Hochschule für
Wirtschaft und Recht Berlin
Berlin School of Economics and Law

Institute for International Political Economy Berlin

The Causes of Original Sin: An Empirical Investigation of Emerging Market and Developing Countries

Author: Dennis Andreas Gegenfurtner

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Abstract

International Original Sin is still a persistent and widespread phenomenon, especially in emerging market and developing (EMD) countries. The difficulties that may arise from the inability of countries to borrow internationally in their domestic currency, among other effects, can hamper EMD countries' efforts to achieve domestic economic stability. The phenomenon of Original Sin and some of its potential causes were examined by Eichengreen *et al.* (2002) and later Hausmann and Panizza (2003). According to their findings, merely the economic size of a country is significant in explaining the variation of Original Sin. This article, first, investigates empirically whether the rather orthodox explanations of Original Sin as examined by Eichengreen *et al.* (2002) and Hausmann and Panizza (2003) remain invalid, even when investigating a greater timeframe with different trends and, second, elaborates an alternative explanatory approach following Fritz *et al.* (2018) and de Paula *et al.* (2017, 2020). The empirical analysis confirms that rather orthodox theories have difficulties in explaining the increased exposure of EMD countries to Original Sin. However, the concept of a currency hierarchy sheds light on the phenomenon. Differences in the liquidity premium between northern and southern currencies and the liquidity preference of investors explain the constraints of southern countries to borrow internationally in their own currency. To climb up the hierarchy of currencies by increasing their liquidity premium is a lengthy and arduous undertaking. One way to achieve this could be by uniting with economic partners, especially in its ultimate form as a currency union.

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Contact: dennis.gege@web.de
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1 Introduction

The inability of countries to borrow internationally in their domestic currency is still a persistent and widespread phenomenon. In particular, emerging market and developing (EMD) countries are suffering the most from what Eichengreen and Hausmann (1999) call Original Sin. The difficulties that may arise from this inability, among other things, hamper EMD countries from achieving domestic economic stability (Eichengreen *et al.*, 2002). Eichengreen *et al.* (2002) and later Hausmann and Panizza (2003) examine various potential explanations of its international occurrence by analyzing 90 (91 at Hausmann and Panizza, 2003) advanced and EMD countries in the period from 1993 to 1998. However, both merely find that the economic size of a country is significant in explaining the variation of Original Sin. Although both studies confirm that rather conventional theories have difficulties to elucidate the phenomenon, several authors still make monetary authorities and governments responsible for countries' inability to borrow internationally in their domestic currency (Bordo, 2006; Essers & Cassimon, 2012; Engel & Parker, 2018).

In recent years, Original Sin gained prominence among heterodox scholars who shed light on the topic by using the concept of a currency hierarchy (Fritz *et al.*, 2018; Gallo *et al.*, 2019; de Paula *et al.*, 2017, 2020). Following their argumentation, the liquidity preference of international investors and differences in the liquidity premium between northern (advanced) and southern (EMD) currencies explain countries' exposure to Original Sin. According to de Paula *et al.* (2020), countries could compensate for their difference in the liquidity premium by appreciating the exchange rate and/or increasing the yield of assets. Additionally, they could try to reduce capital account regulations or to climb up the hierarchy of currencies by increasing their liquidity premium.

This article investigates the development of Original Sin for a sample of 104 advanced and EMD countries from 1999 to 2019. Although this article focuses on EMD countries, advanced countries were necessary as a control group for an improved residual distribution and, hence, a better reliance on the empirical results. The selected timeframe offers the greatest data availability and covers the period right after Eichengreen *et al.* (2002) study almost up to the COVID-19 crisis. To my knowledge, it is so far the most comprehensive analysis dealing with the phenomenon of Original Sin. This study contributes to a better understanding of the underdevelopment of EMD countries and their obstacles in their catching-up process.

The objective of this article is, first, to prove empirically that macroeconomic explanations of Original Sin as examined by Eichengreen *et al.* (2002) and Hausmann and Panizza (2003) remain invalid, even when investigating a greater timeframe with different trends and, second, to figure out what instead could best explain its variation while focusing on EMD countries. The methodology is thus a literature review to identify the potential explanations of Original Sin to be examined, followed by an empirical analysis and an alternative approach. The empirical analysis extends the studies by Eichengreen *et al.* (2002) and Hausmann and Panizza (2003) on multiple levels. Next to the greater timeframe with different trends, an increased number of countries and the focus on EMD countries, the empirical analysis examines further potential explanations and uses time-series analysis in addition to cross-sectional analysis. The advantage of this approach is a more comprehensive analysis and a deeper insight into the phenomenon of Original Sin and its causes.

The findings of this investigation confirm the results of Eichengreen *et al.* (2002) and Hausmann and Panizza (2003) and further suggest that overcoming Original Sin can be achieved by uniting with economic partners, especially in its ultimate form as a currency union. However, the degree of success depends on the economic size of the respective union.

The remainder of this article is structured as follows. Section 2 presents an overview of the development of international debt securities and the exposure to Original Sin in the period under study. Section 3 is divided into three parts. First, a literature review of studies dealing with Original Sin. Second, the investigation of its causes consisting of the empirical methodology, the empirical analysis and an alternative approach and, lastly, third, the assessment of the entire investigation. Section 4 concludes.

2 The Phenomenon of Original Sin

Eichengreen and Hausmann (1999) make use of the term Original Sin for the first time in an economic context when investigating the relationship between exchange rates and financial fragility. According to their definition of Original Sin, they describe two different dimensions, namely an international and a domestic. While the international dimension embraces the inability of a country[1] to borrow in domestic currency on international markets, the domestic dimension

[1] In the context of Original Sin, both the private and public sector of a country is affected by the phenomenon. Thus, using the term country in this article covers both sectors.

depicts the situation in which a country is even unable to borrow long-term at fixed rates in domestic currency on the domestic market (Hausmann & Panizza, 2003). These two different dimensions cause different issues for the country affected. On the one hand, the international dimension potentially generates aggregated currency mismatches (debt denominated in foreign currency is used to finance local currency-generating projects), whereas, on the other hand, the domestic dimension is responsible for maturity mismatches (short-term debt is used to finance long-term projects) (Eichengreen & Hausmann, 1999). Assuming times of distress, these mismatches could cause serious trouble either through exchange rate depreciation (raising the real value of debt denominated in foreign currency) causing bankruptcies or increasing interest rates in countries with fixed exchange rate regimes leading to defaults on short-term debt (Eichengreen & Hausmann, 1999).[2] Both mismatches are ultimately increasing financial fragility and, thus, deteriorating a country's fiscal situation.

It is worth mentioning that Original Sin and currency mismatches are not the same. Indeed, Original Sin and currency mismatches are closely linked, however, currency mismatches only occur when the country suffering from Original Sin has accumulated insufficient international reserves. Eichengreen *et al.* (2007, p. 131) state: „While one possible consequence of original sin is a currency mismatch, another possible consequence is a large reserve accumulation. Either, or to some extent both, may occur". Original Sin also distinguishes from debt intolerance. It is one potential explanation for countries having difficulties to manage their debt levels but not the only one (Eichengreen *et al.*, 2007).

Due to data constraints on the domestic dimension and as it appeared that several EMD countries had overcome domestic Original Sin by the early 2000s (Essers & Cassimon, 2012), this article focuses only on the international dimension. To measure countries' exposure to international Original Sin, the methodology of Hausmann and Panizza (2003), based on Eichengreen *et al.* (2002), is followed. The dataset collected is country-wise closely related to Eichengreen *et al.* (2002) and Hausmann and Panizza (2003), though extended to 104 advanced and EMD countries within a timeframe from 1999 to 2019. The selection of the additional or replacing countries is based on the geographical location and, ultimately, data availability and consistency

[2]Notice that these troubles emerge not due to incompetence of banks or private actors, they are just not able to hedge the currency mismatch or foresee the mismatch of their maturity structure (Eichengreen & Hausmann, 1999).

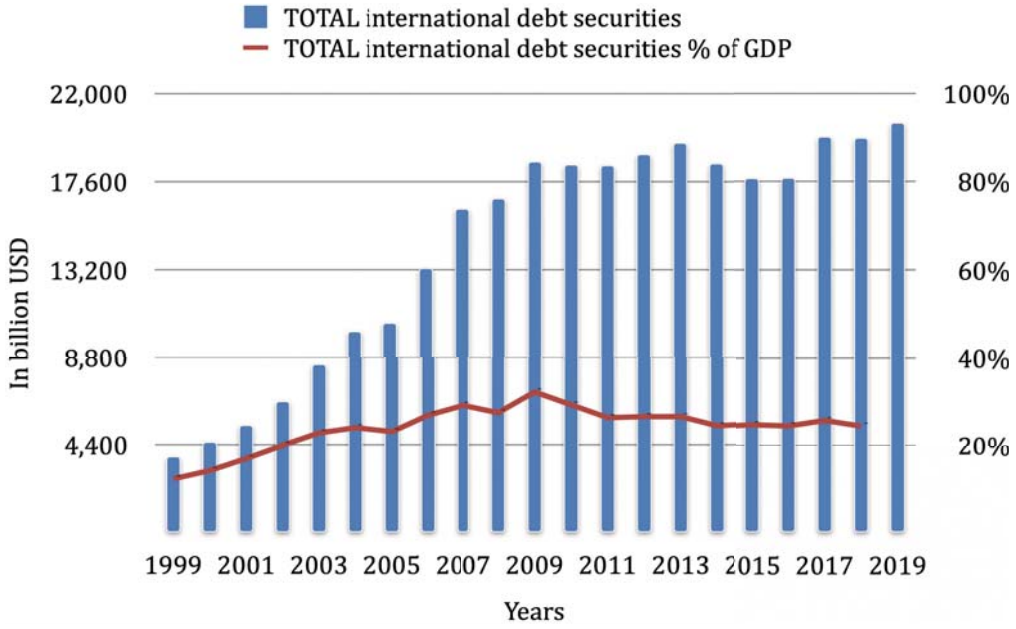
to create the most representative sample possible.[3] The required data on international debt securities is gathered from the Bank of International Settlement (BIS) on a quarterly basis. Following Gallo *et al.* (2019), whenever yearly data is required, the fourth quarter of the year is used as the yearly value. In the following, first, stylized facts about the dataset's international debt securities are provided to grasp the development and extent of this phenomenon within the sample. Next, the applied methodology from Hausmann and Panizza (2003) to measure Original Sin is explained in detail and results of countries' exposure to Original Sin are presented.

2.1 International debt securities

Financial globalization and the accompanying increasing interlinkages of financial markets led in the last decades to a strong increase in financial trade across borders (Lane, 2013). The outstanding stock of the sample's international debt securities increased by more than five times from about 3.8 trillion USD in 1999 to roughly 20.5 trillion USD in 2019 (Figure 1). Interestingly, almost 60 per cent of the increase was seen before the Global Financial Crisis (GFC). In the aftermath of the crisis up to 2016, international debt securities relatively stabilized between 17.6 and 19.5 trillion USD. They then started to increase to a peak of 20.5 trillion USD in 2019. Putting the stock of international debt securities in relation to the common GDP of the sample, a similar trend of the graph can be observed. International debt securities increased relative to the GDP sharper until its peak at 32 per cent in 2009 and stabilized or even slowly declined since then to 24 per cent in 2018.

