Internationalization of emerging market currencies and original sin
An empirical evidence

Delphine Lahet[*] and Stéphanie Prat[**]

February 2019

Preliminary version

Abstract

This article investigates the impact of the internationalization of emerging market currencies on original sin, which is the inability for emerging countries to borrow abroad in local currencies. The objective is to assess the role of direct (metrics of international currency functions fulfillment) and indirect measures (drivers) of internationalization on the currency structure of the debt for a set of emerging market countries. Using two different measures of original sin (local currency external debt as a share of total external debt; and total amount issued in local currencies in international markets) over the period 2005-2016 and panel data empirical analysis, we show a favorable impact of the internationalization process on original sin. The main determinants are the FX turnover of the currencies, the economic size of the issuing country and the VIX. Moreover, we highlight network effects between the functions 'store of value' and 'means of payment'. The tests enhance also the existence of inertia in the use of a currency for financial transactions. Lastly, some results give evidence of the role of derivatives instruments to support the use of emerging market currencies in bond markets.

JEL: F31 F32 F33 G15

Key words: Original Sin, currency internationalization, debt, inertia, network effects, derivatives instruments

[*] Larefi, Bordeaux university, Campus de Pessac, Ave Léon Duguit, 33 608 Pessac Cedex, France. delphine.lahet@u-bordeaux.fr. +33 5 56 84 29 03. Corresponding author.
[**] Inseec Business School and Larefi Bordeaux university, sprat@inseec.com, H19 Quai de Bacalan, CS 60083, 33070 Bordeaux Cedex – France.

1. Introduction

"*The RMB[1]'s inclusion is an important milestone in the integration of the Chinese economy into the global financial system. The IMF's determination that the RMB is freely usable reflects China's expanding role in global trade and the substantial increase in the international use and trading of the renminbi. It also recognizes the progress made in reforms to China's monetary, foreign exchange, and financial systems and acknowledges the advances made in liberalizing, integrating, and improving the infrastructure of its financial markets. We expect that the inclusion of the RMB in the SDR basket will further support the already increasing use and trading of the RMB internationally.*"[2]

The IMF's decision to include the RMB in the SDR basket relates to the progress of China in its currency's internationalization process and to expected positive outcomes for the future. A currency that is internationalizing brings indeed benefits. The objective of the article is to study one of these benefits: the favorable influence of the internationalization of emerging market currencies on the original sin, which is the inability of emerging countries to issue debt in local currency on national and international markets.

The Quarterly external debt statistics give some evidence of the topic. First, the total external debt of some emerging countries has increased since 2000s, notably after 2005, and until 2014 where there were some decreases or slowdowns (Appendix Graph 1). The external debt of Brazil, Mexico, Korea, India, Indonesia and Turkey is broadly above 200 billion $. Second, the share of the local currency external debt in the total external debt (Appendix Graph 2) is above 10% for Thailand, Korea, India, Mexico, Brazil, and South Africa, and has strongly increased up to 37% for Mexico in 2013, 35% for Thailand in 2013, 30% for Korea in 2014, 29% for India in 2015, 23% for Brazil in 2014 and 58% for South Africa in 2013. These figures show that some emerging countries succeed in issuing debts that are denominated in domestic currency and that foreign investors are interested by this king of assets. Third, when we look at the international debt securities outstanding by emerging market currency and issued on international markets (Appendix Graph 3), there are increases, notably after 2004, and four currencies stand out: the Chinese renminbi (100 billion $ in 2015), the Brazilian real (50 billion $ in 2015), the Mexican peso (32 billion $ in 2014), the South African rand (35 billion $ in 2012). The issuing in others currencies are then below 10-12 billion $, with very small amounts for the Korean won and the Argentinean peso (less than 2). We can conclude that investors have increasing confidence in some emerging countries and consequently, they are not afraid to issue debt denominated in these currencies.

The literature underlying our article is at the crossroads of two research fields: Original Sin and Currency internationalization.

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[1] RMN= renminbi.

[2] Interview of S. Tiwari, Director of the IMF's Strategy, Policy and Review Department, September 30, 2016.

First, the term original sin was defined by Eichengreen and Hausmann (1999) to refer to the difficulties of a country to issue debt in local currency on international markets (OSIN) or to borrow in the long term at fixed rates on domestic markets (DSIN). The authors subsequently chose to restrict the definition of the original sin to its international aspect because, according to them, the development of domestic markets, leading to greater financial integration, in particular throughout the 2000's, allowed number of those countries to issue long-term securities in local currency on domestic markets (Eichengreen, Hausmann and Panizza, 2004 2007). From a sectoral perspective, the original sin concerns both public and private entities. The literature proposed two types of explanations of the original sin phenomenon. On one hand, the original sin at the international level is explained by the incompleteness of international financial markets at the end of the 1990s, which is mainly manifested by the lack of hedging instruments against currency risk but also by high transaction costs (Eichengreen *et alii*, 2004, 2007). On the other hand, in emerging countries, the weakness of institutions with a poor rule-of-law and regulatory enforcement (Levy-Yeyati, 2006) and the macroeconomic instability which results into high and volatile inflation, structural current-account deficit and debt sustainability issues are often determining factors of original sin (Reinhart *et alii*, 2003; Calvo and Guidotti, 1990). The consequences of original sin for emerging market countries have been widely documented in the academic literature. In particular, when borrowers (non-financial corporations, banks and public entities) are exposed to original sin and failed to issue debt in domestic currency, they incur debt denominated in foreign currency which can lead to currency mismatches in their balance-sheets (Eichengreen *et al.* 2004, 2007). According to Goldstein and Turner (2004), a currency mismatch can be defined as "the sensitivity of net worth or of the present value of net income to changes in the exchange rates". This asymmetry between the foreign currency-denominated liabilities (or payments) and domestic currency–denominated assets (or incomes) exposes entities to a risk of depreciation of the domestic currency that threatens their solvency. In case of large currency depreciation, negative wealth effects due to currency mismatches in balance sheets increase the cost of financial crisis for a country which suffers from stronger economic contraction (Krugman, 1999; Cespedes, Chang and Velasco, 2004; Goldstein and Turner, 2004). Those negative balance sheet effects tend to undermine the effectiveness of exchange rate adjustments designed to mitigate the effects of exogenous real shocks (Frankel, 2005). The other consequences of the original sin phenomenon also concern monetary policy. The conduct of an independent monetary policy is effectively constrained by its impact on the exchange rate and, by extension, by its impact on the cost of servicing foreign currency-denominated debt in domestic currency (Jeanne and Zettelmeyer, 2004). Since the 1990s, emerging economies have endured macro-economic instability together with under- or few developed financial markets despite liberalization reforms. At the same time, they have handled huge foreign capital inflows. Emerging countries suffer therefore for a long time from currency mismatches and financial instability. Original sin is thus a major concern for them.

Second, the literature on currency internationalization indicates that a currency is internationalized when it is increasingly used by non-residents for international trade and financial transactions, in the official and private sectors (Ma and Villar, 2014). A lot of articles are interested by the potential international status of the renminbi (Eichengreen, 2011 ; Frankel, 2011 ; Subramanian, 2011; Maziad and al, 2011 ; Kenen, 2012 ; Park and Shin, 2012 ; Gao and Yu, 2012 ; Ma and Villar, 2014; Lee, 2014; He and al, 2015; Coudert and Lez, 2015; Eichengreen and Lombardi, 2015; Aizenman, 2015; Chinn and Ito, 2015; Lahet 2017), but some have adopted a broader view by analyzing other currencies, notably the Korean won, the Indian rupee, the Brazilian real, the South African rand, the Mexican peso, the Turkish lira (Rajan and Prakash, 2010; Maziad and al, 2011; Rhee, 2012; Kim and Suh, 2012; Ehlers and Packer, 2013; Padmanabhan, 2013; Ma and Villar, 2014; Reiss, 2015). These articles scarcely include econometric tests; they are rather composed of analyses of the internationalization process and steps, historical facts and comparisons, and a lot of figures to precisely give some measures of the degree of internationalization of emerging market currencies with respect to the three functions of an international currency -like the US dollar- established by Kenen (1983): store of value, medium of exchange, unit of account (Appendix, Table A1). Obviously, the fulfillment of the functions by emerging market currencies is partial, as exposed for example in Maziad et al. (2011) (Appendix A2). Moreover, there is some inertia in this process (or persistence; Frankel, 2011; Eichengreen, 2014). A currency, as the US dollar, stays at the top ranking because of habits and low transaction costs…, whereas some driving forces have been modified and could support other currencies in some functions. Consequently, the internationalization process of emerging market currencies is lengthy, progressive, evolutionary, not linear, with different forms and finally, driven by markets (Maziad and al, 2011; Frankel, 2011; Ma and Villar, 2014). What is really important is the progression in the fulfillment of the functions in a short period. For example, the share of the Brazilian real as invoice currency in the total Brazilian foreign trade has increased from 0.13% in 2007 to 1.25% in 2011: percentages are small but it represents a significant nine-fold growth on a 4-year period (Reiss, 2015). The FX turnover of the Chinese renminbi in the Foreign exchange market moves from 0.9% in 2010 to 2.2% in 2013, which is a jump of 144% on a 3-year period (Ehlers and Packer, 2013) whereas the FX Turnover of the US dollar was 84.9% in 2010 and 87% in 2013, that is an increase of 2.4%.

