table B-1 reports only the estimates of the two crisis dummies that are added to the three currency share estimations.[2] The estimates of the original explanatory variables are intact.

The occurrence of a debt crisis tends to increase the dollar and euro shares in international debt for both the full sample and the subsample of developing countries while the effect is much bigger on the euro share.

[1] We use the crisis dummies from Aizenman and Ito (2013). They use the exchange market pressure index to identify currency crisis. For the debt crisis dummy, they augment the dataset by Reinhart and Rogoff (2011) with other papers including the World Bank's Global Development Finance (2012). See Aizenman and Ito's (2013) appendix for more details.

[2] For the full sample, we use specification (4), and for developing countries, we use specification (8) from Tables 1 through 3.

The effect of currency crisis on the dollar or the euro share is found to be insignificant, though an occurrence of currency crisis increases the share of total foreign currencies.

B.2 Different Measures of Financial Openness and Financial Linkages

In the baseline analysis, we have seen the impact of financial openness on the currency shares both empirically and economically strong in all three estimations. However, as Kose et al. (2006) and Quinn, et al. (2011) argue, it is extremely difficult to compare the extent of financial openness, or the stringency of capital controls, across countries and over years.[3] That necessitates examining the effect of financial openness using other measures of financial openness.

As an alternative measure of financial openness, we use the de jure measures of capital controls developed by Fernández et al. (2015). While this dataset is also constructed using the IMF's *AREAER* like the Chinn-Ito index, it includes disaggregated measures of capital controls by the type of financial instruments –such as equity, bonds, and money market– as well as by the direction of capital flows, i.e., inflows or outflows. Higher values indicate that more stringent restrictions are imposed on cross-border transactions of equities.

As a second alternative, we also test the impact of a *de facto* measure of financial openness for which we use the sum of external assets and liabilities normalized by GDP. The data for external assets and liabilities are extracted from the database compiled by Lane and Milesi-Ferretti (2001, 2007, and 2017).

Finally, it is also possible to examine the extent of financial openness by looking at the volume of financial transactions a country has with respect to major currency issuers. To measure such financial linkages, we use the total stock of foreign direct investment (FDI) and bank lending provided by either the United States or the euro area to country *i* as a share of country *i*'s GDP, including it in place of the Chinn-Ito index.

Table B-2 presents the estimates of the alternative variables for financial openness or linkage when they are included in the estimations for the shares of the dollar, the euro, and total

[3] The approaches of measuring the extent of financial openness or capital controls can be categorized into two groups. One approach looks into the extensity and intensity of regulatory controls on cross-border capital transactions. Such a de jure approach usually uses information from the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)*. The other approach is to construct a de facto measure of financial openness, which can be done in several ways. One is to examine deviations from an interest rate parity such as the uncovered or covered interest rate parity. Another is to examine quantities of financial transactions such as external assets and liabilities, which can be normalized by GDP or trade volumes (Lane and Milesi-Ferretti, 2001, 2007, 2017).

foreign currencies. We only report the estimates of our concern for the subsample of developing countries. The first column of each table reports the estimates on the Chinn-Ito index of financial openness, which is extracted from column (8) of Tables 1 through 3 for comparison purposes.[4]

As far as the dollar and the euro share estimations are concerned, the estimates of the Fernández et al. (2015) index are consistent with those of the Chinn-Ito index. The more stringent capital controls country *i* puts in place, i.e., the less open financial markets it has, the more likely the country will issue international debt in the dollar and less likely in the euro. Also, both inflow and outflow indexes enter the estimations in consistent ways to the aggregate index, though the restrictions on capital inflows matter more than those on capital outflows.

The baseline estimation for the share of total foreign currencies in debt denomination found that the more open financial markets it has, the less likely the country issues its international debt in foreign currencies, i.e., the more likely it issues international debt in its own home currency. When we use the Fernández et al. (2015) measures, however, we do not find such results.

In the estimations that include the variable for FDI stock, or outstanding bank lending, provided by the U.S. or the euro area, we find that a country with strong bank lending ties with the euro area tends to issue international debt less in the dollar and more in the euro, but the impact of bank lending ties with the U.S. is not found to be significant. This finding also indicates that as far as the euro is concerned, the extent of financial linkage with the key currency issuer and the extent of denomination of international debt in that currency have a complementary relationship. Also, the extent of financial linkage with the euro has a (cross-currency) substitutive relationship with the extent of dollar denomination in international debt.