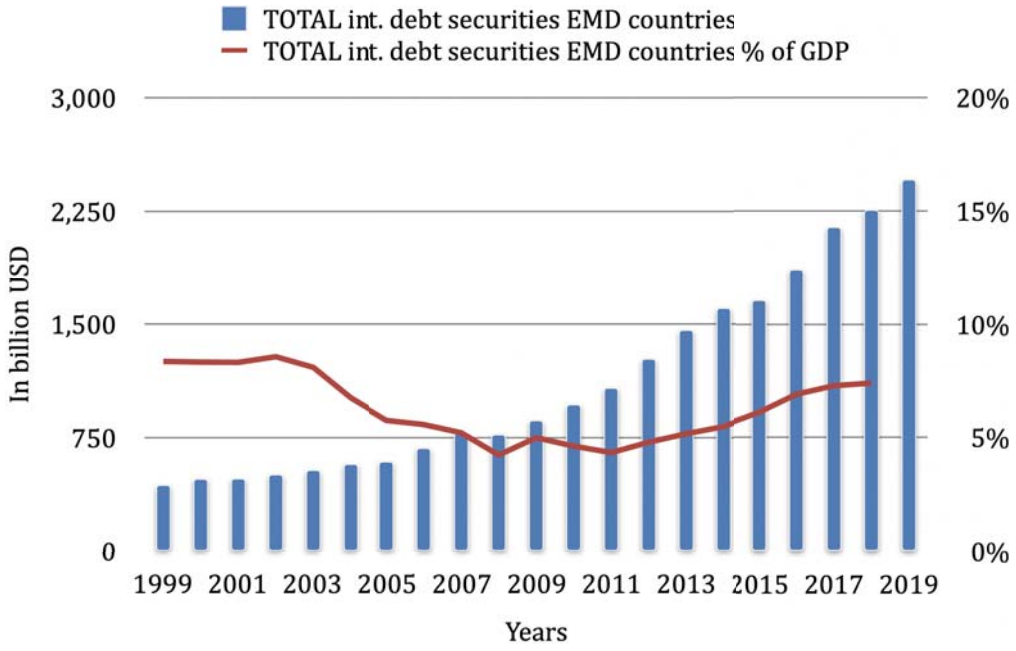
[3]Eichengreen *et al.* (2002) had 90 advanced and EMD countries in their sample. Due to data availability issues, my sample does not cover Algeria, Aruba, the Bahamas, Barbados, Moldova, Netherlands Antilles, Nicaragua, Oman, Papua New Guinea, Suriname, Romania, Taiwan and Zimbabwe. Since Ecuador, El Salvador and Montenegro fully adopted a foreign currency without being in a monetary union with the issuer, these three countries are also left out. Singapore is rejected due to heavy outliers in the residuals. Despite this, the collected sample exceeds the one of Eichengreen *et al.* (2002) by 14 countries and is thus at least comparable regarding its meaningfulness. Replacing and additional countries are Albania, Angola, Armenia, Azerbaijan, Belarus, Cameroon, Côte d'Ivoire, Croatia, Ethiopia, Gabon, Georgia, Honduras, Iraq, Kuwait, Laos, Liberia, Mongolia, Mozambique, Namibia, Nigeria, Paraguay, Rwanda, Saudi Arabia, Senegal, Serbia, Tanzania, United Arab Emirates, Vietnam and Zambia. See appendix A1 for a full list of countries.

Figure 1: International debt securities of the sample.



Source: Own calculations, own depiction based on BIS (2020) and IMF WEO (2020).

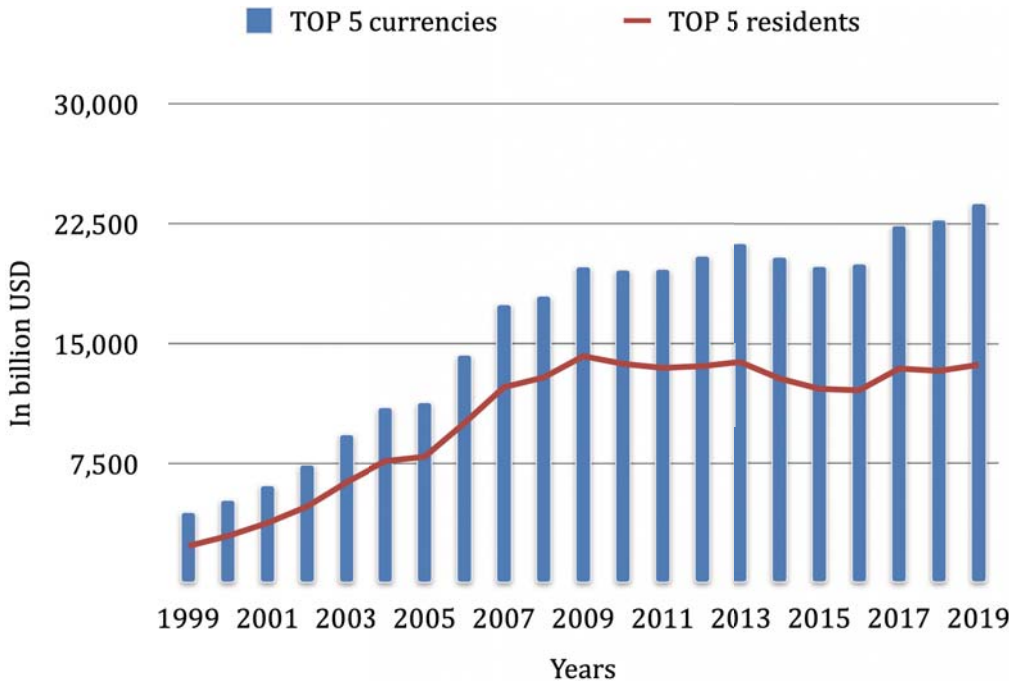
Figure 2: International debt securities of EMD countries.



Source: Own calculations, own depiction based on BIS (2020) and IMF WEO (2020).

The development of EMD countries' international debt securities is shown in Figure 2. In contrast to all international debt securities of the sample, the sharp increase took place in the aftermath of the GFC. While EMD countries' international debt securities increased from about 0.44 trillion USD to 0.78 trillion USD until the outbreak of the GFC, it increased afterwards sharply by nearly 317 per cent to 2.46 trillion USD in 2019. According to Kose *et al.* (2020), the pursuit of attractive yields due to low interest rates in advanced countries after the GFC is one explanation of this strong increase. Compared with Figure 1's depiction of the share of international debt securities as a percentage of GDP of EMD countries with all countries, the opposite trends can be observed. After a decline of more than 4 percentage points from 8.35 in 1999 to its bottom at 4.23 per cent in 2008, it increased to 7.38 per cent in 2018.

Figure 3: International debt securities denominated in the top five currencies.

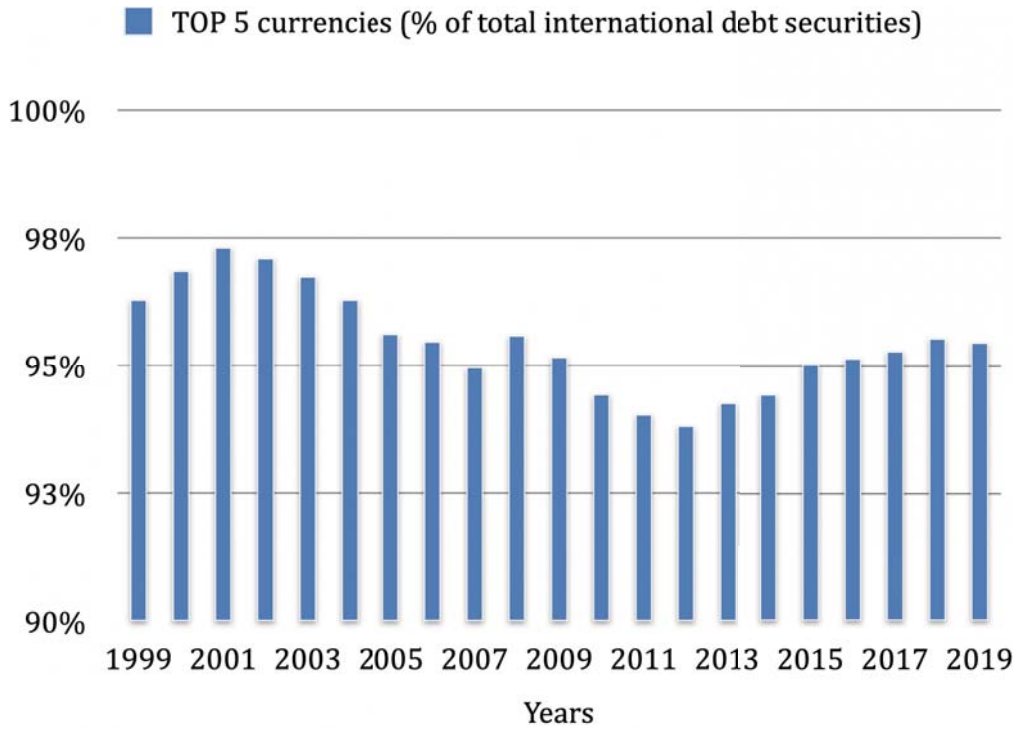


Source: Own calculations, own depiction based on BIS (2020).

Figure 3 depicts the development of all international debt securities denominated in the top five currencies (U.S. dollar, Euro[4], Pound sterling, Yen, and Swiss franc) and the combined issuing of the respective countries (US, Euroland, UK, Japan, and Switzerland) from 1999 to

[4]Euro is the sum of Euro and legacy currencies now included in the Euro.

Figure 4: Share of the top five currencies in international debt securities.



Source: Own calculations, own depiction based on BIS (2020).

2019. In the first 10 years of the period, the combined issuing of the top five currency countries in these five currencies increased in absolute terms similar to all international debt securities denominated in the top five currencies. In relative terms, though, the former increased by roughly 440 per cent, while the latter rose by more than 600 per cent over this time. In 2009, the top five currency countries were thus responsible for 72 per cent of all international debt securities denominated in the top five currencies. This trend changed after 2009. In the last 10 years of the period, the issuing of the top five currency countries in these five currencies remained in a range between 12 and 14 trillion USD per year, whereas all international debt securities denominated in the top five currencies further increased to 23.9 trillion USD in 2019. The share of the top five currency countries in their currencies therefore declined slowly to 57.5 per cent.

This trend is in line with the increased borrowing of EMD countries on international markets, which suggests that it is mainly based on international debt securities denominated in the top five currencies. Putting the stock of international debt securities denominated in the top five currencies in relation to the total stock of international debt securities confirms these findings.

Starting with 96.3 per cent in 1999 it decreased after a short high to its low at 93.8 per cent in 2012 and increased again to 95.5 per cent in 2019. Hence, international debt securities have been consistently dominated by the top five currencies (Figure 4).

Summing this up, the market for international debt securities records a strong increase over the last two decades. Most of this increase took place prior to the GFC followed by a period of stabilization between 2009 and 2016 and a further increase since then. Interestingly, international debt securities of EMD countries saw instead a surge in the aftermath of the GFC. However, the declining share of the top five currency countries in the top five currencies indicates that this increase is mainly based on international debt securities denominated in the top five currencies. The next sub-section, first, explains different indexes to measure Original Sin and then provides an overview of countries' exposure.

2.2 Quantifying Original Sin

To measure Original Sin and track the development from 1999 to 2019, I apply two of the three indexes developed by Eichengreen *et al.* (2002), namely $OSIN1$ and $OSIN3$. Both indexes range from zero to one, while a country with an index of zero does not suffer from Original Sin and a country with an index of one is completely exposed to it. The applied indexes distinguish with regards to the coverage of international debt securities. While $OSIN1$ is limited to the issuing country, $OSIN3$ also includes the issuance of a currency by other countries. According to equation (2.1) and (2.2), $OSIN1$ is equal to one minus the stock of international debt securities issued by country i in currency i divided by the total stock of international debt securities issued by country i and $OSIN3$ is equal to one minus the stock of international debt securities issued by any country in currency i divided by the total stock of international debt securities issued by country i while all negative values are replaced with zeros.[5]

$$OSIN1_i = 1 - \frac{\text{Securities issued by country } i \text{ in currency } i}{\text{Securities issued by country } i} \tag{2.1}$$

$$OSIN3_i = \max\Big(1 - \frac{\text{Securities in currency } i}{\text{Securities issued by country } i},\ 0\Big) \tag{2.2}$$

[5] A more comprehensive elaboration on the indexes can be found in Gegenfurtner (2021).

Table 1 lists the average values of $OSIN1$ and $OSIN3$ by country groups following Hausmann and Panizza (2003) and the IMF (2020a). The period from 1999 to 2019 is divided into three sub-periods following the trends of the international bond market based on historical events. The first period covers the time prior to the GFC from 1999 to 2007. The second period covers the aftermath of the GFC and the peak of the European Debt Crisis from 2008 to 2014 and the third period covers the remaining years almost up to the COVID-19 crisis. Comparing both indexes with one another, the effect of capturing the opportunity to hedge a country's exposure becomes clear. $OSIN3$ is in all cases equal to or less than $OSIN1$. The lowest values of $OSIN1$ and $OSIN3$ are in the simple average of Euroland countries, followed by financial centers (U.S., UK, Japan and Switzerland) and other developed countries. In this table, the advantage of a large monetary union is observable. While Euroland countries have a simple average of 0.34 for $OSIN1$ over all periods, it is 0.00 for $OSIN3$ when the Euro issuance of all countries is taken into account.

Table 1: Exposure to Original Sin by country groupings.

