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Article

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Relationships between exchange rate regime, real exchange rate volatility and currency structure of government bonds in emerging markets

Viktar Dudzich¹

Abstract: Public foreign currency borrowing is a common problem of emerging markets. Scholars named it the original sin of foreign debt. It has a proven negative influence on economic growth and development, undermining financial stability, and increasing the probability of monetary crises. The roots of the original sin often lay in emerging markets' institutional underdevelopment, with low-quality monetary policy, inappropriate exchange rate regime choice, and exchange rate mismanagement being stated among the most important causes. This paper evaluates the influence of the exchange rate policy on the emission of foreign currency sovereign bonds in emerging markets. The relationship is estimated using panel data and GMM approach, with exchange rate regime type (both *de jure* and *de facto*) and real exchange rate volatility serving as explanatory variables. The findings reveal that fixed exchange rate regime and high real exchange rate volatility is promoting the foreign currency borrowing. Thus countries that want to reduce the burden of the original sin should lean towards a more flexible exchange rate policy while maintaining their real exchange rate stable.

Keywords: emerging markets, exchange rate regime, original sin, real exchange rate, sovereign bonds.

JEL Classification: E62, F31, F34

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Introduction

Tightening global economic integration increases developing countries' participation on international capital markets, with government bonds' emission being the basic source of financing for a considerable part of so-called *emerging markets* (Eichengreen et al., 2002; Claessens et al., 2002; Park et al., 2018). But numerous debt crises, which occurred in many less developed countries during the last 30 years, are the reason why today's global economic community is thoroughly studying the effects of foreign debt on national financial and macroeconomic stability. One of the most discussed fundamental problems is the fact that a substantial part of emerging markets' foreign debt, including that from government bonds emission, is nominated in foreign (for the debtor) currency

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– mostly in the U.S. dollar or euro² (Eichengreen and Hausmann, 1999). Economists named this situation the original sin of foreign debt (Eichengreen and Hausmann, 1999). Too high share of foreign currency on national debt may lead to discrepancy between state's foreign exchange revenues and expenditures, puts pressure on the exchange rate, worsens the country's credit rating and limits the availability of financing needed for economic development (Eichengreen et al., 2002; Jeanne, 2003; Ottonello and Perez, 2019).

Today the situation is changing for the better. Even though many developing countries are still unable or unwilling to issue local currency nominated bonds, others are experiencing huge growth of domestic bond markets and foreign demand for local currency nominated government bonds (Bordo et al., 2009; Park et al., 2018). But those changes apply only to certain countries, while many still have to rely on foreign currency financing. Thus, the determination of the factors influencing the currency composition of government bonds is becoming a crucial research topic – it may reveal the policy implications for reducing the costs of the original sin³.

Today's conventional wisdom suggests that monetary policy of the developing countries (or more specifically, its goals, quality, and persistence) is a significant determinant of the sovereign bonds' currency structure; with exchange rate regime type being of particular importance (Claessens et al., 2002; Calvo and Mishkin, 2003; Engel and Park, 2018). Recommendations on the right choice of exchange rate regime (the one limiting the foreign currency indebtedness) are often ambiguous. Traditional reasoning that fixed exchange rate stabilizes currency and so reduces riskiness of local currency nominated debt is proven to be wrong in case of less developed countries with uncredible monetary authorities and often administratively limited currency convertibility (Tornell and Velasco, 1995). At the same moment, the floating exchange rate regime may be the sign of more qualified economic institutions, which might promote local currency debt issuance (Eichengreen et al., 2002). Attempts for empirical verification of this relationship tend to speak in favor of a flexible exchange rate (Eichengreen et al., 2002; Claessens et al., 2002). But some academics argue that officially announced exchange rate regime may be of little importance, with *de facto* exchange rate regime type⁴ and the volatility of exchange rate itself being decisive for the sovereign bonds currency (Calvo and Mishkin, 2003).

This paper is analyzing and empirically verifying the exchange rate and exchange rate regime's influence on the sovereign bonds currency composition in emerging markets. This work is updating the results of papers by Claessens et al., 2002; and Eichengreen et al., 2002; which also deal with the exchange rate regime's influence on the original sin of foreign debt, though those papers investigate a very different (in terms of debt markets' development) period and highly heterogenic set of countries. This paper's

² Even though today the share of local currency on government debt of developing countries is much higher than it was when the "classic" papers on this topic (Eichengreen and Hausmann, 1999; Eichengreen et al., 2002) were written, and overall trend may be seen as improving (Park et al., 2018).

³ Most original sin studies apply to the times when the currency structure of government bonds was much "worse" (Eichengreen et al., 2002; Claessens et al., 2002), and as far as we know, there are no papers analyzing present-day situation.

⁴ Such classification is presented, for example, in Levy-Yeyati and Sturzenegger (2016).

contribution into the analysis of the original sin and exchange rate regimes lays in the inclusion of broad set of explanatory variables – we use not only formal *de jure* exchange rate regime type, but also several sorts (based on different methodology) of *de facto* exchange rate regimes; and real exchange rate volatility.

This paper is structured as follows. The first chapter is reviewing the literature regarding the currency structure of government debt and sovereign bonds and its interactions with economic development and monetary policy of developing countries. The second chapter discusses the influence of the original sin of foreign debt on economic and institutional development, acquaints the reader with the causes and effects of foreign currency indebtedness. The third chapter analyzes the role of the exchange rate regime in determining the currency of developing countries' sovereign bonds. Fourth chapter verifies and quantifies the exchange rate regime type's influence on the currency structure of emerging markets' government bonds using panel data for 13 countries and applying *General Methods of Moments* technique. The last chapter concludes and also presents implications for the analyzed countries' exchange rate policy.

