The determinants of "domestic" original sin in emerging market economies*

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ABSTRACT

This paper explains why domestic debt composition in some emerging economies is risky. To this end, it carries out a systematic analysis of the determinants of the so-called *domestic* original sin, which refers to the inability of emerging economies to borrow domestically in local currency, at long maturities and fixed interest rates. As such, the latter is a measure of financial vulnerabilities arising from domestic debt composition, which encompasses maturity mismatches, rollover risk and interest payment contingency. The paper builds on a large dataset compiled by the authors from national sources. It finds that domestic original sin is particularly severe when inflation is lofty, the debt service-to-GDP ratio high, the slope of the yield curve inverted and the investor base narrow. These results suggest that sound macroeconomic policies, attractive long-term yields and policies aimed at widening the investor base are instrumental to overcome domestic original sin, reduce domestic debt riskiness and tilt its composition towards safer, long-term, unindexed, local currency instruments.

JEL Classification: F34; F41; G15
Key words: Original sin, domestic debt, emerging economies

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1 Introduction

There is growing awareness that a major reason why emerging economies are more prone to financial crises than mature economies is the atypical composition of their debt. Many emerging economies are bound indeed to borrow in foreign currency, short-term or at indexed interest rates. In this respect, literature has focused mainly on external debt composition, especially the inability of emerging economies to borrow in international capital markets in their domestic currency, the so-called international dimension of "original sin".[1]

However, domestic debt has also become increasingly instrumental in assessing the financial vulnerability of emerging economies owing to its sheer size and swift growth. Indeed, some of the major financial crises affecting emerging economies in recent years have been linked to risky domestic debt composition pertaining to, inter alia, maturity mismatches, rollover risk and contingent interest payments. In particular, excessive reliance on short-term domestic paper, namely the Tesobonos and the GKOs, was considered as one of the major sources of vulnerability in the Mexican crisis of 1995 and the Russian crisis of 1998. Two of the largest sovereign defaults (Russia in 1998 and Argentina in 2002) involved domestic liabilities in local currency. For these reasons, risky domestic debt composition in emerging economies is increasingly high on the policy agenda. This growing policy interest is reflected in the initiative of eleven central banks and monetary authorities in the East Asia and Pacific region to launch in 2004 an 'Asian Bond Fund', with a view to investing in Asian bonds denominated in domestic currency and developing domestic markets.

Against this background, the *domestic* dimension of original sin, namely the inability of emerging economies to borrow domestically in local currency at long maturities and fixed interest rates, which makes domestic debt composition risky, has received little attention. The literature on risky domestic debt composition in emerging economies remains scant, indeed, and data availability is poor. Hausmann and Panizza (2003) examine financial vulnerabilities arising from domestic original sin. They find that monetary credibility, as measured by lower inflation and the imposition of capital controls, help explain domestic original sin. However, their empirical analysis is based on a theoretical framework originally developed to explain *international* original sin only and on a small sample of 21 country-observations. Borensztein et al. (2004) review some

[1] See Eichengreen and Hausmann (1999), Eichengreen, Hausmann and Panizza (2003a) and (2003b) for stylised facts; Hausmann and Panizza (2003) on empirical determinants; Bordo, Meissner and Redish (2003) as well as Flandreau and Sussman (2004) for historical evidence; McKinnon and Schnabl (2004) for implications with regard to reserve accumulation and orientation of exchange rate policies to the US dollar in East Asia; Zettelmeyer and Jeanne (2002) as well as Tirole (2003) for implications with regard to international lending; Eichengreen and Hausmann (2005) for a comprehensive overview.

of the determinants of domestic debt composition in emerging economies, including the credibility of monetary and fiscal policies, the size of the investor base and considerations relating to political economy. However, they provide no formal analysis of their statistical significance.[2]

The key contribution of this paper is to present comprehensive evidence on the riskiness of domestic debt composition and its determinants. To this end, the paper relies on a new dataset, constructed by the authors from national statistics on domestic government debt, to measure domestic original sin in 33 countries over the last decade. This dataset contains a relatively large number of observations, which helps address the limitations of the small samples used in previous literature. Based on these new data, an additional strength of the paper is to carry out the first empirical analysis of the determinants specific to domestic original sin highlighted in previous literature. The key results of the paper is to show that domestic original sin is particularly severe when inflation is lofty, the debt service-to-GDP ratio high, the slope of the yield curve inverted and the investor base narrow. The bulk of these results are robust to the inclusion of controls, to specification changes, to various definitions of the variables, as well as to the choice of the estimator, including when correcting for endogeneity.

The remainder of the paper is set out as follows. Section 2 presents the salient features of domestic debt in emerging economies and of domestic original sin. Section 3 reviews the main theoretical determinants of the latter. Section 4 introduces the methodology and the data. Section 5 presents the results and section 6 draws the policy implications of the paper.

2 Stylised facts

2.1 Domestic debt

Although external debt has been the long-standing focus of investors and academics alike, domestic debt is becoming the major source of funding in emerging economies, both for sovereigns and corporations. Domestic debt security markets have grown markedly over the last decade. Late 2004, the stock of domestic debt securities issued by residents of the emerging economies reporting data to the BIS reached USD 2.8 trillion and was four times larger than the corresponding amount of international debt securities (USD 0.7 trillion) (Chart 1).[3] Therefore,

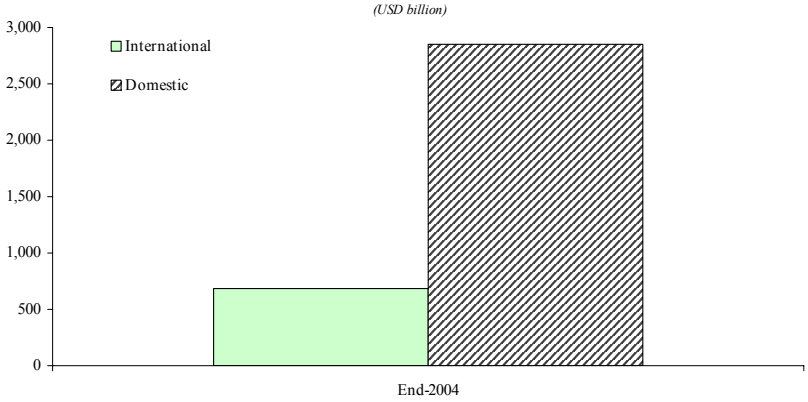
[2] Moreover, in the finalisation of this paper, we have become aware of an ongoing project by Olivier Jeanne at the IMF aiming at collecting data on and explaining the structure of government debt in emerging economies.

[3] See Table 1 for a list of the countries reporting data to the BIS.

from a sheer market size perspective, the domestic dimension of original sin is possibly more important than its international dimension.[4]

Chart 1: Amount outstanding of debt securities issued by emerging economies

(USD billion)



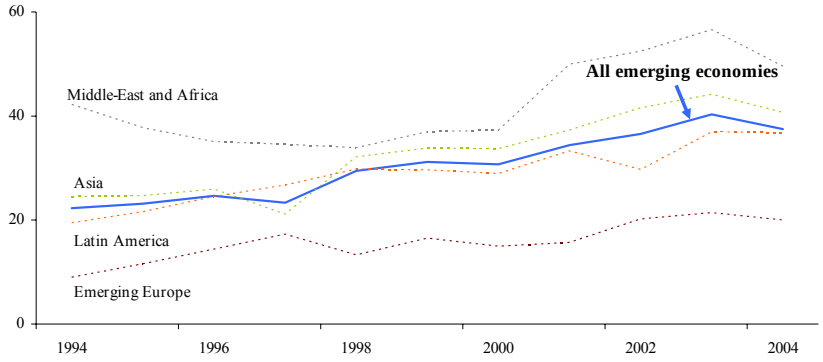
Source: BIS and authors' calculations.

Not only are domestic debt markets large, but they are growing swiftly, which underscores a gradual process of financial deepening in emerging economies. Indeed, relative to GDP, the stock of domestic debt securities issued by emerging economies has almost doubled in the last ten years, to reach close to 40% in 2004 (Chart 2). Marked regional differences remain, however. Emerging Europe (including here the Czech Republic, Hungary, Poland and Russia) has the least developed market for domestic debt securities relative to economic size, with one-fifth of GDP. Interestingly, the latter were most developed in three Middle-East and African countries, standing at about half of GDP, namely: Lebanon (one of the major financial centres in the Mediterranean), Turkey and South Africa.

[4] Interestingly, as some observers have already put it "[A] problem with the original sin measure of mismatch is that it would restrict attention to international bonds […]. It therefore ignores the currency composition and increasing importance of the domestic bond market" (Goldstein and Turner, 2004).

Chart 2: Ratio of the amount outstanding of domestic debt securities to nominal GDP

(As a percentage)



Source: BIS, IMF and authors' calculations.