Country groups	OSIN1 1999 - 2007	OSIN1 2008 - 2014	OSIN1 2015 - 2019	OSIN3 1999 - 2007	OSIN3 2008 - 2014	OSIN3 2015 - 2019
Financial centers	0.56	0.54	0.67	0.08	0.10	0.10
Euroland	0.31	0.28	0.43	0.00	0.00	0.00
Other developed	0.94	0.92	0.95	0.61	0.63	0.74
Emerging and developing countries	0.99	0.96	0.98	0.95	0.90	0.94
- Asia	0.99	0.93	0.96	0.97	0.78	0.84
- Europe	1.00	0.99	0.99	0.91	0.89	0.95
- Latin America & The Caribbean	0.99	0.95	0.96	0.97	0.92	0.94
- Middle East & Central Asia	0.99	0.97	0.99	0.98	0.95	0.98
- Sub-Saharan Africa*	1.00	0.99	1.00	1.00	0.99	1.00

*Excluding South Africa since it distorts the country group averages especially in the first period when only 4 out of 17 Sub-Saharan African countries provide data.

Source: Own calculations, own depiction based on BIS (2020). See Gegenfurtner (2021) for the list of country groupings.

The highest values for both indexes are represented by the group of EMD countries ranging for $OSIN1$ between 0.96 and 0.99 and $OSIN3$ between 0.90 and 0.95 over all periods. Further sub-clustering EMD countries in relation to their geographical location shows that the EMD countries of Asia and Latin America & The Caribbean have the lowest values for $OSIN1$, while Europe and Sub-Saharan Africa have the highest. For $OSIN3$ it looks slightly different. Countries from the Middle East & Central Asia and Sub-Saharan Africa groups are most exposed to

Original Sin, whereas Asian and European countries are suffering from it the least. What is striking, however, is that all EMD country groupings share the same trend for $OSIN3$ over the three periods. The exposure to Original Sin measured by $OSIN3$ declines from period one to two and increases again in period three, though to a less extent. This trend shows that in the years after the crisis EMD countries were more able to borrow internationally in their own currency potentially due to international investors seeking attractive yields. However, the increase of $OSIN3$ in period three indicates that the strong increase of EMD countries' international debt securities shown in Figure 3 was in recent years mainly driven by debt denominated in foreign currencies. These findings are in line with the descriptive analysis of the previous sub-section. From here on, I will focus only on the $OSIN3$ index due to its more precise measurement.

Table 2: Top 15 EMD countries with the least exposure.

Country	OSIN3 1999 - 2007	OSIN3 2008 - 2014	OSIN3 2015 - 2019
South Africa	0.07	0.00	0.22
China	0.95	0.18	0.34
India	0.99	0.91	0.66
Thailand	0.88	0.49	0.68
Peru	0.98	0.82	0.73
Brazil	0.94	0.70	0.78
Uruguay	0.94	0.75	0.78
Turkey	0.89	0.63	0.81
Russia	0.96	0.76	0.87
Indonesia	0.96	0.78	0.87
Poland	0.56	0.79	0.88
Colombia	0.95	0.78	0.88
Mexico	0.94	0.80	0.89
Saudi Arabia	0.93	0.60	0.89
Egypt	0.92	0.82	0.92

Source: Own calculations, own depiction based on BIS (2020).

Table 2 lists the top 15 EMD countries with the least values of $OSIN3$ sorted by period three. South Africa leads this list with a value of 0.22 in the last period followed by China (0.34) and India (0.66). Among the top 15 EMD countries, South Africa is the only country from Sub-Saharan Africa, while countries from Latin America & The Caribbean dominate the list with 5 countries. In sum, out of 73 EMD countries, only 7 countries have achieved values below

0.80, 14 countries below 0.90 and 39 countries are still completely exposed to Original Sin. In Table 3, the top 15 EMD countries with the greatest improvement from period one to three are shown. China has improved the most by far with a difference between the periods of 0.61 followed by India (0.33) and Peru (0.25). Regarding country groupings, EMD countries from Asia achieved the best improvement dominating Table 3 with 6 out of 15 countries followed by Latin America & The Caribbean with 5 countries. However, although, there is an improvement for some EMD countries, the majority does not make progress at all.

Table 3: Top 15 EMD countries with the greatest improvement.

Country	OSIN3 1999 - 2007	OSIN3 2008 - 2014	OSIN3 2015 - 2019	Improvement from period 1 to 3
China	0.95	0.18	0.34	0.61
India	0.99	0.91	0.66	0.33
Peru	0.98	0.82	0.73	0.25
Thailand	0.88	0.49	0.68	0.20
Brazil	0.94	0.70	0.78	0.16
Uruguay	0.94	0.75	0.78	0.15
Russia	0.96	0.76	0.87	0.09
Indonesia	0.96	0.78	0.87	0.09
Turkey	0.89	0.63	0.81	0.09
Colombia	0.95	0.78	0.88	0.07
Philippines	0.99	0.94	0.93	0.06
Mexico	0.94	0.80	0.89	0.05
Kuwait	1.00	1.00	0.96	0.04
Saudi Arabia	0.93	0.60	0.89	0.04
Malaysia	0.99	0.82	0.95	0.03

Source: Own calculations, own depiction based on BIS (2020).

Summing this sub-section up, an overall positive development of the Original Sin phenomenon is observable. Although the Original Sin of some country groups such as the financial centers or other developed countries deteriorated over the entire period, the exposure to Original Sin as a whole declined by 0.04. Focusing on EMD countries, the average of its value improved from period one to three by 0.02, though, it is still the highest value of $OSIN3$ among all country groupings. After quantifying Original Sin and presenting stylized facts, questions arise as to what influences Original Sin and why EMD countries are suffering the most. Therefore, in the next section, potential causes of Original Sin were elaborated and either empirically or theoretically analyzed.

3 Causes of Original Sin

This section first reviews the most prominent approaches and results of the academic literature in analyzing potential causes of Original Sin. Based on this literature review, several hypotheses of the causes of Original Sin are gradually drawn up and examined with the help of empirical cross-sectional regression analysis. To examine the direction of impact and check for reverse causality issues, an additional time-series analysis will be conducted. Next, alternative approaches which do not rely on macroeconomic relationships are discussed in detail, before the whole investigation gets assessed.

3.1 Literature review

In the academic literature dealing with EMD countries, the phenomenon of Original Sin is well known. However, the bulk of the literature focuses on the international dimension for the same reasons I do. Examples of studies on the domestic dimension include Mehl and Reynaud (2005) and Hausmann and Panizza (2003) which provide a comprehensive analysis of both dimensions. Among the studies on the international dimension, the underdevelopment of domestic credit markets is the most frequently mentioned approach to explaining Original Sin (Goldstein & Turner, 2004; Kahn, 2005; Bordo, 2006; Borenzstein *et al.*, 2006; Essers & Cassimon, 2012; Mu *et al.*, 2013; Arslanalp & Tsuda, 2014; Du & Schreger, 2016a). Following Goldstein and Turner (2004) and Kahn (2005), countries suffer less from Original Sin the better their level of development. Developing domestic credit markets to accelerate countries' development is, according to Kahn (2005), key to finding redemption from Original Sin.

Borenzstein *et al.* (2006, chapter 14), for instance, conduct an extensive analysis of debt risks in Latin America. The policy implications for finding redemption from Original Sin are the strengthening and extending of the domestic bond market, the introduction of debt contract contingencies with equity-like features and increased responsibility and activity of international financial institutions such as the World Bank (WB), the International Monetary Fund (IMF) and regional development banks. Essers and Cassimon (2012) and Mu *et al.* (2013) investigate local currency bond markets in Sub-Saharan Africa and come to similar results. The underdevelopment of domestic credit markets are a potential obstacle in overcoming international Original Sin.

Arslanalp and Tsuda (2014) and Du and Schreger (2016a) focus on credit risks and the

related investors' demand for emerging market sovereign debt. According to the results of Arslanalp and Tsuda (2014), countries with high debt-to-GDP ratios and less developed domestic credit markets suffer from foreign-denominated debt when its optimal level is exceeded. Du and Schreger (2016a) measure local and foreign currency credit spreads of emerging market sovereigns and compare them with one another. They come to the conclusion that credit spread differentials are mainly due to an underdevelopment of domestic credit markets, capital controls, selective defaults and the covariance between currency and credit risks, thus, being in turn responsible for Original Sin.

A further paper by Du and Schreger (2016b) analyzes the effects of private sector currency mismatches on local currency sovereign debt. They find in their sample of 14 major emerging markets that although sovereigns are increasingly able to borrow internationally in local currency, the private sector remains exposed to Original Sin. Du and Schreger (2016b) therefore argue that the exposure of the private sector forces the sovereign to stabilize the real exchange rate to avoid an increasing real value of the private sector's external debt. This 'fear of floating' comprehensively analyzed in Calvo and Reinhart (2000) even goes so far that sovereigns are „more inclined to explicitly default than to inflate away the debt because of the effect of depreciation on the private sector" (Du & Schreger, 2016b, p. 2). According to these findings, Original Sin should be correlated with rather *de facto* fixed exchange rate regimes, however, the direction of impact needs to be identified.

Bordo (2006) applies an interesting methodology comparing the recent development of emerging market countries with those of a century ago. The results of his investigations are that the development of domestic bond markets and sound institutions are key to access international capital markets while the trust in domestic currency to overcome Original Sin is based on monetary stability through low inflation. Engel and Parker (2018) come to similar results by quantitatively examining the currency composition of sovereign debt and analyzing governments' monetary policy. They find that the less disciplined a sovereign's monetary policy is (higher inflation rates), the greater the limits are for borrowing in domestic currency since lenders might fear an increased probability of the sovereign to not comply with its debt contracts (Engel & Parker, 2018).

Corsetti and Mackowiak (2000) investigate the relationship between public nominal debt and fiscal and monetary policies during a balance of payments crisis. They find that due

to sudden panic, creditors increasingly withdraw their credit when international reserves are largely exceeded by short-term public debt. Accordingly, the currency devalues as the stock of international reserves diminishes and the lack of demand for public debt reduces the government's ability to defend the exchange rate thereby increasing Original Sin (Corsetti & Mackowiak, 2000). Financial solvency of a country should therefore have a relationship with the ability to borrow internationally in domestic currency.

So far, the literature review suggests relationships between Original Sin and the development of domestic credit markets, monetary stability, financial solvency, capital controls and exchange rate regimes. Eichengreen *et al.* (2002) and Hausmann and Panizza (2003) analyze most of these theories dealing with relationships between Original Sin and macroeconomic variables. In their empirical investigation, the potential correlations between Original Sin and the level of development, the economic size of a country, monetary stability, contract enforcement, the quality of institutions, the openness for trade, financial development, domestic credit market imperfections, exchange rate regimes and credit ratings are analyzed. According to the results of both studies, out of all these theories, only economic country size is robustly significantly correlated with the Original Sin index $OSIN3$. Seeking an explanation, Eichengreen *et al.* (2002) developed a further theory which states that the portfolio diversification of international investors has an optimum of different currencies. Taking on an additional currency would increase investors' portfolio diversification, though with decreasing marginal benefits (Eichengreen *et al.*, 2002). As a result, there is a limited group of currencies on the international level.

Lahet and Prat (2020) further investigate the relationship between Original Sin and the economic size in emerging market countries. To identify non-linearity in the relationship they use a threshold empirical analysis à la Hansen (1999). Indeed, results indicate non-linearity between the economic size and Original Sin, however, with barely significant threshold values. In addition, Lahet and Prat (2020) are interested in the effects of FX turnovers on Original Sin. Following their argumentation, FX turnovers are a strong indicator for the use of a currency and its internationalization. However, the empirical analysis delivers no significant threshold value.

The studies by Fritz *et al.* (2018) and de Paula *et al.* (2017, 2020) are distinguished from previous ones. In contrast to most, these studies do not build upon potential relationships between Original Sin and macroeconomic variables. de Paula *et al.* (2020) try to explain changes in emerging economies' vulnerabilities due to currency mismatches with the help of the concepts

of financialization and currency hierarchy. According to the latter concept, most currencies are „incapable of performing the basic functions of money (medium of exchange, denomination of contracts and international reserve currency) at the international level“ (de Paula *et al.*, 2020, p. 12). Global investors' liquidity preference and the liquidity premium of a currency are thus decisive for the choice of a currency in international debt securities.[6] In addition, de Paula *et al.* (2020) find that temporary overcoming Original Sin due to the seek for attractive yields generates further vulnerabilities. Debt denominated in domestic currency leads in times of distress to capital outflows when the local currency depreciates. The corresponding fall in asset prices increases domestic interest rates which in turn further deteriorates the fiscal situation (de Paula *et al.*, 2020). BIS economists recently labeled this phenomenon as Original Sin redux. Although this is a very interesting field for quantitative research, it is out of the scope of this article.