The significantly negative estimate on the variable for FDI provided by the U.S. in the euro share estimation suggests that the more FDI stock a country has received from the U.S., the less likely it is to denominate its international debt in the euro. This is another example of cross-currency substitution between the extent of financial linkage with the dollar and the extent of euro denomination in international debt.

[4] We omit reporting the estimates on the de facto measure of financial openness based on the Lane and Milesi-Ferretti data because including this variable persistently yields either insignificant or economically unreasonable results.

B.3 Impacts of Currency Weights on Currency Choice

Another possible source of omitted variable bias is the extent to which countries belong to certain currency zones. If a country tries to stabilize the movement of its own currency against a hard currency, it would more likely denominate its debt in that currency because that would mitigate exchange risk and thereby help stabilize the debt burden in terms of the home currency. To what extent a country tries to stabilize its currency against, say, the U.S. dollar is essentially the same as to what extent the country belongs to the dollar zone.

Hence, the extent of belonging to the dollar zone, or "dollar zone weights" could be correlated with the share of the dollar in international debt denomination. McCauley and Chan (2014) and Ito and McCauley (2020) show that the dollar zone weight is positively correlated with the shares of the dollar in official foreign reserves holding, while Ito, McCauley, and Chan (2015) find that the dollar weight is also correlated with the share of the dollar in trade invoicing for Eastern European countries.[5]

We test the impact of the dollar and euro zone weights by using the estimated weights from Ito and Kawai (2016), who based their estimation method on those of Haldane and Hall (1991) and Frankel and Wei (1996).[6] In the dollar (euro) share regressions, we expect the sign of the estimate for the dollar (euro) zone weight variable to be positive and the euro (dollar) to be negative. In the total foreign currency share regression, the expected sign of the estimate is ambiguous. Because the impacts of the two types of the currency weights are opposite, they may cancel each other. We remove the dummy for pegging to the dollar since this variable is redundant with the currency weight variables.

According to Table B-3, an economy with higher dollar (euro) weight tends to denominate its international debt more (less) in the dollar.[7] Comparable results are also found for the euro share estimation, although the estimates are not significant for developing countries. These results are consistent with those of McCauley and Chan (2014), Ito, McCauley, and Chan (2015), and Ito and McCauley (2020). It makes sense that countries issue international debt in

[5] The same kinds of correlations can be expected for the euro weight, which was evidenced by Ito, McCauley, and Chan (2015) and Ito and McCauley (2020).
[6] Variants of the methodology include Ito and Kawai (2016), Kawai and Akiyama (1998), Kawai and Pontines (2016), and Bénassy-Quéré et al. (2006).
[7] The correlation between the dollar and the euro weights is so high that we include each weight variable individually in the estimations.

the currency toward which they pursue exchange rate stability so that they would not have to worry much about exchange rate risk.

B.4 Impacts of the Interest Rates, Exchange Rates, and Trade Invoicing

Impacts of the Interest Rates

We conduct several additional checks on other potential missing variables.

First, we examine the impact on the currency choice for debt denomination of interest rate differentials between our sample countries and the U.S. or the euro area. While our analyses so far have focused only on demand-side factors, supply-side factors could also play an important role in the currency choice for debt denomination. In the aftermath of the GFC, all the issuers of the major currencies, namely, the U.S. Federal Reserve, the Bank of England, the Bank of Japan, and the European Central Bank, implemented unconventional monetary policies, such as quantitative easing and the zero or negative interest rate policy.[8] These monetary policies are aimed at reducing the cost of borrowing and therefore, made it easier to issue debt in the currencies of these advanced economies. Given such an environment, the rise in the dollar share in the immediate aftermath of the GFC seen in Figure 3 may have been driven by the lower cost of issuing dollar-denominated debt, not necessarily the increased demand for it. For the "carry trade" investment strategy (Galati et al. 2007, Koepke 2015), the interest rate differential is of particular interest. In our case, it captures the supply-side factors that could play an important role in the currency choice for debt denomination. In other words, it captures whether the cost of borrowing has had any impact on the currency choice for debt issuance.