Having said, relative to total market size, emerging Asia remained the largest market for domestic debt securities issued in emerging economies, accounting for about two-thirds of the total stock of such securities late 2004 (Table 1). It was followed by Latin America, with about one-fifth thereof and Emerging Europe and the Middle-East and Africa, with around 8-9% each. With regard to issuer types, governments made up for around two-thirds of the debt securities issued in emerging economies, against one-fifth for financial institutions and about 13% for corporations. Emerging Asia stands here again as an exception, with both financial institutions and corporations accounting for close to half of the amount outstanding of domestic debt securities issued in the region.

Table 1: Main characteristics of domestic debt security markets in emerging economies

	Amount outstanding, all issuer types		Breakdown by issuer type			
	(USD billion)	*(As a %)*	*(As a % of the regional amount outstanding)*			
			Government	Financial institutions	Corporations	All issuer types
Emerging Asia[a]	1,685	61.5	55.8	26.3	17.9	100.0
Latin America[b]	594	21.7	79.1	14.1	6.9	100.0
Emerging Europe[c]	211	7.7	94.7	2.9	2.3	100.0
Middle-East & Africa[d]	251	9.2	91.5	3.8	4.7	100.0
All emerging economies	2,741	100.0	67.1	19.8	13.1	100.0

Source: BIS. Data as at the third quarter of 2004.

[a] China, Hong-Kong, India, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan and Thailand.

[b] Argentina, Brazil, Chile, Colombia, Mexico and Peru.

[c] Czech Republic, Hungary, Poland, Russia and Slovakia.

[d] Lebanon, South Africa and Turkey.

The development of domestic debt security markets in emerging economies since the mid-1990's has tended to reflect efforts of many of these economies to self-insure against 'sudden stops' and reversals in international capital flows. From a macroeconomic perspective indeed, domestic debt markets are seen as an alternative source of financing, which helps soften the impact of a loss of access to external funding (IMF, 2003). Moreover, from a microeconomic perspective, deeper domestic debt security markets help widen the menu of instruments available to address currency and maturity mismatches, thereby contributing to reducing risks of financial crises. By the same token, they are additionally expected to help stimulate domestic savings and attract international investors through provision of a larger spectrum of financial instruments available for portfolio diversification.

For all these reasons, local authorities have engaged in deliberate efforts to develop debt security markets, occasionally without immediate fiscal needs (IMF, 2002). They have endeavoured to establish benchmark yield curves to facilitate the pricing of corporate securities. They have organised regular programs for government bond and treasury bill issuance. They have unified multiple issues into standardised treasury bonds. The deepening of government bond markets has been in some instances supported by strong institutional development. For example, public debt management agencies – often employing staff with investment banking and trading experience – have been established and trading and clearing and settlement systems have been improved. Reforms of the domestic pension systems and of the capital markets have further contributed to a deepening of domestic debt security markets by stimulating the growth of a local base of institutional investors.

More recently, growing interest from international investors in emerging economies' local markets has buttressed the development of their domestic debt security markets. In the current environment of historically low interest rates and 'hunt for yield', overstretched valuations in the international bond markets have enticed international investors to venture further out the credit spectrum. International investments in domestic bonds issued by emerging economies have increased markedly. For instance, in the most open economies, such as Mexico, Turkey and Poland, the share of non-resident holdings of domestic government bonds in local currency has doubled in the last two years, to reach about 10%, 20% and 25%, respectively. Moreover, a regular survey of investors carried out by the Emerging Market Trade Association suggests that the trading volume in secondary markets in domestic bonds, as a percentage of total trade volume, has risen from 25% in 1997 to 45% in 2004, now outpacing trading in international bonds. An increasing number of sovereigns have received a rating on their domestic debt from international agencies (Packer, 2003). The unprecedented enthusiasm of international investors for emerging

local markets was echoed last June by the launch of the first local emerging market index by JP Morgan, which aims at facilitating the benchmarking of forthcoming mutual funds dedicated to these assets (JP Morgan, 2005). In line with the 'low bond yield conundrum' globally, yields on domestic bonds issued by emerging sovereigns have also reached historical lows.

Relatedly, Latin American issuers have also been taking on a leading role in the recent development of a local currency bond segment issued by emerging economies internationally. This marks the first milestone towards redemption from the international dimension of original sin, namely the inability of emerging economies to borrow in their currency in international markets. In this respect, sovereigns (Uruguay, Colombia and Argentina) and corporates (mostly Brazilian banks) alike have been active in the recent period.

2.2 Domestic original sin

While domestic debt security markets have tended to develop overall, the extent and evolution of domestic original sin has remained markedly different across emerging economies. Breakdowns of domestic debt securities are publicly available from the BIS by issuer and maturity type only (not by coupon or currency type).[5] As a result, the main source of information on domestic original sin has been JP Morgan's *Guide to Local Markets* (1998, 2000 and 2002 issues; see papers by Eichengreen et al.'s, as well as Borensztein et al., 2004). For each year, this report provides a snapshot of information on domestically-traded public debt for twenty-two emerging economies, including data on amounts outstanding of domestic government bonds as well as their main characteristics (total amount, maturity, currency and coupon type). Issues are divided into five categories: long-term domestic currency fixed rate; short-term domestic currency fixed rate; long-term (or short-term) domestic currency debt indexed to an interest rate; long-term domestic currency debt indexed to prices; and foreign currency debt. Domestic original sin (*DSIN*) is defined as the complement of the share of long-term domestic debt in local currency with a fixed interest rate in the total stock of domestic debt:

$$DSIN = 1 - \frac{\text{Long term domestic debt in local currency with a fixed interest rate}}{\text{Total domestic debt}} \qquad (1)$$

[5] As only data on domestic loans in foreign currency are available from the BIS, the paper – in line with the literature on the international dimension of original sin – focuses on debt securities, leaving aside non-securitised debt instruments. The bias arising from this restriction is unlikely to be large, however. Although financial systems in emerging economies are regarded as bank-dominated traditionally, debt securities have become the mainstay of domestic and external finance of these economies (IMF, 2003).

so that *DSIN* = 0 indicates absence of original sin and *DSIN* = 1 indicates maximal original sin.[6] Sources of financial vulnerability arising from domestic debt composition include:

- Rollover risk. Excessive reliance on short-term debt exposes borrowers to default risk, if debt cannot be rolled over, or to possibly increasing debt service costs, if interest rates have risen prior to refinancing. Excessive short-term borrowing may further limit the ability of the central bank to increase policy rates in order to fight inflationary pressures or support the exchange rate, owing to concerns as to the implied impact on borrowers' short-term financial position;
- Maturity and currency mismatches. Excessive reliance on short-term debt additionally exposes borrowers to liquidity risk if their assets are illiquid. Foreign currency denomination of domestic debt gives rise to balance sheet mismatches if the bulk of revenues and/or assets are in local currency, with potentially adverse consequences in case of exchange rate devaluation;
- Contingency of interest payments. Indexation – either to an interest rate, a price index or a foreign currency – renders liabilities uncertain and possibly increasing in bad times (IMF and World Bank, 2003). In addition, inflation-linked or foreign currency-linked debt securities, while contributing to complete and deepen financial markets, may make indexation difficult to reverse and spill over to labour markets, ultimately making inflation more persistent and costly (IMF, 2003).

By contrast, borrowing in local currency at long maturities and fixed rates helps reduce currency and maturity mismatches, rollover and indexation risks.

Hausmann and Panizza (2003) estimate (1) for the three years for which they have data from JP Morgan. [7] They take its average value on the grounds that original sin is stable over time and caution against over-interpreting their econometric results, as they are based on a small sample of up to 21 country-observations. For this reason, we provide new estimates of (1) by enlarging the country coverage and adding a time dimension to the data. Estimates are based on statistics on the composition of the stock of central government debt for 33 countries, as available from national sources. As can been seen from the statistical appendix, which reports the sources and definitions,

[6] This is the strictest definition of domestic original sin. There are other – looser – definitions (see e.g. Hausmann and Panizza, 2003).

[7] See also Eichengreen, Hausmann and Panizza (2003a) and Eichengreen and Hausmann (2005) where the estimates are also reported.

extensive data collection work was needed, occasionally involving security-by-security checks.[8] Additional data quality checks were carried out using the BIS's databases on domestic debt securities. Our estimates are available since 1994 for half the countries in the sample (Argentina, Chile, the Czech Republic, Egypt, Hong Kong, Hungary, India, Korea, Lithuania, Lebanon, Malaysia, Mexico, Russia, Singapore, Slovenia and Thailand), 1995-2004 for Taiwan, 1995-2002 for Slovakia, 1997-2004 for Latvia and Poland, 1997-2003 for Croatia, 1998-2004 for Turkey, 1999-2004 for Brazil, Bulgaria, Indonesia, Israel, the Philippines, South Africa, Uruguay and Venezuela, 2001-2004 for Colombia and 2002-2004 for Peru.