Review of literature

Academic interest in the currency composition of sovereign debt and eurobonds emission by developing countries began to grow in the last years of the 20th century when many emerging markets experienced devastating foreign debt crises. Their causes, besides others, laid in the discrepancy between governments' foreign exchange revenues and expenses and also exchange rate mismanagement⁵ (Eichengreen et al., 2002). Starting from that period, we can find an abundance of research papers focusing on the negative impact of foreign currency debt on both emerging markets' economic development and monetary policy and discussing why those countries can't (or are not willing to) issue bonds or borrow in local currency.

Claessens et al. (2002) analyze factors influencing the currency structure of developing countries' government bonds and conclude, that low inflation, banking system development, and size of economy are positively (in the sense of larger share of domestic currency on government debt) affecting the currency of bonds' emission. The authors also emphasize the role of institutional development in explaining the government debt currency structure. The impact of the exchange rate regime is also mentioned, with results obtained indicating that countries with the flexible exchange rate tend to issue more bonds in local currency. The role of policy and institutions in determining in which currency to borrow is also highlighted by Jeanne (2003), who argues that countries with under-developed institutions and inconsequential economic policy don't invoke investors' trust in domestic currency and so are forced to borrow in foreign currency. Institutional "explanation" can be found in Bordo et al. (2009), which

⁵ In most cases the problem was monetary authority's effort to retain the fixed rate, which supported foreign currency indebtedness during economic booms (Eichengreen and Hausmann (1999) named it *fixed rate moral hazard*), but became a source of macroeconomic imbalance accumulation when foreign capital flows slumped (Eichengreen and Hausmann, 1999). It's important to mention that that period's conventional wisdom was that fixed exchange rate regime provided more fiscal discipline, but many researchers didn't agree with it even before the start of Asian and Russian crises of the end of the 90. (for example, Tornell and Velasco, 1995).

states that foreign currency debt and poor economic policy combined are the most frequent causes of the developing countries' monetary crises. In the same moment countries that can "afford" to issue foreign currency bonds without significant risks for financial stability, prefer not to do so as their local currency is deemed as trustworthy enough for foreign investors (Bordo et al., 2009). Similar opinions may be found in Fuji (2015), who emphasizes that current account surplus and high foreign reserves do reduce the risks flowing from foreign currency sovereign debt, but discovers, that those less risky countries also have a much smaller share of foreign currency on government debt.

Eichengreen et al. (2002) come with a complex analysis of the roots of original sin. The authors accentuate that local currency bonds of developing countries are associated with high transaction costs for investors, and thus emerging markets tend to have under-developed local bond markets. It is also highlighted that sources of the transaction costs lay in developing countries' currency volatility (Eichengreen et al., 2002). The authors discover the positive relationship between exchange rate flexibility degree and local currency share on public debt, while also assume (based on Mussa, 1986) that fixed exchange rate regimes' main shortcoming lays in real exchange rate volatility. The fact that exchange rate volatility matters more for foreign debt currency structure than the official exchange rate regime type is also assumed by Calvo and Mishkin (2003). They also expect more institutionally developed countries to have less volatile exchange rate and a higher share of local currency on government debt (regardless of exchange rate regime type).

Model explanation of why the foreign currency borrowing in developing countries is sometimes preferred is presented in papers by Du et al. (2016) and Engel and Park (2018), who see the roots of investors' demand for foreign (for the debtor) currency debt instrument in high inflation and thus low yield on local currency securities (Du et al., 2016); and in constraints put on local currency debt by poor and not credible monetary and fiscal policy, which arise from investors' unwillingness to purchase domestic currency instruments when they begin to suspect that the state may abandon inflation control trying to monetize local currency debt (Engel and Park, 2018; debt monetization in developing countries is also studied by Ottonello and Perez, 2019). The riskiness of foreign currency sovereign bonds is also analyzed by Mello and Hussein (2001), which derive it from developing countries' inefficient debt portfolio management.

The evolution of developing countries' public debt's currency composition (and in the case of some countries - its gradual improvement) is described in Presbitero et al., 2015; Engel and Park, 2018. Presbitero et al. (2015) state that the number of developing countries issuing bonds is constantly growing, although local currency bonds emission is "available" only for those more successful both economically and institutionally. Park et al. (2018) prove that in developing countries' local currency bond market development can boost financial stability and limit exchange rate volatility, while this effect being the strongest in Southeast-Asian countries, which tend to have better (comparing to other emerging markets) fiscal discipline and more qualified monetary authorities.

The original sin and sovereign bonds

As was mentioned, the roots of original sin lay in developing countries' inability to borrow in local currency and, therefore, currency mismatch of public revenues and

expenditures. The negative effects of the original sin are best observed during economic turbulence, which, in developing countries, is almost always associated with currency weakening. Empirical research shows that too much foreign currency in public debt affects long-term economic growth; enhances the probability and the consequences of financial crises; ceils the development of the local capital market and financial system (Bordo et al., 2009; Park et al., 2018; Ottonello and Perez, 2019).

The dynamics of sovereign debt currency composition and the original sin itself can be best observed in the case of sovereign bonds (Claessens et al., 2002; Park et al., 2018). Even though a substantial part of many emerging markets' public debt is composed of foreign loans – either bilateral or those from international institutions – these loans are and will be nominated in lender's currency (or some other global currency). In the case of local currency sovereign bonds' emission is theoretically constrained only by the absence of demand for such bonds. But it is still not completely clear why some countries are able to issue bonds in local currency while others have to rely on foreign currency financing.