Against this background, we first include interest rate differentials vis-à-vis the major currency issuers as an additional regressor in our baseline model. In the dollar share regression, we include the interest rate differentials with respect to the U.S. 3-month Treasury bill rate. For the euro share regression, we use the ECB policy interest rate as the reference rate. For the regression on the total share of foreign currencies, we use the GDP-weighted average of the U.S.

[8] In our sample that ends in 2015, Denmark implemented a negative interest rate policy in 2012-14 and 2014-15, Sweden in 2009-10 and 2014-15, Norway in 2015, and Switzerland in 2015. Although the European Central Bank implemented a negative interest rate policy in 2014, the euro member countries are not included in our sample. Japan and several European countries (Bulgaria, Hungary, and Bosnia and Herzegovina) implemented a negative interest rate policy in 2016.

3-month Treasury bill interest rate, the ECB 3-month interest rate, Japan's financing bill rate, and the U.K. Treasury bill interest rate as the reference rate.

Columns (1) and (4) in Table B-4 show that the impact of the interest rate differential is negative but insignificant for all the three currency share estimations. This result confirms that the variations in the shares of the dollar and the euro in the post-GFC period are not relevant to the changes in the cost of borrowing for the issuers of the major currencies. Not to mention, the share of total foreign currencies in debt denomination is unaffected by the cost of borrowing for the advanced economies.

Additionally, we conduct two more robustness checks related to the impact of the cost of borrowing for the major currency issuers. For one, we examine the impact of the interest rate differential between the U.S. and the euro area. For the other, we look at the impact of the *levels* of the interest rates in the U.S. and the euro area.[9] Table B-4 shows that neither the U.S.-Euro interest rate differential (Columns (2) and (5)) nor the interest rate levels of the U.S. and the euro area (Columns (3) and (6)) are significant factors that explain the variation of the three currency shares. These results are consistent with the fact that variations in the shares of the dollar and the euro in the post-GFC period are not relevant to the changes in the cost of borrowing in these currencies.

Impacts of the Exchange Rates

Second, we examine whether exchange rates contribute to the choice of currency for debt denomination. If a currency's value is expected to be on a one-sided trend (e.g., the Chinese RMB before 2013), it could encourage the issuance of debt in that particular currency because of potential capital gains. Bruno and Shin (2017) find that non-financial corporations in emerging markets are less likely to issue debt in the U.S. dollars (outside the U.S.) when their home currencies appreciate against the dollar.

To investigate the impact of the exchange rate trend, we use two types of exchange rates. The first one is the three-year moving average of the rate of change in the nominal exchange rate. In the dollar (euro) share regression, we include the bilateral exchange rate against the dollar (euro). For the regression of the share of total foreign currencies, we use the nominal effective

[9] We thank an anonymous referee for these two suggestions.

exchange rate from the IMF's *International Financial Statistics*. A higher exchange rate trend indicates greater appreciation of the domestic currency.[10]

As the second type of exchange rate, we use the three-year moving average of the rate of change in the Debt Weighted Exchange Rate (DWER) by Berger (2016). Berger (2016) explains that the DWER captures the distribution of the foreign currency compositions of total debt in the same way as the trade-weighted exchange rate captures the distribution of the foreign trade component of GDP. That is, the DWER is the geometric average of its bilateral exchange rate against each of the five major currencies (the U.S. dollar, euro, Japanese yen, pound sterling and Swiss franc), weighted by the shares of these currencies in that country's foreign currency debt.[11]

For both types of the exchange rates, we find similar results (Table B-5), which is not surprising given the strong correlation between the two.[12] The exchange rate trends against the U.S. dollar are found to be significantly negative for the subsample of developing countries (though insignificantly for the full sample). In the total foreign currencies share regression, the significantly negative estimate appears in both the full sample and the subsample of developing countries. These findings suggest that a developing country with its exchange rate on an appreciation trend tends to issue its international debt *less* in the U.S. dollar or foreign currencies in general—i.e., more in domestic currency, a consistent result with Bruno and Shin (2017).

Impacts of Trade Invoicing

Finally, we examine whether the currency choice for trade invoicing would affect the currency shares in debt denomination. In the baseline model, we already have a variable that represents trade links with the U.S., the euro, or the world. It can be argued, however, that the share of the currency used in trade invoicing might matter more than the volumes of trade with respect to the key currency issuer.[13] If a country invoices or settles a large amount of its trade (especially exports) in a hard currency, it would be tempted to issue international debt in that currency.