Since 1990s and notably following the Asian financial crises, emerging countries have adopted liberalization reforms, mainly of interest rates, capital account, to open their economy and consequently, it allows some currencies to strengthen their international status. These reforms, as supply factors, are prerequisites to the internationalization process, like also, macroeconomic stability, the convertibility of the currency, the liberalization or flexibility of the exchange rate regime, the development of financial markets, of offshore markets… (Maziad et al., 2011; Genberg, 2011; Park and Shin, 2011; Gao and Yu, 2012). Network effects are often mentioned as an acceleration vector in this process (Genberg, 2011; Park and Shin, 2011). Krugman (1984) indicated that the functions of an

international currency are seldom separable and generate a self-reinforcing dynamics. As internationalization progresses in a function, transaction costs are lower and convertibility is higher, reforms go on and it becomes relevant to use the currency in other functions, reinforcing the use in the previous function. One of the main challenge of the articles is to evaluate the degree of internationalization, of fulfillment of the international currency's three functions by emerging currencies (Maziad et al., 2011; Genberg, 2012; Frankel, 2011; Park and Shin, 2011; Ma and Villar, 2014). We can classify the measures into two categories. First, direct metrics allow quantifying the internationalization degree with respect to the functions of an international currency (Appendix, Table A.1). These indicators may be the composition of international reserves, the use for foreign exchange interventions and operations, and for the denomination and for the payment of trade and financial transactions. Unfortunately, it is difficult to find historical data on long periods and for all the emerging countries (for example, trade invoicing and payment; the currency composition of international reserves). Consequently, the study of the internationalization degree rests on a second kind of measures: indirect measures of internationalization or drivers (or determinants (Frankel, 2011)) as the economic size of the issuing country, trade network, investability, capital account openness and financial depth… that support and enhance a wider international use of a currency in one or several functions. The economic size[3] is also a way to express network effects: the bigger a country, the more used for several functions its currency is. Thus, network effects may produce inertia (Frankel, 2011): one can use a currency like in the past. Consequently, one way to capture inertia is to use the lag of the endogenous variables in the studies (Frankel, 2011; Eichengreen, 2014; Chitu, Eichengreen and Mehl, 2014).

Finally, articles highlight the benefits and costs brought by the internationalization process (Maziad et al., 2011; Genberg, 2011; Park and Shin, 2011; Frankel, 2011; Gao and Yu, 2012; Kenen, 2012; Ma and Villar, 2014). When a currency is internationalized, it is increasingly demanded by non-residents, securities denominated in the currency are more purchased by international investors. Consequently, the costs of external financing are lower. There is a better financing of public indebtedness; the monetary authority could collect seigniorage from the rest of the world or could pay less seigniorage to the United-States. And it becomes possible to tackle the problem of Original Sin (mainly Gao and Yu, 2012; but also Eichengreen, 2011; Frankel, 2011; Maziad and al, 2011; Kenen, 2012; Ma and Villar, 2014). The internationalization process would support the abroad development of the private sector, notably banks that could be more prone to develop activities in the domestic currency and find easily funding in the domestic currency. Then, it allows a better management of currency risk for the State and the corporates. The process could deepen again financial markets and the efficiency of monetary policy transmission channels… It could result in a better resource allocation and risk diversification. Lastly, it could give power and prestige to the State and the

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[3] This variable is mostly tested to study the determinants of the currency composition of international reserves, for example in Lee (2014).

monetary authorities. Nevertheless, the internationalization process may convey risks. A currency that is increasingly internationalized is subject to great volatility because of large shifts in the portfolio flows of foreign investors. The issuer country and the monetary authorities may be submitted to external shocks and speculative attacks, or to currency appreciation penalizing exports. This volatility is not compatible with fixed exchange rate regime: it refers to the Triangle of Mundell in the context of the financial instability in emerging countries (Kenen, 2012; Park and Shin, 2012; Aizenman, 2015).

The objective of our article is to establish the link between metrics of the currency internationalization process and the reduction in the original sin in an empirical approach. To our knowledge, there are no empirical evidences of this potential effect. When a currency is increasingly used by non-residents for transactions' payments, on FX market, exchange rate risk and transactions costs are reduced for the issuing country and residents. It may create network effects or positive externalities (Krugman, 1984; Rey, 2001; Frankel, 2011; Park and Shin, 2011; Genberg, 2011; Eichengreen, 2014) that compel foreign agents to demand it for other uses, for example the denomination of financial assets, notably bonds. That is to say, a currency used in international trade transactions, in foreign exchange trading, as a reserve currency… is more likely to be used in national and international debt markets. The external financing of the issuing country in local currency is consequently easier. Thus, the problem of original sin may be tackled.

To shed light on this issue, we implement a panel analysis on 14 emerging countries on the 2000s and 2010s, and we investigate the determinants of the share of the external debt in local (emerging country) currency in the total external debt and of the rate of growth of the international debt securities outstanding by emerging market currency and issued on international markets. These two variables are proxy of original sin, but they are also a measure of the fulfilment of an international currency function: store of value. The results show that the variables that express some aspects of the internationalization process explain the growing share of the local currency external debt and the growth of the international debt securities outstanding by emerging market currency. These results give some evidence of a favorable impact of the internationalization process on original sin, so of the existence of network externalities.

Our article parallels a prominent topic. Since January 2017, several Latin American countries have issued sovereign debt, notably in dollar for example Colombia, Dominican Republic, and Argentina. Chili has chosen to issue debt denominated in pesos (1.5Md$). Brazil is the biggest issuer (191Md$), basically in real. Moreover, our article is in line with Chitu, Eichengreen and Mehl (2014) and goes further. Chitu, Eichengreen and Mehl (2014) estimate the determinants of currency shares of public debt issued in foreign markets for 33 countries in the period 1914-1946 (essentially the sterling, the dollar, the French franc, the Swiss franc, the German mark, but also 16 other currencies notably the Argentinean peso). The determinants are the lagged dependent variable to measure inertia, the

economic size of the issuing country, inflation to express confidence and financial depth that represents the result of liberalization reforms.

The contribution of our article to the literature is four-fold. First, because we are interested only by the weight of the domestic currency in the denomination of debt (unlike Chitu, Eichengreen and Mehl (2014)), we give some evidence of the link between currency internationalization and original sin. Second, we test other determinants than in Chitu, Eichengreen and Mehl (2014), which we interpret as direct and indirect measures of the internationalization process. For direct measure, we use the FX Turnover of a currency as a measure of the function 'means of payment or vehicle currency' in the Foreign Exchange market. To our knowledge, it is the first time this variable is tested in this kind of work. For indirect measures (drivers), we test some of the traditional variables of the literature as the economic size, the trade openness, the financial depth… but also the existence of derivatives instruments on a currency: to our knowledge, it is the first time the latter variable is tested as determinants of local currency denominated debt. Third, we test two types of debt variables to better capture the potential evolution of the original sin: the total external debt in local currency issued by a country as a share of total external debt (including that of the private sector); and the total outstanding debt denominated in the local currency and issued in international markets. Fourth, as these variables express also the function 'store of value', our tests show the existence of network externalities between the function 'means of payment' (FX Turnover) and the function 'store of value'.

The remainder of the paper is organized as follows. In Section 2, we present the variables. The tests and results are analyzed in Section 3. Section 4 offers robustness tests. Section 5 concludes.

2. Variables[4]

The countries under study are: Argentina, Brazil, Chile, Colombia, Mexico, Peru, India, Indonesia, Philippine, Thailand, South Korea, South Africa, Turkey and China. Because of the availability of the data, the countries are not included all together.

2.1. The dependent variable

We have tested two dependent variables as proxy of original sin (OSIN) and of the function 'store of value'.

- Based on the QEDS database (Quarterly external debt statistic, IMF-World Bank, Millions of $; from Datastream), we construct: Local currency external debt expressed as a share of total external debt. The QEDS data represent the claims on a country (all sectors) held by non-residents and that are issued on international and domestic markets. Since the value of these

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[4] The descriptive statistics are presented in Appendix Table A3.

shares is restricted between 0 and 1, we use the so-called Hausman transformation (Dinger, 2009; Frankel, 2011; Lee, 2014) when constructing the dependent variables: Y = ln (share/(1-share)). Consequently, the dependent variable can have values between [-∞, +∞]. Data respectively ranges from 2005Q4 to 2016Q2. (Appendix Graph 2)

- Based on the IDS from the BIS, the international debt securities outstanding by currency (Billions of $). This is the total amount issued in local currencies on international markets by all potential issuers (public, private, domestic, foreign) and that may be held by all potential creditors (national and foreign). We construct the rate of growth of this variable. Data ranges from 2001Q4 to 2015Q2. (Appendix Graph 3)

All data are quarterly.

2.2. Direct and indirect explanatory variables

Amongst the explanatory factors, in line with existing literature (see supra) on emerging market currency internationalization, we distinguish between direct measures of the internationalization degree and indirect measures or divers of the internationalization process.

As direct measure, we use the *FX Turnover* from the BIS Triennial Central Bank Survey that is defined as the gross value of all new deals entered into during a given period, and is measured in terms of the nominal or notional amount of the contracts (BIS, 2016). It is expressed in percentage[5]: the share of individual currencies in the total of FX transactions. It reflects the use (sale/purchase) of a local currency by non-resident as a vehicle currency on FX market, with respect to the function 'means of payment'. FX turnover is a measure of market activity and trading of FX instruments in Spot and OTC derivatives markets (Spot transactions, plus outright forward, FX swaps, currency swaps, and FX options). To our knowledge, it is the first time this variable is tested as a determinant of local currency debt. The Chinese renminbi is the eighth most widely used currency in the FX market in 2016 with a FX Turnover at 4% (in 2007, the rank was 20th and the FX turnover was 0.5%). The Mexican peso is following with a FX turnover at 2.2% (rank 10). If a currency is increasingly used in FX transactions, it is more likely to be used in national and international debt markets as the result of network effects. The expected sign is positive.

As indirect measures, we include in the analysis:
- the *Economic size*: nominal GDP/ "World" GDP. The nominal GDP is from Datastream and we calculate the "world" GDP by adding nominal GDPs for a broad set of countries expressed in dollar terms for each period[6]. The expected sign is positive. A currency issued by a growing country is more

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[5] Because two currencies are involved in each transaction, the sum of the % shares of individual currencies totals 200% instead of 100%.

[6] The sample includes the largest advanced economies (in Europe: the Eurozone countries, The United Kingdom, Denmark and Sweden; in North America: the United States and Canada; In Asia/Pacific: Japan, Australia and New-Zealand), the traditional set of emerging countries (in Latin America: Argentina, Brazil, Chile, Colombia,

likely to be used, notably to denominate bonds. This is the main variable tested in this kind of literature and it is sometimes the only one to be significant (Eichengreen et al., 2004; Engel and Park, 2018). It is a way to measure also network effects.

- the *Trade openness*: Exports/GDP (Datastream). The expected sign is positive. A currency issued by a country that is economically opened and plays a major role in international trade, is more likely to be used notably to denominate bonds.

- the ratio 'Claims on private sector/ GDP' (Datastream) expresses the *Financial depth* of a country, the development of the banking sector and its ability to finance growth. The expected sign is positive. A currency issued by a country with an efficient banking sector that intermediates capital flows is more likely to be used, notably to denominate bonds.