It's evident that one of the reasons is in local currency riskiness, which produces transaction costs for potential investors (Eichengreen et al., 2002). High probability of emerging markets' currency weakening is implied by both specifics of their economic development and their government's and monetary authorities' "traditional" behavior (Jeanne, 2003; Bordo et al., 2009; Du et al., 2016).

A considerable share of developing countries has very undiversified exports' structure; highly depends on price fluctuations of exported mineral commodities; heavily relies on imports of industrial goods and often doesn't possess enough foreign reserves to enhance the credibility of local currency (Bordo et al., 2009; Fuji, 2015). At the same moment, many of those countries have some kind of pegged exchange rate regime (either *de jure* or *de facto*), and its preservation may require costly central bank's interventions (Calvo and Mishkin, 2003; Levy-Yeyati and Sturzenegger, 2016). Although those factors speak against foreign currency borrowing (signaling probable issues with debt repayment in case of unfavorable economic development), they also undermine the credibility of the local currency, putting it under depreciating pressure. In such cases local currency bonds are required to offer very steep interest rate to attract investors, and such rate may be disadvantageous during boom when local economy is growing, and the currency is stable and not requiring interventions; and in the same time those bonds will be still risky due to the possibility of currency devaluation followed by galloping inflation, that may turn the yield into negative (Du et al., 2016). From the debt-holders' point of view local currency depreciation may be viewed positively only in countries with trade surplus and fast-growing exports because of its keen effect on public finances and debtor's ability to pay – either high interest in case of local currency debt or smaller one in case of foreign currency (Fuji, 2015). While those "exporting" countries are generally considered to be less risky, they usually have a larger share of local currency on the total outstanding debt amount flowing from sovereign bonds⁶ (Bordo et al., 2009; Fuji, 2015)

Another matter constraining the demand for emerging markets' local currency bonds is investors' expectations that monetary authorities, while holding the control of exchange rate, may decide to carry out debt monetization by allowing the currency to weaken, thus

⁶ While the fundamentals may be "permitting" them to borrow in foreign currency.

reducing the real amount of sovereign debt⁷ (Engel and Park, 2018). Institutionally under-developed countries, which are often managed by poorly qualified or short-sighted politicians, may be keen to erase public debt by abandoning anti-inflationary policy or devaluing the local currency at the expense of both local population and foreign investors holding local currency bonds. That's why investors are often unwilling to finance the government in local currency above a certain limit; when that limit (which is very subjective) is exceeded, the worries of possible debt monetization grow, and lending shifts to foreign currency (Engel and Park, 2018). Because of that government can do nothing but borrow in foreign. This may be labeled as the institutional cause of public debt's currency imbalance (Jeanne, 2003; Engel and Park, 2018).

Even though many institutionally developed and monetary stable countries still have a large share of foreign currency on public debt and prefer (or have no other option) to issue foreign currency nominated bonds. Further causes may lay in lack of domestic investors' (which would prefer local currency bonds – Bengui and Nguyen, 2016) sources or under-development of local bonds markets (Park et al., 2018). The solution may be found in government support for both domestic debt capital markets and the demand for local currency instruments (Park et al., 2018).

Yet, still, the emerging markets' sovereign bonds' currency composition is gradually bettering (Presbitero et al., 2015; Engel and Park, 2018; Ottonello and Perez, 2019). Among the reasons stated by scholars are the improvement of developing countries' institutional environment, more consistent and professional performance of the monetary policy, increase of local currency credibility because of fixed exchange rate's abandoning – which reduces the possibility of debt monetization (Engel and Park, 2018; Ottonello and Perez, 2019). Although it's important to mention that this improvement applies only to certain countries and regions (mainly Eastern European EU-members and some East-Asian states – Park et al., 2018), while others still have to struggle with the original sin.

Exchange rate regime and the currency of sovereign debt

Fixed exchange rate regime is often stated as one of the reasons of developing countries' over-the-top foreign currency indebtedness and is considered to be the cause of debt crises occurred in many Latin American and Asian states in the second half of the nineties (Eichengreen and Hausmann, 1999; Calvo and Reinhart, 2002). Fixed rate may create an illusion of currency risks' absence and thus stimulate domestic demand for foreign currency debt, and because during "good times" fixed rate is perceived as sustainable (and monetary authorities – as trustworthy and having things in control), the use of foreign currency is widening (Eichengreen and Hausmann, 1999). Domestic liabilities (both private and public) tend to dollarize (Eichengreen and Hausmann, 1999). But when foreign capital flows or export revenues are decreasing, the state still has to repay its foreign currency obligations and intervene to maintain the pegged rate. Such situations usually lead to currency devaluations, which only deepen the problem of the foreign currency nominated public debt (Calvo and Mishkin, 2003). Numerous experts also consider fixed exchange rate regime to be the sign of less developed monetary policy *per se* and that pegged rate is usually found in institutionally poor countries,

⁷ The probability of that rises with lesser degree of monetary authorities' independence.

which also affects local currency credibility, sovereign credit rating and countries' ability to issue local currency bonds (Velasco, 1999; Hausmann et al., 2002; Claessens et al., 2002; Bordo et al., 2009).

On the other hand, the flexible rate wasn't always considered a good option for developing countries (Tornell and Velasco, 1995). Their economic growth volatility and numerous crises signaled that their currency would tend to depreciate and thus keep both inflation and interest rates high to the degree where it would decelerate economic growth. Though it applied (and still applies) to certain countries, empirical tests bring different results (Bordo et al., 2009). Developing countries with flexible exchange rate are more politically and economically stable; tend to have a quicker reaction towards external macroeconomic threats; are able to perform more consistent and high-qualified economic policy (Calvo and Reinhart, 2002). It was also proved, that countries with floating exchange rate (both developed and developing) are less affected by the original sin problem (Hausmann et al., 2002; Claessens et al., 2002).