[10] To maintain consistency, we also change the nominal exchange rates (against the dollar or the euro) so that higher values mean currency appreciation.
[11] We thank an anonymous referee for this suggestion.
[12] In our sample, the correlation between the DWER and the bilateral exchange rate against the dollar and the euro is 0.90 and 0.47, respectively. With the nominal effective exchange rate, that correlation is almost 0.90.
[13] Ito and Chinn (2015) find that countries invoice their exports in dollars much more than one might guess from share of their exports to the US.

We reexamine the estimations for the dollar and euro shares while replacing the share of trade with the US, and the euro area, with the shares of the US dollar, and the euro, in export invoicing, respectively. For the data on the invoicing currency shares, we use the dataset from Ito and Kawai (2016).

We find that the estimates of the shares of dollar and euro invoicing are significantly positive for the full sample (not reported). Thus, a country that invoices its trade in the dollar (euro) tends to issue its international debt in the dollar (euro). All of the other explanatory variables maintain the same sign and level of significance as those in the base line specification, which suggests the main results are robust. One drawback of using the dollar or euro share in trade invoicing, however, is that the sample size becomes smaller, especially in the euro share regression for which the sample size for developing countries shrinks by about 27%.

B.5 Alternative Estimation Methods

We also test and confirm that our estimation results are robust to alternative regression methods.

First, we estimate the benchmark specification with country fixed effects, which control for unobservable country (time-invariant) heterogeneity (e.g., institutional development). Table B-6 shows that in all the cases, the estimates' signs and significance levels remain intact, except for the variable for economic size (i.e., GDP in natural log) in the euro share regression. Hence, we can conclude that our main results are robust to the use of a fixed effect regression. One drawback of this estimation method is that we cannot control for the fact that our dependent variable is bounded between zero and one. For this type of situation, Wooldridge (2010) suggests the use of censored regression methods. In our case, we use the tobit model– which is well suited when the dependent variable takes values within fixed bounds – as our main estimation model.

Second, we consider that, in principle, the currency shares in debt denomination, including that of the home currency, must add up to one. That means that a positive disturbance to the share of one currency must be associated with a negative disturbance to the other currencies as a whole. In our empirical context, the error terms in the estimation models for the dollar and the euro shares could be correlated with each other. It is worth noting, however, that since our data are not balanced, such a correlation does not necessarily have to be addressed.[14]

[14] Even if we had a balanced dataset, the sum of the dollar and the euro shares would not always add up to one.

Nonetheless, as an additional robustness check, we redo the estimations using the seemingly unrelated regression (SUR) estimation method to incorporate the possibility that the error terms are correlated between the estimations for the dollar and the euro shares.

Table B-7 reports the results of the joint SUR estimation of the dollar and the euro shares for the subsample of developing countries. While some estimates appear different from those in Tables 1 and 2, the estimates of the important variables such as financial development, the share of exports to the U.S. or the euro area are consistent with what we previously found. Countries with more developed or open financial markets tend to face a choice between the dollar and the euro for debt denomination. Countries with stronger trade ties with the U.S. or the euro area tend to denominate their trade in the respective currencies. Regarding the equation for the share of the dollar, fiscal space now appears with a positive and significant contribution, suggesting that the better fiscal conditions a country has, the less likely it denominates its international debt in the dollar.

Lastly, our main estimates may be affected by endogeneity arising from reverse causality. To mitigate such a possibility, we re-estimate the benchmark specification while lagging all the explanatory variables by one and two years[15]. For all the three currency share estimations, and for both the full sample and the subsample of developing countries, the estimation results remain intact (not reported). Thus, we can conclude that our results are not affected by endogeneity due to bidirectional causality.

[15] We thank an anonymous referee for this suggestion.

References

Aizenman, J., and H. Ito. 2013. Living with the Trilemma Constraint: Relative Trilemma Policy Divergence, Crises, and Output Losses for Developing Countries. *Journal of International Money and Finance* 49 p.28-51, (May 2014).

Bénassy-Quéré, A., Coeuré, B. and Mignon, V., 2006. On the identification of de facto currency pegs. *Journal of the Japanese and international Economies*, *20*(1), pp.112-127.

Bruno, V. and Shin, H.S., 2017. Global dollar credit and carry trades: a firm-level analysis. *The Review of Financial Studies*, *30*(3), pp.703-749.