- the Chinn-Ito index (from Chinn and Ito's Web database, KAOPEN) measures a country's degree of *Capital account openness*. In 2015 (resp 2007), for example, the index is 1, the maximum value, for Mexico (0.69), 0.71 (0.41) for South Korea, 0.69 (1) for Chile, 0.16 (0.16) for China and Thailand… The expected sign is positive. A currency issued by a country that has important or increasing capital account openness, meaning the success of liberalization reforms, is more likely to be used, notably to denominate bonds.

We add four variables, as control variables:

- As measures of monetary credibility, we calculate CPI *inflation* (YoY growth rate on quarterly data from Datastream) and exchange rate volatility (*FX volatility*, four quarter moving standard deviation) to include in the analysis the monetary stability of a country, and its ability to manage the instability and to pull investors' confidence. The expected sign is negative. A currency issued by a country that succeeds in having monetary stability is more likely to be used, notably to denominate bonds.

- The *VIX* is introduced as a measure of global uncertainty (Datastream). The expected sign is negative: a growing financial stress may negatively influence the issuing in emerging market currency.

- We add a domestic factor to account for the domestic and structural context which is the ratio *Current account* over GDP (Datastream). The expected sign is positive: a current account surplus, sign of country health, may support the issuing in local currency and the purchase by non-residents.

Lastly, a *dummy crisis* is constructed with the value 1 for Q3 2008 (Lehman Brothers bankruptcy and the following global financial panics implying outflows from emerging markets despite the good health of a majority of them) and for Q2 2013 (the announcement of the FED Tapering and the following outflows from some emerging markets, notably those with declining fundamentals), and 0 otherwise. The expected sign is negative: this context of financial stress may negatively influence the issuing in emerging market currency. We add three regional dummies: *Latin*

Mexico, Peru and Venezuela; in Asia including newly industrialized countries: China, India, Indonesia, Malaysia, Philippines, Thailand, South Korea, Taiwan, Hong-Kong, Singapore), along with the largest CEEC (Poland, Hungary, Czech Republic, Bulgaria and Romania), including Russia and Turkey. We add South Africa and the sample also includes three major oil exporting countries for which data was available: Qatar, Kuwait and Saudi Arabia.

America takes the value 1 for the Latin American countries and 0 otherwise. *Asia* takes the value 1 for the Asian countries and 0 otherwise. *Others* takes the value 1 for South Africa, Turkey and 0 otherwise. These dummies allow accounting for different impacts according to regions. According to the literature, the Asian currencies appear to be more internationalized than the Latin American ones, even if the FX Turnover of the Mexican peso (from 1.3% in 2007 to 2.2% in 2016) and the Brazilian real (from 0.4% in 2007 to 1% in 2016) is increasing. Nevertheless, the Latin American countries seem more concern by issuing debt in local currency (Graph 2 & 3. Mexico, Brazil, Colombia).

3. Methods and results

The empirical estimation will allow us to investigate the impact of the direct and indirect measures of the internationalization of emerging currencies on the original sin phenomenon, taking into account dynamic aspects related to network externalities and the inertia effect.

Dynamic panel data analysis requires tackling two major econometric issues considering macro panels[7] (Eberhardt, 2012) that are the cross-section dependence and the heterogeneity of parameters (Pesaran and Smith, 1995; Pesaran, Shin and Smith, 1999). Specifically, at macro level, cross sectional correlation stems for common factors that affect countries that are already highly integrated in terms of trade and finance. In these cases, standard econometric methods lead to inconsistent estimation of coefficients and wrong inference (Kapetanios et al, 2011). Moreover, the hypothesis of parameter homogeneity across countries can also lead to inconsistent inference and estimation of parameters in dynamic models if in fact the degree of heterogeneity is important across countries.

Recent academic literature provides different estimation technique to account for parameter heterogeneity and cross-sectional dependence. We apply here the Dynamic Common Correlated Effect Estimator (DCCEE) developed and recommended by Chudik and Pesaran (2015)[8]. The authors showed that the estimator is consistent even with small cross-sectional dimension, non-stationary variables, and cross-sectional dependence (Kapetanios et al, 2011). The estimator is still robust when the lagged dependent variable is introduced in the model.

In particular, the equation we wish to estimate is as follows:

(1)

Original Sin Measures (OSM)$_{it}$
$$= c_i + \alpha_i OSM_{it-1} + \beta_i Direct\ measure\ of\ internationalization_{it} + \gamma_i Drivers_{it}$$
$$+ \theta_i Control\ variables_{it} + \varepsilon_{it}$$

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[7] Macro panels are defined by a cross-sectional dimension equal or smaller than the time dimension (N≤T), in contrast to micro panels whose structure is composed by a large number of individuals (N>100) over a very short period of time (T<10).
[8] The DCCE estimator from Chudik and Pesaran (2015) is implemented on STATA 14 by the command xtdcce2, developed by Jan Ditzen (2018).

where '*Direct measure of internationalization*' stands for the Foreign Exchange turnover of emerging market currencies.

The '*Drivers*' are indirect measures of internationalization of emerging-market currencies and include the Economic size, Trade openness, Financial depth approximated by the ratio private credit to GDP, the countries' degree of Capital account openness approximated by the Chinn-Ito index.

The '*Control variables*' are the Inflation rate and the Foreign exchange volatility, the ratio of Current account over GDP and an indicator of market volatility and investors' sentiment (VIX).

Lastly, c represents the country specific effect and ε is the error term.

We run 2nd generation panel unit root tests (CIPS from Pesaran, 2007) to identify the stationary time series properties of our variables, in presence of cross-sectional dependency. Results are presented in Appendix Table A4.

Results concerning 'Local Currency external debt as a share of total external debt' (Hausman transformation) as a measure of original sin are presented in Table 1. Direct and indirect measures of the internationalization process explain the growing share of local currency external debt for emerging market countries. So, internationalization process has a favorable impact on original sin.

- First, the *FX turnover* which is a direct indicator of the internationalization degree is strongly significant with the expected sign in all regressions ((1) to (12)). When a local currency is increasingly used in FX transactions (as a share of global FX transactions in foreign exchange market), foreign investors are more prone to include local currency bonds in their portfolios. It refers to Krugman (1984)'s network effects between the three main functions of an international currency (see also Frankel, 2011; Eichengreen, 2014), here between 'means of payment' and 'store of value'.

- Second, the lagged dependent variable is strongly significant in all regressions ((1) to (12)) with a positive sign. It is a proof of the existence of inertia in the fulfillment of the function 'store of value' and in the internationalization process or in investors' habits when buying bonds from year to year (Chitu, Eichengreen and Mehl, 2014; Eichengreen, 2014).

- Third, amongst the drivers of internationalization (indirect measures), the *Economic size* is the most significant variable with the expected sign as in Chitu, Eichengreen and Mehl (2014), Eichengreen (2004) and Engel and Park (2018). This is also a traditional variable tested in articles on currency internationalization, whatever the function, which measures network effects. When a country is economically strong, its currency is more prone to be used by international investors for international transactions, notably in bonds markets. Consequently, bonds are more issued in local currency and are more purchased by foreign investors.

Table 1. (2005Q4-2016Q2)

Independant variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependant variable: Local currency debt (expressed as a share of total external debt)												
Lagged depend variable	0.729***	0.750***	0.657***	0.652***	0.645***	0.473***	0.595***	0.605***	0.671***	0.591***	0.561***	0.533***
	7.73	*11.41*	*9.25*	*8.37*	*7.83*	*4.37*	*5.88*	*10.52*	*6.74*	*5.87*	*4.75*	*5.21*
Fx turnover	1.369**	1.276*	1.376*	1.473*	1.649**	0.624*	1.005**	1.580**	1.847*	1.534*	0.432**	1.618**
	2.18	*1.70*	*1.76*	*1.75*	*1.95*	*1.87*	*2.03*	*1.96*	*1.877*	*1.70*	*2.27*	*2.33*
Economic size		2.458*	2.622***	2.320***	2.812**	2.022**	3.528**	2.292**	3.510**	5.476***	6.86*	2.419
		1.77	*3.07*	*2.54*	*2.04*	*2.01*	*1.97*	*1.89*	*2.02*	*2.38*	*1.82*	*1.54*
Trade openess			0.015	0.001	0.014	0.061	0.055*	0.047	0.018	-0.003	0.037	0.077
			0.582	*0.954*	*0.40*	*0.81*	*1.69*	*0.94*	*0.58*	*-0.09*	*0.78*	*1.42*
Financial depth				0.006*	0.011***	-0.009	0.004	0.010***	0.001	-0.001	-0.003	0.007
				1.73	*2.83*	*-0.74*	*0.42*	*3.08*	*0.11*	*-0.20*	*-0.37*	*1.52*
Capital account					0.693*	0.566	0.474	0.664	0.953	0.858***	0.504	0.834*
					1.61	*1.97*	*1.13*	*1.46*	*1.58*	*2.36*	*1.27*	*1.87*
Inflation	-0.221	-0.071	-0.010	-0.045	-0.104	0.126			-0.083	-0.008	-0.087	-0.251
	-0.97	*-0.83*	*0.73*	*-0.91*	*-0.96*	*1.37*			*-0.81*	*-0.23*	*-0.79*	*-0.96*
FX volatility	-0.674					-2.559**	-1.036*		-1.170*	-0.426	-1.654*	-1.295*
	-0.96					*-2.17*	*-1.61*		*-1.63*	*-0.63*	*-1.67*	*-1.63*
Current account	0.048**						0.025	-0.060	0.011	-0.003	0.085	-0.042
	2.04						*1.03*	*-1.52*	*0.43*	*-0.10*	*1.18*	*-0.84*
VIX	-0.004**	-0.004***	-0.004***	-0.004**	-0.004*			-0.004**	-0.004**	-0.004**	-0.001	-0.004**
	-2.04	*-3.06*	*-3.32*	*-2.41*	*-1.67*			*-2.09*	*-2.14*	*-2.15*	*-0.43*	*-2.31*
Dummy Crisis										-0.039		
										-0.44		
Latin America										-0.605		
										-1.27		
Asia											-0.659	
											-1.54	
Others												-0.156
												-1.11
Constant	-0.377**	-0.528*	-0.598*	-0.788***	-0.966***	-0.925	-0.830*	-0.935***	-0.499	-0.349**	-1.479	-0.595**
	-1.24	*-1.83*	*-1.80*	*-2.87*	*-2.76*	*-1.02*	*-1.65*	*-2.74*	*-1.35*	*-1.89*	*-1.59*	*-2.02*
Country specific effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
CD tst statistics	*4.96*	*1.79*	*1.70*	*0.95*	*1.17*	*-0.21*	*0.41*	*1.17*	*0.56*	*1.77*	*-0.28*	*1.03*
p-value	*0.000*	*0.0732*	*0.0896*	*0.3437*	*0.24*	*0.835*	*0.683*	*0.243*	*0.576*	*0.07*	*0.77*	*0.30*
Number of obs.	468	468	468	468	468	468	468	468	468	468	468	468
R² adjusted	0.76	0.77	0.76	0.74	0.71	0.43	0.47	0.75	0.69	0.54	0.39	0.70
F-test	$F_{(156, 312)}$ prob > F = 0.00	$F_{(168, 300)}$ prob > F = 0.00	$F_{(228,240)}$ prob > F = 0.00	$F_{(240,228)}$ prob > F = 0.00	$F_{(252,216)}$ prob>F = 0.00	$F_{(300, 168)}$ prob>F = 0.00	$F_{(252, 216)}$ prob>F = 0.00	$F_{(252, 216)}$ prob>F = 0.00	$F_{(228, 240)}$ prob>F = 0.00	$F_{(300, 168)}$ prob>F = 0.00	$F_{(288, 180)}$ prob>F = 0.00	$F_{(288, 180)}$ prob>F = 0.00