Gallo *et al.* (2019) use a similar approach as Fritz *et al.* (2018) and de Paula *et al.* (2017, 2020). According to their descriptive analysis and theoretical elaborations, the hierarchy of currencies and the liquidity preference of investors are responsible for Original Sin. Their solution to overcome Original Sin is international monetary co-operation in its ultimate form as a currency union. The stronger and more powerful the currency and the higher the position in the currency hierarchy, the less a country is exposed to Original Sin.

Summing this sub-section up, various studies are dealing with the phenomenon of Original Sin. Most of the rather orthodox investigations make the underdevelopment of domestic credit markets and monetary stability responsible for Original Sin. However, there are some studies which follow an alternative approach and see the issue rather in the liquidity premium and hierarchy of currencies. The next sub-section, first, empirically investigates the theories based on relationships with macroeconomic variables elaborated from the literature review. Next, the alternative approach is discussed in detail before the whole investigation gets assessed.

3.2 Examining the theories of causes

By reviewing the related literature, several theories regarding the causes of Original Sin are presented. In the following, first, most of these theories are examined with the help of an empirical cross-sectional regression analysis. Second, whenever possible with the data, an additional time-series analysis will be conducted to examine the direction of impact and to control

[6] A more detailed elaboration of this concept is presented in the next sub-section.

for reverse causality issues. Finally, after summarizing the empirical investigation, approaches other than those based on macroeconomic relationships are discussed in detail. However, before these theories get examined the exact empirical methodology is presented.

3.2.1 Empirical methodology

„The goal of most empirical studies in economics and other social sciences is to determine whether a change in one variable, say w, causes a change in another variable, say y“ (Wooldridge, 2002, chapter 1, p. 3). The investigation of this article pursues the same objective. However, when such a relationship is found, the difficulty lies in the distinction between a causal relationship and a mere correlation of two variables. Wooldridge (2002, chapter 1) states that the crux of identifying a causal relationship is to hold other factors fixed. To cope with this issue several approaches were developed.[7] One way, therefore, is to add explanatory variables which control for other potential effects on the response variable to isolate the relationship under study. In this article, this approach is applied to two different analytical methods, namely cross-sectional and time-series analysis.

Cross-sectional analysis

Using cross-sectional data of 104 advanced and EMD countries around the globe, the sample presented here is the largest ever used to study Original Sin. Next to the database of the BIS, data is gathered from public databases of the World Bank (2020), the IMF (World Economic Outlook, October 2020 version; Internal Financial Statistics (IFS), 2020; Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), 2020) and the OECD (2020). To provide consistency throughout all countries and variables, IMF Article IV Staff Reports (IMF, 2020b) as well as private databases such as CEIC (2020) are additionally used.[8] The dataset of the cross-sectional analysis is on a yearly basis while the simple average is used for the three different periods under study.

The choice of the most appropriate analytical model is crucial in econometrics. The right step to do this is to thoroughly analyze the nature of data being collected. The response variable $OSIN3$ is by definition bounded between 0 and 1 while in the third period 22 countries have a

[7] A thorough discussion and elaboration of dealing with the issue of causality is provided in Wooldridge (2002, various chapters).

[8] A detailed list of the variables used and their origin is presented in the appendix A2.

value of 0, 36 countries have a value of 1 and 46 countries are in between. Using in this case standard multiple linear regression with ordinary least squares (OLS) estimators would provide distorted results since some estimated values would be above 1 or below 0 (Papke & Wooldridge, 1996). To deal with the characteristics of the response variable Hausmann and Panizza (2003) choose a double censored TOBIT linear regression model which bounds the estimated values of the dependent variable between 0 and 1.

This article follows Hausmann and Panizza (2003) and uses this double censored TOBIT linear regression model, further controlling its results with fractional probit and quantile regression models. The advantage of fractional probit models is the ability to analyze proportion data while keeping the estimated values within the boundary without being restricted to linear relationships (Ramalho *et al.*, 2011). The additional use of quantile regression is justified by its robust nature against outliers using the conditional median instead of the mean while being independent of parametric assumptions.[9] This is especially of relevance for unevenly distributed samples of which the conditional mean might not mirror the attributes of interest (Hao & Naiman, 2007, chapter 2). For instance, the median of the response variable $OSIN3$ is 0.97 while the mean is 0.72. In sum, the combination of these three models provides a comprehensive econometric approach to study the cross-sectional dimension.[10]

Time-series analysis

In this article, the time-series analysis is used to examine the direction of impact and to control for reverse causality issues. Although the dataset would allow for panel regression, due to inconsistent periods of variation in the response variable across countries the time-series analysis applied for each country does better exploit the present data. Compared to the cross-sectional analysis, the dataset of the time-series analysis is considerably smaller from the start since advanced countries are not required for controlling. Out of 73 EMD countries, only 23 are ultimately under study which is mainly due to two reasons. First, all EMD countries with a continuous index value of 1 drop out of the investigation since there is no variance in the response variable to explain. Second, to get sufficient observations in the time-frame from 1999 to 2019,

[9] The conditional median is one quantile within quantile regression.

[10] Detailed mathematical elaborations and proofs are presented for the TOBIT model in Wooldridge (2002, chapter 1, 2 and 16), for the fractional probit model in Papke and Wooldridge (1996) and Ramalho *et al.* (2010) and for the quantile regression model in Hao and Naiman (2007).

the time-series analysis must be done quarterly. However, unfortunately, quarterly data is often not consistently available for most EMD countries.

In time-series analysis, a distinction is made between short and long-run effects of the explanatory variables on the response variable. The vector error correction model (VECM) is an analytical model which has the advantage of investigating both relationships. The VECM is thereby based on two concepts. On the one hand, a restricted vector autoregressive (VAR) model designed for non-stationary time-series and, on the other hand, the concept of co-integration developed by Engel and Granger in 1987 (Wooldridge, 2009, chapter 18).[11]

3.2.2 Empirical analysis

This sub-section empirically examines a selection of the most relevant theories of causes of Original Sin based on the previous literature review. The full empirical analysis can be found in Gegenfurtner (2021). Due to the increased availability of data in recent years, the third period from 2015 to 2019 is the most representative. Nevertheless, the examination of all periods is crucial to control the results for trends. Whenever possible with the data, an additional time-series analysis is conducted. Following Hausmann and Panizza (2003), all cross-sectional regressions are weighted by using the share of international debt securities over total international debt to deal with the uncovered portion of bank loans.

To focus on EMD countries and isolate the relationship under study, all cross-sectional regressions are controlled for country groupings (monetary co-operation[12], financial center, Euroland and other developed countries) and the size of a country by the principal component of the log of total GDP, the log of total trade and the log of total domestic credit labeled as SIZE (Eichengreen *et al.*, 2002). Interestingly, using the country grouping dummies in the cross-sectional analysis with a standard OLS regression explains the variance in Original Sin by 88.26 per cent (R-squared) in the third period (see appendix A3). Following Hausmann and Panizza (2003), this leaves only 11.74 per cent for time-varying factors confirming the methodology that the cross-sectional analysis is the main econometric tool to examine the causes of Original Sin while the time-series analysis should have its focus on identifying the direction of impact and reverse causality issues.

[11] All required tests to conduct VEC or VAR models and to diagnose the robustness of its results were done and can be consulted via requests to the author.

[12] See Gegenfurtner (2021) for the methodology of the variable.

In the time-series analysis, whenever possible, the effects of the explanatory variables under study are controlled for country size. In all regressions, the $OSIN3$ index is the response variable of interest. The econometric program Stata is used in its fourteenth version.

Financial development and capital controls

The most identified cause of Original Sin in the literature review is the underdevelopment of domestic credit markets (Kahn, 2005; Bordo, 2006; Borenzstein *et al.*, 2006; Essers & Cassimon, 2012; Mu *et al.*, 2013; Arslanalp & Tsuda, 2014; Du & Schreger, 2016a). According to Du and Schreger (2016a), credit risk spread differentials between domestic and foreign currency debt at the expense of the former are mainly due to this underdevelopment and capital controls. The IMF (2016) developed several indexes to deal with the complex nature of financial development. To investigate the theory of underdeveloped domestic credit markets the IMF's financial institutions index (FII), the financial markets index (FMI), and the financial development index (FDI) which is an aggregate of the previous two indexes are used. While the FII covers data on bank credit to the private sector as a percentage of GDP, bank branches per 100,000 adults and lending-deposit spreads, among others, the FMI covers data on international debt securities of government to GDP, the percentage of market capitalization outside of the top 10 largest financial institutions and the stock market turnover ratio, among others (IMF, 2016). Even though these indexes cover not solely the domestic credit market but financial development in general, due to the large share of the credit market in the financial system they are considered to be a representative indicator of the development of credit markets.

Table 4 shows the results of the TOBIT regression for the FMI which should be the most appropriate indicator of the three.[13] Regressing the FMI on $OSIN3$ for each period detects a negative correlation at a significance level of 1 per cent throughout all periods when leaving the control variables out of the model. However, controlling for country groups and the size of a country renders the FMI insignificant and even turns its coefficient positive in period 1 and 2. Almost the same effect is observable for the FDI and FII, as the the coefficients remain negative and become significant in period 3 at 10 per cent and 5 per cent respectively. Even though the third period is the most representative one, to confirm a significant relationship the co-

[13] All control regressions can be provided upon request.

Table 4: Original Sin and financial development.

	(1) OSIN3_1	(2) OSIN3_1	(3) OSIN3_2	(4) OSIN3_2	(5) OSIN3_3	(6) OSIN3_3
FMI	-1.230 (4.50)***	0.147 (0.61)	-1.476 (4.54)***	0.030 (0.11)	-1.315 (4.44)***	-0.101 (0.66)
SIZE		-0.218 (2.65)***		-0.228 (2.60)**		-0.118 (3.12)***
MO_COOP		-0.281 (2.03)**		-0.057 (0.43)		0.043 (0.70)
FIN_CENTER		-0.578 (3.07)***		-0.332 (1.92)*		-0.516 (3.71)***
EUROLAND		-0.914 (5.12)***		-1.340 (10.85)***		-1.371 (13.87)***
OTH_DEVELOPED		-0.110 (1.19)		-0.059 (0.53)		-0.068 (0.83)
Constant	1.231 (13.68)***	0.994 (16.06)***	1.284 (10.76)***	0.943 (11.72)***	1.305 (11.59)***	1.002 (20.51)***
Observations	74	69	94	93	104	102

Absolute value of t statistics in parentheses
Signifcance levels: 0.1 = * 0.05 = ** 0.01 = ***

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

Table 5: Original Sin and regulations.

	(1) OSIN3_1	(2) OSIN3_1	(3) OSIN3_2	(4) OSIN3_2	(5) OSIN3_3	(6) OSIN3_3
CAP_MARKET_REGU	0.435 (2.88)***	0.201 (2.35)**	0.285 (1.79)*	0.278 (2.91)***	0.130 (0.87)	0.207 (3.02)***
SIZE	-0.511 (5.70)***	-0.220 (3.34)***	-0.553 (5.53)***	-0.261 (4.45)***	-0.447 (5.13)***	-0.153 (4.54)***
MO_COOP		-0.308 (2.20)**		-0.103 (0.81)		0.001 (0.01)
FIN_CENTER		-0.515 (2.72)***		-0.294 (1.80)*		-0.545 (4.34)***
EUROLAND		-0.826 (4.66)***		-1.320 (10.69)***		-1.346 (13.37)***
OTH_DEVELOPED		-0.065 (0.78)		-0.057 (0.62)		-0.112 (1.67)*
Constant	0.579 (4.22)***	0.856 (12.70)***	0.612 (4.08)***	0.718 (8.30)***	0.773 (5.71)***	0.800 (12.10)***
Observations	69	69	93	93	102	102

Absolute value of t statistics in parentheses
Signifcance levels: 0.1 = * 0.05 = ** 0.01 = ***

	(1) OSIN3_1	(2) OSIN3_1	(3) OSIN3_2	(4) OSIN3_2	(5) OSIN3_3	(6) OSIN3_3
FIN_SECTOR_REGU	0.915 (3.26)***	0.124 (0.99)	0.725 (2.61)**	0.080 (0.36)	0.052 (0.15)	0.100 (0.58)
SIZE	-0.357 (4.07)***	-0.181 (3.03)***	-0.441 (4.75)***	-0.220 (3.64)***	-0.435 (4.89)***	-0.135 (4.13)***
MO_COOP		-0.263 (1.85)*		-0.044 (0.35)		0.029 (0.45)
FIN_CENTER		-0.514 (2.97)***		-0.303 (1.86)*		-0.511 (4.21)***
EUROLAND		-0.862 (4.76)***		-1.335 (10.57)***		-1.353 (14.49)***
OTH_DEVELOPED		-0.077 (0.99)		-0.045 (0.53)		-0.081 (1.31)
Constant	0.048 (0.17)	0.900 (4.79)***	0.177 (0.63)**	0.870 (3.92)***	0.840 (2.43)**	0.878 (5.23)***
Observations	69	69	93	93	102	102

Absolute value of t statistics in parentheses
Signifcance levels: 0.1 = * 0.05 = ** 0.01 = ***

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

Table 6: Original Sin and inflation.

