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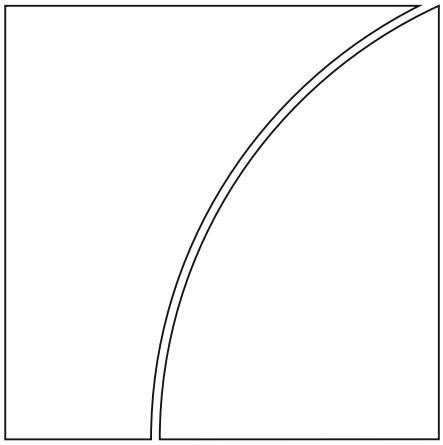

BIS Working Papers

No 627

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by Stefan Avdjiev, Stephan Binder and Ricardo Sousa

Monetary and Economic Department

April 2017

JEL classification: E10, E40, E50, E47

Keywords: credit cycles, external debt composition

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This publication is available on the BIS website (www.bis.org).

ISSN 1020-0959 (print)
ISSN 1682-7678 (online)

External debt composition and domestic credit cycles

Stefan Avdjiev, Stephan Binder and Ricardo Sousa[#]

Abstract

We assess the role of external debt in shaping the dynamics of domestic credit cycles. Using quarterly data for 40 countries between 1980 and 2015, we examine four dimensions of external debt composition: instrument, sector, currency and maturity. We show that the first two dimensions provide valuable information about the likelihood of credit booms and busts. In particular, we find that a higher share of external bank lending in the form of bonds is associated with a greater likelihood of credit booms. Our results also reveal that credit busts tend to be associated with a lower share of interbank lending and a higher share of lending from banks to non-banks.

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[#] Bank for International Settlements. The views expressed in this paper are those of the authors and do not necessarily reflect those of the BIS. We thank Claudio Borio, Michael Chui, Mathias Drehmann, Leonardo Gambacorta, Blaise Gadanecz, Enisse Kharroubi, Cathérine Koch, Patrick McGuire, Ramon Moreno, Nikhil Patel and Philip Wooldridge, for comments and suggestions. Bat-el Berger provided excellent research assistance.

1. Introduction

International capital flows have grown significantly over the past several decades (Bussière et al (2016)). Cross-border bank lending has been one of the most important channels for the expansion of such activity, especially in the pre-crisis period (Rey (2015); Bruno and Shin (2015a, 2015b)). In the post-crisis period, international debt securities issuance has also picked up considerably in what has become known as the "second phase of global liquidity" (Shin (2013)).

It is well documented in the existing literature that international capital flows can be a double-edged sword. On the one hand, a number of benefits are associated with them. For instance, Claessens and van Horen (2014) have shown that they help satisfy domestic credit demand in recipient countries. In addition, international bank flows have helped to improve funding conditions and have promoted stronger competition in destination countries (Claessens et al (2001); Beck et al (2004)).

On the other hand, expanded international capital flows have also brought some challenges. Previous research has shown that excessive credit growth in recipient countries is one of the most visible consequences of international bank flows (Demirgüç-Kunt and Detragiache (1998); Laeven and Valencia (2013)). Others have highlighted the spillovers of banking sector shocks across different jurisdictions (Obstfeld (2012); Kalemli-Ozcan et al (2013)). In addition, the international activities of banks complicate bank regulation and supervision (Cetorelli and Goldberg (2011); Cetorelli et al (2014)).

In this paper, we investigate how four characteristics of external debt affect the probability of domestic credit booms and busts. In particular, we examine the *type of instrument* through which external credit is extended, the *sector* (ie banks versus non-banks) of the lender and the borrower, as well as the *currency* composition and the *maturity* of external debt.

The composition of lending *instruments* may influence the impact of external debt on domestic credit via several channels. First, bonds are more liquid than loans (Choudhry (2001); Bai and Zhang (2012)). This makes it much easier for external investors to gain exposure to a given fast-growing economy (thus potentially fuelling a credit boom) via bonds than via loans. Second, loans tend to be associated with higher monitoring costs than bonds (Shirai (2001)). As a consequence, cross-border credit extension via loans is likely to be related to a greater level of commitment and initial costs on the part of external lenders than cross-border credit extension via bonds. Third, bonds tend to be less regulated than loans (Sercu (2009)). Therefore, one might expect that external bond financing could have a larger and more procyclical impact on credit. All three of the above channels suggest that external bond financing is more strongly associated with periods of an intensified growth in domestic credit than external loan financing. Furthermore, external derivatives assets tend to be much more volatile than loans and bonds (Fight (2004)). This is especially the case during crisis periods, when the prices of the underlying assets in the respective derivatives contracts can move sharply away from their reference prices. Consequently, one could expect that the value of external derivatives obligations spikes up during bust periods. Finally, derivatives tend to be more complex and opaque than both loans and bonds (Dubil (2008)). Such opaque instruments might support credit booms, but their contribution might not be immediately apparent.

Regarding the *borrowing sector*, it has been argued that external lenders' monitoring efforts may be different depending on whether the borrowers are banks or non-banks (Martinez (2015)). Moreover, distortions related to asymmetric information tend to be less (more) severe during expansions (recessions) (Dell'Ariccia and Marquez (2006)). And there are barriers to entry and efficiency issues (Kerl and Niepmann (2015)). On the *lending sector* side, it is well known that banks tend to be more heavily regulated than non-bank providers of credit. This could make it easier for the latter to engage in speculative cross-border lending, thus potentially helping to fuel credit booms in the recipient countries.

The *currency* in which external debt is denominated could potentially also have a significant impact on the evolution of the credit cycle in the borrowing economy. A number of recent studies have emphasised the unique role that the US dollar plays as the premier global funding currency in the international financial system (Rey (2015); Bruno and Shin (2015a and 2015c)). Bruno and Shin (2015b) have outlined a mechanism through which fluctuations in the value of the US dollar influence the global financial cycle. More concretely, a depreciation (an appreciation) of the US dollar vis-à-vis the domestic currency of a given country can increase (reduce) the net worth of local borrowers with currency mismatches, thus easing (tightening) financial conditions in the borrowing country.

Finally, the *maturity* of external debt could also have an impact on domestic credit cycles. In particular, shorter maturities expose borrowers to rollover risk, while providing more flexibility for lenders. Conversely, longer maturities can reduce the rollover risk for borrowers, but at the expense of greater duration risk for lenders (Gruić et al (2014)). Furthermore, shorter external debt maturities could reduce incentives for time-inconsistent economic policies (Alesina et al (1992); Blanchard and Missale (1994)). This means that a longer average external debt maturity can help mitigate the impact of external shocks, but also creates the conditions for financial imbalances that mount over time. Meanwhile, a shorter average external debt maturity could potentially amplify domestic credit cycles.

Our empirical investigation of the role played by external debt composition in shaping the dynamics of credit cycles consists of two main steps. We first draw on a novel methodology developed by Agnello et al (2015) and Burnside et al (2016), who identify the various phases of the housing market cycle, and apply it to detect credit booms, credit busts and "normal times" in the credit cycle. Then, using quarterly data for 40 countries over the period 1980–2015, we assess the contribution of the four above-mentioned dimensions of external debt composition (ie instrument, borrowing/lending sector, currency and maturity) in explaining the likelihood of the different phases of the credit cycle.

We find that the instrument composition of external debt has a significant impact on credit cycles. More concretely, greater reliance on external bond financing increases the likelihood of credit booms. Furthermore, a higher share of derivatives in external bank debt raises the probability of credit busts. Finally, a larger proportion of loans tends to be associated with "normal times" in the credit cycle.

The lending and the borrowing sector are also statistically significant determinants of the phase of the credit cycle. A higher interbank share in external lending is associated with a reduced probability of a credit bust. By contrast, when the share of external lending from banks to non-banks is elevated, credit busts are more likely to occur.

Our findings attribute a less prominent role to the currency distribution and the maturity composition of external debt in shaping the dynamics of credit cycles in borrowing countries. Nevertheless, there are some (data-related) caveats associated with these results.

The remainder of the paper is structured as follows. Section 2 reviews the related literature. Section 3 describes the data, the methodology used for the identification of credit cycles, and the general econometric framework. In Section 4, we present the benchmark empirical results, while in Section 5 we provide a summary of the various robustness checks. Finally, Section 6 concludes and presents the main policy implications.

2. Related literature

The main questions that we address in this paper are related to two main strands of literature.

The first one looks at the determinants of boom-bust credit cycles and tries to disentangle between *domestic* (ie "pull") and *global* (ie "push") factors (Calvo et al (1993); Chuhan et al (1998)). Among domestic factors, economic growth is believed to fuel credit expansion, thus potentially leading to crisis episodes (Hofmann (2004); Aliber and Kindleberger (2011)). Changes in the value of the collateral also affect borrowers' constraints, thus impacting credit growth and generating financial vulnerabilities (Kiyotaki and Moore (1997); Iacoviello (2005); Iacoviello and Minetti (2008)). Furthermore, there is empirical evidence that credit booms typically lead to financial crises (Schularick and Taylor (2012); Jordà et al (2016)) and certain dimensions of debt make them particularly "ugly" (Barajas et al (2007); Dell'Ariccia et al (2008); Reinhart et al (2016)).

Global factors also have the potential to impact domestic credit cycles. Credit booms are normally preceded by sharp rises in capital inflows (Kaminsky and Reinhart (1999); Kaminsky et al (2004)). Episodes of US dollar depreciation are associated with increased cross-border bank flows and an overall tightening of global financial conditions (Bruno and Shin (2015a, 2015b)). There is also evidence that the cross-border component of credit typically outgrows its domestic counterpart during financial booms (Borio et al (2011); Avdjiev et al (2012)). Finally, there is research supporting the idea that "not all flows are the same". For instance, debt flows are more likely to generate credit booms than other flows (Borio and Disyatat (2011); Jordà et al (2011); Gourinchas and Obstfeld (2012); Rey (2015)).

The second avenue of research to which our paper is related investigates different aspects of debt composition. For example, some authors focus on the long-term borrowing costs and on the ability of economic agents to finance expenditures or to roll over existing debts. Here, the minimisation of debt service costs can be seen as relevant for dampening financial vulnerabilities (Dell'Erba et al (2015); Debrun and Kinda (2016)). For emerging market economies, the "original sin" (or inability to finance external borrowing in local currency) is also often mentioned as an important macroeconomic drawback. Indeed, high debt yields are normally seen as a source of financial stress (Eichengreen and Hausmann (2002); Borensztein et al (2004)). Debt composition also matters for the design of optimal policy. For instance, some authors highlight that interest payments on debt should be structured in such a way that they

are kept low when the output (the government spending) is lower (higher) than expected (De Groot et al (2015)). Finally, debt composition can be thought as a relevant incentive mechanism device, as the domestic/external ownership of debt can have implications for the probability of default (De Broeck (1997); Drazen (1998)).

3. Data, credit cycles and econometric methodology

3.1. Data sources

Our data set consists of quarterly data for 40 countries over the period Q1/1980-Q2/2015.[1]

We use the BIS data set on total credit to private non-financial sector in order to identify the different phases of the credit cycle.

To pin down the various dimensions of external debt composition, we combine data from the BIS locational banking statistics (LBS), the BIS consolidated banking statistics (CBS) and the BIS international debt securities statistics (IDSS). The BIS LBS are compiled following principles that are consistent with the balance of payments data. An important advantage of the LBS data is that they allow us to aggregate external bank lending flows and stocks conditional on the country in which the borrower resides. The BIS LBS data also contain a breakdown by borrowing sector (banks versus non-banks) and instrument type (loans, debt securities and other instruments (typically, derivatives).[2] Finally, the LBS data make it possible to distinguish among the various currencies in which external debt to banks is denominated.

We also use the BIS CBS data in our empirical analysis. We take advantage of the fact that the international claims category of the CBS data contains a maturity breakdown, which allows us to decompose bank lending into a short-term component (claims with remaining maturity of up to one year) and a long-term component (claims with remaining maturity of over one year). Strictly speaking, international claims are not equivalent to external lending since, in addition to cross-border claims, they also include the foreign currency-denominated local claims of banks' foreign subsidiaries. Nevertheless, the former series is a fairly good proxy for the latter given that cross-border claims represent over 90% of international claims for most borrowing countries. Furthermore, the growth rates of the two series exhibit positive and strongly statistically significant correlation for the overwhelming majority of countries that we examine.