z-stats are in italics

* significant at 10%, ** significant at 5%, ***significant at 1%

Countries included are Argentina, Brazil, Chile, Colombia, Mexico, Peru, India, Indonesia, Thailand, South Korea, South Africa, Turkey

Dynamic Common Correlated Effects with heterogenous coefficients.

The other drivers (*Trade openness, Financial depth, Capital account openness*) are less and scarcely significant, but with the expected sign.

- Amongst the control variables, the main determinant with the expected sign is the VIX. When financial stress is increasing, foreign investors favor bonds in strong currencies for example in dollars rather than in emerging country currencies. The dummies are never significant.

When testing without the direct measure of internationalization - FX turnover-, results are poorer in terms of adjusted R2 and number of significant variables (not reported here).

Results concerning 'Growth rate of Total amount issued in local currencies in international markets' as a measure of original sin are presented in Table 2. They confirm some of the previous results. Even if some determinants are less or not significant in comparison with Table 1, the results allow us to conclude on a favorable impact of internationalization process on original sin.

- First, the two main determinants are again: the lagged dependent variable which expresses inertia and the economic size which refers to network effects (cf Chitu, Eichengreen and Mehl, 2014).

- Second, the *FX turnover* remains significant with the expected sign (even if it is in 7 specifications rather than 12 in Table 1). Moreover, when *FX turnover* is significant, the specifications appear to be better.

- Third, amongst the other variables (drivers or control variables), the VIX remains a major determinant with the expected sign. Financial stress and uncertainty don't support the issuing of emerging market currency debt in international markets.

- Finally, the only dummy significant is the dummy region 'Latin America' with a positive sign (column 10). When the denomination currency is a Latin American one, the rate of growth of the amount issued in international markets is increasing. This may relate to the situation of Mexico, Brazil, or Colombia: bonds are mostly issued in local currency for some time and more than Asian ones (except China) (Graph 3).

When testing without the direct measure of internationalization- FX turnover-, results are quite the same in terms of adjusted R2 and number of significant variables (not reported here).

Table 2. (2001 Q4-2015Q2)

Independant variables	Dependant variable: Growth rate of Total amount issued in local currencies in international markets											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Lagged depend variable	0.602***	0.662***	0.671***	0.548***	0.585***	0.613***	0.535***	0.580***	0.565***	0.514***	0.514***	0.535***
	13.62	14.05	13.85	6.26	6.58	6.66	8.35	7.88	6.74	7.02	7.02	8.35
Fx turnover	-0.436	1.021	0.970	1.548**	1.408**	0.488	1.047*	1.692***	0.636	1.229***	1.229***	1.047*
	-0.43	0.74	0.68	6.26	2.17	0.79	1.66	2.45	1.01	2.39	2.39	1.66
Economic size		5.431***	5.402**	10.800***	13.281***	10.549***	9.101***	10.611***	9.724***	8.419***	8.419***	9.101***
		2.89	2.05	2.62	2.88	2.99	3.09	3.52	2.68	2.99	2.99	3.09
Trade openess			-0.040	-0.051	0.009	0.057			-0.041			
			-1.19	-0.54	0.12	0.53			-0.36			
Financial depth				0.033**	0.027	0.035*	0.031	0.032	0.039**	0.021	0.021	0.031
				2.14	1.38	1.60	1.45	1.53	2.27	1.12	1.12	1.45
Capital account openess					1.446	0.406	1.549	1.411		1.620	1.620	1.549
					0.82	0.29	0.99	0.91		1.06	1.06	0.99
Inflation	1.055				1.120		0.767	0.944		0.934	0.934	0.767
	1.02				0.99		1.01	1.00		1.03	1.03	1.01
FX volatility	2.418				-0.078	2.858		0.128	0.604			
	1.25				-0.07	1.33		0.13	0.55			
Current account	-0.065	0.062	0.094	-0.067		-0.193			-0.150			
	-1.12	1.00	1.19	-0.83		-1.39			-1.04			
VIX	-0.006**	-0.005***	-0.006***	-0.0006			-0.009***		-0.008*	-0.10**	-0.10**	-0.090***
	-2.50	-2.45	-2.15	-0.15			-3.35		1.65	-1.84	-1.84	-3.35
dummy crisis										0.122	0.122	
										1.04	1.04	
Latin America											1.892**	
											2.21	
Asia											-0.087	
											-0.18	
Others												0.105
												1.00
Constant	0.669**	0.157***	0.183***	1.752	1.942	0.157	2.419**	2.381**	0.843	-0.069	1.910**	2.313**
	2.43	3.31	2.69	1.09	1.49	0.08	2.34	2.11	0.40	0.14	2.24	2.20
Country specific effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
CD tst statistics	4.96	3.37	3.26	2.87	3.80	2.46	3.74	3.68	2.58	3.14	3.14	3.74
p-value	0.000	0.000	0.001	0.004	0.000	0.01	0.000	0.000	0.009	0.000	0.000	0.000
Number of obs.	612	612	612	612	612	612	612	612	612	612	612	612
Adj. R^2	0.24	0.27	0.26	0.26	0.35	0.29	0.33	0.34	0.26	0.30	0.30	0.31
	$F_{(204, 408)}$	$F_{(168, 444)}$	$F_{(180, 432)}$	$F_{(288, 324)}$	$F_{(252, 360)}$	$F_{(300, 312)}$	$F_{(240, 372)}$	$F_{(240, 372)}$	$F_{(300, 312)}$	$F_{(264, 348)}$	$F_{(264, 348)}$	$F_{(252, 360)}$
	prob > F =	prob > F =	prob > F =	prob > F =	prob > F =	prob > F =	prob > F =	prob > F =	prob > F =	prob > F =	prob > F =	prob > F =
F-test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

z-stats are in italics

* significant at 10%, ** significant at 5%, ***significant at 1%

Countries included are Argentina, Brazil, Chile, Colombia, Mexico, India, Indonesia, Philippines, Thailand, South Korea, South Africa, China

Dynamic Common Correlated Effects with heterogenous coefficients.

4. Robustness and extension

In a second step, as robustness checks, we aim to use other explicative variables[9] that are less in line with the traditional literature on the drivers of currency internationalization but that are more specific to financial markets and international investors.

To proxy the drivers of internationalization process, that are in fact the fundamentals of the issuing country, we use the country rating. Investors watch closely ratings in terms of country risks and more precisely observe changes in ratings by agencies (Brana and Lahet, 2010; Morahan and Mulder, 2013). Moreover, ratings measure the ability of a country to issue and manage debts. To calculate the variable *Rating*, we use figures from Standard and Poor's and Moody's ratings and we worked out the arithmetic average. The ratings are long-term ratings, in foreign currency. An increase in the rating expresses an upgrade and better fundamentals, and, consequently, may support the decision of foreign investors to purchase or issue emerging country currency bonds.

Moreover, we test also the Bank for International Settlements (BIS) data on foreign exchange-traded derivatives' turnover and open interest (notional amount outstanding) on futures and options contracts by currency (*Derivatives* and *Derivatives Notional*)[10], traded on organized exchanges. We have two objectives. First, we complement the variable FX Turnover (the measure of 'means of payment') that includes OTC derivatives instruments (in addition to Spot transactions). It is also a measure of the function 'mean of payments' on financial markets. Second, it could allow us to go beyond the traditional literature on internationalization process and to show what some authors consider: the issuing of bonds in emerging market currency is supported by the existence of CDS, and mainly of currency swap and currency derivatives allowing foreign investors to hedge and manage currency risk. The depth of the local currency bond markets depends crucially on the existence of such markets and instruments (the pioneers authors: Eichengreen, Hausmann and Panizza, 2004; and later: Genberg, 2012; Chan et al., 2012; Shim, 2012; Turner, 2012; Ma and Villar, 2014; Cabrillac and Ferrer, 2016; Upper and Valli, 2016). Consequently, it could be relevant to test this kind of variables in our model. To our knowledge, it is the first time these variables are tested in the context of original sin and as determinants of the function 'store of value' for debt. More precisely, the deepening of local

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[9] The descriptive statistics are presented in Appendix Table A3.