	(1) OSIN3_1	(2) OSIN3_1	(3) OSIN3_2	(4) OSIN3_2	(5) OSIN3_3	(6) OSIN3_3
CPI	0.038 (2.14)**	0.000 (0.12)	0.120 (4.10)***	0.011 (2.15)**	0.032 (1.85)*	-0.000 (0.11)
SIZE		-0.178 (3.07)***		-0.216 (3.43)***		-0.139 (4.27)***
MO_COOP		-0.265 (1.93)*		-0.016 (0.12)		0.031 (0.43)
FIN_CENTER		-0.559 (2.94)***		-0.287 (1.74)*		-0.544 (4.19)***
EUROLAND		-0.892 (5.08)***		-1.325 (11.33)***		-1.363 (13.55)***
OTH_DEVELOPED		-0.076 (0.99)		-0.012 (0.14)		-0.095 (1.41)
Constant	0.539 (4.36)***	1.013 (32.96)***	0.154 (0.95)	0.873 (18.07)***	0.706 (7.59)***	0.979 (26.04)***
Observations	73	68	94	93	104	102

Absolute value of t statistics in parentheses
Signifcance levels: 0.1 = * 0.05 = ** 0.01 = ***

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

efficients should be significant in all periods. Controlling the results with the fractional probit and quantile regression validates these findings.[14] Since in the third period the coefficients remain insignificant in the quantile regression, outliers may be responsible for the significance in the TOBIT regression. To conclude these findings, the underdevelopment of domestic credit markets does not explain the phenomenon of Original Sin.

To investigate whether capital controls or regulations of the financial sector affect Original Sin, data of the IMF's AREAER database is used to create two dummy variables. Whenever regulations on capital flows (CAP_FLOW_REGU) or the financial sector (FIN_SECTOR_REGU) exist, the variables have the value of 1 and otherwise 0. Table 5 shows the TOBIT regression results for both variables of each period. Both variables have a positive coefficient and are significant in the first two periods when controlling only for the size of a country. However, when adding the country group dummies, regulations on the financial sector become insignificant while regulations on capital flows remain or become significant in all periods. Results of the control regressions confirm these findings for the second and third period. Summing this up, regulations on capital flows have a significant positive relationship with Original Sin. In other words, countries using these tools are more likely to suffer from Original Sin.

Monetary stability

The second most discussed cause of Original Sin is monetary instability of a country. In the prevalent literature, this theory of cause is rather labeled as monetary credibility (Eichengreen *et al.*, 2002; Hausmann & Panizza, 2003; Bordo, 2006; Essers & Cassimon, 2012; Engel & Parker, 2018). The argument here goes back to Calvo (1987) who mentions the opportunity of governments to inflate away a country's real value of debt. However, the term credibility does not capture the core of the argument. It is the stability of prices which is decisive for the reasoning of this theory. Risk-averse investors would therefore only lend in foreign currency which is unaffected of domestic inflation. Countries with high rates of inflation should therefore be more exposed to Original Sin.

The explanatory variable of this theory is the percentage change in the consumer price index (CPI) compared to the corresponding period of the previous year. The findings of the TOBIT regression show that inflation has a significant positive correlation with Original Sin when it is

[14] In order to make the results of the fractional probit models comparable, marginal effects are computed.

not controlled for country size and groups (Table 6). These findings support the theory, however, adding the control variables the coefficients converge to 0 and turn insignificant in period 1 and 3. A potential explanation for the significance in period 2 could be the impacts of the GFC. While inflation decreased in almost every country in the aftermath of the crisis,[15] international investors increasingly invested in international debt securities of EMD countries (local as well as foreign currency) due to their seek for attractive yields. However, the almost 11 fold shrinkage of the coefficient in this period questions the robustness of this relationship anyway. Controlling the results with the other two models of the cross-sectional analysis confirm the insignificance of inflation in explaining Original Sin.

Table 7: Original Sin and inflation (time-series).

	OSIN3	CPI	SIZE	LR_OSIN3
OSIN3_L1	1(-) 8(+) 14	1(-) 1(+) 14	4(-) 14	
OSIN3_L2	1(-) 11	1(-) 11	2(+) 11	
OSIN3_L3	1(-) 4	- 4	1(-) 1(+) 4	
CPI_L1	1(+) 14	13(+) 14	1(-) 3(+) 14	2(-) 1(+) 9
CPI_L2	2(+) 11	6(-) 2(+) 11	3(-) 11	
CPI_L3	1(+) 4	2(+) 4	1(-) 4	
SIZE_L1	3(-) 1(+) 10	2(+) 10	3(-) 6(+) 10	1(-) 6
SIZE_L2	1(-) 9	1(+) 9	5(-) 9	
SIZE_L3	1(-) 4	- 4	1(-) 2(+) 4	

Note: Results present effects significant at least at 10 per cent.

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

Investigating the relationship of inflation and Original Sin over time for EMD countries confirms the previous results in the short-run, though in the long-run it is ambiguous (Table 7). Although for 9 EMD countries co-integration is detected, the VECM regressions indicate that only 2 countries have a negative and 1 country a positive long-run effect of inflation on Original Sin. These findings question the co-integration and ultimately the long-run relationship. To conclude this theory, both types of analysis deliver no evidence that a country's monetary instability increases Original Sin.

[15] WB data, world average: https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG

Table 8: Original Sin and financial solvency.

	(1) OSIN3_1	(2) OSIN3_2	(3) OSIN3_3	(4) OSIN3_1	(5) OSIN3_2	(6) OSIN3_3
DEBT_TO_GDP	-0.000 (0.45)	0.000 (0.03)	0.000 (0.07)			
BUDGET_BAL				0.009 (1.53)	-0.006 (1.07)	-0.013 (1.85)*
DEBT_TO_REV						
SIZE	-0.210 (3.40)***	-0.221 (3.62)***	-0.138 (4.12)***	-0.186 (3.10)***	-0.219 (3.62)***	-0.140 (4.42)***
MO_COOP	-0.304 (2.11)**	-0.053 (0.42)	0.033 (0.47)	-0.319 (2.19)	-0.028 (0.22)	0.046 (0.73)
FIN_CENTER	-0.534 (2.84)***	-0.329 (1.88)*	-0.545 (3.90)***	-0.563 (3.06)***	-0.358 (2.05)**	-0.533 (4.13)***
EUROLAND	-0.872 (4.83)***	-1.342 (10.89)***	-1.363 (13.46)***	-0.880 (5.12)***	-1.372 (10.39)***	-1.331 (13.39)***
OTH_DEVELOPED	-0.087 (1.09)	-0.053 (0.59)	-0.093 (1.42)	-0.121 (1.37)	-0.047 (0.52)	-0.045 (0.63)
Constant	1.063 (20.25)***	0.950 (16.11)***	0.975 (19.60)***	1.058 (25.00)***	0.934 (21.82)***	0.932 (26.76)***
Observations	68	93	102	69	93	102

Absolute value of t statistics in parentheses
Signifcance levels: 0.1 = * 0.05 = ** 0.01 = ***

	(7) OSIN3_1	(8) OSIN3_2	(9) OSIN3_3
DEBT_TO_GDP			
BUDGET_BAL			
DEBT_TO_REV	-0.002 (0.16)	0.009 (0.59)	0.012 (0.83)
SIZE	-0.210 (3.36)***	-0.219 (3.53)***	-0.134 (4.01)***
MO_COOP	-0.300 (2.05)**	-0.045 (0.35)	0.042 (0.60)
FIN_CENTER	-0.534 (2.83)***	-0.338 (1.91)*	-0.560 (4.04)***
EUROLAND	-0.875 (4.88)***	-1.341 (11.01)***	-1.355 (13.73)***
OTH_DEVELOPED	-0.085 (1.02)	-0.048 (0.55)	-0.082 (1.23)
Constant	1.054 (19.31)***	0.933 (15.28)***	0.947 (18.99)***
Observations	68	93	102

Absolute value of t statistics in parentheses
Signifcance levels: 0.1 = * 0.05 = ** 0.01 = ***

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

Financial solvency

The third theory of causes focuses on the financial solvency of countries (Corsetti & Mackowiak, 2000; Eichengreen *et al.*, 2002; Hausmann & Panizza, 2003; Arslanalp & Tsuda, 2014). According to Corsetti and Mackowiak (2000), countries in weak fiscal situations have increased difficulties to borrow in domestic currencies. The argumentation is thereby again based on the governments' opportunity to inflate or devalue away a country's real value of debt. The weaker the fiscal situation, the greater the debt stock in foreign currency and the higher the inflation rates and devaluation to address the financial issues (Hausmann & Panizza, 2003). Again, risk-averse investors would therefore only lend in foreign currency which is unaffected by domestic inflation. According to this theory, Original Sin and a country's financial solvency should be negatively correlated. However, having the results of the investigation of inflation in mind, fiscal solvency indicators are expected to not explain Original Sin.

Following Hausmann and Panizza (2003), the debt-to-GDP ratio (DEBT_TO_GDP), the average budget deficit (BUDGET_BAL) and the debt-to-revenue ratio (DEBT_TO_REV) are the explanatory variables used to investigate the theory of financial solvency. Table 8 shows the results of the TOBIT regression with each explanatory variable controlled for country size and groups. As expected, none of the indicators has a significant correlation with Original Sin. Rather, in the third period, the average budget deficit has a weak significant negative relationship with $OSIN3$. However, looking at the entirety, this significance is negligible. Using the control models confirms the overall impression of the insignificance of this theory. Although the average budget deficit and the debt-to-revenue ratio are significant in both control models in the third period, they are insignificant in the first and second period.

Running the time-series analysis with the log of the debt-to-GDP ratio for EMD countries confirms the results of the cross-sectional analysis in the short-run (Table 9). For only 9 EMD countries, a time-series analysis was conducted. On the first lag, 2 records a significant negative and 1 a significant positive effect of the debt-to-GDP ratio on Original Sin in the short-run. To confirm a significant relationship in the short-run these results are too weak and ambiguous. However, in the long-run, in 3 out of the 9 countries co-integration is detected of which in all cases the debt-to-GDP ratio has a significant positive effect on Original Sin. According to these findings, financial solvency does not explain Original Sin in the short-run, though 3 out of 9 significant positive long-run effects suggest a potential very weak relationship in the long-run.

Summing both analyses up, overall there is no significant correlation between a country's financial solvency and Original Sin.

Table 9: Original Sin and financial solvency (time-series).

	OSIN3	DEBT_TO_GDP	SIZE	LR_OSIN3
OSIN3_L1	6(+) 9	3(+) 9	3(-) 1(+) 9	
OSIN3_L2	1(-) 1(+) 5	- 5	1(-) 5	
OSIN3_L3	1(+) 3	- 3	1(+) 3	
DEBT_TO_GDP_L1	2(-) 1(+) 9	4(+) 9	4(-) 2(+) 9	3(+) 3
DEBT_TO_GDP_L2	1(-) 1(+) 5	1(-) 1(+) 5	2(-) 5	
DEBT_TO_GDP_L3	- 3	- 3	1(-) 3	
SIZE_L1	2(-) 7	1(-) 7	2(-) 5(+) 7	2(-) 1(+) 3
SIZE_L2	1(-) 1(+) 4	2(-) 4	1(-) 4	
SIZE_L3	- 3	- 3	2(-) 3	

Note: Results present effects significant at least at 10 per cent.