We complete the construction of our external debt composition measures by using the BIS international debt securities statistics (IDSS). For the purposes of the BIS

[1] The countries included in the analysis are: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Italy, Japan, Korea, Luxembourg, Malaysia, Mexico, the Netherlands, Norway, Poland, Portugal, Russia, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, the United Kingdom and the United States,

[2] In the BIS LBS data, the category "other instruments" is a residual category which covers banks' residual claims (ie those not included under "loans and deposits" and "debt securities"). The category tends to be dominated by bank's derivatives instruments with positive market value, as well as their equity holdings and participations.

IDSS data, debt securities are defined as international if they meet at least one of the following three criteria: (i) if they are issued in a market other than the local market of the country where the borrower resides; (ii) if they are traded in a market other than the local market of the country where the borrower resides; and (iii) if they are governed by the law of a country which is different from that of the country in which the borrower resides (Gruić and Wooldridge (2012)). The IDSS data are compiled on a security-by-security basis and, consequently, contain very detailed breakdowns along a number of dimensions. The breakdowns that we exploit in our empirical analysis are those by borrowing country, borrowing sector, currency and maturity. It should be noted that the universe of international debt securities does not overlap perfectly with the universe of externally held debt securities. That said, for most countries and sectors, the degree of overlap between the two categories is very high (Avdjiev et al (2016)).

Other data series that we use in our empirical analysis include: 1) real GDP growth; 2) long-term (10-year) interest rates; 3) residential property price growth rates; 4) the inflation rates; and 5) effective exchange rate indices. Finally, we use the Chicago Board Options Exchange (CBOE) Volatility Index (VIX).

3.2. Identification of credit cycles

Following the methodology applied by Agnello et al (2015) and Burnside et al (2016) to the case of the housing market cycle, we identify episodes of booms, busts and "normal times" in the credit cycle.

This approach captures three major characteristics of credit cycles: 1) magnitude; 2) persistence; and 3) own history. In fact, it identifies large (magnitude) and persistent (duration) deviations from long-term trends. Moreover, it recognises that while some credit booms are followed by busts, others do not display the same pattern (own history). Finally, it requires the preliminary detection of upturns and downturns in real credit to the non-financial sector: we smooth quarterly real credit growth using a moving average and the (cumulative) real credit growth in a upturn (downturn) is required to exceed (fall below) a minimum (maximum) threshold before it can be labelled as a credit boom (bust).

Let us assume that y_t denotes the logarithm of real credit and x_t is the centred-moving average of y_t, that is, $x_t = \frac{\sum_{j=-n}^{n} y_{t+j}}{2n}$. An upturn (downturn) corresponds to an interval of time during which $\Delta x_t > 0$ ($\Delta x_t < 0$) for all t, and a peak (trough) is the last time period within an upturn (downturn). Consequently, a credit boom (bust) is defined as an upturn (downturn) such that $y_T - y_{T-L} > z$ ($y_T - y_{T-L} < -z$), where T is the peak of the boom (the trough of the bust) and L is the duration of the upturn (downturn). To identify booms and busts, we consider a five-quarter centred-moving average (ie $n=5$) and we assume that z is equal to the average size of upturns and downturns over the full sample.

In summary, the algorithm consists of the following steps:

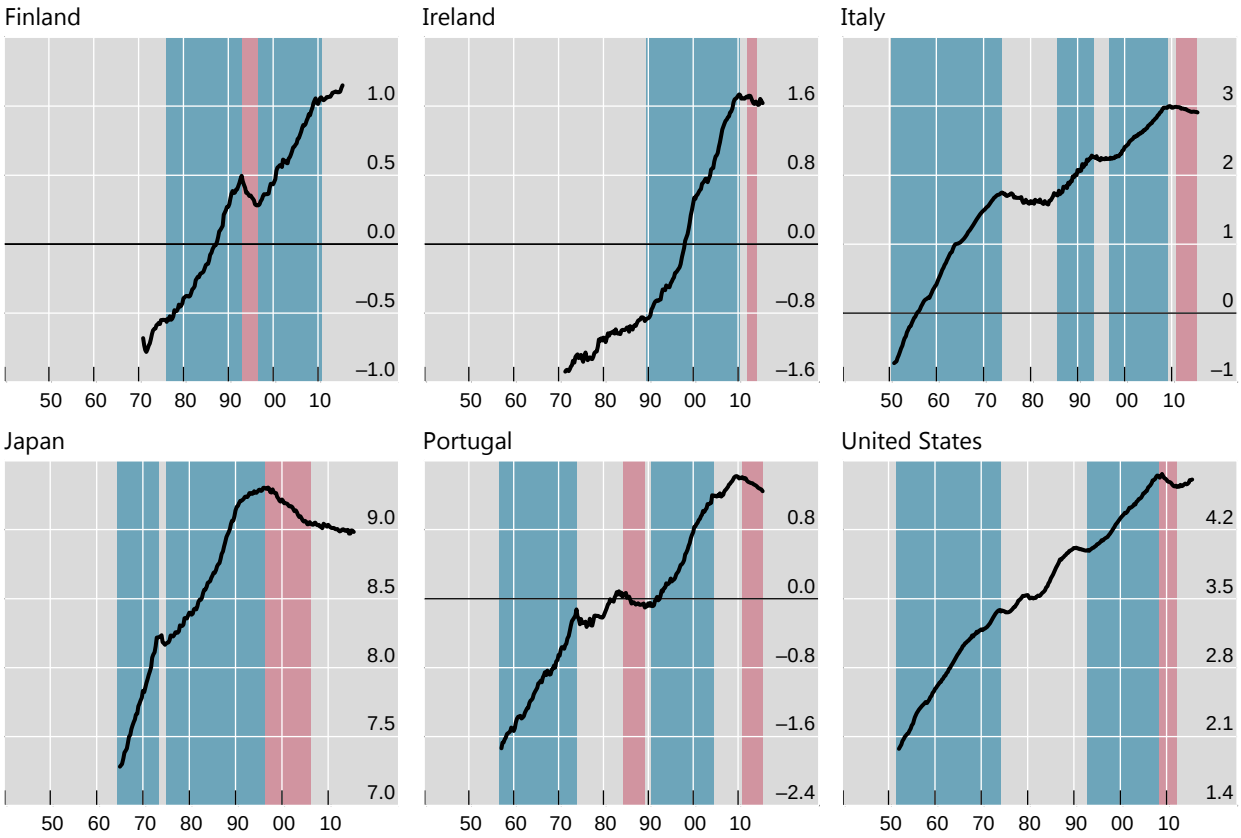
1. Smooth quarterly real credit growth series using a (five-quarter) moving average.
2. Detect periods of consecutive upturns (downturns) in real credit to the non-financial sector.
3. Build on cross-country variation to set (average) thresholds of (cumulative) real credit growth.

4. If a run-up (downturn) exceeds (falls below) a minimum (maximum) bound, then it is a credit boom (bust).

As an illustration, Graph 1 displays the credit booms (blue areas), the credit busts (red regions) and the "normal times" of the credit cycle (non-shaded areas) over time and for a subsample of countries. The solid line corresponds to the smoothed series of real credit to the private non-financial sector.

Real credit

Booms, busts and "normal times" Graph 1



Solid black line shows the smoothed series of real credit to the private non-financial sector. Blue areas indicate credit booms, red areas indicate credit busts and grey areas indicate "normal times".

Three main lessons can be drawn. First, credit cycles are strongly asymmetric. More specifically, credit booms are long and persistent. Our methodology identifies boom episodes as periods of consecutive upturns such that the cumulative real credit growth amounts to, at least, 51% (ie y_T-y_{T-L}>0.51). In contrast, credit busts are typically short and sharp. We identify bust episodes as periods of consecutive downturns such that the real credit growth falls by, at least 7%, in cumulative terms (ie y_T-y_{T-L}<-0.07). This labelling of the credit boom-bust cycle is consistent with the idea that the financial cycle tends to be much longer than the traditional business cycle (Drehmann et al (2012)).

Second, credit booms are typically followed by busts. However, there are several periods of large and persistent deviations of credit from its long-run equilibrium that do not materialise into sharp corrections in credit growth.

Third, a characterisation of the credit cycle must include credit booms, credit busts, and also "normal" or tranquil times, which may last for extended periods.

3.3. Econometric methodology

In order to investigate the impact of debt composition of the credit cycle, we estimate the following probit models:

$$Prob(Cycle\_phase_{it}=1|Debt\_Dim_{it}, \boldsymbol{X}_{it}) = \Phi(\lambda_i+\delta_t+\alpha Debt\_Dim_{it}+\boldsymbol{\beta X}_{it}) \quad (1)$$

where $Cycle\_phase=\{Boom, Bust, Normal\}$, α and $\boldsymbol{\beta}$ and are the vectors of the parameters to be estimated, *Prob* denotes probability, and Φ is the Cumulative Distribution Function (CDF) of the standard normal distribution.

Given that we rely on panel data, the structural models are as follows:

$$Cycle\_phase_{it}^{*} = \lambda_i+\delta_t+\alpha Debt\_Dim_{it}+\boldsymbol{\beta X}_{it}+\varepsilon_{it}$$
$$Cycle\_phase_{it} = 1 \text{ if } Cycle\_phase_{it}^{*} > 0, \text{ and } 0 \text{ otherwise,} \quad (2)$$

where $Cycle\_phase_{it}^{*}$ is the latent variable, i denotes the country, t corresponds to time, i= 1, …, 40, t = 1940, …, 2015, and ε_{it} is the error term.

We focus on various dimensions of *debt composition* (*Debt_Dim*), namely: 1) the type of instrument; 2) the lending/borrowing sector; 3) the currency in which debt is denominated; and 4) the maturity.

We also include a set of (economic, external and global) control variables ($\boldsymbol{X}_t$), namely: (i) the real GDP growth; (ii) the long-term interest rate; (iii) the residential property price growth rate; (iv) the inflation rate; (v) the effective exchange rate; (vi) the VIX index; and (vii) its squared term.

4. Empirical results

4.1. Type of instrument

The first dimension of external debt that we look at is the type of instrument. The data allow us to distinguish among three instruments: 1) bonds; 2) loans; and 3) other instruments (ie mostly derivatives). We start by looking at bonds, whereby, in model (1), *Debt_Dim* captures:

- the *share* of *debt securities* (bonds) in *total* external bank claims, counterparty sector: *all (ibs_all_curr_debt_all_all)*;
- the *share* of *debt securities* (bonds) in *total* external bank claims, counterparty sector: *banks (ibs_all_curr_debt_all_banks)*; and
- the *share* of *debt securities* (bonds) in *total* external bank claims, counterparty sector: *non-banks (ibs_all_curr_debt_all_non-banks)*.

The results are summarised in Table 1, which shows that when the share of bonds in total external bank claims rises, the likelihood of credit booms increases (Columns 1, 4 and 7). Moreover, a rise in the share of bonds in total external bank claims (in particular, when non-banks are the borrowing sector) is associated with a fall in the likelihood of "normal times" in the credit cycle (Columns 3 and 6).

Credit cycles and type of instrument (bonds) Table 1

	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal
GDP growth	0.106**	-0.201***	-0.032	0.084**	-0.211***	-0.008	0.110***	-0.184***	-0.043
	(0.042)	(0.052)	(0.041)	(0.040)	(0.057)	(0.041)	(0.042)	(0.047)	(0.041)
Long-term interest rate	0.000	0.120**	-0.066	0.006	0.115***	-0.068	0.006	0.123**	-0.073
	(0.048)	(0.047)	(0.049)	(0.049)	(0.043)	(0.052)	(0.048)	(0.052)	(0.049)
Property price growth	0.055**	-0.119***	-0.025	0.052**	-0.113***	-0.024	0.059**	-0.115***	-0.031
	(0.026)	(0.032)	(0.020)	(0.025)	(0.031)	(0.020)	(0.026)	(0.031)	(0.021)
Inflation rate	0.245***	-0.358***	-0.131	0.208**	-0.367***	-0.091	0.260***	-0.318***	-0.161*
	(0.093)	(0.092)	(0.089)	(0.097)	(0.103)	(0.094)	(0.094)	(0.089)	(0.088)
Effective exchange rate	0.401	0.197	-0.225	0.037	0.234	0.194	0.417	0.344	-0.370
	(1.519)	(0.909)	(1.529)	(1.593)	(0.930)	(1.631)	(1.532)	(0.929)	(1.529)
VIX	-6.886***	11.696***	3.751*	-6.365***	12.197***	3.294*	-7.107***	10.907***	4.149**
	(2.031)	(3.385)	(1.958)	(2.048)	(3.505)	(1.942)	(2.029)	(3.490)	(1.972)
VIX^2	1.132***	-1.900***	-0.601*	1.039***	-1.987***	-0.518*	1.167***	-1.762***	-0.667**
	(0.326)	(0.509)	(0.312)	(0.329)	(0.537)	(0.309)	(0.327)	(0.520)	(0.315)
ibs_all_curr_debt_all_all	2.505**	0.641	-2.596**						
	(1.042)	(1.704)	(1.162)						
ibs_all_curr_debt_all_banks				2.423*	-1.781	-1.797			
				(1.328)	(2.351)	(1.365)			
ibs_all_curr_debt_all_non-banks							1.307**	0.977	-1.639**
							(0.647)	(1.027)	(0.693)
Observations	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917
Log-likelihood	-1080	-320.6	-1121	-1105	-318.0	-1163	-1092	-313.6	-1115
R^2	0.182	0.302	0.124	0.163	0.308	0.092	0.173	0.318	0.129

Note: The table summarises the results of the estimation of Equation (1), with *Deb_Dim* captured by *ibs_all_curr_debt_all_all*, *ibs_all_curr_debt_all_banks* or *ibs_all_curr_debt_all_non-banks*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

These findings are in line with the fact that bonds tend to be less regulated, more liquid and associated with lower monitoring costs than loans. As a consequence, it is easier for external investors to alter their exposure to a given country at high frequencies via bonds than via loans. This, in turn, makes the impact of external bond financing more procyclical than that of loans. Thus, our empirical finding that an increase in the relative importance of bonds as an instrument for financing external debt is associated with a domestic credit boom is likely to be a manifestation of the combined effect of the above channels.