Our new (time-varying) estimates of domestic original sin are consistent with previous (time-invariant) estimates found in the literature (Table 2).[9]

With the exception of Colombia, economies characterised by high domestic original sin include Croatia, Turkey and Latin American economies (Argentina, Brazil, Chile, Mexico, Uruguay, Venezuela). Conversely, Asian economies (such as Korea, Malaysia, Singapore, Taiwan, Thailand) are characterized by a safe domestic debt composition, together with South Africa. The evolution of the phenomenon, which is shown here for the first time, suggests that some countries have managed to reduce sizably the riskiness of their domestic debt composition. In particular, the latter has approximately halved from a peak reached in the mid-1990's in Bulgaria, the Czech Republic, Hungary, Latvia, Lithuania, Slovenia and Poland, in the run-up to EU accession. The most striking example remains Russia, where domestic debt composition, highly risky in the mid-1990s, became safer after 1998, which is partly linked to a restructuring of the country's debt after its default.[10] Many countries have managed to place issues at the very long end of the yield curve, with tenors extending to the 15-year maturity in Hungary, the Czech Republic and Singapore, against 20 years for Poland and South Africa and even 25 years for the Philippines.

[8] Admittedly, our data - like those used by Eichengreen et al. – do not include private bond issues. However, the resulting bias is unlikely to be large for most emerging economies, as debt security issuance by financial institutions and corporations is limited, with the important exception of some of the emerging Asian economies.

[9] The only exception is Malaysia where Hausmann and Panizza (2003) found that domestic original sin is maximal, in contrast with our estimates, which suggest that it is low. This discrepancy likely results from inaccuracies in JP Morgan's data. Indeed, according to the Malaysian central bank, the coupon rate of the Malaysian government securities (MGS) with a maturity above one year is determined by the weighted average of the successful yield, thereby fixed. Security-by-security data, also available from the central bank, confirm that the coupon rate of government bonds, once determined, does not change over time. This is additionally confirmed by the Bloomberg pages available for MGS issues, which indicate that their coupon is fixed.

[10] Late 1998, the government announced a novation (i.e. a substitution of a new for an old debt) of the GKOs and OFZs on which payments were frozen since the summer of that year (IMF, 1999).

Table 2: Estimated domestic original sin in emerging economies[e]

(End-of-period values)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Hausmann & Panizza (2003)[f]
Argentina	0.72	0.78	0.76	0.79	0.80	0.86	0.93	0.97	0.99	...	...	1.00
Brazil	...	...	...	...	...	1.00	1.00	1.00	1.00	0.98	0.98	0.92
Bulgaria	...	...	...	...	...	0.84	0.57	0.49	0.36	0.38	0.35	...
Chile	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.86	0.81	1.00
Colombia	...	...	...	...	...	...	...	0.67	0.69	0.63	0.56	...
Croatia	...	...	...	1.00	1.00	1.00	1.00	1.00	1.00	0.96	...	...
Czech Republic	0.46	0.50	0.59	0.55	0.59	0.63	0.61	0.56	0.42	0.34	0.22	0.59
Egypt	0.48	0.40	0.41	0.45	0.52	0.39	0.38	0.24	0.27	0.29	...	0.79
Estonia	...	...	...	...	...	0.13	0.14	0.17	0.20	0.25	...	...
Hong Kong	0.84	0.76	0.77	0.72	0.66	0.66	0.67	0.64	0.60	0.57	0.56	0.62
Hungary	0.74	0.80	0.81	0.70	0.64	0.60	0.55	0.51	0.46	0.37	0.33	0.30
India	0.17	0.06	0.07	0.08	0.04	0.05	0.04	0.04	0.05	0.03	0.07	0.04
Indonesia	...	...	...	...	...	0.80	0.55	0.56	0.61	0.59	0.55	1.00
Israel	...	...	...	...	...	0.87	0.83	0.79	0.76	0.71	0.68	0.69
Korea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	...
Latvia	...	...	...	0.66	0.39	0.52	0.28	0.11	0.13	0.25	0.17	...
Lebanon	0.43	0.59	0.46	0.32	0.21	0.22	0.23	0.14	0.11	0.07	0.20	...
Lithuania	1.00	1.00	1.00	0.88	0.77	0.67	0.50	0.32	0.25	...	...	...
Malaysia	0.12	0.13	0.11	0.10	0.08	0.08	0.09	0.07	0.08	0.08	0.07	1.00
Mexico	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.85	0.74	0.67	0.61	0.87
Peru	...	...	...	...	...	...	...	...	0.70	0.60	0.42	...
Philippines	...	...	...	...	...	0.64	0.58	0.52	0.48	0.55	0.53	0.36
Poland	...	...	...	0.73	0.62	0.46	0.36	0.39	0.32	0.27	0.27	0.30
Russia	1.00	1.00	0.99	0.74	0.07	0.03	0.09	0.13	0.08	0.06	0.03	...
Singapore	0.31	0.31	0.29	0.32	0.30	0.34	0.31	0.27	0.29	0.27	0.28	0.28
Slovakia	...	0.24	0.38	0.41	0.18	0.15	0.16	0.38	0.38	...	...	0.13
Slovenia	0.99	0.95	0.91	0.82	0.72	0.65	0.63	0.63	0.67	0.62	0.53	...
South Africa	...	...	...	...	...	0.07	0.10	0.07	0.07	0.10	0.14	0.08
Taiwan	…	0.01	0.02	0.02	0.05	0.11	0.03	0.03	0.08	0.02	0.05	0.01
Thailand	0.00	0.00	0.00	0.00	0.00	0.04	0.09	0.13	0.11	0.10	0.11	0.14
Turkey	...	...	...	...	0.89	0.55	0.57	0.90	0.87	0.72	0.66	1.00
Uruguay	...	...	...	...	...	1.00	1.00	1.00	1.00	1.00	1.00	...
Venezuela	...	...	...	...	...	1.00	1.00	1.00	1.00	1.00	1.00	1.00

[e] Complement of the share of long-term domestic debt in local currency with a fixed interest rate to the total stock of domestic debt. See the statistical appendix for the sources and definitions of the data.

[f] Time-invariant estimates from Hausmann and Panizza (2003) based on a three-year average of data available from JP Morgan's *Guide to Local Markets* (1998, 2000 and 2002 issues) and reported here pro memoria.

3 Theoretical determinants

Determinants at work in shaping the composition of domestic public debt in emerging economies are multifaceted. They pertain to the soundness of macroeconomic policies (both on the fiscal and monetary front), to sovereign debt management (namely the slope of the yield curve) and to the financial environment (including the size of the local investor base as well as political economy considerations). These determinants are now reviewed in turn.

3.1 Level of the debt burden

Public indebtedness gives rise to a time inconsistency problem, as governments may have an incentive to reduce debt service costs by reneging on their promise to pay back investors, either through inflation, unexpected changes in interest rates, explicit taxation, or outright default. However, the maturity and composition of debt can help enforce time consistency. Clearly, issuance of inflation-indexed domestic debt reduces incentives to inflate debt obligations away (Leong, 1999). Relatedly, Missale and Blanchard (1994) argue that governments may be reluctant to inflate their debt away if reputation costs are high. Given that the gain from inflating debt away increases with both the level of debt and its maturity, they show that the maximum maturity consistent with a credible pledge to price stability decreases with the level of debt. In other words, governments will tend to have a shorter maturity debt composition to enhance credibility when the debt burden is high, but not necessarily at low levels. In a similar vein, Drudi and Giordano (2000) develop a model where the relation between the level and maturity of debt depends on both inflation and default risk. The relation is negative at low levels of debt, reflecting lender concerns that debt may be inflated away as it becomes larger, but also at high levels, because the default risk premium becomes then too large for governments to issue long-term debt. In the intermediate range, the relation is positive, as governments try to reduce refinancing risk by lengthening debt maturity.

3.2 Monetary credibility

Monetary credibility is conducive to the deepening of domestic debt markets, as suggested by Burger and Warnock (2003), who find that the ratio of domestic debt to total (including international) debt is higher in countries with lower and less volatile inflation. There is additionally evidence that price stability can change the composition of public debt and make it less risky. Indeed, Falcetti and Missale (2002) attribute the rise in the share of fixed rate bonds and loans in central government debt of twenty OECD countries from the mid-1980s to increased central bank independence, in turn reflecting growing investor confidence in long-run price stability. Likewise, Hausmann and Panizza (2003) find that monetary credibility, as measured by lower inflation and the imposition of capital controls are associated with lower domestic original sin in emerging economies.[11] The possible persistence of domestic original sin long after disinflation has been achieved suggests, however, that monetary credibility is not necessarily

[11] Exchange rate rigidity is also positively correlated with domestic original sin, although the relationship is not robust to the inclusion of capital controls. As Hausmann and Panizza (2003) put it, this suggests that while countries that float tend to interfere more with capital flows, once controls are taken into account, their exchange rate choice does not matter.

restored immediately. Persistence of creditor fears that debt might be inflated away can prevent governments from issuing long-term bonds durably, thereby pointing to a potential "credibility barrier" (Jeanne, 2003). Turning to capital controls, the negative correlation with domestic original sin found by Hausmann and Panizza (2003) – albeit in a small sample of 21 country-observations – suggests that such restrictions may force residents to hold long-term domestic currency denominated bonds by narrowing the range of alternative funding or investment opportunities. However, this may not be so clear cut. Indeed, the lifting of capital controls could also be expected to help reduce domestic original sin, for instance, by contributing to a widening of the investor base to foreigners (see also 3.5).