[10] The BIS indicates that the exchange-traded derivatives (XTD) statistics cover the turnover (daily average) and open interest of foreign exchange (and interest rate) futures and options. The statistics are compiled from commercial data sources and cover contracts traded on over 50 organized exchanges. The main value added by the BIS is the conversion of data on the number of contracts into notional amounts using information about contract sizes. This enables consistent comparisons of levels and trends in activity across different exchanges. The BIS does not compile XTD statistics for equity, commodity or credit derivatives contracts, nor for derivatives that reference non-standard underlying instruments (eg inflation, weather or energy contracts). The daily average turnover is the total amount of derivatives contracts traded in a day, calculated as the amount traded over a specified time period divided by the number of business days within this period. The open interest or the notional amount outstanding is the total amount of exchange-traded contracts that have been entered into on a given day and not yet settled.

bonds market may be simultaneous with the development of derivatives instruments[11]. It could also refer more globally to the financial development of local markets. As emerging economies' asset prices and exchange rate are generally speaking more volatile than those of advanced economies, carrying risks, even after the 1990s crises, derivative markets and instruments are developing in emerging markets and in emerging market currencies. Much of the rise in emerging currency trading has been driven by increased demand for foreign exchange derivatives in the period of 2001-13 (Ma and Villar, 2014). The availability of derivatives instruments increases the faith of international investors: it offers the market depth necessary to take emerging market currencies into consideration in the investment strategies, so investors would be more prone to enter local bond markets or foreign ones and to issue local-currency bonds in international markets. If these amounts are increasing, it doesn't necessarily imply a growing risk on the currency, the debt or the country, but mainly an increase in the derivatives' transactions on a currency. Data are only available for seven emerging currencies (Brazil, Mexico, India, Korea, South Africa, Turkey and China), but all the emerging regions are considered; tests cover the period Q4 2005-Q2 2016. In our article, we focus on FX derivatives and not on interest rate derivatives because we study the denomination of the debt in local currency. When we look at the turnover (daily average) of foreign exchange-traded contracts (*Derivatives*), it appears that the Brazilian real is the most concerned with a turnover between 20 and 30 billion $ in the 2010s; then we can find the Indian rupee (4-8 billion $), the Korean won (2-3 billion $) and the Mexican peso (1.5-2.5 billion $). The contracts in Chinese renminbi have a low turnover. When we look at the open interest of foreign exchange-traded contracts (*Derivatives Notional*), the Brazilian real remains the most concerned (100-180 billion $, but with a decrease on 2013-17); then, we can find the Mexican peso (around 28 billion $), the Indian rupee (around 14 billion $). The contracts in Chinese renminbi have a lower amount outstanding in 2016-17 (5-7 billion $).

The empirical analysis of the influence of internationalization of emerging market currencies on original sin is always carried out using the same dynamic panel data methodology[12].

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[11] Broadly, in 2016, only 10% of global derivatives turnover is in contracts denominated in an emerging market currency (Upper and Valli (2016) and Ehlers and Packer (2013) from the BIS; analyses have not yet been updated). It is much lower than the share of these economies in global GDP. Despite a rapid development on a short period, it remains lower than for advanced economies and contracts are less complex. The contracts may be traded domestically in emerging markets, but also offshore (notably in New York for Latin American currencies; Hong Kong and Singapore for Asian currencies; only the Brazilian real, Russian rouble and Korean won have onshore OTC turnover above offshore turnover). In April 2016 (Upper and Valli, 2016), the average daily turnover in FX and interest rate derivatives denominated in emerging market currencies is at 800 billion $ (OTC+exchange-traded derivatives), almost the same as in April 2013. More precisely, the largest and most rapidly growing market is the one for contracts on the Chinese FX and interest rates: +50% from 2013 to 2016, with a peak of 150 billion $ a day in April 2016. The Chinese renminbi is consequently the eighth most traded currency in derivatives markets in 2016, above the Brazilian real (108 billion $), the Korean won (83 billion $) and the Mexican peso (81 billion $). Next in the ranking, we can find the Turkish lira, the Indian rupee and the South African Rand (around 50 billion $ a day). OTC derivatives appear to play a bigger role in emerging markets than exchange-traded derivatives (Ehlers and Packer, 2013).

[12] Unit Root tests are presented in Appendix, Table A4.

The equation (1) becomes:

Original Sin Measure$_{it}$

$$= c_i + \beta_i OSM_{it-1} + \gamma_i Rating_{it} + \theta_i FX\ Turnover_{it} + \rho_i Derivatives_{it} + \sigma VIX_t + \varepsilon_{it} \qquad (2)$$

Rating represents domestic variables, *VIX* external ones and the financial global stress, and *Derivatives* proxies the development of derivatives instruments on a currency with two measures (daily average Turnover and Notional)[13].

Results concerning 'Local Currency external debt as a share of total external debt' (Hausman transformation) as a measure of Original sin are presented in Table 3a and Table 3b.

In table 3a, when using daily turnover for Derivatives, alongside *FX Turnover*, some of the market-oriented variables, notably *Derivatives*, explain the growing share of local currency external debt for some emerging countries and consequently have a favorable impact on original sin. Dummies are not significant. The main results are:

- First, when *FX Turnover* is tested, it is significant with the expected sign, and *Derivatives* is also significant with a positive sign. When the availability of derivatives instruments on emerging market currencies is increasing, investors are more prone to enter local bond markets or foreign ones to purchase local-currency bonds. This result fits the literature.

- Second, VIX is strongly significant with a negative sign in all regressions. Financial stress and uncertainty don't support the purchase of local-currency debt by foreign investors.

- Third, the lagged dependent variable is strongly significant in all regressions: inertia is still operating in this context of currency denomination.

- Lastly, when the *FX Turnover* is not tested, *Rating* appears to be significant with the expected positive sign and *Derivatives* is not significant any more. Better ratings support investors in their investment choice in favor of local-currency debt.

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[13] We test also the lagged variable of Derivatives to capture the potential prior of the development of derivatives instruments over the deepening of local currency debt market. Results are not improved.

Table 3a. (2005 Q4-2016 Q2) (Derivatives daily turnover)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependant variable: Local currency debt (expressed as a share of total external debt)										
Independant variables										
Lagged depend variable	0.579***	0.564***	0.579***	0.579***	0.579***	0.645***	0.639***	0.639***	0.639***	0.692***
	6.96	6.30	6.96	6.96	6.96	5.78	5.50	5.50	5.50	9.32
Fx turnover	0.146*	0.156**	0.146*	0.146*	0.146*					0.326**
	1.75	1.95	1.75	1.75	1.75					1.91
Rating	-0.017	0.005	-0.017	-0.017	-0.017	0.054*	0.051*	0.051*	0.051*	-0.002
	-0.35	0.15	-0.35	-0.35	-0.35	1.66	1.66	1.66	1.66	-0.11
Derivatives	0.0001**	0.0002**	0.0001**	0.0001**	0.0001**	0.0008	0.0005	0.0005	0.0005	
	2.05	2.06	2.05	2.05	2.05	1.26	1.30	1.30	1.30	
VIX	-0.003***	-0.003**	-0.003***	-0.003***	-0.003***	-0.002**	-0.002***	-0.002***	-0.003***	-0.003***
	-2.04	-2.24	-2.04	-2.04	-2.04	-2.17	-2.34	-2.34	-2.34	-2.92
Dummy Crisis		-0.022				-0.022				
		-0.78				-0.67				
Latin America			-0.764				-0.499			
			-0.79				-1.05			
Asia				-1.24				-0.011		
				-1.30				-0.09		
Others					-1.054				-0.721	
					-0.82				-1.15	
Constant	-3.397***	-4.066***	-2.633**	-2.15	-2.342**	-1.354*	-0.732	-1.22*	-0.510	-3.289***
	-2.51	-3.42	-2.02	-1.53	-2.04	-1.82	-1.15	-1.77	-1.04	-2.43
Country specific effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
CD tst statistics	-0.75	-0.79	-0.75	-0.75	-0.75	0.77	1.32	1.32	1.32	0.51
p-value	0.4538	0.4318	0.4538	0.4538	0.4538	0.4393	0.1858	0.1858	0.1858	0.6068
Number of obs.	234	234	234	234	234	234	234	234	234	234
R² adjusted	0.43	0.41	0.41	0.41	0.71	0.38	0.42	0.42	0.42	0.32
F-test	F(84,150) prob > F = 0.00	F(90,144) prob > F = 0.00	F(90,144) prob > F = 0.00	F(90,144) prob > F = 0.00	F(90,144) prob > F = 0.00	F(84,150) prob > F = 0.00	F(84,150) prob > F = 0.00	F(84,150) prob > F = 0.00	F(84,150) prob > F = 0.00	F(102,132) prob > F = 0.00

z-stats are in italics

* significant at 10%, ** significant at 5%, ***significant at 1%

Countries included are Brazil, Mexico, India, South Korea, South Africa, Turkey

Dynamic Common Correlated Effects with heterogenous coefficients.

In table 3b, when using the notional of Derivatives, three variables stand out, notably *Derivatives Notional* which has a favorable impact on original sin.

- First, tests show that the lagged dependent variable and VIX are still the main determinants with the expected sign, as in all other specifications. Dummies are not significant.
- Second, *Derivatives Notional* is weakly significant with the positive expected sign. It remains significant when FX Turnover is not tested.
- Third, *FX Turnover* is significant only when *Derivatives Notional* is not tested.

Table 3b. (2005 Q4-2016 Q2) (Derivatives Notional)

Independant variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependant variable: Local currency debt (expressed as a share of total external debt)							
Lagged depend variable	**0.714***	**0.704***	**0.704***	**0.714***	**0.714***	**0.714***	**0.692***
	4.44	*4.43*	*4.60*	*4.44*	*4.44*	*4.44*	*9.32*
Fx turnover	-0.064		-0.025	-0.064	-0.064	-0.064	**0.32****
	-0.84		*-0.33*	*-0.84*	*-0.84*	*-0.84*	*1.91*
Rating	-0.069	-0.013	-0.053	-0.069	-0.069	-0.069	-0.002
	-1.48	*-0.35*	*-1.17*	*-1.48*	*-1.48*	*-1.48*	*-0.11*
Derivatives notional	**0.00003***	**0.00003***	**0.00003***	**0.00003***	**0.00003***	**0.00003***	
	1.65	*1.70*	*1.85*	*1.65*	*1.65*	*1.65*	
VIX	**-0.005****	**-0.004***	**-0.004****	**-0.005****	**-0.005****	**-0.005****	**-0.003***
	-2.23	*-2.28*	*-2.11*	*-2.23*	*-2.23*	*-2.23*	*-2.92*
Dummy Crisis			-0.019				
			-0.71				
Latin America				0.639			
				1.38			
Asia					0.604		
					1.58		
Others						-0.320	
						-1.07	
Constant	0.923	0.099	0.618	0.283	0.319	**1.24***	**-3.28***
	1.37	*0.17*	*0.90*	*0.51*	*0.51*	*2.73*	*-2.43*
Country specific effects	yes	yes	yes	yes	yes	yes	yes
CD tst statistics	*3.25*	*3.25*	*3.12*	*3.25*	*3.25*	*3.25*	*0.51*
p-value	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.60*
Number of obs.	234	234	234	234	234	234	234
R² adjusted	0.70	0.75	0.70	0.69	0.69	0.69	0.32
F-test	F(84,150) prob > F = 0.00	F(78,156) prob > F = 0.00	F(90,144) prob > F = 0.00	F(90,144) prob > F = 0.00	F(90,144) prob > F = 0.00	F(90,144) prob > F = 0.00	F(102,132) prob > F = 0.00

z-stats are in italics

* significant at 10%, ** significant at 5%, ***significant at 1%

Countries included are Brazil, Mexico, India, South Korea, South Africa, Turkey

Dynamic Common Correlated Effects with heterogenous coefficients.