As for the other economic, external and global determinants of credit cycles, we find that real GDP growth, stronger growth in residential property prices and higher inflation are associated with more frequent credit booms and lower probability of credit busts. Higher long-term interest rates also raise the likelihood of credit busts in a statistically significant manner. Interestingly, the VIX index displays a non-linear (inverted U-shaped) relationship with the probability of credit booms and a U-shaped link with the probability of credit busts. Thus when the VIX index is high, an increase in global risk aversion and uncertainty leads to a fall in the likelihood of credit booms and a rise in the likelihood of credit busts.

An important point to bear in mind is that the share of bonds is computed as a fraction of total claims, which includes volatile banks' cross-border derivatives positions (as a part the "other claims" category). This could potentially bias the estimates. In order to tackle this issue, we exclude "other claims" from the computation of *Debt_Dim* and consider the following variables:

- the *share* of *debt securities* (bonds) in *total* external bank claims *(excluding* "other claims"*),* counterparty sector: *all (ibs_all_curr_debt_dl_all)*;
- the *share* of *debt securities* (bonds) in *total* external bank claims *(excluding* "other claims"*)*, counterparty sector: *banks (ibs_all_curr_debt_dl_banks)*; and
- the *share* of *debt securities* (bonds) in *total* external bank claims *(excluding* "other claims"*)*, counterparty sector: *non-banks (ibs_all_curr_debt_dl_non-banks)*.

A summary of the results is presented in Table 2. They are both qualitatively and quantitatively very similar to the empirical findings in Table 1, suggesting that the previous empirical findings are robust and not biased due to the presence of derivatives.

Next, we consider the importance of derivative positions. Formally, we use the "other claims" category as a proxy for bank's external derivatives positions. As

Credit cycles and type of instrument (bonds, excluding derivatives) Table 2

	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal
GDP growth	0.103**	-0.203***	-0.028	0.083**	-0.211***	-0.007	0.108***	-0.185***	-0.040
	(0.041)	(0.052)	(0.040)	(0.040)	(0.057)	(0.041)	(0.042)	(0.047)	(0.040)
Long-term interest rate	0.001	0.120**	-0.066	0.006	0.114***	-0.067	0.006	0.124**	-0.074
	(0.048)	(0.047)	(0.050)	(0.050)	(0.043)	(0.052)	(0.048)	(0.052)	(0.049)
Property price growth	0.055**	-0.118***	-0.025	0.052**	-0.112***	-0.024	0.059**	-0.116***	-0.031
	(0.026)	(0.031)	(0.020)	(0.025)	(0.031)	(0.020)	(0.026)	(0.031)	(0.021)
Inflation rate	0.242**	-0.362***	-0.127	0.206**	-0.367***	-0.089	0.258***	-0.321***	-0.158*
	(0.094)	(0.092)	(0.090)	(0.097)	(0.103)	(0.094)	(0.094)	(0.089)	(0.089)
Effective exchange rate	0.337	0.180	-0.149	0.004	0.246	0.225	0.367	0.300	-0.307
	(1.534)	(0.909)	(1.546)	(1.603)	(0.938)	(1.643)	(1.540)	(0.907)	(1.538)
VIX	-6.836***	11.798***	3.701*	-6.377***	12.219***	3.320*	-7.018***	11.001***	4.038**
	(2.032)	(3.405)	(1.956)	(2.036)	(3.529)	(1.934)	(2.038)	(3.486)	(1.972)
VIX^2	1.123***	-1.918***	-0.592*	1.040***	-1.991***	-0.521*	1.153***	-1.778***	-0.650**
	(0.327)	(0.513)	(0.312)	(0.327)	(0.541)	(0.308)	(0.329)	(0.520)	(0.315)
ibs_all_curr_debt_dl_all	2.195**	0.393	-2.219**						
	(0.971)	(1.553)	(1.075)						
ibs_all_curr_debt_dl_banks				1.906	-1.899	-1.306			
				(1.176)	(2.116)	(1.191)			
ibs_all_curr_debt_dl_non-banks							1.248**	0.897	-1.553**
							(0.630)	(1.004)	(0.675)
Observations	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917
Log-likelihood	-1086	-321.3	-1130	-1111	-316.7	-1168	-1093	-314.5	-1118
R^2	0.177	0.301	0.117	0.158	0.311	0.088	0.172	0.316	0.126

Note: The table summarises the results of the estimation of Equation (1), with *Deb_Dim* captured by *ibs_all_curr_debt_dl_all*, *ibs_all_curr_debt_dl_banks* or *ibs_all_curr_debt_dl_non-banks*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

discussed in the Data Section, this category does not approximate external derivatives positions perfectly since it contains additional items (such as banks' cross-border equity holdings). Nevertheless, in the case of most countries in our sample, "other claims" is a reasonably good proxy for banks' derivatives positions since the latter series account for the overwhelming majority of the outstanding stock of claims in the former series. Thus, we redefine *Debt_Dim* and compute:

- the *share* of *other instruments* (derivatives) in *total* securities, counterparty sector: *all (ibs_all_curr_other_all_all)*;
- the *share* of *other instruments* (derivatives) in *total* securities, counterparty sector: *banks (ibs_all_curr_other_all_banks)*; and
- the share of other securities (derivatives) in total securities, counterparty sector: non-banks (ibs_all_curr_other_all_non-banks).

The results in Table 3 show that when the share of derivatives as a percentage of total instruments issued by non-banks rises, the likelihood of credit busts increases (Column 8). This implies that an increase in the relative importance of derivatives, which tend to be opaque and complex instruments, is associated with periods of sharp decline in the growth rate of domestic credit.

Credit cycles and type of instrument (derivatives) Table 3

	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal
GDP growth	0.081**	-0.222***	-0.006	0.076*	-0.206***	-0.004	0.079**	-0.236***	-0.002
	(0.039)	(0.055)	(0.039)	(0.039)	(0.057)	(0.040)	(0.039)	(0.058)	(0.039)
Long-term interest rate	-0.004	0.137***	-0.059	-0.001	0.119***	-0.061	-0.005	0.156***	-0.063
	(0.051)	(0.044)	(0.053)	(0.050)	(0.045)	(0.052)	(0.052)	(0.045)	(0.054)
Property price growth	0.054**	-0.120***	-0.025	0.054**	-0.118***	-0.025	0.055**	-0.130***	-0.025
	(0.026)	(0.030)	(0.021)	(0.026)	(0.030)	(0.020)	(0.026)	(0.028)	(0.021)
Inflation rate	0.199**	-0.385***	-0.085	0.193*	-0.368***	-0.082	0.197**	-0.407***	-0.079
	(0.098)	(0.100)	(0.094)	(0.099)	(0.099)	(0.096)	(0.097)	(0.099)	(0.093)
Effective exchange rate	0.098	0.065	0.180	-0.093	0.150	0.265	0.065	-0.226	0.401
	(1.711)	(0.931)	(1.729)	(1.670)	(0.898)	(1.711)	(1.683)	(0.961)	(1.690)
VIX	-6.496***	12.324***	3.426*	-6.375***	11.976***	3.369*	-6.543***	12.873***	3.310*
	(1.975)	(3.442)	(1.893)	(1.985)	(3.406)	(1.912)	(1.953)	(3.580)	(1.890)
VIX^2	1.058***	-2.020***	-0.537*	1.036***	-1.949***	-0.527*	1.063***	-2.124***	-0.517*
	(0.318)	(0.523)	(0.302)	(0.320)	(0.523)	(0.306)	(0.315)	(0.545)	(0.302)
ibs_all_curr_other_all_all	-1.647	2.456	0.953						
	(1.880)	(2.371)	(2.216)						
ibs_all_curr_other_all_banks				-0.607	-0.347	0.734			
				(1.973)	(1.673)	(1.894)			
ibs_all_curr_other_all_non-banks							-0.672	3.084***	-0.319
							(1.092)	(0.991)	(1.280)
Observations	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917
Log-likelihood	-1125	-316.0	-1175	-1130	-321.6	-1176	-1129	-302.3	-1177
R^2	0.148	0.312	0.082	0.144	0.300	0.081	0.145	0.342	0.080

Note: The table summarises the results of the estimation of Equation (1), with *Deb_Dim* captured by *ibs_all_curr_other_all_all*, *ibs_all_curr_other_all_banks* or *ibs_all_curr_other_all_non-banks*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

Finally, in Table 4, we provide the empirical evidence associated with the third type of (external bank claim) instrument: loans. As before, we compute:

- the share of loans in total securities, counterparty sector: all (ibs_all_curr_loans_all_all);
- the *share* of *loans* in *total* securities, counterparty sector: *banks (ibs_all_curr_loans_all_banks)*; and
- the share of loans in total securities, counterparty sector: non-banks (ibs_all_curr_loans_all_non-banks).

We find that when the share of loans in total instruments rises, "normal times" in the credit cycle are more likely (Columns 3 and 9) and the probability of credit booms and credit busts falls (Columns 1, 7 and 8). This observation should not be interpreted as implying that an increase in loans may not fuel credit booms. Instead, it is the dynamics of the share of loans in total instruments vis-à-vis the dynamics of the share of other instruments that determines the likelihood of the various phases of the credit cycle. Thus, a higher share of loans is associated with a lower probability of credit busts and a higher likelihood of "normal times".