3.3 Slope of the yield curve

An important objective of a large number of public debt managers is to ensure that government financing needs and payment obligations are met at the lowest possible cost over the medium to long run in line with a prudent degree of risk (IMF and World Bank, 2003; see also Missale, 1999, Leong, 1999, as well as Wolswijk and de Haan, 2005). The trade-off between costs and risks is familiar to private sector portfolio managers. Admittedly, there are a number of considerations specific to governments which make it difficult to use corporate finance theory as a framework, not least because they may have other objectives than wealth maximisation.[12] This notwithstanding, many countries have explicitly adopted private sector practices in government debt management (Leong, 1999). In theory, and given the existence of term premia, issuing short-term debt is cheaper than issuing long-term debt.[13] As a result, taking a short-run cost perspective, an optimal policy is to borrow short-term and rollover debt (ibid.). In particular, an upward-sloping yield curve (i.e. a lower cost of funding at its short end than at its long end) tends to be associated with higher short-term borrowing and, hence, higher original sin. This said, refinancing risk is higher for short-term debt and frequent refinancing implies a larger risk of facing higher interest rates. Therefore, governments face a trade-off between cheaper funding

[12] The reference to macroeconomic goals in the academic literature clearly distinguishes public debt management from private debt management, where cost considerations dominate. Historically, theory has indeed focused on the contribution of debt management to monetary policy and stabilisation policy, following Tobin (1963) who regarded minimisation of interest costs as secondary, and risk minimisation not playing a role at all. More recent developments have focused on the relation between public debt management and fiscal policy, drawing on the optimal taxation literature. For instance, tax smoothing is the main government objective in Barro's work on debt management (1999) and, in this respect, it has been shown that the choice of debt maturity can play a role in smoothing tax rates (Angeletos, 2002). An important limitation of this literature is that it bears little resemblance to the practice of public debt management. Allegedly, the gap between theory and practice is "striking" (Wolswijk and de Haan, 2005) and, for this reason, it is not attempted to test here for the significance of macroeconomic goals as a determinant of domestic original sin.

[13] This also holds true for debt with a variable interest rate, which is typically indexed to short-term debt.

costs, which tilts the duration towards short-term maturities, on the one hand, and refinancing risk, which tilts the duration towards longer-term maturities, on the other (Broner, Lorenzoni and Schmukler, 2004).

However, this is the borrower's perspective. The investor's perspective turns the argument on its head. Investors are attracted to the highest (risk-adjusted) yields, so that – when the yield curve is upward-sloping – they are encouraged to invest at its low end, especially when they have long-term liabilities. There is indeed strong evidence in the recent period of historically low interest rates that the so-called "hunt for yield" has been a key determinant of investment decisions taken by market participants (IMF, 2005; ECB, 2005). This in turn encourages the government to issue long-term. As a result, focusing on yield considerations only, an upward-sloping yield curve (i.e. higher yields at its long end than at its short end) may well be associated with higher long-term borrowing to meet investor demand and, hence, lower original sin.

3.4 Size of the investor base

A larger local base of institutional investors, as a result of pension system and capital market reforms, can contribute to the deepening of domestic debt security markets (IMF, 2002 and 2003). The introduction of a fully-funded pension system is of particular relevance in this regard, as pension funds have an interest in debt securities carrying low default risk and denominated in domestic currency (Borensztein et al., 2004). This may also apply, to some extent, to domestic mutual funds. Reflecting these considerations, Claessens, Klingebiel and Schmukler (2003) find that countries with larger domestic investor bases have larger domestic currency bond markets, while smaller economies rely more on foreign currency bonds. A larger investor based can therefore be expected to contribute to lessen domestic original sin.

3.5 Political economy considerations

There is evidence that political stability and respect for the rule of law tend to be associated with a larger share of domestic public debt in GDP (Borensztein et al., 2004). This is in line with studies pointing to a correlation between the size of the domestic bond market and variables pertaining to political economy considerations, including rule of law and democracy (Claessens, Klingebiel and Schmukler, 2003; Burger and Warnock, 2003). This suggests that democracy is important in the eyes of investors, perhaps as it is associated with greater public credibility, better decision-making and wider acceptance of the overall policy-making process, including at the macroeconomic level. More specifically, Miller (1997) showed that political instability triggers inflation uncertainty and a steeper slope of the yield curve, ultimately leading to a reduction in

debt maturity. In this respect, political stability can therefore be expected to help lower domestic original sin.

4 Methodology and data

4.1 Core specification

The econometric analysis raises challenges relating to both the measure of domestic original sin and the nature of our dataset. Firstly, given that domestic original sin is by definition bounded between zero and one, estimation has to resort to censored regression methods. This can be done by using the tobit model, which is well suited when the dependent variable takes values within fixed bounds, a solution retained in previous literature. Secondly, given the panel structure of our dataset, the possible existence of unobservable country effects has to be taken into account. Indeed, unobserved country heterogeneity would bias standard tobit estimations. To address these issues, we resort to random-effects tobit estimation, which is defined as the following combination of linear and probabilistic regression:

$$
\begin{aligned}
& y^*_{i,t} = \beta x_{i,t} + v_i + \varepsilon_{i,t} \\
& \text{with:} \qquad\qquad (2) \\
& y_{i,t} = \begin{cases} 1 & \text{if } y^*_{i,t} > 1 \\ y^*_{i,t} & \text{if } 0 \le y^*_{i,t} \le 1 \\ 0 & \text{if } y^*_{i,t} < 0 \end{cases}
\end{aligned}
$$

where *i* and *t* are the country and time dimensions, respectively, $y^*_{i,t}$ the measure of domestic original sin defined in (1), $x_{i,t}$ a vector of explanatory variables and β a vector of parameters to be estimated. The disturbances are split into both unobserved country effects, noted v_i, which are i.i.d. $N(0, \sigma^2_v)$, and panel level effects, noted $\varepsilon_{i,t}$, which are i.i.d. $N(0, \sigma^2_\varepsilon)$ and independent of v_i.

To gauge whether random-effects tobit estimation is required, it is useful to calculate the ρ-statistic, which measures the contribution of the variance of the disturbances due to country effects to the total variance of the disturbances:

$$\rho = \frac{\sigma^2_v}{\sigma^2_\varepsilon + \sigma^2_v}$$

When ρ is close to zero, random-effect tobit estimation is not significantly different from a standard tobit one. Formal comparison between the two models can be achieved by running a likelihood-ratio test, where the null hypothesis is that the standard tobit is better suited than the random-effect tobit.

Moreover, a likelihood-ratio test of the nullity of v_i, also comparing the tobit estimator and the panel estimator, as well as Wald tests on nullity of the estimated parameters can be calculated.

4.2 Data

The dependent variable is our estimate of domestic original sin for which we have a sample about thirteen times larger than that of Hausmann and Panizza (2003).[14] Turning to the explanatory variables, the level of the debt burden is proxied by the ratio of the general government interest expenditures to GDP, taken from the IMF's *World Economic Outlook* (WEO). We include inflation to capture considerations relating to monetary credibility and use the annual growth rate of the GDP deflator to that end, also taken from the WEO. Turning to capital controls, we resort to a measure of *de jure* openness often used in the literature, namely the removal of restrictions to capital account transactions as published in line E.2 of the IMF's *Annual Report on Exchange Arrangements* (see, for instance, Fratzscher and Bussière, 2004). We introduce the slope of the yield curve to account for cost of issuance and yield attractiveness considerations, which is proxied by the spread between the yield on the 5-year Treasury bond and that on the 3-month Treasury bill, both in domestic currency, as available from *Global Financial Data*.[15] The size of the investor base is proxied by the ratio of gross private savings to GDP, as available from the WEO. Political stability is proxied by country ratings of political risk and government stability taken from the *International Country Risk Guide (ICRG)* database (annual averages from monthly observations).