Results concerning 'Growth rate of Total amount issued in local currencies in international markets' as a measure of Original sin are presented in Table 4a and Table 4b. Results are less relevant. In table 4a, when using the daily turnover for Derivatives:

- First, tests show that the lagged dependent variable and VIX are still the main determinants with the expected sign, as in all other specifications. Dummies are not significant.
- Second, amongst the other variables, *Derivatives* remains significant, but with negative sign. The availability of derivative instruments on an emerging market currency would reduce the issuing of bonds denominated in this currency on international markets. This result doesn't fit the literature.
- Third, *FX Turnover* and *Rating* are never significant.

Table 4a (2005 Q4-2015 Q2) (Derivatives daily turnover)

Dependant variable: Growth rate of Total amount issued in local currencies in international markets							
Independant variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lagged depend variable	0.720***	0.724***	0.720***	0.720***	0.720***	0.734***	0.805***
	7.90	8.56	7.90	7.90	7.90	7.12	9.96
Fx turnover	0.001	-0.053	0.001	0.001	0.001		0.221
	0.00	-0.23	0.00	0.00	0.00		0.79
Rating	0.212	0.176	0.212	0.212	0.212	0.178	0.030
	0.73	0.62	0.73	0.73	0.73	0.68	0.35
Derivatives	-0.0004**	-0.0002	-0.0004**	-0.0004**	-0.0004**	-0.0005**	
	-2.11	-1.22	-2.11	-2.11	-2.11	-2.26	
VIX	-0.006***	-0.006***	-0.006***	-0.005***	-0.005***	-0.004***	-0.006***
	-4.02	-5.16	-4.02	-4.02	-4.02	-2.98	-3.42
Dummy Crisis		-0.090					
		-1.58					
Latin America			0.278				
			1.48				
Asia				-2.252			
				-0.75			
Others					0.149		
					1.53		
Constant	-1.824	-1.475	-2.103	0.428***	-1.974	-1.411	2.267
	-0.60	-0.50	-0.70	2.43	-0.65	-0.50	1.55
Country specific effects	yes	yes	yes	yes	yes	yes	yes
CD tst statistics	4.07	4.40	4.07	4.07	4.07	4.53	5.54
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Number of obs.	245	245	245	245	245	245	245
R² adjusted	0.46	0.45	0.43	0.43	0.43	0.43	0.42
F-test	F(98,147) prob > F = 0.00	F(105,140) prob > F = 0.00	F(105,140) prob > F = 0.00	F(105,140) prob > F = 0.00	F(105,140) prob > F = 0.00	F(91,154) prob > F = 0.00	F(91,154) prob > F = 0.00

z-stats are in italics

* significant at 10%, ** significant at 5%, ***significant at 1%

Countries included are Brazil, Mexico, India, South Korea, South Africa, Turkey and China

Dynamic Common Correlated Effects with heterogenous coefficients.

In table 4b, when using Derivatives Notional:

- First, tests show that the lagged depend variable and VIX remain the main determinants with the expected sign. Dummies are not significant.
- Second, *FX Turnover* is never significant, whether tested with or without *Derivatives Notional*. *Derivatives Notional* is not significant either, as *Rating*.

Table 4b (2005 Q4-2015 Q2) (Derivatives Notional)

Dependant variable: Growth rate of Total amount issued in local currencies in international markets							
Independant variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lagged dependent variable	0.751***	0.783***	0.754***	0.772***	0.751***	0.751***	0.773***
	6.68	*6.92*	*6.99*	*6.90*	*6.70*	*6.70*	*7.26*
Fx turnover	0.011		0.106	-0.569	0.046	0.046	-0.119
	0.05		*0.44*	*-0.76*	*0.22*	*0.22*	*'-0.56*
Rating	-0.025	0.021	0.017	-0.021	-0.025	-0.025	-0.019
	-0.34	*0.19*	*0.19*	*-0.25*	*-0.34*	*-0.34*	*-0.26*
Derivatives notional	0.000	0.000	0.000	0.000	0.000	0.000	
	0.59	*0.82*	*0.62*	*0.72*	*0.59*	*0.59*	
VIX	-0.007***	-0.006***	-0.006***	-0.005***	-0.006***	-0.006***	-0.007***
	-5.64	*-3.71*	*-4.42*	*-4.14*	*-5.56*	*-5.56*	*-5.55*
Dummy Crisis			-0.065				
			-0.68				
Latin America				0.105			
				0.43			
Asia					0.598		
					0.53		
Others						-0.181	
						-0.70	
Constant	0.559	0.068	0.035	0.362	-0.039	0.740	0.596
	0.47	*0.04*	*0.03*	*0.28*	*0.11*	*0.65*	*0.50*
Country specific effects	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
CD tst statistics	*3.37*	*1.72*	*3.32*	*1.20*	*3.28*	*3.28*	*3.32*
p-value	*0.00*	*0.08*	*0.00*	*0.22*	*0.00*	*0.00*	*0.00*
Number of obs.	245	245	245	245	245	245	245
R² adjusted	0.40	0.50	0.38	0.43	0.37	0.37	0.47
F-test	F(98,147) prob > F = 0.00	F(63,182) prob > F = 0.00	F(105,140) prob > F = 0.00	F(77,168) prob > F = 0.00	F(105,140) prob > F = 0.00	F(105,140) prob > F = 0.00	F(91,154) prob > F = 0.00

z-stats are in italics

* significant at 10%, ** significant at 5%, ***significant at 1%

Countries included are Brazil, Mexico, India, South Korea, South Africa, Turkey and China

Dynamic Common Correlated Effects with heterogenous coefficients.

Conclusion and recommendations

This article provides an empirical evidence of one of the benefits of emerging currencies internationalization: greater internationalization of emerging market currencies through direct and indirect metrics of the process tends to diminish the original sin that affects emerging countries from more than two decades. Issuing debt in local currency is easier and is enhanced by network effects. To our knowledge, it was so far scarcely demonstrated.

First, Table 1 shows clearly that an increased share of the use of an emerging country currency in the FX market positively influences the share of local currency denominated external debt. This factor contributes in a large way to decrease the original sin for emerging countries. The drivers of internationalization of emerging currencies are also key determinants of the decline of original sin. In particular, countries that are more economically developed seem to be more able to denominate their external debt in local currency avoiding supporting the exchange rate risk. Moreover, an increasing financial stress doesn't support the issuing of bonds in emerging market currency. Finally, tests show also the existence of inertia (lagged dependent variable) and of network effects between the functions 'store of value' and 'means of payment' (*FX turnover*) and also because of the significant impact of the variable Economic size. Table 2, when original sin is measured by the total debt amount issued in local currency in international markets, confirms our previous results.

Second, results of the robustness tests are less clear, mainly for *FX Turnover*. The VIX and the availability of derivative instruments on emerging market currencies are main determinants, notably when original sin is measured by the share of local currency denominated external debt (Table 3a and 3b). Tests highlight also the existence of inertia as in the baseline approach.

We can conclude that having a currency involved in internationalization process is an important factor for the issuing of debt in the local currency. As internationalization process is market-driven but also depends on supply factors, emerging countries have to keep strengthening and opening their economies: currency internationalization will go on and investors will be comforted. Even if fundamentals will be better, and as evolutions are lengthy, the existence of derivatives instruments on emerging market currencies is crucial, but derivatives instruments should become more complex. This mainly fits Eichengreen, Hausmann and Panizza (2004): the authors highlighted the case of Chile in the 1990s with macroeconomic stability, strong growth…, but unable to issue local currency debt because of the lack of hedging instruments. Thus, it is not so much a problem of strong fundamentals or upgraded rating as it is a problem of hedging instruments diversity. The more the supply of derivatives instruments will be, the more prone to invest in local currency debt investors will be.

In order to improve our analysis, we could also calculate an index of internationalization on the basis of the direct and indirect measures. As articles on the currencies composition of international reserves (Lee, 2014), it could be interesting to highlight some tipping points or threshold on some

variables (FX Turnover, Economic size) beyond which there would be an acceleration in the debt issuing in emerging market currency.

Appendix

Table A1. The uses of an international currency

Function	Private sector	Official sector
Unit of account	Currency used in invoicing merchandise trade *(Invoice)*	Currency used in defining parities *(Peg)*
Means of payment	Vehicle currency in foreign-exchange markets *(Vehicule)*	Intervention currency in foreign-exchange markets *(Intervention)*
Store of value	Currency in which deposits, loans, and bonds are denominated *(Banking)*	Currency in which reserves are held *(Reserve)*

Source: Kenen (1983), p.16. In brackets and italics, expression from Krugman (1984).

Table. A2. International currency status: A score board. In Maziad et al. (2011), p.14.

AE currencies	USD	Euro	Yen	Pound	SWF	AUD	CAD	NZD
Widely used as international reserves	●	●	●	●	◑	○	○	○
Widely used in capital and trade payments	●	●	◑	◑	○	○	○	○
Widely traded in FX markets	●	●	●	●	◑	◑	◑	◑
Economic size	●	●	●	●	◑	◑	◑	○
Trade network	●	●	●	●	◑	◑	◑	◑
Investability 2/	●	●	●	●	●	●	●	●
Capital account openness 3/	●	●	●	●	●	◑	●	●
Financial depth index 4/	●	●	●	●	◑	◑	◑	○

EM and NIE currencies	HKD	Won	SGD	RMB	Real	Rupee	Ruble	Rand
Widely used as international reserves	○	○	○	○	○	○	○	○
Widely used in capital and trade payments	○	○	○	○	○	○	○	○
Widely traded in FX markets	●	◑	◑	○	○	○	○	○
Economic size	○	◑	○	●	◑	◑	◑	◑
Trade network	◑	◑	◑	●	◑	◑	◑	◑
Investability 2/	●	●	●	●	◑	◑	◑	●
Capital account openness 3/	●	◑	●	○	◑	○	◑	○
Financial depth index 4/	◑	◑	◑	●	◑	◑	◑	◑

1/ "●" criteria fully met; "◑"patially met; "○"not met.