Credit cycles and type of instrument (loans) Table 4

	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal
GDP growth	0.095**	-0.201***	-0.023	0.080**	-0.204***	-0.005	0.109***	-0.170***	-0.049
	(0.041)	(0.059)	(0.040)	(0.039)	(0.059)	(0.040)	(0.042)	(0.057)	(0.039)
Long-term interest rate	0.004	0.134**	-0.071	0.003	0.113**	-0.065	0.016	0.161***	-0.094*
	(0.049)	(0.052)	(0.051)	(0.050)	(0.044)	(0.052)	(0.050)	(0.061)	(0.051)
Property price growth	0.055**	-0.124***	-0.025	0.054**	-0.115***	-0.025	0.059**	-0.124***	-0.031
	(0.026)	(0.034)	(0.020)	(0.025)	(0.030)	(0.020)	(0.026)	(0.038)	(0.020)
Inflation rate	0.228**	-0.349***	-0.118	0.200**	-0.359***	-0.085	0.261***	-0.266***	-0.178**
	(0.096)	(0.098)	(0.090)	(0.096)	(0.102)	(0.094)	(0.095)	(0.098)	(0.088)
Effective exchange rate	0.037	0.253	0.135	-0.100	0.231	0.301	0.061	0.320	0.031
	(1.510)	(0.863)	(1.516)	(1.597)	(0.953)	(1.646)	(1.490)	(0.902)	(1.461)
VIX	-6.617***	11.417***	3.586*	-6.387***	12.105***	3.337*	-6.854***	9.889***	3.990**
	(2.022)	(3.346)	(1.966)	(2.000)	(3.533)	(1.922)	(2.022)	(3.518)	(1.969)
VIX^2	1.084***	-1.856***	-0.570*	1.040***	-1.968***	-0.522*	1.128***	-1.600***	-0.646**
	(0.326)	(0.509)	(0.314)	(0.321)	(0.544)	(0.307)	(0.326)	(0.525)	(0.315)
ibs_all_curr_loans_all_all	-2.120*	-1.853	2.426*						
	(1.208)	(1.249)	(1.260)						
ibs_all_curr_loans_all_banks				-1.495	1.535	0.969			
				(1.234)	(1.128)	(1.229)			
ibs_all_curr_loans_all_non-banks							-1.572*	-2.605***	2.350***
							(0.816)	(0.856)	(0.801)
Observations	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917
Log-likelihood	-1095	-314.3	-1130	-1117	-317.9	-1172	-1088	-285.3	-1086
R^2	0.170	0.316	0.117	0.154	0.308	0.085	0.175	0.379	0.152

Note: The table summarises the results of the estimation of Equation (1), with *Deb_Dim* captured by *ibs_all_curr_loans_all_all, ibs_all_curr_loans_all_banks* or *ibs_all_curr_loans_all_non-banks*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

4.2. Lending/borrowing sector

The second dimension of interest in the composition of external debt is the lending/borrowing sector. To examine this, we re-estimate model (1), while constructing *Debt_Dim* as follows:

- the *share* of *bank-to-bank flows* as percentage of total external debt flows *(ids_all_curr_debt_b_b_all4)*;
- the share of bank-to-non-bank flows as percentage of total external debt flows (ids_all_curr_debt_b_nb_all4);
- the share of non-bank-to-non-bank flows as percentage of total external debt flows (ids_all_curr_debt_nb_nb_all4); and
- the share of non-bank-to-bank flows as percentage of total external debt flows (ids_all_curr_debt_nb_b_all4).[3]

The main findings are summarised in Table 5. They indicate that a lower share of cross-border interbank lending (as a percentage of total cross-border lending) is associated with a statistically significant increase in the likelihood of credit busts (Column 2). By contrast, when bank-to-non-bank lending becomes relatively more important, the likelihood of credit busts increases (Column 5).

The explanation for this finding may be related to the information asymmetries in financial intermediation (Akerlof (1970); Hellmann et al (2000)). More specifically, banks located in a given country naturally have informational advantages (about both the creditworthiness of local borrowers and the phase of the local credit cycle) over banks located abroad. Thus, cross-border interbank lending is an opportunity for the latter to gain exposure to the respective borrowing economy while benefiting from the informational advantage of the former. This would tend to reduce information asymmetries, thus making credit busts less likely. By contrast, direct cross-border lending from banks to non-banks would not benefit from the above mechanism for reducing information asymmetries and, consequently, would be more likely to pave the way for the occurrence of credit busts.

[3] As discussed in the Data Section, the universe of international debt securities does not overlap perfectly with the universe of externally held debt securities. Consequently, our estimated series for non-bank to non-bank lending is an approximation, whose degree of accuracy varies across borrowing countries. Nevertheless, as we demonstrate in Section 5.5, our results are robust to using alternative measures of externally held debt securities.

Credit cycles and lending-borrowing sector Table 5

	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal
GDP growth	0.085**	-0.224***	-0.014	0.080**	-0.182***	-0.014	0.060	-0.213***	0.014	0.071*	-0.215***	0.003
	(0.040)	(0.060)	(0.042)	(0.040)	(0.059)	(0.040)	(0.043)	(0.056)	(0.045)	(0.040)	(0.056)	(0.041)
Long-term interest rate	-0.016	0.103**	-0.042	-0.001	0.136***	-0.061	-0.023	0.117**	-0.041	-0.005	0.123***	-0.056
	(0.047)	(0.046)	(0.046)	(0.049)	(0.045)	(0.050)	(0.047)	(0.047)	(0.046)	(0.047)	(0.042)	(0.048)
Property price growth	0.050**	-0.102***	-0.020	0.053**	-0.111***	-0.024	0.050**	-0.116***	-0.021	0.053**	-0.114***	-0.024
	(0.025)	(0.031)	(0.019)	(0.026)	(0.030)	(0.020)	(0.025)	(0.030)	(0.019)	(0.025)	(0.029)	(0.020)
Inflation rate	0.185**	-0.367***	-0.070	0.196*	-0.318***	-0.091	0.155*	-0.379***	-0.042	0.183**	-0.380***	-0.069
	(0.092)	(0.121)	(0.089)	(0.102)	(0.111)	(0.095)	(0.093)	(0.101)	(0.087)	(0.092)	(0.103)	(0.087)
Effective exchange rate	-0.102	1.166	0.279	-0.162	0.349	0.393	-0.296	0.225	0.482	-0.305	0.201	0.527
	(1.678)	(1.165)	(1.730)	(1.629)	(1.101)	(1.694)	(1.675)	(0.863)	(1.709)	(1.618)	(0.907)	(1.658)
VIX	-6.403***	12.957***	3.378*	-6.397***	11.462***	3.409*	-6.196***	12.291***	3.171	-6.300***	12.775***	3.274*
	(1.957)	(3.877)	(1.903)	(1.989)	(3.494)	(1.901)	(1.995)	(3.459)	(1.941)	(1.982)	(3.650)	(1.908)
VIX^2	1.041***	-2.095***	-0.529*	1.040***	-1.858***	-0.535*	1.001***	-2.001***	-0.488	1.022***	-2.078***	-0.509*
	(0.315)	(0.599)	(0.304)	(0.321)	(0.537)	(0.304)	(0.321)	(0.526)	(0.309)	(0.318)	(0.553)	(0.303)
ibs_all_curr_debt_b_b_all4	-0.662	-5.128**	0.858									
	(0.898)	(2.524)	(0.907)									
ibs_all_curr_debt_b_nb_all4				0.178	1.707**	-0.456						
				(0.679)	(0.840)	(0.670)						
ibs_all_curr_debt_nb_nb_all4							0.674	0.254	-0.639			
							(0.535)	(0.542)	(0.543)			
ibs_all_curr_debt_nb_b_all4										-0.408	-1.052	0.483
										(0.543)	(0.965)	(0.543)
Observations	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917
Log-likelihood	-1116	-295.2	-1153	-1130	-305.6	-1169	-1109	-321.3	-1157	-1124	-317.6	-1167
R^2	0.155	0.357	0.100	0.144	0.335	0.087	0.160	0.301	0.096	0.149	0.309	0.088

Note: The table summarises the results of the estimation of Equation (1), with *Deb_Dim* captured by *ibs_all_curr_debt_b_b_all4*, *ibs_all_curr_debt_b_nb_all4*, *ibs_all_curr_debt_nb_nb_all4* or *ibs_all_curr_debt_nb_b_all4*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

4.3. Currency

The third dimension of external debt composition that we assess is the currency of denomination. Here, *Debt_Dim* in model (1) is defined in three alternative ways:

- the share of debt denominated in US dollars in total debt, counterparty sector: all (ibs_usd_all_curr_all_all);
- the share of debt denominated in US dollars in total debt, counterparty sector: banks (ibs_usd_all_curr_all_banks); and
- the share of debt denominated in US dollars in total debt, counterparty sector: non-banks (ibs_usd_all_curr_all_non-banks).

We summarise the main findings in Table 6. None of the variables capturing the currency dimension of the external debt composition is statistically significant. While this result suggests that this dimension does not help explain the dynamics of the domestic credit cycle, it must be interpreted with caution. As most of the bank claims are denominated in US dollars, the existing data do not allow us to capture enough

variation in the composition of external debt vis-à-vis the currency of denomination. Moreover, for some countries – in particular, countries in emerging Europe – other currencies, such as the euro or the Swiss franc may play a more prominent role than the US dollar.

Credit cycles and currency

Table 6

	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal
GDP growth	0.070*	-0.158***	-0.011	0.068*	-0.155***	-0.009	0.077**	-0.166***	-0.017
	(0.038)	(0.041)	(0.039)	(0.037)	(0.041)	(0.039)	(0.037)	(0.042)	(0.038)
Long-term interest rate	-0.020	0.147***	-0.054	-0.023	0.149***	-0.053	-0.017	0.148**	-0.057
	(0.051)	(0.056)	(0.051)	(0.052)	(0.058)	(0.051)	(0.051)	(0.058)	(0.051)
Property price growth	0.057**	-0.095***	-0.031	0.055**	-0.091***	-0.030	0.060**	-0.102***	-0.032
	(0.027)	(0.030)	(0.021)	(0.026)	(0.032)	(0.021)	(0.027)	(0.028)	(0.021)
Inflation rate	0.162*	-0.252**	-0.084	0.156	-0.243**	-0.080	0.180*	-0.271***	-0.098
	(0.097)	(0.108)	(0.095)	(0.097)	(0.109)	(0.095)	(0.093)	(0.102)	(0.093)
Effective exchange rate	-0.111	0.688	0.064	-0.058	0.569	0.066	-0.111	0.824	-0.004
	(1.514)	(1.045)	(1.587)	(1.527)	(0.983)	(1.603)	(1.490)	(1.132)	(1.538)
VIX	-4.597***	5.115	2.460	-4.611***	5.027	2.429	-4.735***	5.457	2.568
	(1.720)	(3.563)	(1.721)	(1.695)	(3.515)	(1.705)	(1.749)	(3.526)	(1.744)
VIX^2	0.777***	-0.907*	-0.402	0.779***	-0.893*	-0.396	0.801***	-0.966*	-0.421
	(0.276)	(0.517)	(0.277)	(0.272)	(0.510)	(0.274)	(0.281)	(0.513)	(0.280)
ibs_usd_all_curr_all_all	0.505	-1.103	-0.003						
	(0.593)	(1.245)	(0.644)						
ibs_usd_all_curr_all_banks				0.657	-1.234	-0.079			
				(0.596)	(1.215)	(0.625)			
ibs_usd_all_curr_all_non-banks							0.181	-0.867	0.179
							(0.532)	(1.164)	(0.601)
Observations	1,972	1,972	1,972	1,972	1,972	1,972	1,972	1,972	1,972
Log-likelihood	-1184	-353.2	-1222	-1180	-349.9	-1221	-1190	-357.0	-1221
R^2	0.128	0.267	0.071	0.131	0.274	0.071	0.124	0.259	0.071

Note: The table summarises the results of the estimation of Equation (1), with *Deb_Dim* captured by *ibs_usd_all_curr_all_all*, *ibs_usd_all_curr_all_banks* or *ibs_usd_all_curr_all_non-banks*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

4.4. Maturity

Finally, in this Section, we focus on the fourth dimension of the external debt composition: maturity. As before, we re-estimate model (1) while adjusting the computation of *Debt_Dim* to account for:

- the share of "short-term" international bank lending in total international bank lending (ids_st_all); and
- the share of "short-term international credit" in total international credit (itc_st_resid_all).

To compute the share of "short-term" international bank lending in total international bank lending, we rely on the BIS consolidated banking statistics, which allows us to distinguish between the outstanding amount of short-term and long-

term debt (ie debt with maturity longer than one year). Thus, we construct the ratio of "short-term" international bank claims in total international bank claims. And in the computation of the "short-term international credit", we use data from the BIS IDSS, which makes it possible to disaggregate between residual (remaining) maturity of up to one year and residual (remaining) maturity of more than one year. Consequently, we construct the share of "short-term" international debt securities in total international debt securities.

Our results are shown in Table 7. We do not find a statistically significant influence of either the outstanding amount of "short-term" international bank lending (as percentage of total international bank lending) or the "short-term international credit" (as percentage of total international credit) on the likelihood of the various phases of the credit cycle. In fact, in all cases, the coefficients associated with *itc_st_all* and *itc_st_resid_all* are not statistically significant.

The above result should be interpreted against the background of an important caveat related to data availability. Namely, the existing (international bank lending) data only allow us to distinguish between debt with residual maturity of up to one year and debt with residual maturity longer than one year. It is possible that the disaggregation using that particular horizon is not the most relevant in the context of examining the impact of external debt composition on domestic credit cycles.