Fernández, Andrés, Michael W. Klein, Alessandro Rebucci, Martin Schindler, and Martín Uribe. 2015. "Capital Control Measures: A New Dataset," NBER Working Paper series #20970. Cambridge, MA: National Bureau of Economic Research.

Frankel, J. and S.J. Wei. 1996. Yen Bloc or Dollar Bloc? Exchange Rate Policies in East Asian Economies, In T. Ito and A. Krueger, eds., *Macroeconomic Linkage: Savings, Exchange Rates, and Capital Flows*, University of Chicago Press, pp 295–329.

Galati, Gabriele, Alexandra Heath, and Patrick McGuire. 2007. "Evidence of Carry Trade Activity." *BIS Quarterly Review* 3: 27-41

Haldane, A.G. and Hall, S.G., 1991. Sterling's Relationship with the Dollar and the Deutschemark: 1976-89. *The Economic Journal*, *101*(406), pp.436-443.

Ito, H. and M. Kawai. 2016. Trade Invoicing in Major Currencies in the 1970s-1990s: Lessons for Renminbi Internationalization. *Journal of the Japanese and International Economies*, vol 42, December, pp 123–145.

Ito, Hiro and Robert McCauley. 2020. "Emerging Market Currency Composition of Reserves, Denomination of Trade and Currency Movements," *Emerging Markets Review*, 25, 16-29. (October).

Ito, Hiro, Robert McCauley, and Tracy Chan. 2015. "Emerging Market Currency Composition of Reserves, Denomination of Trade and Currency Movements," *Emerging Markets Review*, 25, 16-29. (October).

Kawai, M. and S. Akiyama. 1998. The Role of Nominal Anchor Currencies in Exchange Rate Arrangements, *Journal of the Japanese and International Economies*, vol. 12, pp. 334–87.

Kawai, Masahiro & Pontines, Victor. 2016. "Is there really a renminbi bloc in Asia?: A modified Frankel–Wei approach," *Journal of International Money and Finance*, Elsevier, vol. 62(C), pages 72-97.

Koepke, Robin, What Drives Capital Flows to Emerging Markets? A Survey of the Empirical Literature (April 23, 2015). Available at SSRN: http://dx.doi.org/10.2139/ssrn.2569249

Kose, M. A., E. Prasad, K. Rogoff, and S. J. Wei. 2006. Financial Globalization: A Reappraisal. IMF Working Paper WP/06/189. Washington, DC: International Monetary Fund.

Lane, P and G-M Milesi-Ferretti. 2001. "The external wealth of nations: measures of foreign assets and liabilities for industrial and developing countries", Journal of International Economics, vol 55, pp 263–294.

Lane, P. R., and G. M. Milesi-Ferretti. 2007. "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004." *Journal of International Economics* 73(2): 223–250.

Lane, P. R., and G. M. Milesi-Ferretti. 2017. "International financial integration in the aftermath of the Global Financial Crisis", International Monetary Fund Working Paper no 17/115, 10 May.

McCauley, R. and T. Chan. 2014. Currency Movements and Reserve Composition, *BIS Quarterly Review*, December.

Quinn, D., M. Schindler, and A. M. Toyoda. 2011. Assessing Measures of Financial Openness and Integration, *IMF Economic Review*, Vol. 59, No. 3.

Reinhart, Carmen M. and Kenneth S. Rogoff. 2011. The Forgotten History of Domestic Debt, *Economic Journal*, Royal Economic Society, vol. 121(552), pages 319-350, 05.

Wooldridge, J.M., 2010. *Econometric analysis of cross section and panel data*. MIT press.

Table B-1: Effects of Financial Crises on the Currency Shares in International Debt Denomination, 1995-2015

(a) Dollar Share

	FULL SAMPLE			DEVELOPING COUNTRIES		
Dep. Var.: % of Dollar	(1)	(2)	(3)	(4)	(5)	(6)
Currency Crisis	-0.283		-1.190	2.569		1.781
	(3.137)		(3.252)	(3.994)		(4.319)
Debt Crisis		9.023**	8.991**		8.495*	10.797**
		(4.074)	(4.089)		(4.390)	(4.443)
Number of observations	782	757	724	575	549	566
Number of countries	71	67	65	61	57	55