2/ "●" Based on sovereign risk ratings "A" or above by Moody's and S&P.

3/ Based on Chinn and Ito "Capital Account Openness Indicator, 2008"

4/ Country contributions to global financial depth , "●" for top five contributors.

Table A3. Descriptive Statistics

Baseline approach:

Variable	Obs.	Min.	Max.	Mean	Std.Dev.
LC external debt	516	-7,901	0,333	-2,125	1,290
VIX	516	11,390	44,140	20,125	8,413
Trade openess	516	8,607	61,839	25,027	12,766
Current acc. Bal.	516	-9,024	11,119	-1,170	3,248
Financial depth	516	10,972	165,297	53,188	35,052
Economic size	516	0,172	3,988	1,205	0,921
Cap.Acc. Openess	516	0,000	1,000	0,471	0,280
Inflation	516	-3,028	44,041	5,327	5,323
FX volatility	516	0,005	0,172	0,048	0,034
FX Turnover	516	0,000	2,500	0,564	0,573

Variable	Obs.	Min.	Max.	Mean	Std.Dev.
issue LC	660	-3,530	4,753	0,291	0,765
VIX	660	11,390	44,140	20,243	8,383
Trade openess	660	8,607	61,839	26,323	12,470
Current acc. Bal.	660	-6,067	10,335	0,363	3,145
Financial depth	660	7,317	165,297	57,971	39,196
Economic size	660	0,202	15,615	1,728	2,458
Cap.Acc. Openess	660	0,000	1,000	0,404	0,238
Inflation	660	-8,627	40,306	4,602	5,149
FX volatility	660	0,000	0,557	0,047	0,052
FX Turnover	660	0,000	2,500	0,504	0,546

Robustness part:

Variable	Obs.	Min.	Max.	Mean	Std.Dev.
issue LC	273	-0,651	2,59	0,301	0,51
VIX	273	11,39	44,14	20,335	8,72
FX Turnover	273	0,1	2,5	0,976	0,532
Rating	273	8	17	12,58	2,532
Derivatives	273	0	29970,33	3964,781	7416,28
Derivatives notional	273	0	179943	18813,07	39366,53

| Variable	Obs.	Min.	Max.	Mean	Std.Dev.
LC external debt	258	-3,712	0,333	-1,459	0,916
VIX	258	11,39	44,14	20,124	8,421
FX Turnover	258	0,1	2,5	1,008	0,5
Rating	258	8	17,5	12,001	2,227
Derivatives	258	0	29138	4620,22	7618,971
Derivatives notional	258	0	179943	22101,33	41733,4

Table A4. Unit Root tests

	Pesaran (2007) Panel Unit Root test (CIPS) **Second generation**					
	With constant and no trend			With constant and trend		
Variable	Lags	zt-bar	p-value	Lags	zt-bar	p-value
Trade openess	0	4.282	1.000	0	3.963	1.000
	1	2.253	0.988	1	1.513	0.935
	2	2.139	0.984	2	1.309	0.905
	3	2.414	0.992	3	1.232	0.891
	4	3.980	1.000	4	4.564	1.000
Current account deficit	0	2.312	0.990	0	2.645	0.996
	1	0.999	0.841	1	0.791	0.785
	2	0.159	0.563	2	-0.092	0.463
	3	-0.625	0.266	3	-0.704	0.241
	4	-0.251	0.401	4	1.381	0.916
Financial depth	0	-3.031	0.001	0	-1.397	0.081
	1	-2.327	0.010	1	-0.488	0.313
	2	-2.154	0.016	2	-0.166	0.434
	3	-1.562	0.059	3	0.561	0.712
	4	-0.706	0.240	4	1.269	0.898
Inflation	0	0.868	0.807	0	0.453	0.675
	1	-0.889	0.187	1	-2.092	0.018
	2	-1.167	0.122	2	-2.607	0.005
	3	-1.298*	0.097	3	-2.557	0.005
	4	1.811	0.965	4	1.027	0.848
FX volatility	0	-2.606	0.005	0	-1.750	0.040
	1	-2.541	0.006	1	-2.428	0.008
	2	-2.771	0.003	2	-2.404	0.008
	3	-1.069	0.142	3	-0.554	0.290
	4	1.115	0.867	4	2.134	0.984
Economic size	0	5.677	1.000	0	7.294	1.000
	1	1.104	0.865	1	0.381	0.648
	2	0.454	0.675	2	-0.086	0.466
	3	0.687	0.754	3	0.833	0.798
	4	1.700	0.955	4	3.578	1.000
Capital account openess	0	5.873	1.000	0	6.326	1.000
	1	6.198	1.000	1	7.154	1.000
	2	6.002	1.000	2	7.343	1.000
	3	5.799	1.000	3	6.999	1.000
	4	5.259	1.000	4	6.336	1.000
FX turnover	0	2.140	0.984	0	3.546	1.000
	1	1.997	0.977	1	3.503	1.000
	2	1.762	0.961	2	3.200	0.999
	3	1.362	0.913	3	2.664	0.996
	4	0.492	0.689	4	1.360	0.913
Total amount issued in local currencies in international markets	0	-4.291	0.000	0	-3.565	0.000
	1	-5.561	0.000	1	-4.777	0.000
	2	-6.422	0.000	2	-5.904	0.000
	3	-8.261	0.000	3	-8.868	0.000
	4	-2.758	0.003	4	-2.661	0.004
Local currency external debt	0	-2.655	0.004	0	-2.818	0.002
	1	-2.824	0.002	1	-2.697	0.003
	2	-2.297	0.011	2	-1.270	0.102
	3	-1.734	0.041	3	-0.865	0.194
	4	-1.664	0.048	4	-0.314	0.377
Derivatives	0	-0.998	0.159	0	-2.534	0.006
	1	0.704	0.759	1	-1.957	0.025
	2	1.271	0.898	2	0.792	0.786
	3	1.917	0.972	3	1.894	0.971
	4	1.505	0.934	4	2.028	0.979
Derivatives notional	0	0.035	0.514	0	-2.588	0.005
	1	1.190	0.883	1	-1.155	0.124
	2	1.708	0.956	2	-0.176	0.430
	3	2.624	0.996	3	0.774	0.781
	4	2.945	0.998	4	0.323	0.627

H0: all series are non-stationary

		t-Statistic	Prob.*
VIX	Augmented Dickey-Fuller test statistic	-3.2809**	0.0222
	Test critical values: 1% level	-3.596616	
	5% level	-2.933158	
	10% level	-2.604867	

*MacKinnon (1996) one-sided p-values.

Graph 1. QEDS total external debt (Million $)