Turning to the control variables, it is worth noting that a number of countries in the sample were in default for at least part of the sample period, including Argentina, Croatia, Russia and Venezuela. The potential impact of a restructuring on the composition of these countries' debt is controlled by a dummy variable which equals 1 when a country is considered to be in default by Standard & Poor's (Standard & Poor's, 2004). Moreover, some countries (including Hong-Kong and Singapore) issue little amounts of long-term bonds because they have run large fiscal surpluses. These countries authorities have, however, justified official involvement in the

[14] However, due to missing data for some of the explanatory variables, estimations make use of a sample which is about eight times larger.

[15] Due to data unavailability, the 1-year, 3-year and 15-year maturity are taken for Colombia, Mexico and Lebanon, respectively.

development of domestic debt markets, which they consider as public goods – when it comes to market infrastructure, in particular – to become regional financial centres (IMF, 2002). For this reason, we include a dummy variable which equals 1 when a country is a regional financial centre. We additionally include a dummy variable which equals 1 from the start of membership negotiations with the European Union (EU) onwards. This captures potential disciplinary and credibility effects brought about by the EU Accession process in central and eastern European countries, which could have helped reduce the riskiness of their domestic debt composition.[16] Last, we also control for regional and time effects in the regressions.

Selected descriptive statistics are reported in Table 3 hereafter. On average, domestic origin sin stands at 0.49 in the sample. However, its standard deviation is large (0.34), confirming that the phenomenon varies markedly both across countries and time. Debt service accounts for 4% of GDP on average and is positively correlated with domestic original sin, as is inflation, whose large standard deviation points to bouts of hyperinflation experienced by some of the countries in the sample, including Brazil, Russia, Turkey and Venezuela. The slope of the yield curve is upward-sloping on average but exhibits substantial volatility (with a standard deviation of about 300 basis points) as well as a negative correlation with domestic original sin. The ratio of private savings to GDP, our proxy for the investor base, stands at about 20% on average and is (slightly) negatively correlated with domestic original sin.

Table 3: Selected descriptive statistics

	Mean	Standard deviation	Correlation with *DSIN*
Domestic original sin (*DSIN*)	0.493	0.346	-
Debt service to GDP	0.040	0.040	0.219
Inflation	0.219	1.291	0.220
Slope of the yield curve	0.029	0.300	-0.253
Investor base	0.200	0.065	-0.097

Note: All variables expressed in percentage.

5 Results

5.1 Main results

Baseline estimates are in Table 4, which reports marginal effects. The marginal effects of the explanatory variables on the observed domestic original sin are estimated at their sample means.

[16] Moreover, insofar as these countries are perceived by market participants as eventually adopting the euro, convergence in interest rates towards euro area levels could have mirrored increasing international investor interest in their domestic bond issues.

The marginal effects of dummy variables are estimated for a change in these variables from 0 to 1. For the sake of comparability between the various specifications, we ensure that the number of observations remains the same. The ρ-statistic is significantly positive, confirming that standard tobit estimation – which does not take into account unobserved country effects – would be inappropriate.

In line with Hausmann and Panizza (2003), we find that lack of monetary credibility (i.e. higher inflation) is also associated with higher domestic original sin. According to our median point estimate, an increase in inflation by 1 percentage point translates into a rise in domestic original sin by about 0.8 percentage point. This confirms that progress towards price stability is instrumental in alleviating creditor fears that domestic debt could be inflated away and changing its composition towards local currency, long-term and unindexed instruments.

The debt service-to-GDP ratio is positively correlated with domestic original sin, albeit with lower levels of statistical significance. According to our median point estimate, an increase in the debt service-to-GDP ratio by 1 percentage point is associated with a rise in domestic original sin by about 1.9 percentage points. As suggested in Missale and Blanchard (1994), this result could reflect governments' efforts to enhance the credibility of their commitment to price stability by shortening debt maturity when the debt burden itself becomes too heavy. The result may also confirm that when the debt burden is too heavy, the default risk premium becomes too large for governments to issue long-term debt, as modelled in Drudi and Giordano (2000).

The slope of the yield curve is negatively and significantly correlated with domestic original sin. This is consistent with an investor perspective, whereby debt maturity lengthens if bond yields are sufficiently high relative to short-term rates (i.e. the yield curve is upward-sloping) in order to attract investors to the long end of the maturity spectrum. In this respect, our median point estimate suggests that a steepening of the yield curve by 100 basis points is associated with a reduction in domestic original sin of about 200 basis points.

Likewise, domestic original sin tends to decrease when the investor base grows, as proxied by an increase in the private savings-to-GDP ratio. According to our median point estimate, an increase in the investor base by 1 percentage point is associated with a decrease in domestic original sin by around 0.8 percentage point. This result indicates that financial deepening underpinned by growing private savings as a share of revenue increases potential demand for, and eases issuance of, longer-term, unindexed, local currency instruments, thereby resulting in a safer domestic debt composition. This sharpens the findings of Claessens, Klingebiel and Schmukler (2003) who had

found that countries with larger domestic investor bases have larger domestic currency bond markets.

Conversely, unlike Hausmann and Panizza (2003) we find no robust evidence that countries that have capital controls also have lower original sin. In many regressions, the corresponding dummy variable is insignificant. The difference between our results and theirs is likely to be explained by the much larger size of our sample of observations, both in terms of country coverage and time. According to one specification, lifting capital account controls is associated with lower domestic original sin, which even turns Hausmann and Panizza (2003)'s finding on its head (see row 8 of Table 4). This could suggest that capital account liberalisation helps reduce domestic original sin by widening the investor base to foreigners.

The introduction of control dummies does not affect the results. The financial centre dummy is positively significant, mirroring the depth of money markets in Singapore, Hong-Kong and Lebanon. The sovereign default dummy is negatively signed, possibly reflecting that, upon default, restructuring may have led to a rescheduling and lengthening of debt maturity. The EU accession dummy is also negatively signed (but mostly insignificant) possibly reflecting that the accession process brings about discipline and credibility which help reduce the riskiness of domestic debt composition. When controlling for regional effects, it is interesting to note that – relative to the benchmark region (which is here emerging Asia) – domestic original sin is close to 30 percentage points higher in Latin America and about 25 percentage points lower in the Middle-East and Africa (which include here India and South Africa, whose domestic original sin is among the lowest in the sample). The introduction of time effects does not affect the results. Interestingly, the year dummies are significant in 1995, 1996 and 1998, at the time of the Mexican, Asian and Russian crises.

Table 4: Core specification results[g,h]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Inflation	0.708 ***	0.706 ***	0.886 ***	0.524 ***	1.010 ***	1.110 ***	0.764 ***	0.917 ***
	(4.09)	(4.16)	(5.08)	(3.61)	(5.11)	(5.39)	(3.41)	(3.94)
Debt service to GDP	1.551 *	2.286 **	1.074 *	1.048 *	1.831 **	2.022 **	1.977 **	1.911 **
	(1.92)	(2.55)	(1.72)	(1.71)	(2.33)	(2.31)	(2.26)	(2.07)
Slope of the yield curve	-0.172 ***	-0.201 ***	-0.199 ***	-0.115 **	-0.257 ***	-0.270 ***	-0.198 ***	-0.216 ***
	(2.96)	(3.41)	(3.76)	(2.40)	(4.19)	(4.20)	(2.71)	(3.07)
Investor base	-0.467 **	-0.751 ***	-0.694 ***	-0.628 ***	-0.853 ***	-1.113 ***	-0.859 ***	-1.150 ***
	(2.14)	(2.94)	(3.85)	(3.59)	(3.66)	(4.16)	(3.51)	(4.31)
Lifting of capital controls	0.040	0.039	0.098 ***	0.105 ***	0.048	-0.054	0.045	-0.065 *
	(1.07)	(1.14)	(3.22)	(3.52)	(1.52)	(1.40)	(1.40)	(1.75)
Financial center dummy		0.206 ***			0.201 ***	0.254 ***	0.198 ***	0.246 ***
		(2.73)			(3.97)	(5.81)	(4.01)	(5.59)
Sovereign default dummy			-0.311 ***		-0.322 ***	-0.404 ***	-0.291 ***	-0.402 ***
			(4.73)		(3.98)	(5.16)	(3.47)	(5.10)
EU Accession dummy				-0.072 ***	-0.040	-0.027	-0.029	0.032
				(2.71)	(1.48)	(0.77)	(0.98)	(0.84)
Latin America dummy						0.270 ***		0.298 ***
						(6.49)		(7.60)
Eastern Europe dummy						0.061		0.021
						(1.16)		(0.39)
Middle-East & Africa dummy						-0.280 **		-0.252 ***
						(2.50)		(3.58)
Year 1995 dummy							0.108 *	0.123 **
							(1.88)	(2.14)
Year 1996 dummy								0.103 *
								(1.91)
Year 1998 dummy								0.094 *
								(1.88)
Constant	0.390 ***	0.427 ***	0.460 ***	0.524 ***	0.474 ***	0.595 ***	0.462 ***	0.586 ***
	(4.20)	(4.67)	(4.15)	(5.90)	(5.29)	(5.52)	(4.38)	(4.93)
σ^2_{υ}	0.261 ***	0.267 ***	0.316 ***	0.288 ***	0.268 ***	0.212 ***	0.263 ***	0.199 ***
	(8.86)	(8.38)	(7.38)	(7.49)	(9.28)	(6.48)	(8.63)	(6.28)
σ^2_{ε}	0.174 ***	0.173 ***	0.166 ***	0.174 ***	0.162 ***	0.159 ***	0.155 ***	0.150 ***
	(14.68)	(14.95)	(15.08)	(15.08)	(14.58)	(14.88)	(14.41)	(15.11)
ρ	0.690	0.705	0.783	0.733	0.733	0.640	0.743	0.637
	[0.054]	[0.055]	[0.051]	[0.057]	[0.048]	[0.080	[0.053]	[0.082]
Likelihood ratio test	138.54 ***	131.11 ***	150.86 ***	139.42 ***	142.32 ***	59.92 ***	146.55 ***	57.30 ***
Number of observations	169	169	169	169	169	169	169	169
Wald test	50.24 ***	47.58 ***	92.63 ***	67.50 ***	62.77 ***	126.15 ***	83.25 ***	278.49 ***
Log likelihood	-11.29	-8.45	-4.50	-10.37	-1.84	10.06	3.27	19.55