Nowadays developing countries are going through gradual liberalization of exchange rate regime (Levy-Yeyati and Sturzenegger, 2016; AREAER IMF Database, 2019). The number of countries with pegged rate is decreasing,⁸ although this regime is usually abandoned as a result of economic and currency crisis (Levy-Yeyati and Sturzenegger, 2016). The costly and economically destabilizing fixed rate remains prerogative of either rich oil-exporting countries, which can guarantee the rate due to huge exports revenues; or less developed countries with weak economic institutions. The exchange rate liberalization is also associated with developing countries' growing activities on global debt capital markets (Presbitero et al., 2015; Park et al., 2018).

Although it's important to mention that in the case of developing countries, the exchange rate regime they proclaim to have is not always the regime they actually have (Velasco, 1999; Calvo and Reinhart, 2002). Numerous officially "floating countries" still preserve some degree of control over the exchange rate and intervene when needed, or even use administrative exchange rate restrictions (Levy-Yeyati and Sturzenegger, 2016). A mismatch between *de jure* and *de facto* exchange rate regime is considered to be of negative effect on the original sin (Eichengreen et al., 2002). At the same moment, the *de jure* exchange rate liberalization is taking place much faster than the actual fixed-to-floating shift (AREAER IMF Database, 2019).

There are even opinions that exchange rate regime's (either *de facto* or *de jure*) impact on developing countries' fiscal policy, and debt currency is highly overestimated (Calvo and Mishkin, 2003). In these countries, exchange rate regime is just an "output" of general institutional development and economic policymakers' qualification, while only historical and expected volatility of national currency (regardless the exchange rate type) is significant in determining the degree of original sin (Calvo and Mishkin, 2003). Given that developing countries' currencies are not always more stable under fixed exchange rate than under floating, real exchange rate fluctuations (meaning those of nominal rate and domestic price level – Mussa, 1986) and thus indirectly the fluctuations of government bonds' yield are determining if the local currency will be considered trustworthy enough by foreign investors (Calvo and Mishkin, 2003). In the same

⁸ The relationship between exchange rate regime and foreign currency sovereign debt is insinuated by today's decline of developing countries' original sin (Park et al., 2018).

moment stable real exchange rate results from efficient monetary policy and is encountered mostly in more advanced and internationally integrated countries, which are able to issue local currency bonds and are not subject to original sin (Carrera and Vuletin, 2003).

According to the above-mentioned findings and tests' results, we can assume that the exchange rate regime may be a crucial determinant of sovereign bonds' emission currency. Taking that into consideration, we see a necessity of empirical verification of the relationship between the share of local/foreign currency on the total outstanding amount of issued government bonds on the one hand; and type of exchange rate regime on the other hand. Since the object of this paper's analysis being emerging markets, it is appropriate to use not only *de jure* exchange rate regime classification, but also *de facto* one (see the next chapter, such classification can be found in Levy-Yeyati and Sturzenegger, 2016; or in IMF reports). In reaction to paper by Calvo and Mishkin (2003) we also assume that real exchange rate fluctuations are of big influence on government's fiscal policy and approach to debt's currency; thus, the relationship between real exchange rate volatility and sovereign bonds' currency composition should also be examined.

Empirical analysis and discussion

This chapter presents the econometric estimation of the exchange rate regime's and real exchange rate volatility's influence on sovereign bonds' currency composition of selected emerging markets. The estimation is conducted using panel data for 13 countries.⁹ The choice of the country sample was based on the following conditions:

- The countries should be classified as emerging markets either by IMF or EM Bond Index and MSCI, which is relevant towards their position in the international bond markets.
- The countries should be categorized as either high- or medium-income by the World Bank classification.
- Selected countries should have a convertible currency based on AREAER IMF (2019) and be active on international bond markets as reported by the Bank for International Settlements.
- The countries should be covered by the past research on this topic found either in Claessens et al. (2002) or Eichengreen et al. (2002).
- There should be long enough time series on their bonds' currency structure, covering at least a period from 2000 to 2018.

The analysis covers the period from 2000 to 2018 (annual data were used) and thus considerably updates the works by Claessens et al. (2002) and Eichengreen et al. (2002). Methodology, dependent, independent, and control variables are presented below.

⁹ Argentina, Brazil, Chile, China, Croatia, Hungary, India, Indonesia, Israel, Saudi Arabia, South Africa, South Korea, Thailand.