Latin america

Asia
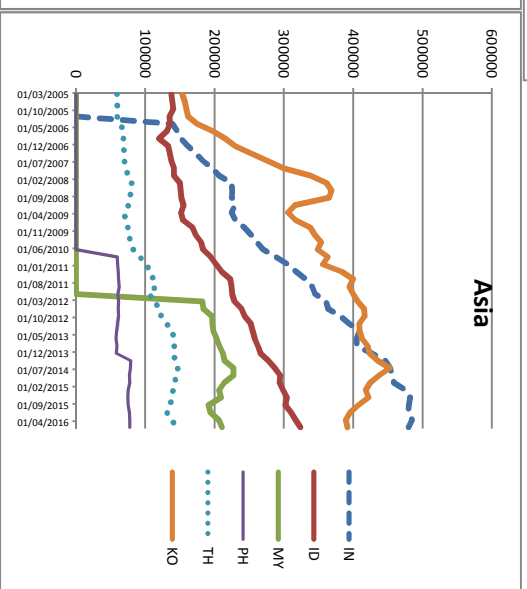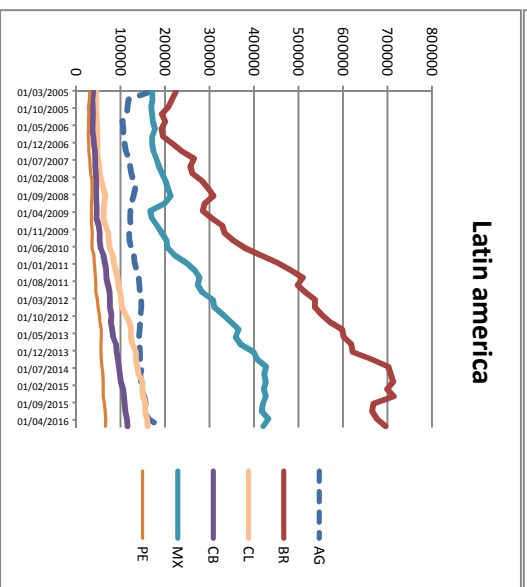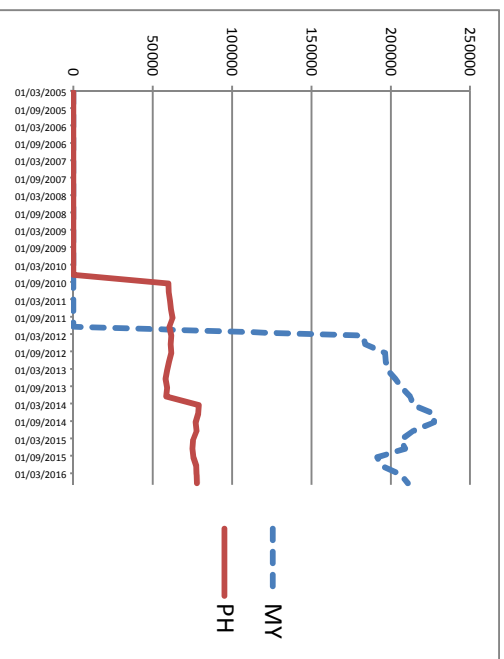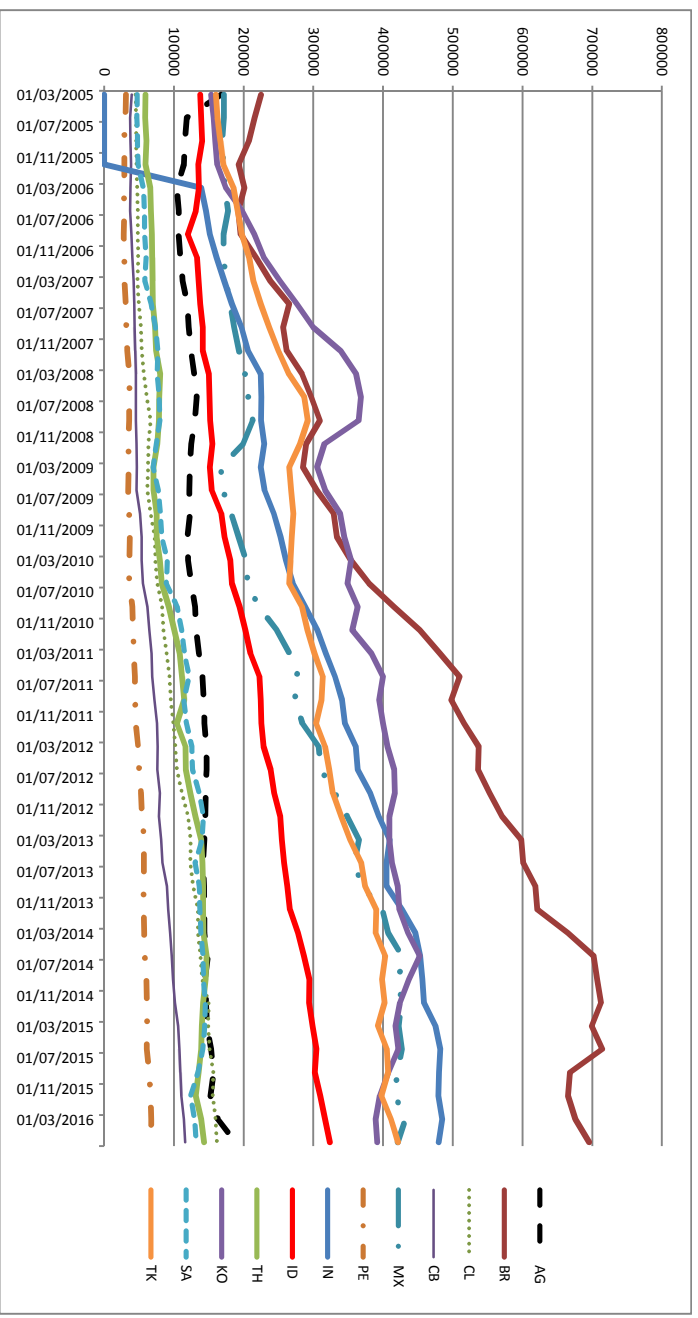
Graph 2. QEDS External debt in domestic currency/ QEDS Total External debt (%)
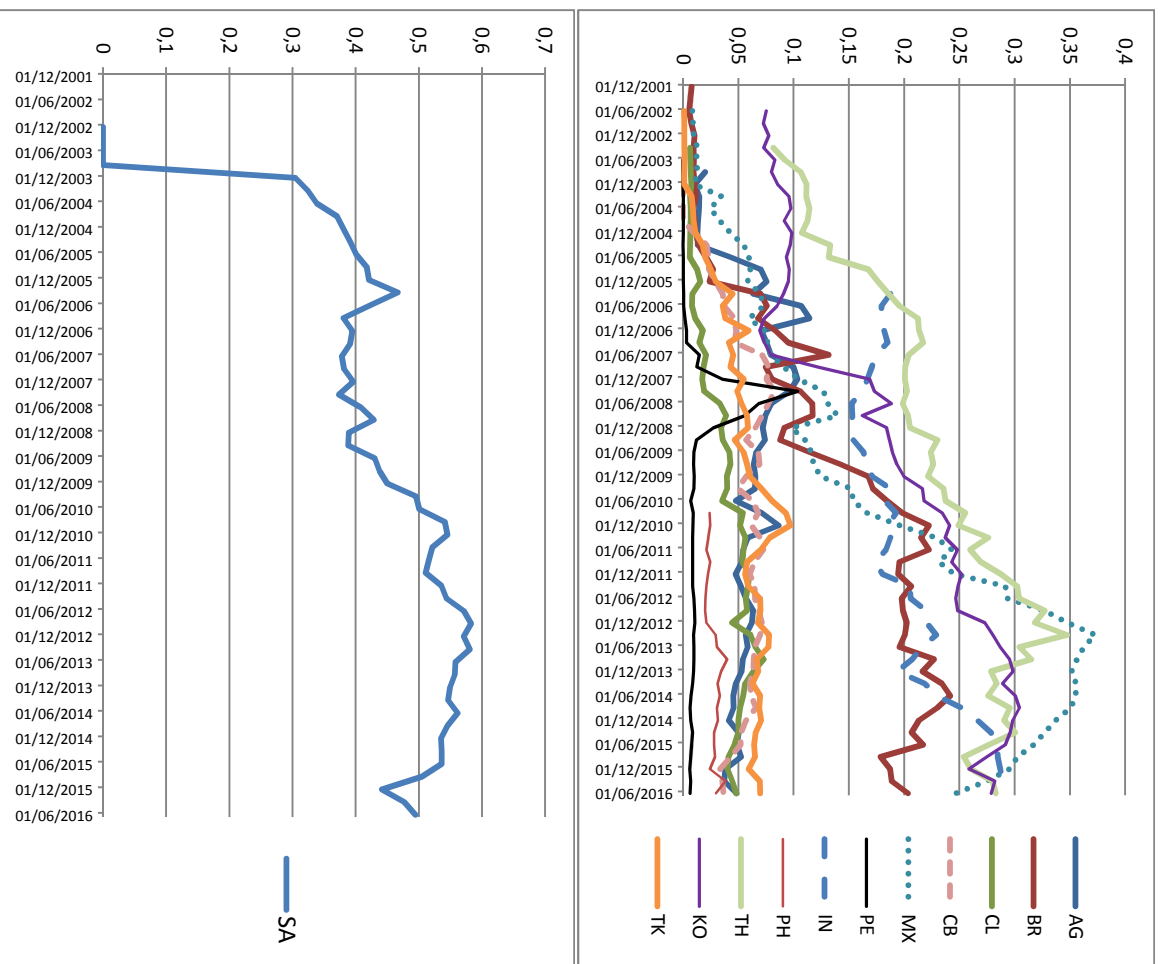
Graph 3. BIS international debt securities outstanding by currency (Billion $)
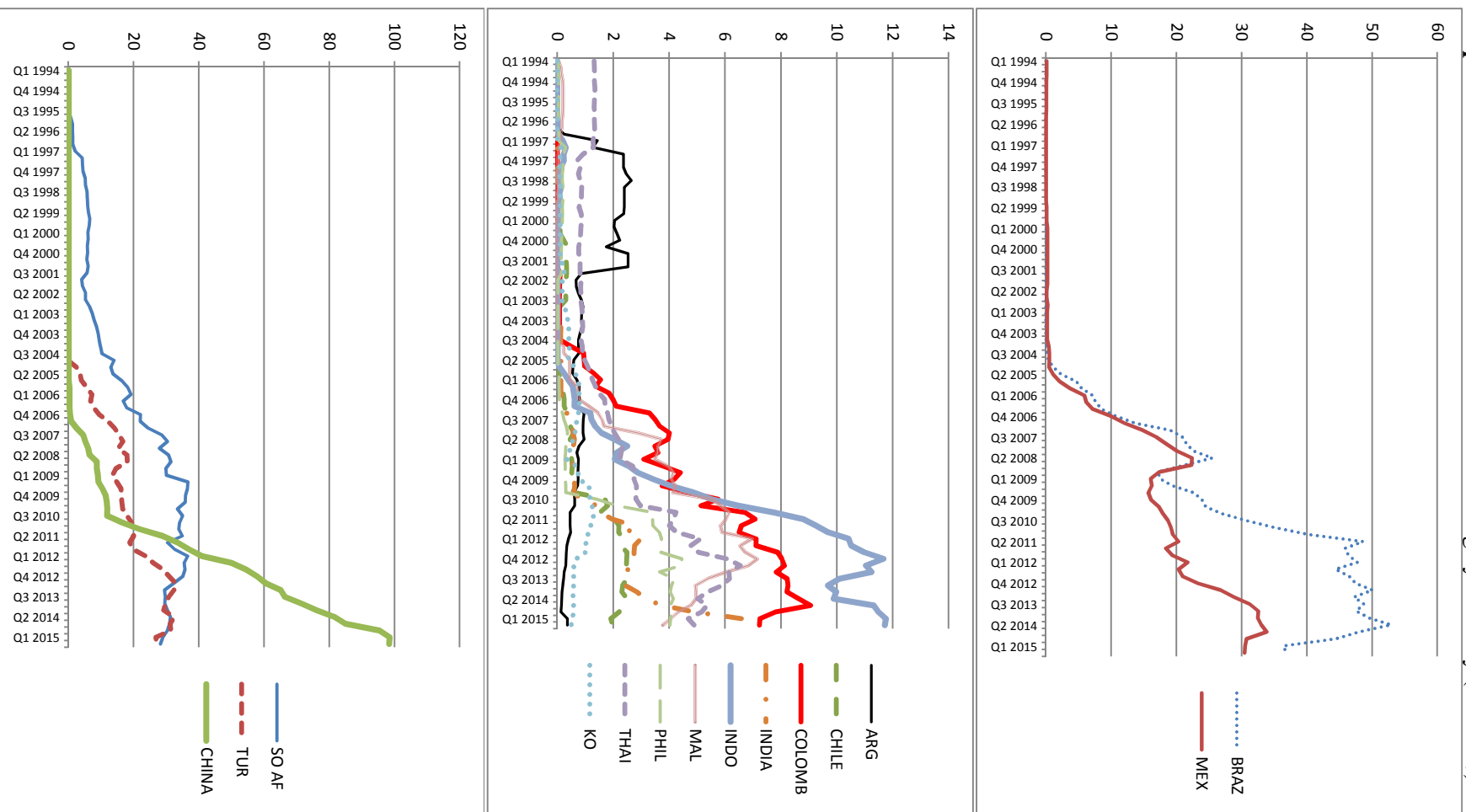
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