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

Economic development

The fourth potential cause is the level of economic development (Hausmann & Panizza, 2003). According to this theory, the underdevelopment of institutions and the weakness in policies is responsible for the inability of countries to borrow abroad in their own currency (Hausmann & Panizza, 2003). The level of economic development representing the quality of institutions and policies is measured by the log of GDP per capita (L_GDP_pC). Table 10 shows the results of the TOBIT regression for each period. When regressing the log of GDP per capita on *OSIN*3 without controlling for other effects, throughout all periods the level of economic development is significantly negatively correlated with Original Sin. However, adding the control variables, all coefficients of the log of GDP per capita become insignificant. The quality of institutions and policies is therefore not of relevance in explaining Original Sin. Results of the fractional probit and quantile regressions confirm these findings in the cross-sectional analysis.

Examining the relationship of the log of GDP per capita and *OSIN*3 over time for EMD countries shows that the level of economic development does not have a significant causal impact on Original Sin in the short and long-run (Table 11). Although for both time dimensions some coefficients of the log of GDP per capita are significant, they have different signs and are thus inconsistent. Interestingly, analyzing the effects of Original Sin, at lag order 1, out of 13 time-series regressions, coefficients are significant and have a negative sign. According to these findings,

Table 10: Original Sin and economic development.

	(1) OSIN3_1	(2) OSIN3_1	(3) OSIN3_2	(4) OSIN3_2	(5) OSIN3_3	(6) OSIN3_3
L_GDP_pC	-0.269 (4.29)***	0.000 (0.01)	-0.357 (4.60)***	-0.011 (0.21)	-0.345 (4.88)***	-0.038 (1.07)
SIZE		-0.184 (3.10)***		-0.218 (3.13)***		-0.128 (3.46)***
MO_COOP		-0.276 (1.87)*		-0.044 (0.28)		0.059 (0.68)
FIN_CENTER		-0.560 (2.71)***		-0.313 (1.92)*		-0.483 (3.67(***
EUROLAND		-0.889 (4.82)***		-1.336 (11.18)***		-1.339 (13.16)***
OTH_DEVELOPED		-0.083 (0.658)		-0.036 (0.28)		-0.023 (0.25)
Constant	3.204 (5.93)***	1.024 (2.64)***	4.113 (5.68)***	1.046 (2.35)**	4.067 (6.26)***	1.311 (4.33)***
Observations	74	69	94	93	103	102

Absolute value of t statistics in parentheses

Signifcance levels: 0.1 = * 0.05 = ** 0.01 = ***

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

Table 11: Original Sin and economic development (time-series).

	OSIN3	GDP_pC	SIZE	LR_OSIN3
OSIN3_L1	10(+) 13	4(-) 13	5(-) 13	
OSIN3_L2	4(-) 1(+) 9	1(-) 2(+) 9	1(-) 3(+) 9	
OSIN3_L3	1(-) 2(+) 8	1(-) 8	2(-) 1(+) 8	
GDP_pC_L1	3(-) 2(+) 13	5(+) 13	3(+) 13	3(-) 2(+) 6
GDP_pC_L2	1(-) 1(+) 9	1(-) 2(+) 9	1(-) 1(+) 9	
GDP_pC_L3	1(-) 1(+) 8	2(-) 1(+) 8	1(-) 8	
SIZE_L1	2(-) 1(+) 11	3(-) 2(+) 11	7(+) 11	2(-) 3(+) 6
SIZE_L2	4(+) 7	2(-) 1(+) 7	3(-) 1(+) 7	
SIZE_L3	2(-) 1(+) 6	1(-) 6	1(-) 1(+) 6	

Note: Results present effects significant at least at 10 per cent.

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

every third EMD country records a significantly negative impact of Original Sin on the level of economic development. To conclude both analyses, overall there is no significant effect from the level of economic development on Original Sin.

Exchange rate regimes

The fifth explanation that emerges from the literature review is about exchange rate regimes (Hausmann & Panizza, 2003; Du & Schreger, 2016b). The reasoning is as follows: in countries with fixed exchange rate regimes risk-averse investors tend to lend in foreign currency, whereas in countries with floating exchange rate regimes focusing on interest rate stability risk-averse investors prefer local currency (Chamon & Hausmann, 2005). Following this argumentation, countries with fixed exchange rate regimes are facing the risk of running into a vicious cycle. Being exposed to foreign currency forces a country to stabilize the exchange rate to avoid increasing real values of debt which in turn further attracts debt denominated in foreign currency and, thus, iterates the loop (Du & Schreger, 2016b). A reverse causality issue is therefore very likely in this theory, however, it is hard to tackle since there is too little variation in the explanatory variable over time. Although empirical analysis provides other approaches such as instrumental variable strategies to deal with reverse causality, in case of this explanatory variable, there is no way to my knowledge.

Table 12: Original Sin and exchange rate regimes.

	(1) OSIN3_2	(2) OSIN3_2	(3) OSIN3_3		(4) OSIN3_3
FX_REGIME	0.487 (4.37)***	0.183 (2.25)**	0.459 (4.34)***		0.131 (2.16)**
SIZE		-0.187 (4.35)***			-0.114 (3.96)***
MO_COOP		-0.286 (1.72)*			-0.150 (1.28)
FIN_CENTER		-0.302 (1.84)*			-0.529 (4.13)***
EUROLAND		-0.980 (4.97)***			-1.100 (7.97)***
OTH_DEVELOPED		-0.016 (0.18)			-0.072 (1.17)
Constant	-0.066 (0.32)	0.678 (5.55)***	0.133	-0.76	0.792 (9.43)***
Observations	94	93	104		102

Absolute value of t statistics in parentheses
Signifcance levels: 0.1 = * 0.05 = ** 0.01 = ***

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

Finding that *de jure* announced exchange rate regimes often do not represent the practice, Levy-Yeyati and Sturzenegger (2005) elaborate a *de facto* classification based on the volatilities of international reserves, as well as the nominal exchange rate and its rate of change. Although Levy-Yeyati and Sturzenegger updated their classifications in a more recent paper from 2016, it lacks data for the third period. In 2009, the IMF revised its classification of exchange rate regimes and has since provided a *de facto* classification based on market nominal exchange rate behaviors (IMF, 2009). Using this *de facto* classification of the IMF's AREAER database covering the second and third period, I created a categorical variable (FX_REGIME) representing floating regimes with 1, intermediate regimes with 2 and fixed regimes with 3.

Table 12 shows the results of the TOBIT regression. The coefficient of the foreign exchange rate regime variable is statistically significantly positive in all regressions. Controlling for country groups and size, in both periods the coefficient remains significant, although it shrinks by about 3.5 times indicating that a larger part of the variance is explained by the control variables. Nevertheless, countries with fixed exchange rate regimes are statistically significantly correlated with greater exposure to Original Sin. For instance, in period 3, a one-class change of the exchange rate regime towards fixed regimes is associated with a 0.183 percentage points higher value of Original Sin. Results of the control models confirm these findings for both periods and underline the significance of this relationship. However, the question of the causal direction of the effect remains.

Control variables

Eichengreen *et al.* (2002) and Hausmann and Panizza (2003) come to the conclusion in their analysis that it is ultimately the size of a country that matters in explaining Original

Sin. Hausmann and Panizza (2003) argue that the larger a country's size, the more attractive its currency is regarding the diversification in the world portfolio. Thus, all regressions are controlled by the size of a country as the principal component of the log of total GDP, the log of total trade and the log of total domestic credit. Functioning as a control variable, the coefficient of SIZE is in almost all regressions statistically significantly negative. Table 13 shows the results of TOBIT regressions with each component of SIZE. As expected, the coefficient of each size component is significantly negatively correlated with Original Sin throughout all periods. Controlling these findings with the fractional probit and quantile models confirms these results indicating a significantly negative relationship between the size of a country and Original Sin.

Interestingly, when analyzing this relationship over time for EMD countries using the log of total GDP and total trade, results suggest that the causal direction of impact is bidirectional for GDP and rather unidirectional from Original Sin on trade (Table 14). The time-series analysis for GDP finds that every sixth EMD country experiences a statistically significantly negative short-run impact from GDP on Original Sin and every fourth the other way around. Regarding trade, short-run effects on Original Sin have different signs and are thus ambiguous. However, when analyzing the opposite direction, short-run effects from Original Sin on trade are statistically significantly negative in more than one out of three EMD countries. So while Eichengreen *et al.* (2002) conclude that country size is a reason for Original Sin, these findings indicate that Original Sin also hampers EMD countries in catching-up.

Next to country size, all cross-sectional regressions are controlled by country grouping dummies, namely monetary co-operations, financial centers, Euroland and other developed countries. The strongest effect with the consistently highest significance levels among the country groups throughout all regressions is being a Euroland country followed by being a financial center and an other developed country. Interestingly, while the Euroland has the strongest impact, monetary co-operation, in general, is often insignificant. These results indicate that monetary co-operation alone is not enough, it is the magnitude of such co-operations which is critical to overcoming Original Sin. Table 15 shows the results for TOBIT regressions with all country group dummies. Whereas being a country of the Euroland reduces the value of Original Sin by 1.448 percentage points in the third period, being a financial center reduces it by 0.811 percentage points. Being an other developed country merely decreases Original Sin by 0.205 percentage points and having

monetary co-operation has no significant effect.

Table 13: Original Sin and components of size.

	(1) OSIN3_1	(2) OSIN3_2	(3) OSIN3_3	(4) OSIN3_1	(5) OSIN3_2	(6) OSIN3_3
L_GDP	-0.061 (2.90)***	-0.103 (4.01)***	-0.083 (4.38)***			
L_TRADE				-0.070 (3.11)***	-0.111 (3.87)***	-0.082 (4.27)***
L_D_CREDIT						
MO_COOP	-0.206 (1.67)*	-0.080 (0.70)	-0.003 (0.05)	-0.222 (1.80)*	-0.030 (0.27)	0.032 (0.49)
FIN_CENTER	-0.699 (4.04)***	-0.421 (2.81)***	-0.522 (4.36)***	-0.690 (3.89)***	-0.427 (2.62)***	-0.542 (4.22)***
EUROLAND	-1.045 (6.90)***	-1.403 (11.69)***	-1.387 (13.85)***	-0.978 (6.58)***	-1.387 (11.65)***	-1.362 (13.56)***
OTH_DEVELOPED	-0.175 (2.64)***	-0.145 (1.81)*	-0.112 (1.71)*	-0.153 (2.40)**	-0.116 (1.50)	-0.094 (1.42)
Constant	1.275 (11.68)***	1.475 (9.59)***	1.409 (12.65)***	1.280 (12.21)***	1.464 (9.32)***	1.363 (13.15)***
Observations	74	94	103	73	94	103
Absolute value of t statistics in parentheses						
Significance levels: 0.1 = * 0.05 = ** 0.01 = ***						

	(7) OSIN3_1	(8) OSIN3_2	(9) OSIN3_3
L_GDP			
L_TRADE			
L_D_CREDIT	-0.077 (3.03)***	-0.096 (3.67)***	-0.073 (4.29)***
MO_COOP	-0.225 (1.69)*	-0.054 (0.44)	0.008 (0.12)
FIN_CENTER	-0.551 (2.87)***	-0.328 (1.93)*	-0.476 (3.85)***
EUROLAND	-0.944 (5.40)***	-1.342 (11.01)***	-1.368 (13.47)***
OTH_DEVELOPED	-0.082 (1.04)	-0.053 (0.60)	-0.056 (0.86)
Constant	1.828 (6.48)***	2.035 (6.34)***	1.821 (8.63)***
Observations	70	93	102
Absolute value of t statistics in parentheses			
Significance levels: 0.1 = * 0.05 = ** 0.01 = ***			

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

Summarizing the empirics

Analyzing empirically the potential causes of Original Sin shows that macroeconomic variables play almost no role in explaining the increased exposure of EMD countries to Original Sin. Merely the economic size of a country has a statistically significant correlation with Original Sin, taking into account that this relationship is bidirectional and potentially hampers EMD countries to from catching-up. Apart from macroeconomic variables, the empirical analysis suggests that capital flow regulations and a country's exchange rate policy have a significant relationship with Original Sin. Countries using capital flow restrictions or with fixed exchange rate regimes are more likely to suffer from Original Sin. However, the direction of causality remains unexamined. Interestingly, the strong effects of the Euroland dummy indicate that currency unions as the ultimate form of monetary co-operation are one way to overcome Original Sin. The decisive factor, however, is the size of the monetary union, since otherwise it remains exposed to Original Sin. Summing these findings up, conventional theories provide partial evidence for the variation in Original Sin and the increased exposure of EMD countries. However, the direction of impact is ambiguous. In the following, an alternative approach is discussed in detail.