Table 1. Government bonds currency structure development, %

	Bonds' currency	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Aver age
Argentina	Local	21	19	7	22	19	40	43	46	53	60	60	61	60	58	62	68	57	55	50	45
	Foreign	79	81	93	78	81	60	57	54	47	40	40	39	40	42	38	32	43	45	50	55
Brazil	Local	87	82	81	85	87	90	93	95	94	96	96	96	96	96	95	95	96	97	97	92
	Foreign	13	18	19	15	13	10	7	5	6	4	4	4	4	4	5	5	4	3	3	8
Croatia	Local	40	33	60	40	46	58	64	67	67	69	72	65	64	57	56	52	54	55	56	57
	Foreign	60	67	40	60	54	42	36	33	33	31	28	35	36	43	44	48	46	45	44	43
Hungary	Local	53	83	89	84	80	76	75	76	73	70	70	62	70	69	71	73	76	80	82	74
	Foreign	47	17	11	16	20	24	25	24	27	30	30	38	30	31	29	27	24	20	18	26
Chile	Local	80	83	71	67	64	75	75	75	82	87	88	83	81	89	86	81	82	82	78	79
	Foreign	20	17	29	33	36	25	25	25	18	13	13	17	19	11	14	19	18	18	22	21
China	Local	96	96	98	97	97	98	98	99	99	100	100	99	99	99	99	99	100	100	98	98
	Foreign	4	4	2	3	3	2	2	1	1	0	0	1	1	1	1	1	0	0	2	2
India	Local	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Foreign	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Indonesia	Local	98	100	100	100	98	91	89	88	82	78	78	78	75	71	73	69	70	69	69	83
	Foreign	2	0	0	0	2	9	11	12	18	22	22	22	25	29	27	31	30	31	31	17
Israel	Local	93	93	93	91	89	88	88	90	91	92	91	91	91	91	90	91	91	89	87	91
	Foreign	7	7	7	9	11	12	13	10	9	8	9	9	9	9	10	9	9	11	13	9
Korea	Local	94	94	94	96	97	97	97	98	98	98	98	98	98	99	99	99	99	99	99	97
	Foreign	6	6	6	4	3	3	3	2	2	2	2	2	2	1	1	1	1	1	1	3
Saudi Arabia	Local	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	65	56	54	93
	Foreign	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	44	46	7
South Africa	Local	92	86	87	88	91	90	90	89	88	92	93	92	93	92	92	90	91	91	89	90
	Foreign	8	14	13	12	9	10	10	11	12	8	7	8	7	8	8	10	9	9	11	10
Thailand	Local	85	86	91	91	93	93	94	98	98	99	99	100	100	100	100	100	100	100	100	96
	Foreign	15	14	9	9	8	7	6	2	2	1	1	0	0	0	0	0	0	0	0	4

Source: *The Bank for International Settlements, 2019*

Dependent variable

As the *dependent* variable, we chose the share of domestic currency on the total outstanding amount of sovereign debt flowing from government bonds (both in foreign and domestic currency). The data used are published by the Bank for International Settlements (BIS, 2019). The analyzed countries' statistics on the currency composition of public debt from issued bonds are presented in table 1. The data show substantial improvement (in terms of eliminating the original sin) in the case of some countries (mainly those whose debt at the beginning of the period was composed mostly of foreign currency). On the other hand, several countries (Indonesia, Saudi Arabia) switched to more foreign currency bonds' emission and became more exposed to the original sin. In a large number of cases, the changes over time were only marginal. Overall, a glimpse on the data couldn't confirm recent papers (for example, Park et al., 2018) stating that the magnitude of the original sin problem has been greatly decreasing.

Independent variables

The choice of independent variables that would correctly express the exchange rate regimes of analyzed countries was conducted based on the paper by Claessens et al. (2002), while also taking into regard the discussion on exchange rate volatility by Calvo and Mishkin (2003). We use the official exchange rate regimes' classification by IMF (AREAR IMF Database, 2019). Because of discrepancies between formally announced and actual implemented exchange rate practices in emerging markets, we also use *de facto* classification of two types: a) created by IMF based on experts' evaluation of exchange rate restrictions implemented; b) found in Levy-Yeyati and Sturzenegger (2016) and based on foreign reserves and interest rates' fluctuations.¹⁰ The data on exchange rate regimes were categorized as dummy-variables with the value of 1 in case of floating and 0 in case of some kind of fixed exchange rate regime,¹¹ thus positive sign would mean that flexible exchange rate supports local currency bonds' emission. The data on the exchange rate regimes' development (with 1 standing for floating and 0 for some type of the fixed rate) are presented in table 2.

¹⁰ Detailed methodology of both classifications is described in AREAR IMF (2019) and Levy-Yeyati and Sturzenegger (2016).

¹¹ In case of Levy-Yeyati and Sturzenegger's classification value 1 represents floating exchange rate regime, value 0 – either fixed or intermediate. Although IMF divides the exchange rate regimes into three general categories (hard pegs, soft pegs and floating), the usage of binary dummies could be justified by the fact that there were no hard pegs in the country sample except for Argentina's currency board in 2000 and 2001, when the Argentinian currency was on the brink of collapse and possibly didn't possess the credibility expected from the hard peg. As for Levy-Yeyati and Sturzenegger's classification, intermediate regimes were grouped with fixed due to the authors labeling countries' exchange rate regimes as intermediate when they conduct interventions, but still have a more volatile exchange rate than the "fixed" ones – in regard to the topic of this paper intermediate regimes may as well be fixed, but not successful and credible ones.

Table 2. Exchange rate regimes of the country sample as dummy variables

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Argentina	De Jure IMF	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto IMF	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	1	1	1	1
	De Facto LYS	0	0	0	1	1	1	0	0	1	1	0	0	1	1					
Brazil	De Jure IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto LYS	1	0	0	0	1	1	1	1	0	0	1	1	1	0					
Chile	De Jure IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto LYS	1	1	1	1	1	1	1	0	0	1	1	1	1	1					
China	De Jure IMF	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
	De Facto IMF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	De Facto LYS	0	0	0	0	0	0	0	0	1	0	0	0	0	0					
Croatia	De Jure IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto LYS	0	1	1	1	1	1	0	0	1	1	0	0	0	0					
Hungary	De Jure IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto LYS	0	1	1	0	1	1	1	1	1	1	1	1	1	1					
India	De Jure IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto LYS	1	0	0	0	1	1	1	1	1	1	1	1	1	1					
Indonesia	De Jure IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto IMF	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0
	De Facto LYS	0	0	1	1	1	1	1	1	0	1	1	1	1	1					
Israel	De Jure IMF	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto IMF	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto LYS	1	1	1	1	1	1	1	1	0	1	1	1	1	1					
Saudi Arabia	De Jure IMF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	De Facto IMF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	De Facto LYS	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
South Africa	De Jure IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto LYS	1	0	0	1	0	1	0	1	0	0	1	1	1	1					
South Korea	De Jure IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto LYS	0	1	1	1	0	1	1	1	0	0	1	0	1	1					
Thailand	De Jure IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto IMF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	De Facto LYS	1	1	1	1	1	1	1	0	1	0	1	0	1	1					