(b) Euro Share

	FULL SAMPLE			DEVELOPING COUNTRIES		
Dep. Var.: % of euro	(1)	(2)	(3)	(4)	(5)	(6)
Currency Crisis	0.796		0.920	-0.978		0.241
	(2.669)		(2.618)	(5.241)		(5.203)
Debt Crisis		21.432***	21.266***		19.589***	19.592***
		(5.522)	(5.520)		(6.233)	(6.233)
Number of observations	722	692	689	512	479	479
Number of countries	63	60	60	53	50	50

(c) Share of Total Foreign Currencies

	FULL SAMPLE			DEVELOPING COUNTRIES		
Dep. Var.: % of Foreign-Currency	(1)	(2)	(3)	(4)	(5)	(6)
Currency Crisis	1.227		2.223**	1.982*		2.068**
	(1.251)		(0.925)	(1.073)		(0.907)
Debt Crisis		0.584	0.393		0.615	0.466
		(0.724)	(0.762)		(0.644)	(0.686)
Number of observations	913	830	847	699	622	633
Number of countries	75	70	68	65	60	58

Notes: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Robust standard errors are presented below the corresponding coefficient. All columns include the covariates from specification (4) for the full sample and specification (8) for developing countries from Tables 1 through 3.

Table B-2: Effects of Financial Openness or Financial Linkages on Currency Choice, Developing Countries, 1995-2015

(a) Dollar Share

Dep. Var.: % of Dollar	(1)	(2)	(3)	(4)	(5)	(6)
Chinn-Ito index of financial openness	-20.946***					
	(5.069)					
Fernández et al. (2015) – Average restriction		8.365**				
		(3.642)				
Fernández et al. (2015) – Inflow restriction			6.011*			
			(3.113)			
Fernández et al. (2015) – Outflow restriction				4.441*		
				(2.636)		
FDI from the U.S.					0.003	
					(0.023)	
FDI from the euro area					-0.095	
					(0.064)	
Bank lending from the U.S.						0.004
						(0.050)
Bank lending from the euro area						-0.035*
						(0.019)
Number of observations	678	640	640	640	522	705
Number of countries	63	51	51	51	52	64

(b) Euro Share

Dep. Var.: % of euro	(1)	(2)	(3)	(4)	(5)	(6)
Chinn-Ito index of financial openness	27.787***					
	(5.140)					
Fernández et al. (2015) – Average restriction		-13.701***				
		(3.969)				
Fernández et al. (2015) – Inflow restriction			-14.128***			
			(3.585)			
Fernández et al. (2015) – Outflow restriction				-7.092**		
				(2.810)		
FDI from the U.S.					-0.059***	
					(0.021)	
FDI from the euro area					-0.028	
					(0.048)	
Bank lending from the U.S.						0.007
						(0.051)
Bank lending from the euro area						0.101*
						(0.056)
Number of observations	518	496	496	496	424	535
Number of countries	54	48	48	48	49	56

(c) Share of Total Foreign Currencies

Dep. Var.: % of Foreign-Currency	(1)	(2)	(3)	(4)	(5)	(6)
Chinn-Ito index of financial openness	-4.487***					
	(1.120)					
Fernández et al. (2015) – Average restriction		1.512				
		(1.308)				
Fernández et al. (2015) – Inflow restriction			1.205			
			(1.145)			
Fernández et al. (2015) – Outflow restriction				0.833		
				(0.992)		
FDI from the U.S.					-0.004	
					(0.008)	
FDI from the euro area					0.005	
					(0.024)	
Bank lending from the U.S.						-0.000
						(0.016)
Bank lending from the euro area						-0.002
						(0.003)
Number of observations	712	669	669	669	536	734
Number of countries	64	51	51	51	53	64

Notes: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Robust standard errors are presented below the corresponding coefficient.

Table B-3: Effects of the Currency Weight with Major-Currency-Zone Countries on the Currency Choice for International Debt Denomination, 1995-2015

(a) Dollar Share

	FULL SAMPLE		DEVELOPING COUNTRIES	
Dep. Var.: % of Dollar	(1)	(2)	(3)	(4)
Currency weight – US Dollar	0.203***		0.202***	
	(0.060)		(0.062)	
Currency weight – Euro		-0.243***		-0.244***
		(0.069)		(0.071)
Number of observations	740	740	587	587
Number of countries	65	65	55	55

(b) Euro Share

	FULL SAMPLE		DEVELOPING COUNTRIES	
Dep. Var.: % of euro	(1)	(2)	(3)	(4)
Currency weight – US Dollar	-0.122**		0.209	
	(0.056)		(0.286)	
Currency weight – Euro		0.158***		0.035
		(0.057)		(0.169)
Number of observations	547	547	366	366
Number of countries	54	54	44	44

Notes: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Robust standard errors are presented below the corresponding coefficient. All columns include the covariates from specification (4) for the full sample and specification (8) for developing countries from Tables 1 and 2. We remove the dummy for pegging to the dollar since this variable is redundant with the currency weight variables.