[g]Random-effect tobit estimates.

[h]Absolute *t* -values of the estimates in brackets and standard deviation in square brackets. (***), (**) and (*) indicate significance at the 1%, 5% and 10% level of confidence, respectively.
Only significant year dummies are reported in columns 7 and 8.

5.2 Robustness checks

To test the robustness of the results, we first use standard tobit estimation with country fixed effects instead of random-effects (Table 5, column 1). The results remain unchanged.

We also proxy the ability to service debt with an array of macroeconomic indicators drawn from Milesi-Ferretti and Razin (1998), including the ratios of the fiscal balance to GDP, primary balance to GDP and government debt to exports (columns 2 to 4). Our estimates suggest that countries with sounder public finances tend to have lower domestic original sin. According to our point estimate, an increase (lowering) in the fiscal surplus (deficit) of 1 percent of GDP is associated with a decrease in domestic original sin by 1.2 percentage point. A similar result holds with the primary balance, albeit smaller in magnitude and not statistically significant. This said, the correlation is negative, indeed, given that the corresponding *t*-statistic is above 1 in absolute value. The impact of the government debt-to-export ratio is not significant on domestic original sin, which does not come as a surprise, given that export proceeds are used to pay back external debt rather than domestic debt.[17] The estimates for the other determinants are unaltered.

To further test the robustness of the results, we use alternative definitions of the variables. We introduce bond yields and short-term rates separately. In line with an investor perspective, domestic original sin is positively correlated with short-term rates and negatively correlated with long-term yields (column 5). We replace inflation with the growth of M1 and find again that lack of monetary credibility (i.e. an acceleration in money supply growth) is associated with higher domestic original sin (column 6). Using a dummy for domestic financial sector liberalisation – taken from Fratzscher and Bussière (2004) – to assess the robustness of our results to a change in the definition of the proxy for capital controls, we confirm that the latter's correlation with domestic original sin is not significant (column 7). Last, when controlling for inflation and the slope of the yield curve, we do not find that greater political stability – as proxied by an increase in the ICRG's political risk and government stability ratings – is associated with lower domestic original sin (columns 8 and 9).

[17] Exceptions could include countries in the Gulf region, where the bulk of government revenues originate from oil exports. These countries are not included in our sample, however.

Table 5: Robustness checks[i,j]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inflation	0.881 ***	1.045 ***	1.116 ***	0.719 ***			0.776 ***	0.814 ***	0.813 ***
	(4.49)	(4.31)	(5.18)	(3.96)			(5.30)	(3.38)	(3.63)
M1 growth						0.265 ***			
						(2.74)			
Debt service to GDP	4.036 ***				2.522 **		1.118 **	1.668 *	1.709 *
	(4.03)				(2.25)		(2.17)	(1.65)	(1.68)
Fiscal balance to GDP		-1.219 **							
		(2.04)							
Primary balance to GDP			-0.600						
			(1.08)						
Government debt to exports				-0.047					
				(1.44)					
Slope of the yield curve	-1.123 ***	-0.215 **	-0.209 ***	-0.131 **		-0.096 *	-0.182 ***	-0.192 **	-0.185 **
	(4.03)	(5.56)	(2.97)	(2.02)		(1.80)	(3.88)	(2.58)	(2.52)
5-year bond yield					-0.243 **				
					(2.55)				
3-month T-bill rate					1.257 ***				
					(3.01)				
Investor base	-0.647 *	-1.082 ***	-0.794 ***	-0.673 *	-1.305 **	-0.939 ***	-0.562 ***	-0.861 **	-1.012 ***
	(1.72)	(3.16)	(2.71)	(1.95)	(3.02)	(3.92)	(2.84)	(2.52)	(3.51)
Lifting of capital controls dummy	0.016	-0.118 **	-0.035	-0.071	-0.142 **	0.091 ***		-0.018	-0.010 **
	(0.17)	(2.34)	(0.72)	(1.27)	(2.47)	(2.85)		(0.42)	(2.54)
Domestic financial liberalisation dummy							-0.006		
							(0.24)		
Political risk rating								0.004	
								(0.03)	
Government stability rating									0.040
									(0.58)
Financial center dummy		0.277 ***	0.161 ***		0.256 ***	0.195 **	0.091	0.208 ***	0.187 ***
		(5.83)	(2.92)		(3.40)	(2.55)	(1.14)	(2.74)	(2.74)
Sovereign default dummy		-0.395 ***	-0.433 ***		-0.152	-0.081	-0.328 ***	-0.356 ***	-0.372 ***
		(4.89)	(5.71)		(1.29)	(1.07)	(4.70)	(4.26)	(4.35)
Constant	0.609 ***	0.636 ***	0.778 ***	0.875 ***	0.919 ***	0.426 ***	0.681 ***	0.499 ***	0.672 ***
	(4.66)	(4.40)	(5.00)	(4.55)	(6.23)	(4.35)	(9.12)	(2.66)	(4.96)
σ^2_{υ}	0.090	0.166 ***	0.204 ***	0.200 ***	0.154 ***	0.299 ***	0.323 ***	0.214 ***	0.214 ***
	[0.005]	(5.52)	(4.99)	(4.83)	(3.12)	(7.86)	(7.78)	(4.25)	(5.11)
σ^2_{ε}		0.173 ***	0.158 ***	0.174 ***	0.159 ***	0.179 ***	0.162 ***	0.152 ***	0.152 ***
		(15.43)	(14.32)	(13.71)	(13.12)	(15.15)	(15.05)	(14.79)	(15.05)
ρ		0.479	0.625	0.571	0.485	0.736	0.799	0.663	0.665
		[0.099]	[0.103]	[0.112]	[0.179]	[0.054]	[0.045]	[0.115]	[0.096]
Likelihood ratio test		41.17 ***	52.54 ***	46.39 ***	32.69 ***	138.75 ***	136.11 ***	56.87 ***	53.19 ***
Number of observations	149	185	169	156	169	169	169	169	169
Wald test	379.17 ***	142.22 ***	117.22 ***	113.92 ***	140.32 ***	43.99 ***	61.90 ***	235.88 ***	198.73 ***
Log likelihood	132.66	2.72	10.37	-4.73	14.71	-12.95	-1.91	17.57	18.67

[i]Random-effect tobit estimates, with the exception of column 1 which reports the results for standard tobit estimation with fixed effects.

[j]Absolute *t* -values of the estimates in brackets and standard deviation in square brackets. (***), (**) and (*) indicate significance at the 1%, 5% and 10% level of confidence, respectively.

5.3 Endogeneity

Clearly, another challenge that we have not taken into account so far is the potential endogeneity of some of our variables. Indeed, the Wu-Hausmann *F*-test and the Durbin-Wu-Hausman χ^2 tests suggest that inflation and the slope of the yield curve exhibit signs of endogeneity in some of the specifications.

To correct for endogeneity, we re-estimate (2) using system GMM estimation, as developed in Blundell and Bond (1998). With regard to the latter, it is worth acknowledging that the composition of domestic debt cannot be adjusted instantaneously, as it is a stock variable. Stocks tend to evolve slowly, implying that domestic original sin is characterised by a certain degree of persistence. This calls for explicit modelling of dynamic effects. To this end, equation (2) can be rearranged as

$$y_{i,t} = \sum_{j=1}^{p} \varphi_j y_{i,t-j} + \beta x_{i,t} + \upsilon_i + \gamma_t + \varepsilon_{i,t} \qquad (3)$$

where the φ_j are p parameters to be estimated and γ_t are time effects.