Credit cycles and maturity

Table 7

	Booms	Busts	Normal	Booms	Busts	Normal
GDP growth	0.074*	-0.193***	-0.009	0.068*	-0.204***	0.003
	(0.040)	(0.060)	(0.040)	(0.039)	(0.061)	(0.041)
Long-term interest rate	-0.005	0.097**	-0.051	-0.015	0.121***	-0.054
	(0.046)	(0.046)	(0.047)	(0.049)	(0.044)	(0.049)
Property price growth	0.047**	-0.117***	-0.021	0.053**	-0.117***	-0.024
	(0.024)	(0.035)	(0.019)	(0.025)	(0.030)	(0.020)
Inflation rate	0.186**	-0.344***	-0.085	0.170*	-0.358***	-0.066
	(0.091)	(0.103)	(0.087)	(0.095)	(0.105)	(0.094)
Effective exchange rate	-0.174	0.759	0.185	0.060	0.051	0.204
	(1.626)	(1.105)	(1.621)	(1.655)	(0.901)	(1.693)
VIX	-6.595***	13.500***	3.604**	-6.307***	12.065***	3.307*
	(1.923)	(3.293)	(1.826)	(1.936)	(3.412)	(1.901)
VIX^2	1.059***	-2.152***	-0.555*	1.022***	-1.962***	-0.514*
	(0.306)	(0.513)	(0.289)	(0.311)	(0.525)	(0.304)
itc_st_all	-0.324	-2.695	1.018			
	(0.935)	(1.691)	(0.972)			
itc_st_resid_all				-1.617	0.741	0.968
				(1.450)	(1.035)	(1.352)
Observations	1,800	1,800	1,800	1,917	1,917	1,917
Log-likelihood	-1077	-295.3	-1117	-1123	-321.3	-1175
R^2	0.134	0.342	0.079	0.149	0.301	0.0823

Note: The table summarises the results of the estimation of Equation (1), with *Deb_Dim* captured by *itc_st_all* or *itc_st_resid_all*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

4.5. Economic significance

How economically significant is the external debt composition for our understanding of the dynamics of the credit cycle? While a number of results are statistically significant, if the magnitude of the estimated coefficients is small, then the variables capturing the various dimensions of debt composition will not really matter in terms of explaining the various phases of the credit cycle.

One complication that arises in the assessment of the economic significance is that we use a limited-dependent variable (probit) model. Hence the estimated coefficients cannot be interpreted as measuring the effect on the conditional mean of the dependent variable of a given (unit) change in each regressor. The signs of the coefficients give an indication of the direction of the effects, but not of the marginal effects; and the magnitude of the estimated coefficients are expressed in units of standard deviation of the errors (Wooldridge (2002); Cameron and Trivedi (2005); Long and Freese (2006)).

For continuous variables, such as the shares computed along a specific dimension of external debt composition, the marginal effects evaluated, for instance, at the means of the different regressors can be retrieved as follows

$$\frac{\partial \Phi(\lambda i + \delta t + \alpha Debt\_Dim_{it} + \boldsymbol{\beta X_{it}})}{\partial Deb\_Dim_{it}} \Big|_{Deb\_Dim_{it}=\overline{Deb\_Dim_{it}},\, \boldsymbol{X_{it}}=\overline{\boldsymbol{X}_{it}},} =$$

$$= f(\lambda i + \delta t + \alpha Debt\_Dim_{it} + \boldsymbol{\beta X} it) \cdot \alpha, \qquad (3)$$

where $f(\lambda i + \delta t + \alpha Debt\_Dim_{it} + \boldsymbol{\beta X} it)$ is the Probability Density Function (PDF) of the standard normal distribution, $\overline{Deb\_Dim_{it}}$ is the sample mean of a specific variable capturing the dimension of external debt composition and $\overline{\boldsymbol{X}_{it}}$ is the vector of the sample means of all the other control variables. Consequently, the marginal effects measure the impact on the probability of the event that we are looking at (ie credit boom, credit bust or "normal time" in the credit market) of an instantaneous change in the regressor.

The economic significance of our results is summarised in Table 8. For brevity, we only present the marginal effects associated with the different variables that track the dynamics of external debt composition along each of the four dimensions considered in the analysis. We also report the predicted (conditional) probability of the model that includes the "row" variable and the final row of the table provides the unconditional probability of credit booms, credit busts and "normal times" in the credit cycle.

The effects of external debt composition (especially regarding the type of instrument) on the likelihood of the various phases of the credit cycle are economically important. For instance, a 1 percentage point increase in the share of bonds in total external bank claims leads to an increase in the probability of a credit boom of close to 1 percentage point and a fall in the likelihood of "normal times" of about the same magnitude. In contrast, a 1 percentage point increase in the share of loans in total external bank claims is associated with a fall in the probability of a credit boom of around 1 percentage point and a rise in the likelihood of "normal times" of the same magnitude. Finally, a 1 percentage point rise in the share of bank-to bank lending in total lending leads to a fall in the probability of credit busts of 0.08 percentage points and a rise in the probability of credit busts of 0.05 percentage points, approximately.

Interestingly, the predictive (conditional) probabilities of booms, busts and "normal times" implied by our models also closely match the unconditional probabilities. In fact, in the data, the unconditional probabilities of booms, busts and "normal times" are 58.0%, 6.8% and 35.1%, respectively. Our models' predictive probabilities range between 55.6% and 56.5% in the case of credit booms, between 0.5% and 3.0% for credit busts, and between 36.3% and 37.7% in the case of "normal times".

Economic significance

Table 8

	Booms		Busts		Normal	
	Marginal effects	Fitted probability	Marginal effects	Fitted probability	Marginal effects	Fitted probability
Type of instrument (bonds) (I)						
ibs_all_curr_debt_all_all	0.986**	0.565	0.025	0.016	-0.977**	0.367
ibs_all_curr_debt_all_banks	0.955*	0.561	-0.067	0.015	-0.681	0.374
ibs_all_curr_debt_all_non-banks	0.515**	0.563	0.037	0.015	-0.617**	0.367
Type of instrument (bonds) (II)						
ibs_all_curr_debt_dl_all	0.864**	0.564	0.015	0.016	-0.837**	0.369
ibs_all_curr_debt_dl_banks	0.752	0.560	-0.070	0.015	-0.495	0.375
ibs_all_curr_debt_dl_non-banks	0.492**	0.563	0.034	0.015	-0.585**	0.368
Type of instrument (derivatives)						
ibs_all_curr_other_all_all	-0.650	0.557	0.088	0.014	0.362	0.377
ibs_all_curr_other_all_banks	-0.239	0.558	-0.014	0.016	0.279	0.377
ibs_all_curr_other_all_non-banks	-0.265	0.558	0.094**	0.012	-0.121	0.376
Type of instrument (loans)						
ibs_all_curr_loans_all_all	-0.835*	0.565	-0.065	0.014	0.914*	0.368
ibs_all_curr_loans_all_banks	-0.590	0.560	0.058	0.015	0.367	0.375
ibs_all_curr_loans_all_non-banks	-0.619*	0.565	-0.067*	0.010	0.882***	0.363
Lender/borrower sector						
ids_all_curr_debt_b_b_all4	-0.261	0.562	-0.075*	0.005	0.324	0.372
ids_all_curr_debt_b_nb_all4	0.070	0.559	0.053*	0.012	-0.173	0.375
ids_all_curr_debt_nb_nb_all4	0.265	0.563	0.010	0.015	-0.242	0.372
ids_all_curr_debt_nb_b_all4	-0.161	0.560	-0.036	0.013	0.183	0.374
Currency						
ibs_usd_all_curr_all_all	0.199	0.556	-0.075	0.030	-0.001	0.375
ibs_usd_all_curr_all_banks	0.260	0.556	-0.083	0.030	-0.030	0.375
ibs_usd_all_curr_all_non-banks	0.071	0.556	-0.059	0.030	0.068	0.375
Maturity						
itc_st_all	-0.129	0.538	-0.072**	0.010	0.391	0.392
itc_st_resid_all	-0.638	0.559	0.029	0.016	0.367	0.376
Unconditional probability		*0.580*		*0.068*		*0.351*

Note: The table summarises the marginal effects associated with the different variables considered in *Deb_Dim*, as described in Equation (3) and reported in Tables 1-7. *** p<0.01, ** p<0.05, * p<0.1.

5. Sensitivity analysis

5.1. "Early-warning indicator" literature

Our empirical results demonstrate the existence of a significant "contemporaneous" relationship between some dimensions of external debt composition and credit cycles. But can we actually use the shares of external debt across a specific dimension to make predictions about the future likelihood of credit booms, busts and "normal times"? If so, then external debt composition would not only be the "symptom" of financial imbalances that are already at place, but it would also allow us to consider timely policy responses aimed at preventing adverse outcomes.

To investigate this issue, we consider different lags of *Debt_Dim* and re-estimate model (1). More specifically, we run the following regressions:

$$Prob(Cycle\_phase_{it}=1|Debt\_Dim_{it}, \boldsymbol{X}_{it}) = \Phi(\lambda_i+\delta_t+\alpha Debt\_Dim_{it-H}+\boldsymbol{\beta X}_{it}), \quad (4)$$

with $H = 1, ..., 8$.

Credit cycles and external debt composition – An early warning indicator? Table 9

	H=1			H=4			H=8		
	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal
Type of instrument (bonds) (I)									
ibs_all_curr_debt_all_all	2.522**	0.580	-2.614**	2.459**	0.704	-2.673**	2.352**	1.024	-2.756**
ibs_all_curr_debt_all_banks	2.384*	-1.743	-1.788	2.191*	-1.034	-1.775	1.957	-0.226	-1.761
ibs_all_curr_debt_all_non-banks	1.319**	0.971	-1.659**	1.313**	1.011	-1.719***	1.302**	1.142	-1.792***
Type of instrument (bonds) (II)									
ibs_all_curr_debt_dl_all	2.230**	0.332	-2.255**	2.217**	0.445	-2.344**	2.155**	0.737	-2.445**
ibs_all_curr_debt_dl_banks	1.902	-1.866	-1.325	1.813	-1.226	-1.379	1.670	-0.465	-1.419
ibs_all_curr_debt_dl_non-banks	1.264**	0.889	-1.576**	1.272**	0.922	-1.642**	1.262**	1.039	-1.709***
Type of instrument (derivatives)									
ibs_all_curr_other_all_all	-1.550	2.552	0.867	-1.285	2.304	0.768	-1.429	1.738	1.096
ibs_all_curr_other_all_banks	-0.444	-0.432	0.611	-0.041	-0.899	0.397	0.182	-1.363	0.370
ibs_all_curr_other_all_non-banks	-0.666	3.290***	-0.350	-0.569	3.133***	-0.377	-0.800	2.844**	-0.102
Type of instrument (loans)									
ibs_all_curr_loans_all_all	-2.188*	-1.836	2.497**	-2.258*	-1.829	2.639**	-2.154*	-1.952	2.678**
ibs_all_curr_loans_all_banks	-1.564	1.600	1.037	-1.646	1.428	1.154	-1.586	0.945	1.168
ibs_all_curr_loans_all_non-banks	-1.590**	-2.715***	2.390***	-1.614**	-2.766***	2.494***	-1.540**	-2.968***	2.516***
Lender/borrower sector									
ids_all_curr_debt_b_b_all4	-0.663	-4.682*	0.858	-0.749	-3.255	0.938	-0.982	-1.813	1.133
ids_all_curr_debt_b_nb_all4	0.134	1.841**	-0.424	0.063	1.951**	-0.366	-0.002	2.038**	-0.308
ids_all_curr_debt_nb_nb_all4	-0.389	-0.991	0.455	-0.353	-0.764	0.403	-0.355	-0.347	0.354
ids_all_curr_debt_nb_b_all4	0.690	0.134	-0.636	0.732	-0.011	-0.658	0.806*	-0.253	-0.682
Currency									
ibs_usd_all_curr_all_all	0.516	-1.097	-0.014	0.577	-1.096	-0.069	0.639	-1.166	-0.097
ibs_usd_all_curr_all_banks	0.682	-1.226	-0.104	0.760	-1.254	-0.165	0.813	-1.378	0.172
ibs_usd_all_curr_all_non-banks	0.172	-0.874	0.188	0.178	-0.851	0.177	0.228	-0.845	0.136
Maturity									
itc_st_all	-0.328	-2.861*	1.057	-0.358	-3.359*	1.227	-0.466	-3.390*	1.418
itc_st_resid_all	-1.750	0.702	1.157	-2.129	1.008	1.546	-2.810*	-0.370	2.553*

Note: The table summarises the results of the estimation of Equation (4). It reports the coefficients associated with the different variables considered in $Debt\_Dim_{it-H}$, with $H = 1, 4, 8$. *** p<0.01, ** p<0.05, * p<0.1.

Table 9 shows the main results. For brevity, we only present the coefficients associated with $Debt\_Dim_{it\text{-}H}$, but organise the results by lags. As can be seen, both the magnitude and the statistical significance of external debt composition remain quite stable over time and broadly unchanged. Therefore, we argue that changes in the composition of external debt can be used as a predictor for the evolution of credit cycles.