Table B-4: Effects of Interest Rate Differentials on the Currency Choice for International Debt Denomination, 1995-2015

(a) Dollar Share

	FULL SAMPLE			DEVELOPING COUNTRIES		
Dep. Var.: % of Dollar	(1)	(2)	(3)	(4)	(5)	(6)
Interest Rate Differential (domestic currencies vs. the dollar)	-0.251 (0.268)			-0.213 (0.240)		
U.S.-Euro Interest Rate Differential		0.510 (0.381)			0.568 (0.369)	
U.S. Interest Rate			0.576 (0.486)			0.631 (0.719)
Euro area's Interest Rate			-0.977 (0.624)			-1.431 (0.920)
Number of observations	518	595	595	353	425	425
Number of countries	45	47	47	35	37	37

(b) Euro Share

	FULL SAMPLE			DEVELOPING COUNTRIES		
Dep. Var.: % of Euro	(1)	(2)	(3)	(4)	(5)	(6)
Interest Rate Differential (domestic currencies vs. the euro)	-0.087 (0.173)			-0.205 (0.204)		
U.S.-Euro Interest Rate Differential		-0.476 (0.405)			-1.121 (0.873)	
U.S. Interest Rate			-0.311 (0.432)			-1.383 (0.923)
Euro area's Interest Rate			0.716 (0.517)			1.793 (1.265)
Number of observations	395	471	471	265	348	348
Number of countries	43	45	45	33	35	35

(c) Share of Total Foreign Currencies

	FULL SAMPLE			DEVELOPING COUNTRIES		
Dep. Var.: % of Foreign -Currency	(1)	(2)	(3)	(4)	(5)	(6)
Interest Rate Differential (domestic currencies vs. basket[#])	-0.007 (0.089)			-0.040 (0.069)		
U.S.-Euro Interest Rate Differential		1.100 (0.728)			1.198 (0.955)	
U.S. Interest Rate			1.119 (0.795)			1.204 (1.054)
Euro area's Interest Rate			-1.060 (1.011)			-1.187 (1.286)
Number of observations	497	605	605	366	455	455
Number of countries	46	47	47	36	37	37

Notes: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Robust standard errors are presented below the corresponding coefficient. [#] This basket includes the U.S. dollar, the euro, the Japanese yen, and the pound sterling.

Table B-5: Effects of the Exchange Rate Trend on the Currency Choice for International Debt Denomination, 1995-2015

(a) Dollar Share

	FULL SAMPLE		DEVELOPING COUNTRIES	
Dep. Var.: % of Dollar	(1)	(2)	(3)	(4)
Bilateral ER against the dollar, MA(3)	-0.118		-0.207**	
	(0.085)		(0.092)	
Debt-weighted Exchange Rate, MA(3)		-14.911		-15.704**
		(9.611)		(7.917)
Number of observations	643	431	449	294
Number of countries	48	35	38	25

(b) Euro Share

	FULL SAMPLE		DEVELOPING COUNTRIES	
Dep. Var.: % of Euro	(1)	(2)	(3)	(4)
Bilateral ER against the euro, MA(3)	0.029		-0.051	
	(0.045)		(0.064)	
Debt-weighted Exchange Rate, MA(3)		8.877		-4.572
		(9.148)		(12.367)
Number of observations	494	444	368	310
Number of countries	48	40	38	30

(c) Share of Total Foreign Currencies

	FULL SAMPLE		DEVELOPING COUNTRIES	
Dep. Var.: % of Foreign-Currency	(1)	(2)	(3)	(4)
Nominal Effective Exchange Rate, MA(3)	-0.115**		-0.117***	
	(0.050)		(0.032)	
Debt-weighted Exchange Rate, MA(3)		-17.781***		-9.295**
		(5.596)		(4.176)
Number of observations	677	442	483	305
Number of countries	50	35	40	25

Notes: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Robust standard errors are presented below the corresponding coefficient.