Source: AREAER IMF, 2019; Levy-Yeyati and Sturzenegger, 2016.

Taking into consideration Calvo and Mishkin's (2003) thoughts on the unimportance of exchange rate regime type for the country's fiscal policy we also tested the influence of

real exchange rate's volatility on currency structure of issued sovereign bonds, using it as the dependent variable. We used the data on real effective exchange rates which are calculated as the weighted averages of bilateral real exchange rates weighted by the shares of counterparties in the foreign trade of the countries for which the real effective exchange rates are calculated (Darvas, 2012). The dataset of real effective exchange rates was first published by Darvas (2012) and is being actualized by the Brussels European and Global Economic Laboratory (BRUEGEL, 2019). The individual countries' real effective exchange rate volatility was calculated as a standard deviation of monthly values for each year.

Control variables

The choice of control variables was influenced by Claessens et al. (2002) and Eichengreen et al. (2002), with variables of two types – both economic and institutional. The conventional wisdom is that a higher level of economic development, macroeconomic stability, and better institutions is reducing the burden of the original sin. Next economic control variables were used:¹²

- The economy's size measured by absolute GDP – it can be assumed that larger countries have more developed local bonds markets and more possibilities for issuance of local currency bonds. This variable was discovered to have a positive impact on domestic currency bonds emission by both Claessens et al. (2002) and Eichengreen et al. (2002).
- Economic openness measured as the sum of exports and imports divided by GDP – it can be expected that more economically open countries would be less affected by the original sin because of the more credible domestic currency. Eichengreen et al. (2002) also state that countries that trade more may be more disciplined about the obligations towards their creditors – in case of foreign debt that means they will be less willing to devalue their currency and thus reduce the value of debt held by foreign subjects.¹³
- The share of foreign exchange reserves on GDP – this variable directly affects the credibility of the domestic currency, with higher reserves making the domestic currency more reliable for foreign investors; in the same moment countries with higher reserves should be more willing to issue foreign currency bonds due to their ability to handle the debt. This variable's sign will also either support or disprove Eichengreen's et al. (2002) remarks about reserves to GDP being a proxy for exchange rate volatility – in our paper, we found no significant correlation between the reserves and either exchange rate's flexibility or real exchange rate's volatility (see below).
- Inflation – higher inflation decreases domestic currency bonds' real yield and thus supports foreign currency borrowing; higher inflation may be signaling about the government's tendency to reduce the local currency debt's real value

¹² If not stated otherwise, World Bank's *World Development Indicators Database* was used as data source.

¹³ Although the authors didn't discover a statistically significant relations between economic openness and the original sin, the explanation presented in their paper makes this variable worth incorporating, especially dealing with the sample of emerging markets.

through money emission, thus decreasing its ability to borrow in local currency. This relationship was discovered by Claessens et al. (2002).

- Lending interest rate – a proxy for the risk premium, with high values being negative in terms of original sin. The values of the risk premium for the country sample were unavailable.

The following institutional control variables were used:

- Index of economic freedom by Heritage Foundation, which evaluates the advancement of democracy and political institution's level of development; law enforceability; legislation quality, etc. The higher value of index represents better performance in terms of economic freedom.
- Index of fiscal freedom by Heritage Foundation, which evaluates the level of government debt; government's approach to fiscal policy; tax burden etc. The fiscal freedom increases with higher values of the index.

Methodology, regression output, and results' discussion

The dependent variables and non-dummy independent variables are stationary in level based on the results of Levin, Lin and Chu test and ADF-test. The control variables are also stationary in levels except for the above-mentioned institutional indexes. There was no multicollinearity present among the regressors (see table 3).

Table 3. Correlation matrix of the independent and control variables

	REER Volatility	Ec. freedom index	Fiscal freedom index	Log (GDP)	Economic openness	FX reserves to GDP	Inflati on	Lending interest rate
REER Volatility	1							
Ec. freedom index	0,00647 665	1						
Fisc. freedom index	- 0,02060 24	0,076929 42	1					
Log (GDP)	- 0,00862 42	- 0,298982 8	-0,0709525	1				
Economic openness	- 0,26783 66	0,400588 36	0,0556778 7	- 0,276 3841	1			
FX reserves to GDP	- 0,21045 03	0,077629 18	0,4434413 6	0,119 67351	0,3437670 4	1		
Inflation	0,35835 702	- 0,421137 3	-0,1260169	- 0,076 1121	- 0,3194479	- 0,2665434	1	
Lending interest rate	0,50592 514	- 0,259112 1	-0,0375997	- 0,024 433	- 0,4757657	- 0,3957719	0,402 7987	1