5.2. Advanced versus emerging market economies

To see whether the impact of composition of external debt differs in advanced economies and emerging markets we re-estimate our models for these two subsamples. A caveat is that a large amount of information is lost from each subsample. This can add a substantial amount of noise and thus affect the quality of the empirical findings.

In Table 10, we only report, for brevity, the coefficients associated with external debt composition. The empirical results are both quantitatively and qualitatively very similar to those reported in Tables 1–7, where we make use of the full sample. In particular, they show that when the share of bonds in total external bank claims rises, the likelihood of credit booms also significantly increases for both advanced economies and emerging markets. The same significantly positive effect on the probability of credit busts is observed in the case of emerging markets. A higher share of bonds in total external bank claims is also associated with a fall in the likelihood of "normal times" in the credit cycles of emerging markets. By contrast, the impact is not significant for advanced economies. Interestingly, for emerging market economies, while a higher share of bonds is linked with a lower probability of credit busts when banks are the borrowing sector, in the case of non-banks, the relationship has the opposite sign: a higher share of bonds issued by non-banks is associated with a higher probability of credit busts.

Additionally, we find that, for advanced economies, credit busts are more likely to occur when the share of derivatives in total cross-border bank claims and when the share of derivatives issued by non-banks increases. The empirical results are weaker for the share of bank loans, as this specific external debt instrument loses significance in the various model specifications.

Turning to the lender-borrower relationship, we show that, for advanced economies, an increase in the relative importance of interbank lending is associated with a lower likelihood of credit booms and credit busts and a higher probability of "normal times". By contrast, for the same group of countries, a rise in the relative importance of lending from non-banks to non-banks is linked with a higher probability of credit booms and credit busts and a lower probability of "normal times". For emerging markets, a higher share of cross-border interbank lending is associated with a lower likelihood of credit busts. However, this phase of the credit cycle is also associated with an increase of the relative importance of bank-to-non-bank lending.

Finally, the other two dimensions of external debt composition that we examine (ie currency and maturity) do not seem to affect the different phases of the credit cycle.

Advanced economies versus emerging markets

Table 10

	Advanced economies			Emerging markets		
	Booms	Busts	Normal	Booms	Busts	Normal
Type of instrument (bonds) (I)						
ibs_all_curr_debt_all_all	2.928**	-1.028	-1.734	5.910**	2.638*	-6.180**
ibs_all_curr_debt_all_banks	2.674*	-3.286	-0.749	7.084*	-4.693*	-6.872*
ibs_all_curr_debt_all_non-banks	1.517*	-0.054	-1.084	3.668**	3.468***	-3.988***
Type of instrument (bonds) (II)						
ibs_all_curr_debt_dl_all	2.499**	-1.067	-1.412	4.817*	2.354	-5.027*
ibs_all_curr_debt_dl_banks	2.087	-3.195*	-0.415	6.299*	-3.903*	-6.123*
ibs_all_curr_debt_dl_non-banks	1.371*	-0.078	-0.964	3.417**	2.913***	-3.695***
Type of instrument (derivatives)						
ibs_all_curr_other_all_all	-2.640	3.505**	0.444	-3.414	0.367	3.413
ibs_all_curr_other_all_banks	-3.198	1.586	1.614	-1.167	1.194	1.053
ibs_all_curr_other_all_non-banks	-2.017	2.990***	0.018	0.747	-6.554***	-0.529
Type of instrument (loans)						
ibs_all_curr_loans_all_all	-2.510	-0.395	1.939	-2.520	-1.875	2.630
ibs_all_curr_loans_all_banks	-1.476	2.461*	0.239	-1.095	0.059	1.102
ibs_all_curr_loans_all_non-banks	-1.723	-1.703*	1.824*	-3.376**	-2.470**	3.608**
Lender/borrower sector						
ids_all_curr_debt_b_b_all4	-4.070***	-5.682*	4.668***	0.502	-4.091**	-0.452
ids_all_curr_debt_b_nb_all4	1.605*	0.219	-1.332	-0.572	2.149**	0.501
ids_all_curr_debt_nb_nb_all4	1.701**	2.077**	-1.793**	-1.335	-0.921	1.429
ids_all_curr_debt_nb_b_all4	-1.145**	-1.061	1.120*	2.735*	0.959	-2.824*
Currency						
ibs_usd_all_curr_all_all	0.299	0.523	-0.490	0.784	-28.835***	-0.366
ibs_usd_all_curr_all_banks	0.578	0.246	-0.607	0.748	-36.718***	-0.308
ibs_usd_all_curr_all_non-banks	0.153	0.795	-0.512	0.359	-18.100***	-0.023
Maturity						
itc_st_all	-1.855	-1.510	1.990	1.344	-7.961***	-1.067
itc_st_resid_all	-2.169	-4.705**	2.301	-2.112	3.010***	1.935

Note: The table summarises the results of the estimation of Equation (1) for the subsample of advanced economies and the subsample of emerging markets. It reports the coefficients associated with the different variables considered in *Debt_Dim*. *** p<0.01, ** p<0.05, * p<0.1.

5.3. Accounting for the presence of international financial centres

International financial centres are also among the countries included in the analysis. The presence of such centres could affect the characterisation of the various dimensions of external debt composition and thus may influence their effect on the dynamics of the credit market cycle. For this reason, we re-estimate our models by excluding them from our sample. More concretely, we consider various subsamples: (i) we exclude Asian international financial centres (Hong Kong SAR and Singapore);

Credit cycles excluding offshore centres

Table 11

	Excluding HK and SG			Excluding HK, IE, LU and SG			Excluding CH and GB			Excluding CH, GB, HK, IE, LU and SG		
	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal
Type of instrument (bonds) (I)												
ibs_all_curr_debt_all_all	2.444**	0.204	-2.465**	2.415**	0.163	-2.447**	1.899*	1.509	-2.231*	1.231	1.008	-1.575
ibs_all_curr_debt_all_banks	2.228	-2.325	-1.501	2.196	-2.383	-1.503	1.691	-1.141	-1.215	0.926	-1.926	-0.369
ibs_all_curr_debt_all_non-banks	1.234*	0.795	-1.554**	1.205*	0.813	-1.545**	0.911	1.546	-1.433**	0.435	1.407	-1.046
Type of instrument (bonds) (II)												
ibs_all_curr_debt_dl_all	2.141**	-0.027	-2.090*	2.118**	-0.077	-2.073*	1.604*	1.161	-1.845*	0.965	0.649	-1.197
ibs_all_curr_debt_dl_banks	1.734	-2.415	-1.042	1.711	-2.482	-1.051	1.229	-1.352	-0.752	0.557	-2.114	-0.003
ibs_all_curr_debt_dl_non-banks	1.167*	0.714	-1.457**	1.137*	0.734	-1.446**	0.866	1.452	-1.357**	0.379	1.314	-0.955
Type of instrument (derivatives)												
ibs_all_curr_other_all_all	-2.271	2.189	1.572	-2.144	2.269	1.508	-1.867	1.855	1.422	-2.474	1.669	2.122
ibs_all_curr_other_all_banks	-0.823	-0.572	1.049	-0.738	-0.599	0.977	-0.762	-1.102	1.085	-0.931	-1.457	1.368
ibs_all_curr_other_all_non-banks	-1.332	2.936***	0.238	-1.260	3.071***	0.203	-0.746	2.602**	-0.055	-1.148	2.628**	0.308
Type of instrument (loans)												
ibs_all_curr_loans_all_all	-2.019	-1.384	2.288*	-2.023	-1.380	2.281*	-1.359	-2.794**	1.834	-0.404	-2.448*	0.934
ibs_all_curr_loans_all_banks	-1.314	2.291*	0.628	-1.345	2.431*	0.674	-0.822	1.567	0.315	-0.178	2.783*	-0.501
ibs_all_curr_loans_all_non-banks	-1.360	-2.466***	2.181**	-1.338	-2.578***	2.180**	-0.985	-3.420***	1.917**	-0.232	-3.564***	1.389**
Lender/borrower sector												
ids_all_curr_debt_b_b_all4	-0.636	-4.724**	0.855	-0.632	-4.967**	0.841	0.425	-4.437	-0.133	0.924	-4.410*	-0.531
ids_all_curr_debt_b_nb_all4	0.165	1.782**	-0.472	0.164	1.895**	-0.471	-0.723	1.212	0.341	-1.104	1.462*	0.589
ids_all_curr_debt_nb_nb_all4	0.873	0.324	-0.860	0.864	0.343	-0.845	0.051	0.092	0.009	0.277	0.208	-0.222
ids_all_curr_debt_nb_b_all4	-0.627	-1.294	0.729	-0.615	-1.326	0.716	0.372	-0.382	-0.278	0.040	-0.742	0.067
Currency												
ibs_usd_all_curr_all_all	0.586	-0.904	-0.109	0.573	-0.848	-0.116	0.684	-1.139	-0.160	0.836	-0.868	-0.351
ibs_usd_all_curr_all_banks	0.751	-1.044	-0.189	0.731	-0.956	-0.203	0.813	-1.255	-0.216	0.958	-0.958	-0.405
ibs_usd_all_curr_all_non-banks	0.392	-0.617	-0.067	0.377	-0.586	-0.062	0.326	-0.950	0.059	0.609	-0.649	-0.264
Maturity												
itc_st_all	0.111	-2.432	0.661	0.055	-2.326	0.684	-0.102	-5.335***	1.002	0.781	-5.586***	0.268
itc_st_resid_all	-2.240	1.126	1.375	-2.278	1.021	1.450	-0.623	0.357	-0.021	-1.132	0.611	0.231

Note: The table summarises the results of the estimation of Equation (1) for the subsamples indicated. It reports the coefficients associated with the different variables considered in *Debt_Dim*. *** p<0.01, ** p<0.05, * p<0.1.

(ii) we exclude "small" international financial centres (Hong Kong SAR, Singapore, Ireland and Luxembourg); (iii) we exclude "large" international financial centres (Switzerland and the United Kingdom); and (iv) we exclude both "small" and "large" international financial centres (Hong Kong SAR, Singapore, Ireland, Luxembourg, Switzerland and the United Kingdom).

Table 11 presents a summary of the main findings. For brevity, we only show the coefficients associated with $Debt\_Dim_{it}$. The empirical results are both quantitatively and qualitatively similar to those associated with the full sample. Interestingly, the magnitude of the various coefficients and their statistical significance remain broadly unchanged. Some of the variables tracking external debt composition lose significance, but only when we drop all international financial centres from the sample. This is mainly because the number of usable data points falls substantially (by between 20% and 25% depending on the model specification). Therefore, our benchmark results are robust to the exclusion of international financial centres.

5.4. Controlling for the size of the "external sector"

We also control for the size of the "external sector" by adding the ratio of external debt to domestic credit to the set of explanatory variables and examining to what extent this affects the results. The rationale for this exercise is that, while for some countries (especially emerging market economies) the external sector may represent an important source of financing (and thus of credit growth), for other countries credit

Credit cycles and the size of the "external sector" Table 12

	Booms	Busts	Normal
GDP growth	0.072*	-0.216***	0.001
	(0.040)	(0.063)	(0.041)
Long-term interest rate	-0.000	0.116**	-0.061
	(0.049)	(0.045)	(0.051)
Property price growth	0.048**	-0.123***	-0.020
	(0.024)	(0.032)	(0.020)
Inflation rate	0.186*	-0.382***	-0.075
	(0.095)	(0.106)	(0.093)
Effective exchange rate	-0.194	0.058	0.408
	(1.696)	(0.977)	(1.716)
VIX	-6.599***	14.459***	3.508*
	(2.004)	(3.353)	(1.906)
VIX^2	1.061***	-2.306***	-0.540*
	(0.319)	(0.529)	(0.301)
External debt / Domestic credit	0.003	-0.000	-0.004
	(0.003)	(0.001)	(0.004)
Observations	1,847	1,847	1,847
Log-likelihood	-1095	-311.7	-1143
R^2	0.141	0.311	0.0781

Note: The table summarises the results of the estimation of Equation (1), with *Deb_Dim* captured by the ratio of external debt to domestic credit. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

originates mainly from domestic sources (which implies that the external sector plays a minor role in shaping the dynamics of the credit cycle).

As shown in Table 12, the size of the external sector does not have a significant effect on the various phases of credit cycle. Moreover, our results on the importance of external debt composition are consistent with those of the baseline model.