Table B-6: Determinants of the U.S. Dollar, Euro, and Foreign-Currency Shares in International Debt with Fixed Effects, 1995-2015

	FULL SAMPLE			DEVELOPING COUNTRIES		
	Dollar Share (1)	Euro Share (2)	Foreign-Currency Share (3)	Dollar Share (4)	Euro Share (5)	Foreign-Currency Share (6)
Log(GDP)	-1.913*	-2.240	-2.502***	-2.330*	-3.614*	-2.565***
	(1.159)	(1.433)	(0.520)	(1.394)	(1.967)	(0.565)
Real GDP growth trend	-0.106	0.680**	-0.226**	-0.005	0.758*	-0.145
	(0.236)	(0.303)	(0.108)	(0.264)	(0.401)	(0.110)
Domestic savings (% of GDP)	-0.270***	-0.010	-0.017	-0.440***	0.121	-0.003
	(0.094)	(0.151)	(0.044)	(0.101)	(0.198)	(0.044)
Inflation volatility	0.095	0.127	0.012	0.141**	-0.069	0.010
	(0.060)	(0.214)	(0.062)	(0.062)	(0.247)	(0.061)
Fiscal space (reciprocal)	0.255	2.126	3.133***	1.002	3.568	2.595***
	(1.336)	(1.691)	(0.614)	(1.541)	(2.496)	(0.650)
Financial development	-0.051***	0.085***	0.005	-0.045	-0.033	0.024
	(0.019)	(0.020)	(0.009)	(0.044)	(0.052)	(0.018)
Exports to the U.S. (% of total exp.)	0.176**			0.045		
	(0.081)			(0.089)		
Exports to the euro area (% of total exp.)		0.386***			0.057	
		(0.136)			(0.178)	
Share of Exports (% of world exp.)			-2.933***			-3.263***
			(0.552)			(0.545)
Quality of institutions	0.489	-6.265***	-1.833**	-1.400	-6.661***	-2.382***
	(1.411)	(1.442)	(0.715)	(1.586)	(2.000)	(0.731)
Financial openness	-18.219***	22.720***	-4.405***	-23.219***	30.440***	-4.370***
	(3.126)	(3.096)	(1.441)	(3.798)	(5.196)	(1.610)
Within-R^2	0.845	0.864	0.663	0.855	0.807	0.657
Number of observations	828	731	912	678	538	704
Number of countries	73	64	78	63	54	68

Notes: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Robust standard errors are presented in parentheses. All specifications control for geographical regions, currencies pegged to the U.S. dollar or the euro, and for the period after the introduction of the euro as a currency as well as year fixed effects and a constant term, but we do not report their estimates to conserve space. See Appendix A for the definitions and constructions of the data.

Table B-7: Determinants of the Currency Shares in International Debt, 1995-2015

Estimation with the Seeming Unrelated Regression Method

	DEVELOPING COUNTRIES	
	Dollar Share (1)	Euro Share (2)
Log(GDP)	-1.043***	-4.291***
	(0.373)	(0.378)
Real GDP growth trend	-0.099	0.432
	(0.342)	(0.301)
Domestic savings (% of GDP)	0.086	-0.082
	(0.086)	(0.076)
Inflation volatility	0.657**	0.036
	(0.262)	(0.232)
Fiscal space (reciprocal)	1.876*	1.068
	(0.965)	(0.845)
Financial development	-0.120***	0.052***
	(0.015)	(0.013)
Exports to the U.S. / euro area	0.151***	0.122***
(% of total exports)	(0.034)	(0.042)
EU dummy	-23.503***	27.844***
	(1.768)	(1.635)
Quality of institutions	-1.387	-3.033**
	(1.422)	(1.256)
Financial openness	-9.847***	4.525**
	(2.326)	(2.032)
Number of observations	403	

Notes: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. The table shows the results of the seemingly unrelated regression (SUR). Robust standard errors are presented below the corresponding coefficient. All specifications control for the dummies for geographical regions, currencies pegged to the U.S. dollar or the euro, European Union membership (time variant), and for the introduction of the euro in 1999 as well as year fixed effects and a constant term. We do not report their estimates to conserve space. See Appendix 1 for the definitions and constructions of the data.