Table 14: Original Sin and components of size (time-series).

	OSIN3	LOG_GDP	LOG_TRADE	LR_OSIN3
OSIN3_L1	15(+) 16	4(-) 16	6(-) 16	
OSIN3_L2	6(-) 1(+) 15	4(+) 15	4(+) 15	
OSIN3_L3	1(-) 6(+) 14	2(-) 14	1(-) 14	
LOG_GDP_L1	2(-) 12	12(+) 12	1(-) 3(+) 12	1(-) 1
LOG_GDP_L2	1(+) 11	2(-) 11	2(+) 11	
LOG_GDP_L3	- 10	3(-) 10	2(-) 1(+) 10	
LOG_TRADE_L1	1(-) 2(+) 12	1(-) 3(+) 12	12(+) 12	
LOG_TRADE_L2	1(-) 1(+) 11	- 11	5(-) 11	
LOG_TRADE_L3	2(-) 1(+) 10	1(-) 10	1(-) 10	

Note: Results present effects significant at least at 10 per cent.

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

Table 15: Original Sin and country group dummies.

	(1) OSIN3_1	(2) OSIN3_2	(3) OSIN3_3
MO_COOP	-0.166 (1.35)	-0.014 (0.11)	0.029 (0.41)
FIN_CENTER	-0.935 (4.89)***	-0.772 (4.17)***	-0.811 (5.88)***
EUROLAND	-1.174 (7.85)***	-1.546 (10.61)***	-1.448 (12.73)***
OTH_DEVELOPED	-0.234 (3.11)***	-0.272 (3.45)***	-0.205 (3.24)***
Constant	1.008 (35.36)***	0.958 (24.68)***	1.004 (29.53)***
Observations	74	94	104

Absolute value of t statistics in parentheses
Signifcance levels: 0.1 = * 0.05 = ** 0.01 = ***

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

3.2.3 Alternative approach

Next to conventional theories, the literature review reveals academic papers which follow an alternative approach and see the issue rather in the liquidity premium and hierarchy of currencies (Fritz *et al.*, 2018; Gallo *et al.*, 2019; de Paula *et al.*, 2017, 2020). The applied approach of a currency hierarchy is based on Keynesian-structuralist perspectives. It combines Keynes (1930) who already explains the hierarchical structures of the international monetary system in his book 'Treatise on Money' and the structuralist concept of dividing the world into center/northern (advanced) and periphery/southern (EMD) countries (Fritz *et al.*, 2018). Following this approach, currencies have a so-called liquidity premium representing a non-pecuniary rate of return for holding liquidity (Fritz *et al.*, 2018). In the global economy, the U.S. dollar is the most liquid currency and thus the key currency on top of this hierarchy. Currencies of other advanced countries are liquid too, however, not as liquid as the U.S. dollar and therefore positioned in descending order according to their liquidity premium. In contrast, at the bottom of the hierarchy are countries of the periphery which have „non-liquid currencies as they are incapable of performing the basic functions of money (medium of exchange, denomination of contracts and international reserve currency) at the international level“ (de Paula *et al.*, 2020, p. 12). Accordingly, it follows that

$$l_S < l_N \tag{3.1}$$

where l_S is the liquidity premium of southern and l_N of northern countries. In order to attract

foreign investors, countries of the periphery must compensate for the difference in the liquidity premium. Following de Paula *et al.* (2020), this can either be done by appreciating the exchange rate a_S, increasing the yield of assets measured by the interest rate q_S, reducing capital account regulations c_S or a combination of these. In equilibrium, it is:

$$a_S + q_S - c_S + l_S = a_N + q_N - c_N + l_N \tag{3.2}$$

and according to equation (3.11) with differences in the liquidity premium it is:

$$a_S + q_S - c_S > a_N + q_N - c_N \tag{3.3}$$

While in theory simply increasing the sum of $a_S + q_S - c_S$ to close the difference in the liquidity premium and overcome Original Sin sounds easy to manage, it is an arduous undertaking. Southern countries with non-liquid currencies experience greater volatility of capital flows and ultimately greater volatility of exchange rates (Fritz *et al.*, 2018). To cope with these volatilities, increased central bank intervention is necessary thereby increasing the reliance on policy rates and shrinking the autonomy of the monetary authority (de Paula *et al.*, 2017). In addition, monetary policy transmission channels in southern countries are often constrained since domestic capital markets are less developed, low private sector to GDP ratios make the credit channel less effective and higher exchange rate volatility causes higher inflation rates (Fritz *et al.*, 2018).

The difficulty of dealing with these limits becomes clear by including the external sector. Southern countries are exposed to changes in investors' liquidity preference and the monetary policy of northern countries. Assuming a sudden increase in investors' liquidity preference, capital outflows to 'safe havens' reduce asset prices and depreciate the southern currency. To prevent this, constrained monetary policy would have to do more than it already does. One way to support monetary policy by providing more autonomy to its authorities could be the adoption of „capital controls to drive a wedge between onshore and offshore interest rates“ (Fritz *et al.*, 2018, p. 9). However, the success of this support depends on the currency expectation of investors. Expected future depreciation could lead to immediate capital outflows when capital controls are announced.

Instead of trying to compensate the difference in the liquidity premium by increasing the sum of $a_S + q_S - c_S$, southern countries could also try to climb up the currency hierarchy by increasing

the liquidity premium itself. Exchange rate stability is therefore decisive to gain international competitiveness (de Paula *et al.*, 2017; Fritz *et al.*, 2018). The effectiveness of monetary policy depends on the transmission channel limiting factors, the stock of international reserves and the financial openness (de Paula *et al.*, 2017). Capital controls and financial development as well as fiscal and wage policy support the effectiveness of monetary policy and strengthens the autonomy of monetary authorities. Nevertheless, it remains a lengthy and arduous process. Increasing its liquidity premium and climbing up the hierarchy of currencies, however, could also be achieved by uniting with economic partners, especially in its ultimate form as a currency union (Fritz & Mühlich, 2006). The degree of success, though, depends on the economic size of the respective union.

3.3 Assessing the findings

Results of the empirical analysis confirm that Original Sin cannot be explained by macroeconomic variables such as the inflation rate, the debt-to-GDP ratio or GDP per capita, among others. Findings suggest that the size of a country is decisive for the degree of Original Sin. However, analyzing the direction of causality for EMD countries reveals that the significant negative relationship between the components measuring the size and Original Sin is bidirectional for GDP and rather unidirectional from Original Sin on trade. These results, therefore, indicate that Original Sin also hampers EMD countries' process to catch-up.

While conventional theories have difficulties in explaining the increased exposure of EMD countries to Original Sin, the concept of a currency hierarchy sheds light on it. Differences in the liquidity premium between northern and southern currencies and the liquidity preference of investors explain the constraints of countries to borrow internationally in their own currency. In theory, to overcome these constraints southern countries can compensate for the difference in the liquidity premium by appreciating the exchange rate or increasing the yield of assets. Additionally, to support the effectiveness and autonomy of monetary authorities southern countries should use capital account regulations and policy coordination. However, in practice, these countries are still constantly exposed to the associated risks of sudden capital outflows due to changes in investors' liquidity preference and the monetary policy of northern countries.

Interestingly, findings of the empirical analysis suggest that capital flow regulations and a country's exchange rate policy have a significant relationship with Original Sin. Original Sin is

therefore more present in countries using capital flow restrictions or with fixed exchange rate regimes. While the empirics could not reveal the direction of impact of these relationships, the alternative approach indicates that it is Original Sin which drives countries to introduce capital flow regulations and fixing the exchange rate rather than the other way around.

The other option, to climb up the hierarchy of currencies by increasing the liquidity premium is a lengthy and arduous undertaking. However, it could also be achieved by uniting with economic partners, especially in its ultimate form as a currency union (Fritz & Mühlich, 2006). Interestingly, the empirics confirm that being part of a currency union like the Euroland is a way to overcome Original Sin. However, the insignificance of the monetary co-operation dummy suggests that the economic size of a currency union is crucial for its success.

4 Conclusion

The inability of countries to borrow internationally in their domestic currency is still a persistent and widespread phenomenon. Although the development of the international debt securities and especially of EMD countries records an overall strong increase from 1999 to 2019, the share of international debt securities denominated in the top five currencies remained consistently high. The declining share of the top five currency countries in international debt securities denominated in their currencies from 2009 onwards indicates that EMD countries increasingly borrow internationally, though mainly in the top five currencies. Nevertheless, an overall positive development of the Original Sin phenomenon is observable. Although the Original Sin of some country groups such as the financial centers or other developed countries deteriorated over the entire period, the exposure to Original Sin as a whole measured by the $OSIN3$ index declined by 0.04. Focusing on EMD countries, the average of its value improved from period one to three by 0.02.

While the initial Original Sin literature by Eichengreen *et al.* (2002) and Hausmann and Panizza (2003) come to the conclusion that solely the economic size of a country has a causal relationship with Original Sin, the literature review reveals that most of the rather orthodox recent investigations make the underdevelopment of domestic credit markets and monetary stability responsible for Original Sin. Analyzing empirically the potential causes of Original Sin shows that macroeconomic variables as well as the development of domestic credit markets play

almost no role in explaining the increased exposure of EMD countries to Original Sin. Findings suggest that only the economic size of a country is decisive for the degree of Original Sin and, thus, confirm the results of Eichengreen *et al.* (2002) and Hausmann and Panizza (2003).

However, analyzing the direction of causality for EMD countries find that the significantly negative relationship between the components measuring the size and Original Sin is bidirectional for GDP and rather unidirectional from Original Sin on trade. These results, therefore, indicate that Original Sin also hampers EMD countries' process to catch up. Apart from macroeconomic variables, the empirical analysis suggests that capital flow regulations and a country's exchange rate policy have a significant relationship with Original Sin. Countries using capital flow restrictions or fixed exchange rate regimes are more likely to suffer from Original Sin. However, the direction of causality is rather from Original Sin than the other way around.

The concept of a currency hierarchy sheds light on the phenomenon where conventional theories have their difficulties. The constraints of southern countries to borrow internationally in their own currency can be explained by the differences in the liquidity premium between northern and southern currencies and the liquidity preference of investors. Appreciating the exchange rate, increasing the yield of assets and/or reducing capital account regulations are one way to close the difference in liquidity premia. While in theory, these adjustments sound easy to manage, in practice, southern countries are constantly exposed to the associated risks of sudden capital outflows due to changes in investors' liquidity preference and the monetary policy of northern countries.

The other option, to climb up the hierarchy of currencies by increasing the liquidity premium is a lengthy and arduous undertaking. Exchange rate stability is decisive for southern countries to gain international competitiveness (de Paula *et al.*, 2017; Fritz *et al.*, 2018). The effectiveness of monetary policy depends on the transmission channel limiting factors, the stock of international reserves and the financial openness (de Paula *et al.*, 2017). Capital controls and financial development as well as fiscal and wage policy support the effectiveness of monetary policy and strengthens the autonomy of monetary authorities.

However, it could also be achieved by uniting with economic partners, especially in its ultimate form as a currency union. Interestingly, the empirics confirm that being part of a currency union like the Euroland is a way to overcome Original Sin. Having said this, it is important to keep in mind that the Euro is the second strongest currency at the moment and

it is obvious that joining the Euro frees a country from Original Sin. The insignificance of the monetary co-operation dummy confirms this and suggests that the economic size of a currency union is crucial for its success. The extent to which monetary co-operation contributes to reduce Original Sin is thus of great interest. The applied methodology reaches its limit at this point. Comprehensive threshold analysis focusing on the economic size of monetary co-operations could therefore be an interesting future research to help EMD countries to find redemption from Original Sin.

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Appendix

A1: Measures of Original Sin - countries.