To estimate (3), the standard Arellano-Bond (1991) 'first-difference' GMM estimator suffers from finite-sample bias and poor precision when the autoregressive parameter φ is moderately large (as lagged levels of the series are then poor instruments for their first differences) and the number of time series observations is moderately small. This is the present case here: estimations reported hereafter confirm that domestic original sin exhibits persistence and 8 years are available for estimation on average. Blundell and Bond (1998) show that adding lagged differences of the endogenous variables as instruments for equations in levels to the standard lagged levels of the endogenous variables as instruments for equations in first differences allows for substantial efficiency gains in the estimation. By the same token, instrumentation addresses potential endogeneity problems that may arise. The results are reported in Table 6 hereafter.

Table 6: Robustness checks for endogeneity[k,l]

	(1)	(2)
Lagged domestic original sin	0.917 ***	0.915 ***
	(27.56)	(28.55)
Inflation	0.151 **	0.194 ***
	(2.70)	(3.25)
Debt service to GDP	0.368	
	(1.17)	
Fiscal balance to GDP		-0.142
		(0.83)
Slope of the yield curve	-0.245 **	-0.282 **
	(2.38)	(2.54)
Investor base	-0.357 *	-0.410 **
	(1.88)	(2.16)
Lifting of capital controls dummy	0.011	0.011
	(0.42)	(0.48)
Financial center dummy	0.004	-0.005
	(0.13)	(0.17)
Constant	-0.101 **	-0.104 **
	(2.76)	(2.36)
Hasen test of overidentification	11.87	11.06
F-test	486.82 ***	595.35 ***
Arellano-Bond test for AR(1)	-1.71 *	-1.88 *
Arellano-Bond test for AR(2)	-0.85	-0.90
Number of observations	138	152

[k]Columns 1-2 report system GMM à la Blundell and Bond estimations.

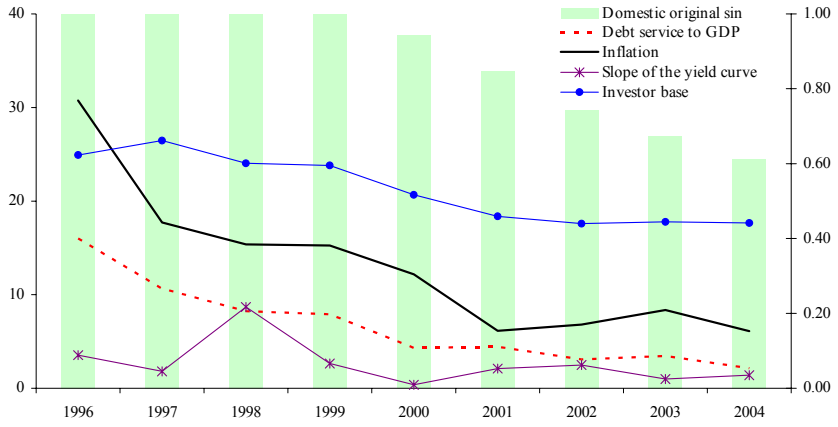
[l]Absolute values of *t*-statistics in parentheses. (***), (**) and (*) indicate significance at the 1%, 5% and 10% level of confidence, respectively.

Hansen's test cannot reject the hypothesis that the instruments are valid (columns 1 and 2) Arrellano-Bond's test can reject the absence of autocorrelation of order 1 but not of order 2, suggesting that the lagged value of domestic original sin suffices to capture dynamic effects. In this respect, the large and significantly positive autoregressive coefficient confirms that it is a persistent phenomenon. Still, the estimations suggest that about 10% of the composition of domestic debt changes per year in emerging economies.

The variables enter the regression significantly, with the expected sign. The debt service-to-GDP ratio, however, loses significance. Likewise, the fiscal balance-to-GDP ratio, the measure of ability to service debt, loses significance (column 2). The lifting of capital controls and financial sector dummies are also insignificant. Long-run elasticities – obtained by dividing the estimated coefficients by the inverse of (1 - 0.9) – are larger than those previously obtained, albeit not strictly comparable, given that the specification of (3) is linear. Overall, results confirm that, even after accounting for endogeneity, the inflation rate, the slope of the yield curve and the size of the investor base robustly and causally explain domestic original sin.

The experience of Mexico illustrates how the interplay between these determinants bears on domestic original sin. For instance, domestic original sin was maximal in Mexico in the mid-1990s (i.e. at the time of the financial crisis) but declined by about 40 percentage points thereafter (Chart 3). Interestingly, inflation decelerated by around 25 percentage points in the meantime. Taking our core elasticity estimate of around 0.8, this could have contributed to reduce – ceteris paribus – domestic original sin by about 20 percentage points. Moreover, this decline was accompanied by a sharp reduction in the debt service-to-GDP ratio in the order of 14 percentage points. Taking our core elasticity estimate of around 1.9, this has been associated – ceteris paribus – with a decrease in domestic original sin by about 26 percentage points. In the meantime, the slope of the yield curve (i.e. the difference between the long-term bond yield and the 3-month Treasury bill rate) flattened by around 200 basis points. Taking our core elasticity estimate of around 2, this could have contributed to increase – ceteris paribus – domestic original sin by about 4 percentage points. Last, the investor base shrunk by around 7 percentage points over the period. Taking our core elasticity estimate of around 0.8, this could have contributed to increase – ceteris paribus – domestic original sin by about 6 percentage points. In total, the overall decrease in domestic original sin resulting from developments in these determinants is estimated at 36 percentage points (4 percentage points below the actual one).

Chart 3: Selected determinants of domestic original sin in Mexico



Source: authors' calculations. All variables expressed in percentage points (left scale), with the exception of *DSIN* (in percentage, right scale).

6 Conclusions

This paper has endeavoured to explain why domestic debt composition in some emerging economies is risky. To this end, it has carried out a comprehensive empirical analysis of the

determinants specific to the so-called "domestic" original sin, the fact that the domestic debt of these economies is often in foreign currency, short-term or indexed. It has relied on a large dataset constructed by the authors from national sources, which helps address the limitations of the small samples used in previous literature.

The paper has shown that domestic original sin is particularly severe when inflation is lofty, the debt service-to-GDP ratio high, the slope of the yield curve inverted and the investor base narrow. These results are robust to the inclusion of controls, to specification changes, to various definitions of the variables, as well as to the choice of the estimator, including when correcting for endogeneity. An exception is the debt service-to-GDP ratio, whose causal impact is not ascertained. Interestingly, unlike Hausmann and Panizza (2003), we do not find robust evidence that countries that have capital controls also have lower domestic original sin. The difference between our results and theirs is likely to be explained by the much larger size of our sample of observations.

Our results have clear policy implications. Sound macroeconomic policies (on the monetary front, in particular), attractive long-term yields and a wider investor base are instrumental to overcome domestic original sin. In particular, bringing down inflation in a context of diminishing debt service and upward-sloping yield curve, together with policies aimed at widening the investor base (such as reforms of the domestic capital markets and pension system), help reduce domestic debt riskiness and tilt its composition towards safer, long-term, unindexed, local currency instruments. The road to redemption is not necessarily long. Emerging economies can – and did so in the past – improve their domestic debt composition swiftly. Estimated elasticities suggest in particular that domestic original sin can be reduced substantially.

Looking ahead, we intend to expand our analysis to corporations and financial institutions, which could be of relevance to better understand financial fragilities arising from the private sector – and possible differences with the public sector – in particular in emerging Asia. However, given the related challenges in terms of data collection, we leave this for future research.