Source: author's own calculations

Due to explanatory variables' possible endogeneity (the exchange rate regime variables' endogeneity is presumed by Claessens et al., 2002; the real exchange rate volatility's endogeneity was discovered when the residues of the volatility's time series was proved to be a statistically significant explanatory variable) the estimation was conducted using *General Methods of Moments*. This method controls for unobserved fixed effects, thus decreasing the possible distortions due to the country sample heterogeneity and possible country-specific effects. (Arellano and Bond, 1991; Blundell and Bond, 1998). The dynamic panel-data GMM transforms the independent variables using first differences which reduce the endogeneity bias and subsequently estimates the regression combining both the variables in level and their first differences. Usage of GMM and the variables' transformation reduces the country-specific effects and thus decreases the possibility of the omitted variable bias (Arellano and Bond, 1991; Blundell and Bond, 1998). The control variables and their lagged values (along with the lagged values of the independent variables) were employed as instruments. The values of J-statistics are derived from the Sargan-Hansen test for GMM working with the time series (the test is conducted automatically along with the regression); and significate the validity of the instrumental variables' overidentifying restrictions.

Period dummy variables were used in all estimations. Their economic interpretation may lay in the factors that influence the investors' willingness to provide funds (or invest in local currencies) to emerging markets depending on the economic cycles and risk-on/risk-off phases; with this influence being common for the country sample used. The results are presented in table 4.

The evaluation discovered the statistical significance of three (out of four) explanatory variables – formal exchange rate regime type, *de facto* exchange rate regime based on IMF classification and real effective exchange rate volatility. Both classification's statistical significance, along with the same signs of control variables, adds to the results' robustness. In the case of the *de facto* exchange rate regime based on Levy-Yeyati and Sturzenegger (2016), there was no significant relationship between this variable and the share of domestic currency sovereign bonds on the total amount of debt from sovereign bonds.¹⁴ As presumed (except for model 3, which may be biased due to short time series) more economically open countries were less affected by the original sin – being more integrated in the international economic relations could make the currency more credible and even demanded by the trade partners. This finding confirmed the thoughts of Eichengreen et al. (2002), even though their paper didn't discover the significance of this variable. The sign and significance of logarithmic GDP are in line with theory and replicates the results of both the above-mentioned papers. Inflation appeared to be only marginally significant in model 2 and 4; with its positive sign being possible to explain by the borrowers' behavior aimed at debt monetization – domestic currency bonds are less costly to issue when the prices are inflating (the question lays in the demand for such bonds – it may be driven by either investors' lack of information or high enough yield). The negative sign of foreign exchange reserves showed that countries with larger reserves are relying on foreign currency financing – this result

¹⁴ The explanation may lay in too short time period available for this type of exchange rate regime classification (only until 2013). The lower quality of the model used is confirmed by smaller number of statistically significant control variables and different (from the ones in other models) signs in case of those statistically significant.

disproves the assumption that higher reserves make the domestic currency more credible and thus viable for local currency bonds' emission. Lending interest rate also proved to be statistically significant, and its sign indicates that with the rates' increase the countries tend to switch to foreign currency borrowing and subject themselves to the original sin. The positive sign of fiscal freedom in models 2 and 4 is in line with conventional wisdom. The other institutional index, which is significant across the estimations, has a sign that is difficult to interpret – the only explanation may lay in the more economically free and advanced countries' better ability to handle foreign currency debt.

Table 4. Regression results

Variable	Model 1	Model 2	Model 3	Model 4
Economic openness	0,001554*** [14,92280]	0,001493*** [15,35895]	-0,000646*** [-3,577154]	0,001125*** [12,50731]
Log (GDP)	0,001554*** [23,79002]	0,077056*** [19,36152]	-0,027050*** [-4,326694]	0,049547*** [18,36383]
Inflation	1,23E-0,5 [0,048774]	0,000556** [1,990660]	0,000298 [0,479941]	0,000552* [1,858789]
Lending interest rate	-0,001730*** [-13,00697]	-0,002229*** [-26,44473]	-0,001197*** [-4,930028]	-0,001692*** [-14,09331]
FX reserves to GDP	-0,043628*** [-3,635235]	-0,042668*** [-3,156194]	-0,027724 [-0,987294]	-0,046861*** [-4,080102]
Ec. freedom index	-0,001554*** [-12,14082]	-0,002302*** [-18,01679]	-0,004637*** [-9,853612]	-0,002376*** [-13,95463]
Fisc. freedom index	-8,99E-05 [-0,505199]	0,000656*** [3,974075]	-0,000266 [-0,609449]	0,000340* [1,907734]
De Jure IMF	0,061089*** [9,382657]			
De Facto IMF		0,022366*** [10,59952]		
De Facto LYS			0,000895 [0,364324]	
REER Volatility				-0,000976** [-2,126149]
Number of observations	220	220	156	220
J-statistic	109,5810	112,7533	77,39262	119,9658
Period dummy variable	Yes	Yes	Yes	Yes

Source: author's own calculations.

Note: T-statistic in bracket: (*) 10% level of significance, (**) 5% level of significance, (***) 1% level of significance

The positive sign of explanatory variables in models 1 and 2 shows that countries with flexible exchange rate regime (either *de jure* or *de facto*) have a larger share of local currency on issued sovereign bonds. These findings confirm the theoretical explanation of exchange rate flexibility's positive influence on the original sin – either because of lower credibility of the fixed exchange rate in emerging markets; either due to, in

general, lower quality of monetary policy in countries with fixed rate (see the previous chapter). The need to preserve fixed rate is limiting monetary authorities' capabilities of stimulating the economy in case of need and also requires significant foreign exchange expenditures when the inflows decrease (for example, in case of exported commodities' prices decrease, which is a common threat for many analyzed countries). All this increases the riskiness of domestic currency and supports foreign currency bonds' emission. On the other hand, countries with a flexible exchange rate may be perceived as less risky because of the flexible rate's ability to restrict the macroeconomic imbalance accumulation and while this regime may be an indicator of the government's trust into the state's own currency.