5.5. Using alternative measures for the bank and non-bank sectors

Finally, we combine BIS IDSS data with data on externally held debt securities from the Quarterly External Debt Statistics (QEDS) of the World Bank (WB) and International Investment Position (IIP) data of the International Monetary Fund (IMF) to obtain alternative measures of the lending/borrowing sectors. More concretely, we re-construct: 1) the *share* of *bank-to-bank flows* as percentage of total debt flows, using WB data *(qeds_b_b_all4)* or IMF data *(bopS_b_b_all4)*; 2) the *share* of *bank-to-non-bank flows* as percentage of total debt flows, using WB data *(qeds_b_nb_all4)* or IMF data *(bopS_b_nb_all4)*; 3) the *share* of *non-bank-to-non-bank flows* as percentage of total debt flows, using WB data *(qeds_nb_nb_all4)* or IMF data *(bopS_nb_nb_all4)*; and 4) the *share* of *non-bank-to-bank flows* as percentage of total debt flows, using WB data *(qeds_nb_b_all4)* or IMF data *(bopS_nb_b_all4)*.

The main results are displayed in Table 13 (WB data) and Table 14 (IMF data). They are in line with our benchmark findings reported in Table 5, which combines BIS IDSS data with BIS LBS data. More specifically: (i) a lower share of interbank lending is associated with a significantly higher probability of credit busts; and (ii) a higher share of bank-to-non-bank lending is linked with an increase in the likelihood of credit busts. Interestingly, the magnitude of the coefficients is very similar to the ones obtained in the benchmark regressions. Other lending/borrowing relationships are only weakly significant.

Credit cycles and lending-borrowing sector, World Bank data

Table 13

	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal
GDP growth	0.048	-0.176**	0.038	0.048	-0.175**	0.038	0.037	-0.160***	0.041	0.037	-0.161***	0.041
	(0.035)	(0.076)	(0.031)	(0.035)	(0.076)	(0.031)	(0.036)	(0.049)	(0.031)	(0.036)	(0.049)	(0.031)
Long-term interest rate	0.022	0.120**	-0.093*	0.022	0.124**	-0.093*	0.022	0.215***	-0.099*	0.022	0.216***	-0.099*
	(0.053)	(0.056)	(0.056)	(0.053)	(0.057)	(0.056)	(0.054)	(0.066)	(0.060)	(0.054)	(0.066)	(0.060)
Property price growth	0.044	-0.124	-0.007	0.044	-0.125*	-0.007	0.038	-0.143***	-0.005	0.038	-0.143***	-0.005
	(0.027)	(0.076)	(0.026)	(0.027)	(0.076)	(0.026)	(0.025)	(0.045)	(0.024)	(0.025)	(0.045)	(0.024)
Inflation rate	0.173*	-0.119	-0.044	0.173*	-0.121	-0.044	0.147	-0.195	-0.039	0.147	-0.196	-0.039
	(0.102)	(0.133)	(0.093)	(0.102)	(0.130)	(0.093)	(0.101)	(0.124)	(0.097)	(0.102)	(0.124)	(0.097)
Effective exchange rate	0.624	0.924	-0.578	0.624	0.465	-0.578	0.480	1.392	-0.464	0.481	1.360	-0.464
	(1.440)	(3.223)	(1.429)	(1.440)	(3.391)	(1.429)	(1.516)	(1.673)	(1.483)	(1.517)	(1.670)	(1.484)
VIX	-5.973***	10.697***	2.670	-5.974***	10.685***	2.670	-5.790***	10.376***	2.602	-5.791***	10.387***	2.602
	(1.994)	(3.770)	(1.931)	(1.994)	(3.790)	(1.931)	(1.980)	(2.875)	(1.912)	(1.981)	(2.870)	(1.912)
VIX^2	0.942***	-1.650***	-0.380	0.942***	-1.649***	-0.380	0.907***	-1.658***	-0.367	0.908***	-1.660***	-0.367
	(0.319)	(0.579)	(0.303)	(0.319)	(0.583)	(0.303)	(0.316)	(0.434)	(0.299)	(0.316)	(0.433)	(0.299)
qeds_debt_b_b_all4	-0.000	-0.365***	0.001									
	(0.002)	(0.096)	(0.002)									
qeds_debt_b_nb_all4				0.000	0.397***	-0.001						
				(0.002)	(0.100)	(0.002)						
qeds_debt_nb_nb_all4							-0.001	0.059**	-0.001			
							(0.004)	(0.027)	(0.004)			
qeds_debt_nb_b_all4										0.001	-0.059**	0.001
										(0.004)	(0.027)	(0.004)
Observations	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530
Log-likelihood	-916.7	-189.5	-956.3	-916.7	-186.8	-956.3	-916.2	-249.8	-959.7	-916.2	-250.2	-959.7
R^2	0.135	0.557	0.089	0.135	0.563	0.089	0.135	0.416	0.086	0.135	0.415	0.086

Note: The table summarises the results of the estimation of Equation (1), with *Deb_Dim* captured by *qeds_debt_b_b_all4*, *qeds_debt_b_nb_all4*, *qeds_debt_nb_nb_all4* or *qeds_debt_nb_b_all4*. Robust standard errors clustered by country in parentheses. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

Credit cycles and lending-borrowing sector, IMF data

Table 14

	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal	Booms	Busts	Normal
GDP growth	0.080	-0.204**	0.049	0.080	-0.200**	0.049	0.083	-0.121**	0.046	0.083	-0.122**	0.046
	(0.060)	(0.083)	(0.052)	(0.060)	(0.083)	(0.052)	(0.060)	(0.050)	(0.052)	(0.060)	(0.050)	(0.052)
Long-term interest rate	0.093	0.080	-0.162***	0.093	0.085	-0.162***	0.106	0.216**	-0.170***	0.106	0.216**	-0.170***
	(0.065)	(0.077)	(0.059)	(0.065)	(0.078)	(0.059)	(0.066)	(0.093)	(0.060)	(0.066)	(0.094)	(0.060)
Property price growth	0.029	-0.130*	0.034	0.029	-0.131*	0.034	0.031	-0.147***	0.033	0.031	-0.148***	0.033
	(0.033)	(0.076)	(0.036)	(0.033)	(0.075)	(0.036)	(0.034)	(0.052)	(0.036)	(0.034)	(0.052)	(0.036)
Inflation rate	0.160	-0.205	0.060	0.160	-0.199	0.060	0.178	-0.143	0.048	0.178	-0.145	0.048
	(0.151)	(0.158)	(0.135)	(0.151)	(0.155)	(0.135)	(0.153)	(0.145)	(0.136)	(0.153)	(0.146)	(0.136)
Effective exchange rate	-0.854	0.184	0.644	-0.854	-0.223	0.644	-0.743	0.546	0.527	-0.743	0.520	0.527
	(1.641)	(3.830)	(1.474)	(1.641)	(3.992)	(1.474)	(1.613)	(2.614)	(1.418)	(1.613)	(2.605)	(1.418)
VIX	-6.869***	11.800** *	2.549	-6.869***	11.711** *	2.549	-7.079***	11.416** *	2.618	-7.079***	11.408** *	2.618
	(2.351)	(3.693)	(2.311)	(2.351)	(3.701)	(2.311)	(2.379)	(2.843)	(2.337)	(2.379)	(2.833)	(2.337)
VIX^2	1.069***	-1.824***	-0.343	1.069***	-1.811***	-0.343	1.104***	-1.802***	-0.358	1.104***	-1.801***	-0.358
	(0.372)	(0.571)	(0.360)	(0.372)	(0.574)	(0.360)	(0.374)	(0.434)	(0.362)	(0.374)	(0.432)	(0.362)
bopS_debt_b_b_all4	0.000	-0.338***	0.000									
	(0.000)	(0.100)	(0.000)									
bopS_debt_b_nb_all4				-0.000	0.370***	-0.000						
				(0.000)	(0.104)	(0.000)						
bopS_debt_nb_nb_all4							-0.000	0.071*	0.000			
							(0.000)	(0.036)	(0.000)			
bopS_debt_nb_b_all4										0.000	-0.070*	-0.000
										(0.000)	(0.036)	(0.000)
Observations	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120
Log-likelihood	-572.0	-181.1	-600.7	-572.0	-179.1	-600.7	-567.5	-221.0	-601.5	-567.5	-221.7	-601.5
R^2	0.263	0.497	0.197	0.263	0.502	0.197	0.269	0.385	0.196	0.269	0.384	0.196

Note: The table summarises the results of the estimation of Equation (1), with *Deb_Dim* captured by *bopS_debt_b_b_all4*, *bopS_debt_b_nb_all4*, *bopS_debt_nb_nb_all4* or *bopS_debt_nb_b_all4*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

6. Conclusions

In this paper, we investigate the role that external debt composition plays in shaping credit cycles. We apply a novel methodology to identify credit booms, credit busts and "normal times" in the credit cycle. Then we use quarterly data for 40 countries over the period Q1 1980–Q2 2015 to evaluate how four dimensions of external debt composition (ie instrument type, lending/borrowing sector, currency of denomination and remaining maturity) affect credit cycles.

We show that the breakdown of external debt by instrument type is particularly important. In fact, we find that: (i) a higher share of external bank lending in the form of bonds is associated with a greater likelihood of credit booms; (ii) a higher share of derivatives claims signals a higher probability of credit busts; and (iii) a higher share of bank loans is linked with "normal times" in the credit cycle.

We also find that the sectoral composition of external debt is an important determinant of credit cycles. More concretely, credit busts tend to be associated with: (i) a lower share of interbank lending; and (ii) a higher share of bank-to-non-bank lending.

Our results also suggest that the currency and the maturity of the external debt play a less prominent role. Nevertheless, the findings for currency and the maturity should be interpreted with caution due to caveats related to data availability.

From a policy perspective, it is well known that credit booms and busts have damaging effects on real economic activity. Our work shows that certain dimensions of external debt composition can "signal" mounting financial imbalances. Therefore, an important implication of our results is that policymakers should track closely the *instrument* and *sector* composition of their respective countries' external debt. Monitoring the behaviour of these dimensions of external debt can help in the design of policies aimed at managing domestic credit cycles.

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Appendix

A.1.Alternative econometric methodologies

We also analyse the sensitivity of the empirical findings vis-à-vis alternative econometric methodologies, such as: 1) the logit regression; 2) the tobit regression; 3) the multinomial probit model; and 4) the multinomial logit model.

The main advantage of the logit model is that its distribution has fatter tails than the probit model. It also requires a large number of parameters to be estimated, which implies a relatively low statistical power. In this context, model (1) is re-estimated as follows:

$$Prob(Cycle\_phase_{it}=1|Debt\_Dim_{it}, \boldsymbol{X}_{it}) = \Phi(\lambda_i+\delta_t+\alpha Debt\_Dim_{it}+\boldsymbol{\beta X}_{it}), \quad \text{(A1)}$$

$$\Phi(\cdot)=1/[1+exp-(\lambda_i+\delta_t+\alpha Debt\_Dim_{it}+\boldsymbol{\beta X}_{it})] =1/[1+exp-(\boldsymbol{Z'}_{it}\,\boldsymbol{\vartheta})],$$

where *Cycle_phase={Boom, Bust, Normal}*, α and $\boldsymbol{\beta}$ and are the vectors of the parameters to be estimated, *Prob* denotes probability, and Φ is the Logistic function.

The results are reported in Table A1. For brevity, we only show the coefficients associated with the different variables that track the dynamics of external debt composition along each of the four dimensions considered in the analysis. The empirical findings are both quantitatively and qualitatively very similar to those of the probit model. Thus the main results are broadly unchanged.

We also implement a tobit regression. As our dependent variable is a (non-negative) categorical (dummy) variable bounded between zero and one, one could argue that the baseline econometric methodology is biased, as there is a downward-biased estimate of the slope coefficients and an upward-biased estimate of the intercept.

The main findings are reported in Table A2, and are very similar to those of the probit model. The composition of external debt by type of instrument and by lending-borrowing relationship is particularly useful at providing information about the various phases of the credit cycle. Again, there is no significant impact of the composition of external debt by currency on the likelihood of credit booms, busts and "normal times". However, we find some evidence that debt maturity influences the credit cycle: the higher the share of short-term debt in total debt, the lower the probability of credit busts.

We also estimate multinomial probit and multinomial logit models, which are generalisations of the probit and logit model, respectively. They are used when the dependent variable falls into various categories. As our dependent variable can be classified into three main categories (ie booms, busts and "normal times"), this multiclass classification could improve the characterisation of the dynamics of the credit cycle. We estimate these multinomial models, using "normal times" as the baseline case (or outcome). For brevity, we only report the results of the multinomial probit model.