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Statistical appendix: Overview of the data on stocks of long-term bonds with a fixed interest rate issued by emerging economies

	Selected charateristics of the issues	Sample size	Source
Argentina	Debt securities issued in domestic currency with a fixed coupon and held by residents (includes Bocones whose interest rate can be indexed to that of the Savings Bank and Préstamos Garantizados; estimates based on security-by-security data).	1994-2002	Courtesy of the Oficina Nacional de Crédito Público (www.mecon.gov.ar)
Brazil	Issues with a pre-fixed rate and a maturity above 1 year. Fixed rate bonds include the zero-coupon LTNs (with maturities of up to 2 years) and the coupon-bearing (10%) NTN-F whose maturity is January 2008.	1999-2004	Ministério da Fazenda. Tesouro Nacional (www.stn.fazenda.gov.br)
Bulgaria	Long and medium-term debt bonds in Leva with a fixed coupon. Those issues extend to the 15-year maturity. The remaining long and medium-term debt securities (denominated in euro), as well as the government securities issued for structural reform (which are either foreign currency-denominated or indexed to the base interest rate (BIR), LIBOR or EURIBOR) are not included.	1999-2004	Ministry of Finance (www.minfin.government.bg)
Chile	Fixed-coupon peso-denominated BCP bonds issued by the central bank since 2002. Maturities include 2, 5, and 10 year issues.	1994-2004	Ministerio de Hacienda (www.hacienda.gov.cl)
Colombia	TES (bond) issues with a fixed rate (Tasa fija). Tenors extend to 10-year issues.	2001-2004	Ministerio de Hacienda y Crédito Publico (www.minhacienda.gov.co)
Croatia	The first issue in kuna with a fixed (6.125%) coupon was completed in 2003 with a 5-year maturity (series 04 D-8). The remaining bonds have been either indexed to inflation, linked to foreign currency deposits frozen during the war or denominated in deutsche mark or euro.	1997-2003	Ministry of Finance (www.mfin.hr)
Czech Republic	Medium-term and long-term Treasury bonds (CZGBs) which, according to the Ministry of Finance, are fixed-interest bearing issues with annual coupon payments. Tenors extend to 15-year issues.	1994-2004	Ministry of Finance (www.mfcr.cz)
Egypt	Tradable domestic bonds (excluding euro-denominated issues).	1994-2003	Central Bank of Egypt (www.cbe.org.eg)

Estonia	Bonds denominated in domestic currency and paying a fixed (10%) coupon.	1999-2003	Ministry of Finance (www.fin.ee)
Hong Kong	Hong-Kong Exchange Fund (HKEF) notes. These are government-guaranteed securities issued in 2-, 3-, 5-, 7- and 10-year maturities with semiannual fixed coupons announced in advance of each tender.	1994-2004	Hong Kong Monetary Authority (www.info.gov.hk/ hkma)
Hungary	Fixed-rate bonds (HGBs). Tenors extend to 15-year issues.	1994-2004	Government Debt Management Agency (www.allampapir.hu)
India	Central government bonds (GoIs) are issued with maturities ranging from 2 to (since 2002) 30 years. Those issues mostly bear a fixed coupon with the exception of a few floating rate bonds since late 2001, which are linked to the cut-off yields at the 1-year T-bill auctions (including: -0.05% 2006; -0.01% 2009; + 0.13% 2011; + 0.09% 2012; + 0.14% 2014: + 0.34% 2017).	1994-2004	National Stock Exchange of India (www.nse-india.com)
Indonesia	Government domestic debt securities issued with a fixed coupon. Recapitalisation Treasury bonds were first issued in 1999 to recapitalise troubled banks. Some issues have a floating or inflation-indexed coupon. Bonds are issued for budget financing since 2002 and bear only a fixed coupon.	1999-2004	Ministry of Finance (Courtesy of the Directorate General of Treasury)
Israel	Unindexed Treasury bonds (SHAHARS). These are fixed-rate bonds and were first issued in 1996 for two-year term. They are issued for up to a 10-year maturity.	1999-2004	Ministry of Finance (Courtesy of the Debt Management Unit)
Korea	Government bonds are issued by the Ministry of Finance and Economy and are direct obligations of the national government. Historically, they were divided into Treasury Bonds, National Housing Bonds, Grain Management Securities (GBs) and Foreign Exchange Stabilization Fund Bonds (FXSBs). The government does not issue GBs since December 1999 and FXSBs have been merged since 2004 in an effort to enhance market liquidity and achieve standardization. The secondary market is the most liquid in Asia. Three-year maturities are currently considered as the benchmark although the government is trying to promote the 5-year segment and 10-year issues were introduced in 2000. The issuance of Treasury bills discontinued in 1994 and restarted in 2003.	1994-2004	National Statistical Office (http:// kosis.nso.go.kr)
Latvia	Medium-term bonds and long-term bonds (with an initial maturity above 5-years) denominated in lats. The coupon is set as the average of the yield bids. It remains unchanged if the security is issued repeatedly.	1997-2004	Financial resources department of the State Treasury (www.kase.gov.lv)

Lithuania	Bonds and notes denominated in Litas. They bear a fixed coupon, according to both the register of government securities issued by the Ministry of Finance and Bloomberg. An exception is issue No. 61001 auctionned in 1996 for 10 years under a special law, which bears floating interest.	1994-2002	Ministry of Finance (www.finmin.lt)
Lebanon	2-year and 3-year domestic bonds issued by the government, which all have a fixed rate.	1994-2004	Banque du Liban (www.bdl.gov.lb)
Malaysia	Government bonds (MGS), excluding islamic bonds. According to the Malaysian central bank, the tenor of MGS is above one year and the coupon rate is determined by the weighted average of the successful yield, thereby fixed. Security-by-security data confirm that the coupon rate of government bonds, once determined, does not change over time. This is additionally confirmed by the Bloomberg pages available for MGS issues. Bonds are issued with maturities of 3, 5, 7, 10 and 15 years. There was also a 20-year issue in 1998.	1994-2004	Bank Negara Malaysia (www.bnm.gov.my)
Mexico	Fixed-rate semiannual coupon bonds (Bonos) issued with a maturity of up to 20 years. They were first introduced in 2000 with maturities of 3 and 5 years.	1994-2004	Ministry of Finance and Public Credit (www.shcp.gob.mx)
Peru	Bonos soberanos (tasa fija).	2002-2004	Ministerio de economia y finanzas (www.mef.gob.pe)
The Philippines	Fixed-rate bonds (including zero-coupon bonds). Fixed-rate Treasury bonds were introduced in 1994 to deepen the capital market. Treasury bonds are issued in tenors of 2, 5, 7, 10, 20 and 25 years.	1999-2004	Bureau of the Treasury (www.treasury.gov.ph)
Poland	Marketable fixed rate bonds, including zero-coupon issuances. They are issued in tenors of 2, 3, 4, 5, 10 and 20 years.	1997-2004	Ministry of Finance (www.mofnet.gov.pl)
Russia	Federal loan bonds (OFZs) with fixed interest rate, including OFZ-PDs (constant coupon issues), OFZ-FDs (fixed coupon issues, including multi-step coupon issues) and OFZ-ADs (including multi-step coupon issues and net of issue 48000 with a variable coupon).	1994-2004	Ministry of Finance (www.minfin.ru)
Singapore	Given the government's ample finances, sovereign bonds (SGSs) are primarily issued for corporate benchmarking purposes. Maturities range between 1 to 15 years. SGS bonds carry a fixed semi-annual coupon.	1994-2004	Singapore government securities (www.sgs.gov.sg)
Slovakia	Treasury bonds in domestic currency, excluding those with a floating rate (i.e. issues No. 004, 005, 006, 143, 144, 151, 152, 161).	1995-2002	National Bank of Slovakia (www.nbs.sk)

Slovenia	Long-term bonded debt denominated in tolar with a fixed rate estimated by crossing information on the composition of domestic debt by maturity, currency and coupon type.	1994-2004	Ministry of Finance (www.gov.si/mf)
South Africa	National government bonds, net of issues with a variable or various coupon rates (i.e. issues R103c, R104c, R105c, R106c, R107c, R108c, R192, R193, R199, R305c, R306c, R307c, R308c, R199 and Sundry). Tenors extend to the 20-year maturity. A substantial share of new issuance has been switched into CPI-linked bonds in recent years.	1999-2004	South African Reserve Bank (www.reservebank.co.za)
Taiwan	Government bonds are issued by the Central Bank of China on behalf of the Ministry of Finance with maturities between 5 and 30 years, with tenors beyond 10 years the most common. Bonds have annual fixed-rate coupons, including two zero coupon bond issues.	1995-2004	Central Bank of China (www.cbc.gov.tw)
Thailand	Government bonds consist mainly of "loan bonds" which are issued to fund both fiscal deficits and the recapitalization of the financial sector. Tenors extend to the 20-year maturity.	1994-2004	Thai bond dealing centre (www.thaibdc.or.th)
Turkey	Amounts of long-term fixed rate bond issues have to be estimated by crossing information on the composition of public debt both by instrument and maturity. Most issues likely have a maturity below 2 years. Explicit evidence from auction data available from the Turkish Treasury website (fixed couponed TRL-denominated Treasury auctions) suggest indeed that, in 2003, TRL 3 trillion worth of bonds with a 2-year maturity and a fixed rate were issued against TRL 3.7 billion worth of bonds with a maturity of 2 to 3 years and a fixed rate (in 2004).	1998-2004	Turkish Treasury (www.treasury.gov.tr)
Uruguay	All debt securities are either short-term or indexed (to prices or wages).	1999-2004	Banco central de Uruguay (www.bcu.gub.uy)
Venezuela	Vebonos are the main notes issued by the government and have a floating rate. Security-by-security data indicate that, early 2005, all bonds had a floating rate, in line with the 2001 estimate of JP Morgan (90% floating, 10% short-term). It is therefore plausible that none of the Venezuelan bonds have a fixed rate (consistently with evidence available from Bloomberg).	1999-2004	Ministerio de Finanzas (www.mf.gov.ve)