In model 4 we discovered a negative relationship between real exchange rate volatility and local currency's share on total debt from public bonds (thus countries with less volatile real exchange rate are more successful in overcoming the original sin). The real exchange rate's stability means that currency weakening corresponds to the differential between domestic and foreign inflation, which makes the bonds' real yield more persistent. If both types of the variables (exchange rate regime and real exchange rate volatility) influence the original sin the way the regression discovered, it may be indirect support of Carrera and Vuletin's (2003) findings, which discover that countries with flexible exchange rate regime tend to have less volatile real exchange rate. Based on that, flexible exchange rate may be influencing the original sin either directly or due its' stabilizing impact on real exchange rate¹⁵, while fixed exchange rate regime (which, in the same moment, can be a source of real exchange rate's volatility) is damaging the local currency's attractiveness for foreign investors and supports foreign currency sovereign bonds emission.

The research could be subjected to certain limitations arising mostly from the data availability, country sample, and employed methodology. The analysis covers only the foreign debt from government bonds, with total foreign currency debt being beyond the reach of this paper. Thus, the above-mentioned recommendations on the exchange rate policy and its possible impact on the original sin are relevant only for the countries borrowing on the bond markets. As it was mentioned before, the borrower usually can't influence the currency of the bilateral loans received, so the nations relying on direct foreign financing wouldn't be able to benefit (in terms of the original sin) from the exchange rate regime liberalization or real exchange rate stabilization. The research covers more developed nations, so the inclusion of less developed countries, that have become more active on the international bonds markets as stated by Presbitero et al. (2015), could have changed the results¹⁶. Although several recent papers (for example, Park et al., 2018) state that currency stabilization, in general, is tied to local bond markets development, conventional wisdom suggests that smaller and less developed countries will still need a fixed rate to invoke trust in their lenders.

Although a statistically significant relation between exchange rate regime and sovereign bonds' currency was discovered, we should still pay attention to Calvo and Mishkin's

¹⁵ Although, of course, this presumption would require an empirical confirmation which is beyond this paper's topic.

¹⁶ Once again, we were deprived of this possibility by too short time series available for a broader set of countries, but future research could make this issue clear.

(2003) thoughts concerning the limited impact of exchange rate regime on the exchange rate stability and thus the original sin. The model 4 discovers the positive relation between real exchange rate stability and local currency bonds' stock, thus the paper's findings may be perceived not as "liberalize the exchange rate policy" but "stabilize both the exchange rate and price level", which is less achievable by administrative means and monetary policy adjustments; and more dependent on external factors.

Conclusion

Foreign currency public debt is a common headache of less developed countries that don't possess well-developed institutions and economic policy while struggling with the macroeconomic imbalance and local currency volatility. Academics labeled this issue as the original sin. The original sin is proved to have a negative influence on development by increasing economic growth's volatility and requiring costly hedging (Eichengreen et al., 2002; Ottonello and Perey, 2019). In general, dealing with the original sin requires an increase of the local currency's credibility to make it more attractive as an investment instrument. Thus, the demand for local currency nominated sovereign bonds should rise (Eichengreen and Hausmann, 1999; Bordo et al., 2009).

Currency's stability is highly influenced by monetary policy and exchange rate regime (Tornell and Velasco, 1995; Eichengreen and Hausmann, 1999), and in less developed countries fixed exchange rate is perceived as negative in terms of the original sin (Claessens et al., 2002; Bordo et al., 2009). This paper is trying to verify this perception using actual data.

We evaluated the influence of exchange rate regime on currency composition of 13 emerging markets' sovereign bonds for the period from 2000 until 2018. Both formal and *de facto* types (as classified by IMF and Levy-Yeyati and Sturzenegger, 2016) of the exchange rate regime were used as explanatory variables. Taking into consideration Calvo and Mishkin's (2003) statement on exchange rate regime's limited influence on fiscal policy and currency stability in emerging markets, we employed real exchange rate volatility as an additional explanatory variable.

We proved existence of the statistically significant positive relationship between exchange rate flexibility (both *de jure* and *de facto* as classified by IMF) and domestic currency's share on total sovereign debt's amount flowing from bonds of the selected countries – those with flexible exchange rate are less affected by the original sin. At the same moment, we discovered a negative relationship between real exchange rate volatility and local currency bonds' share. This confirms theoretical statements about the low credibility of the fixed exchange rate regime in emerging markets, with the fixed rate increasing the local currency's riskiness. As the fixed exchange rate is prevalent among the countries with less qualified monetary authorities (Carrera and Vuletin, 2003), we can assume that switch to flexible exchange rate may be perceived as a sign of more "mature" economy and would have positive influence on local currency's attractivity (as an investment instrument). Abandoning of the fixed exchange rate and enhancement of monetary policy (aiming for real exchange rate stabilization) should be among the goals of countries pursuing the reduction of foreign currency borrowing and elimination of the original sin. Even though, it should be mentioned that the research covered only more developed nations with higher activity on international bond markets,

so its findings may be irrelevant for less advanced nations that have started to issue sovereign bonds recently. They may not be benefitting from the exchange rate regime liberalization due to their monetary authorities' lack of qualification and credibility. The research also doesn't address the situations when the original sin's roots lay in loan-based foreign currency borrowing, which is less common among the analyzed countries but can become relevant in case of economic turbulence they may encounter.

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