Country	OSIN1_1	OSIN1_2	OSIN1_3	OSIN3_1	OSIN3_2	OSIN3_3
Albania	1.00	1.00	1.00	1.00	1.00	1.00
Angola		1.00	1.00		1.00	1.00
Argentina	0.99	1.00	0.99	0.98	0.99	0.99
Armenia		1.00	1.00		1.00	1.00
Australia	0.86	0.88	0.92	0.62	0.49	0.56
Austria	0.43	0.27	0.20	0.00	0.00	0.00
Azerbaijan		1.00	1.00		1.00	1.00
Bahrain	1.00	1.00	1.00	1.00	1.00	1.00
Belarus		1.00	1.00		1.00	1.00
Belgium	0.29	0.12	0.12	0.00	0.00	0.00
Bolivia		1.00	1.00		1.00	1.00
Brazil	0.98	0.92	0.97	0.94	0.70	0.78
Bulgaria	1.00	0.95	1.00	0.97	0.80	1.00
Cameroon			1.00			1.00
Canada	0.78	0.69	0.91	0.65	0.56	0.84
Chile	1.00	0.97	0.98	0.87	0.94	0.98
China	0.99	0.64	0.83	0.95	0.18	0.34
Colombia	0.96	0.84	0.92	0.95	0.78	0.88
Costa Rica	1.00	1.00	1.00	1.00	1.00	1.00
Côte d'Ivoire	1.00	1.00	1.00	1.00	1.00	1.00
Croatia	1.00	1.00	1.00	1.00	1.00	0.99
Cyprus	0.25	0.27	0.34	0.25	0.00	0.00
Czech Republic	1.00	0.98	0.97	0.00	0.37	0.73
Denmark	0.97	0.99	0.99	0.82	0.96	0.97
DomRep	0.99	0.95	0.96	0.99	0.95	0.96
Egypt	0.96	0.86	1.00	0.92	0.82	0.92
Estonia	1.00	1.00	1.00	0.93	0.00	0.00
Ethiopia			1.00			1.00
Finland	0.35	0.43	0.44	0.00	0.00	0.00
France	0.27	0.24	0.33	0.00	0.00	0.00
Gabon		1.00	1.00		1.00	1.00
Georgia		1.00	1.00		1.00	1.00
Germany	0.38	0.40	0.50	0.00	0.00	0.00
Ghana		1.00	1.00		1.00	1.00
Greece	0.26	0.05	0.03	0.00	0.00	0.00
Guatemala	1.00	1.00	1.00	1.00	1.00	1.00
Honduras			1.00			1.00
Hong Kong SAR	0.80	0.86	0.94	0.02	0.29	0.67
Hungury	1.00	1.00	1.00	0.87	0.95	0.96
Iceland	0.96	0.91	0.89	0.93	0.90	0.89
India	1.00	0.99	0.93	0.99	0.91	0.66
Indonesia	1.00	1.00	1.00	0.96	0.78	0.87
Iraq		1.00	1.00		1.00	1.00
Ireland	0.35	0.24	0.31	0.00	0.00	0.00
Israel	1.00	0.99	0.99	0.98	0.93	0.98
Italy	0.25	0.07	0.07	0.00	0.00	0.00
Jamaica	1.00	1.00	1.00	1.00	1.00	1.00
Japan	0.52	0.50	0.82	0.00	0.00	0.01
Jordan	1.00	1.00	1.00	1.00	1.00	1.00
Kazakhstan	1.00	1.00	0.99	1.00	1.00	0.99
Kenya			1.00			1.00
Kuwait	1.00	1.00	0.96	1.00	1.00	0.96
Laos			1.00			1.00
Latvia	1.00	1.00	1.00	0.96	0.28	0.00
Lebanon	1.00	0.98	0.99	1.00	0.98	0.99
Liberia		1.00	1.00		1.00	1.00
Lithuania	0.98	1.00	1.00	0.98	1.00	0.00
Luxembourg	0.40	0.48	0.48	0.00	0.00	0.00

Source: Own depiction.

A1: Measures of Original Sin - countries (continued).

Country	OSIN1_1	OSIN1_2	OSIN1_3	OSIN3_1	OSIN3_2	OSIN3_3
Malaysia	1.00	1.00	1.00	0.99	0.82	0.95
Malta	1.00	0.46	0.74	0.96	0.00	0.00
Mauritius	1.00	1.00	1.00	1.00	1.00	1.00
Mexico	0.99	0.94	0.95	0.94	0.80	0.89
Mongolia	1.00	1.00	1.00	1.00	1.00	1.00
Morocco	1.00	1.00	0.98	1.00	1.00	0.98
Mozambique			1.00			1.00
Namibia		1.00	1.00		1.00	1.00
Netherlands	0.33	0.31	0.36	0.00	0.00	0.00
New Zealand	0.99	0.98	0.97	0.06	0.00	0.00
Nigeria	1.00	0.87	0.97	1.00	0.87	0.97
Norway	0.98	0.94	0.98	0.77	0.70	0.75
Pakistan	1.00	1.00	1.00	1.00	1.00	1.00
Panama	1.00	1.00	1.00	1.00	1.00	1.00
Paraguay		1.00	1.00		1.00	1.00
Peru	0.98	0.82	0.73	0.98	0.82	0.73
Philippines	1.00	0.95	0.94	0.99	0.94	0.93
Poland	1.00	1.00	0.99	0.56	0.79	0.88
Portugal	0.19	0.04	0.05	0.00	0.00	0.00
Qatar	1.00	0.99	0.99	1.00	0.99	0.99
Russia	1.00	0.96	0.97	0.96	0.76	0.87
Rwanda			1.00			1.00
Saudi Arabia	0.93	0.72	0.92	0.93	0.60	0.89
Senegal		1.00	1.00		1.00	1.00
Serbia		1.00	1.00		1.00	1.00
Slovakia	0.15	0.10	0.33	0.15	0.00	0.00
Slovenia	0.06	0.22	0.68	0.06	0.00	0.00
South Africa	0.85	0.84	0.92	0.07	0.00	0.22
South Korea	1.00	1.00	1.00	0.99	0.99	0.99
Spain	0.24	0.10	0.11	0.00	0.00	0.00
Sri Lanka	1.00	1.00	1.00	1.00	1.00	1.00
Sweden	0.96	0.87	0.88	0.86	0.77	0.78
Switzerland	0.79	0.68	0.89	0.00	0.00	0.00
Tanzania			1.00			1.00
Thailand	0.91	0.82	0.91	0.88	0.49	0.68
Trinidad and Tobago	1.00	1.00	1.00	1.00	1.00	1.00
Tunisia	1.00	1.00	1.00	1.00	1.00	1.00
Turkey	1.00	1.00	0.99	0.89	0.63	0.81
Ukraine	1.00	0.99	0.99	1.00	0.99	0.99
United Arab Emirates	0.99	0.90	0.99	0.96	0.80	0.99
United Kingdom	0.66	0.62	0.63	0.34	0.40	0.37
United States	0.28	0.36	0.33	0.00	0.00	0.00
Uruguay	0.94	0.75	0.78	0.94	0.75	0.78
Venezuela	1.00	1.00	1.00	1.00	1.00	1.00
Vietnam	0.99	0.94	0.98	0.99	0.94	0.98
Zambia			1.00			1.00

Source: Own depiction.

A2: List of variables and their origin.

Dependent variables		
OSIN3	Original Sin Index 3	Bank of International Settlement (2020)
Independent variables		
BUDGET_BAL	General government net lending/borrowing in billions USD	IMF World Economic Outlook (2020)
CAP_FLOW_REGU	Regulations on capital flows	IMF AREAER (2020)
CONTRACT_ENF	Contract enforcement index, new methodology from 2016 onwards	World Bank (2020)
CPI	Consumer price index, percent change, corresponding period previous year	IMF IFS (2020), World Bank (2020)
CREDIT_RATINGS	S&P + Fitch country ratings	Trading Economics (2020)
DEBT_TO_GDP	General government total gross debt, percent of GDP	IMF World Economic Outlook (2020), World Bank (2020)
DEBT_TO_REV	General government debt to revenue ratio	IMF World Economic Outlook (2020)
EUROLAND	Dummy for being a Euroland country	EU (2020)
FDI	Financial development index	IMF IFS (2020)
FII	Financial institutions index	IMF IFS (2020)
FIN_CENTER	Dummy for being a financial center	Eichengreen *et al.* (2002)
FIN_SECTOR_REGU	Regulations on the financial sector	IMF AREAER (2020)
FMI	Financial markets index	IMF IFS (2020)
FX_REGIME	De facto exchange rate classification; 1 = float, 2 = intermediate, 3 = fix	IMF AREAER (2020)
L_D_CREDIT	Log of total domestic credit	IMF World Economic Outlook (2020), CEIC (2020), IMF (2020b)
L_EXP_TO_GDP	Log of exports of goods and services, percent of GDP	IMF IFS (2020)
L_GDP	Log of nominal GDP in billion USD	IMF World Economic Outlook (2020)
L_GDP_pC	Log of nominal GDP per Capita in USD	IMF IFS (2020), OECD (2020)
L_TRADE	Log of the sum of exports and imports of goods and services in billion USD	IMF World Economic Outlook (2020)
MO_COOP	Dummy for monetary co-operation	Own consideration
OTH_DEVELOPED	Dummy for being an advanced country excluding Euroland countries and financial centers	IMF (2020a)
RULE_OF_LAW	Rule of law index, percentile rank	World Bank (2020)
SIZE	Country size index	IMF World Economic Outlook (2020), CEIC (2020)

Source: Own depiction.

A3: OLS country group model to receive R-squared.

```
Linear regression                               Number of obs     =        104
                                                F(3, 99)          =          .
                                                Prob > F          =          .
                                                R-squared         =     0.8826
                                                Root MSE          =     .13053

------------------------------------------------------------------------------
             |               Robust
    OSIN3_3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
DUMMY_MO_COOP_NEW |   .0172425   .0455285     0.38   0.706    -.073096    .1075809
       FIN_CENTER |  -.7149649   .1094597    -6.53   0.000    -.9321567   -.4977732
       EUROLAND_3 |  -.9511525   .0429817   -22.13   0.000    -1.036438   -.8658674
  OTH_DEVELOPED_3 |  -.1334886    .052473    -2.54   0.013    -.2376063   -.0293708
            _cons |     .93391   .0163065    57.27   0.000     .9015544    .9662655
------------------------------------------------------------------------------
```

Source: Own calculations, own depiction. List of variables and their origin is shown in the appendix A2.

A4: Monetary co-operation.

Monetary Co-op	Bilateral ER	ø monthly volatility in the nominal exchange rate	Δ to ø fixed	Δ to ø crawling peg	Δ to ø intermediate	Δ to ø float
AMU	TND to MAD	1.19%	1.17%	0.80%	0.60%	0.50%
APEC	AUD to CLP	3.93%	3.91%	3.54%	3.34%	3.24%
ASEAN+3	CNY to THB	1.19%	1.17%	0.80%	0.60%	0.50%
	PHP to MYR	0.80%	0.78%	0.41%	0.21%	0.11%
CAN	BOB to COP	3.16%	3.14%	2.77%	2.57%	2.47%
CAREC	PKR to MNT	1.58%	1.56%	1.19%	0.99%	0.89%
CARICOM	TTD to JMD	3.07%	3.05%	2.68%	2.48%	2.38%
CEEAC	RWF to XAF	1.13%	1.11%	0.74%	0.54%	0.44%
COMESA	TND to ETB	1.94%	1.92%	1.55%	1.35%	1.25%
EAC	TZS to KES	1.15%	1.13%	0.76%	0.56%	0.46%
ECOWAS	NGN to XAF	1.20%	1.18%	0.81%	0.61%	0.51%
EEU	RUB to KZT	2.30%	2.28%	1.91%	1.71%	1.61%
EFTA	NOK to ISK	2.54%	2.52%	2.15%	1.95%	1.85%
EU	EUR to HUF	1.15%	1.13%	0.76%	0.56%	0.46%
	EUR to PLN	0.97%	0.95%	0.58%	0.38%	0.28%
	EUR to SEK	1.08%	1.06%	0.69%	0.49%	0.39%
	EUR to CZK	0.78%	0.76%	0.39%	0.19%	0.09%
	EUR to GBP	1.54%	1.52%	1.15%	0.95%	0.85%
ERM	EUR to HRK	0.29%	0.27%	0.10%	0.30%	0.40%
	EUR to DKK	0.08%	0.06%	0.31%	0.51%	0.61%
	EUR to BGN	0.19%	0.17%	0.20%	0.40%	0.50%
GCC	KWD to BHD	0.16%	0.14%	0.23%	0.43%	0.53%
	KWD to SAR	0.22%	0.20%	0.17%	0.37%	0.47%
MERCOSUR	BRL to ARS	5.21%	5.19%	4.82%	4.62%	4.52%
NAFTA	USD to CAD	1.38%	1.36%	0.99%	0.79%	0.69%
SADC	MUR to TZS	1.34%	1.32%	0.95%	0.75%	0.65%
SICA	DOP to CRC	2.14%	2.12%	1.75%	1.55%	1.45%

Source: Own calculations, own depiction based on Exchange Rates (2020).

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