Logit model

Table A1

	Booms	Busts	Normal
Type of instrument (bonds) (I)			
ibs_all_curr_debt_all_all	4.077**	2.072	-4.215**
ibs_all_curr_debt_all_banks	3.869*	-3.038	-2.789
ibs_all_curr_debt_all_non-banks	2.155**	2.656	-2.708**
Type of instrument (bonds) (II)			
ibs_all_curr_debt_dl_all	3.559**	1.446	-3.577*
ibs_all_curr_debt_dl_banks	3.021	-3.313	-1.995
ibs_all_curr_debt_dl_non-banks	2.060*	2.469	-2.560**
Type of instrument (derivatives)			
ibs_all_curr_other_all_all	-2.819	4.294	1.579
ibs_all_curr_other_all_banks	-1.041	-1.020	1.200
ibs_all_curr_other_all_non-banks	-1.234	5.848***	-0.431
Type of instrument (loans)			
ibs_all_curr_loans_all_all	-3.451	-3.804	3.936*
ibs_all_curr_loans_all_banks	-2.346	2.669	1.441
ibs_all_curr_loans_all_non-banks	-2.617*	-5.318***	3.982***
Lender/borrower sector			
ids_all_curr_debt_b_b_all4	-1.290	-9.709*	1.655
ids_all_curr_debt_b_nb_all4	0.276	3.166*	-0.779
ids_all_curr_debt_nb_nb_all4	1.102	0.245	-1.031
ids_all_curr_debt_nb_b_all4	-0.657	-1.695	0.770
Currency			
ibs_usd_all_curr_all_all	0.775	-3.240	0.015
ibs_usd_all_curr_all_banks	1.015	-3.430	-0.096
ibs_usd_all_curr_all_non-banks	0.025	0.112	-0.047
Maturity			
itc_st_all	-0.437	-6.031*	1.552
itc_st_resid_all	-2.806	0.930	1.650

Note: The table summarises the results of the estimation of Equation (1) using a logit model. It reports the coefficients associated with the different variables considered in *Debt_Dim*. *** p<0.01, ** p<0.05, * p<0.1.

Tobit regression

Table A2

	Booms	Busts	Normal
Type of instrument (bonds) (I)			
ibs_all_curr_debt_all_all	1.339**	0.897	-2.314**
ibs_all_curr_debt_all_banks	1.388*	-2.520	-1.635
ibs_all_curr_debt_all_non-banks	0.737*	1.277	-1.460***
Type of instrument (bonds) (II)			
ibs_all_curr_debt_dl_all	1.193**	0.557	-1.983**
ibs_all_curr_debt_dl_banks	1.125	-2.679	-1.200
ibs_all_curr_debt_dl_non-banks	0.707*	1.177	-1.386**
Type of instrument (derivatives)			
ibs_all_curr_other_all_all	-1.238	3.254	0.696
ibs_all_curr_other_all_banks	-0.602	-0.552	0.463
ibs_all_curr_other_all_non-banks	-0.526	3.905***	-0.357
Type of instrument (loans)			
ibs_all_curr_loans_all_all	-1.133	-2.519	2.164**
ibs_all_curr_loans_all_banks	-0.859	2.232	0.917
ibs_all_curr_loans_all_non-banks	-0.878*	-3.102***	2.031***
Lender/borrower sector			
ids_all_curr_debt_b_b_all4	-0.366	-6.829**	0.787
ids_all_curr_debt_b_nb_all4	0.055	1.866*	-0.434
ids_all_curr_debt_nb_nb_all4	0.337	0.571	-0.595
ids_all_curr_debt_nb_b_all4	-0.190	-1.326	0.458
Currency			
ibs_usd_all_curr_all_all	0.329	-1.491	0.010
ibs_usd_all_curr_all_banks	0.428	-1.680	-0.067
ibs_usd_all_curr_all_non-banks	0.124	-1.125	0.185
Maturity			
itc_st_all	-0.075	-3.541*	0.968
itc_st_resid_all	-0.986***	0.359	0.918***

Note: The table summarises the results of the estimation of Equation (1) using a tobit regression. It reports the coefficients associated with the different variables considered in *Debt_Dim*. *** p<0.01, ** p<0.05, * p<0.1.

Credit cycles and type of instrument (bonds)

Multinomial probit model

Table A3

	Busts	Booms	Busts	Booms	Busts	Booms
GDP growth	-0.338***	0.131***	-0.370***	0.094***	-0.298***	0.137***
	(0.071)	(0.036)	(0.070)	(0.035)	(0.073)	(0.036)
Long-term interest rate	0.245***	0.049*	0.229***	0.058**	0.275***	0.067***
	(0.041)	(0.025)	(0.041)	(0.025)	(0.043)	(0.025)
Property price growth	-0.193***	0.078***	-0.185***	0.073***	-0.176***	0.086***
	(0.042)	(0.022)	(0.041)	(0.022)	(0.042)	(0.022)
Inflation rate	-0.541***	0.369***	-0.593***	0.309***	-0.412***	0.401***
	(0.134)	(0.066)	(0.131)	(0.065)	(0.139)	(0.067)
Effective exchange rate	0.652	0.750	0.343	0.051	1.264	0.910
	(1.566)	(0.568)	(1.446)	(0.559)	(1.692)	(0.571)
VIX	20.225***	-9.603***	22.849***	-8.879***	16.901***	-10.021***
	(6.049)	(2.137)	(6.028)	(2.073)	(6.095)	(2.144)
VIX^2	-3.278***	1.573***	-3.694***	1.440***	-2.734***	1.640***
	(0.972)	(0.345)	(0.967)	(0.335)	(0.980)	(0.347)
ibs_all_curr_debt_all_all	3.927***	4.409***				
	(0.951)	(0.449)				
ibs_all_curr_debt_all_banks			-1.602	3.629***		
			(1.377)	(0.577)		
ibs_all_curr_debt_all_non-banks					3.784***	2.588***
					(0.544)	(0.267)
Observations	1,917	1,917	1,917	1,917	1,917	1,917
Log-likelihood	-1338.650	-1338.650	-1371.421	-1371.421	-1330.666	-1330.666
R^2	0.201	0.201	0.182	0.182	0.206	0.206

Note: The table summarises the results of the estimation of Equation (1) using a multinomial probit model and "normal times" as the baseline case (or outcome). It reports the coefficients associated with the different variables considered in *Debt_Dim*, namely, *ibs_all_curr_debt_all_all*, *ibs_all_curr_debt_all_banks* or *ibs_all_curr_debt_all_non-banks*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

Credit cycles and type of instrument (bonds, excluding derivatives)

Multinomial probit model

Table A4

	Busts	Booms	Busts	Booms	Busts	Booms
GDP growth	-0.345***	0.126***	-0.371***	0.091***	-0.302***	0.133***
	(0.071)	(0.036)	(0.070)	(0.035)	(0.073)	(0.036)
Long-term interest rate	0.245***	0.050**	0.227***	0.057**	0.275***	0.068***
	(0.041)	(0.025)	(0.041)	(0.025)	(0.043)	(0.025)
Property price growth	-0.192***	0.078***	-0.184***	0.073***	-0.178***	0.086***
	(0.041)	(0.022)	(0.041)	(0.022)	(0.042)	(0.022)
Inflation rate	-0.552***	0.363***	-0.592***	0.304***	-0.422***	0.397***
	(0.134)	(0.066)	(0.131)	(0.065)	(0.139)	(0.067)
Effective exchange rate	0.580	0.624	0.346	-0.011	1.095	0.808
	(1.547)	(0.566)	(1.437)	(0.559)	(1.678)	(0.569)
VIX	20.768***	-9.544***	22.871***	-8.880***	17.306***	-9.862***
	(6.049)	(2.125)	(6.029)	(2.065)	(6.085)	(2.139)
VIX^2	-3.364***	1.562***	-3.698***	1.438***	-2.798***	1.615***
	(0.971)	(0.343)	(0.967)	(0.333)	(0.979)	(0.346)
ibs_all_curr_debt_dl_all	2.999***	3.797***				
	(0.878)	(0.415)				
ibs_all_curr_debt_dl_banks			-2.229*	2.755***		
			(1.283)	(0.514)		
ibs_all_curr_debt_dl_non-banks					3.519***	2.454***
					(0.530)	(0.259)
Observations	1,917	1,917	1,917	1,917	1,917	1,917
Log-likelihood	-1347.638	-1347.638	-1376.346	-1376.346	-1334.434	-1334.434
R^2	0.196	0.196	0.179	0.179	0.204	0.204

Note: The table summarises the results of the estimation of Equation (1) using a multinomial probit model and "normal times" as the baseline case (or outcome). It reports the coefficients associated with the different variables considered in *Debt_Dim*, namely, *ibs_all_curr_debt_dl_all*, *ibs_all_curr_debt_dl_banks* or *ibs_all_curr_debt_dl_non-banks*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

Credit cycles and type of instrument (derivatives)

Multinomial probit model

Table A5

	Busts	Booms	Busts	Booms	Busts	Booms
GDP growth	-0.393***	0.087**	-0.372***	0.079**	-0.419***	0.082**
	(0.072)	(0.035)	(0.071)	(0.035)	(0.074)	(0.035)
Long-term interest rate	0.263***	0.044*	0.236***	0.049**	0.298***	0.044*
	(0.043)	(0.025)	(0.041)	(0.025)	(0.044)	(0.025)
Property price growth	-0.198***	0.075***	-0.195***	0.074***	-0.218***	0.075***
	(0.042)	(0.022)	(0.041)	(0.022)	(0.042)	(0.022)
Inflation rate	-0.637***	0.288***	-0.608***	0.276***	-0.685***	0.281***
	(0.135)	(0.065)	(0.132)	(0.064)	(0.139)	(0.065)
Effective exchange rate	0.112	0.189	0.112	-0.153	-0.520	-0.031
	(1.536)	(0.574)	(1.472)	(0.560)	(1.527)	(0.587)
VIX	22.843***	-9.006***	22.212***	-8.776***	23.871***	-9.012***
	(6.021)	(2.049)	(6.002)	(2.040)	(6.013)	(2.053)
VIX^2	-3.710***	1.456***	-3.603***	1.415***	-3.892***	1.452***
	(0.966)	(0.331)	(0.963)	(0.329)	(0.964)	(0.331)
ibs_all_curr_other_all_all	3.441**	-2.551***				
	(1.433)	(0.787)				
ibs_all_curr_other_all_banks			-1.408	-1.198*		
			(1.264)	(0.716)		
ibs_all_curr_other_all_non-banks					5.577***	-0.639
					(0.931)	(0.573)
Observations	1,917	1,917	1,917	1,917	1,917	1,917
Log-likelihood	-1385.701	-1385.701	-1393.529	-1393.529	-1376.784	-1376.784
R^2	0.173	0.173	0.168	0.168	0.178	0.178

Note: The table summarises the results of the estimation of Equation (1) using a multinomial probit model and "normal times" as the baseline case (or outcome). It reports the coefficients associated with the different variables considered in *Debt_Dim*, namely, *ibs_all_curr_other_all_all*, *ibs_all_curr_other_all_banks* or *ibs_all_curr_other_all_non-banks*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

Credit cycles and type of instrument (loans)

Multinomial probit model

Table A6

	Busts	Booms	Busts	Booms	Busts	Booms
GDP growth	-0.346***	0.111***	-0.364***	0.087**	-0.276***	0.131***
	(0.073)	(0.036)	(0.070)	(0.035)	(0.079)	(0.036)
Long-term interest rate	0.281***	0.059**	0.227***	0.054**	0.365***	0.105***
	(0.043)	(0.025)	(0.041)	(0.025)	(0.048)	(0.026)
Property price growth	-0.202***	0.077***	-0.188***	0.075***	-0.196***	0.081***
	(0.043)	(0.022)	(0.041)	(0.022)	(0.045)	(0.022)
Inflation rate	-0.546***	0.336***	-0.583***	0.293***	-0.324**	0.401***
	(0.137)	(0.065)	(0.131)	(0.065)	(0.149)	(0.066)
Effective exchange rate	0.387	0.030	0.235	-0.199	0.350	0.110
	(1.666)	(0.559)	(1.419)	(0.559)	(1.915)	(0.566)
VIX	19.485***	-9.145***	22.644***	-8.887***	14.653**	-9.230***
	(6.048)	(2.108)	(6.018)	(2.059)	(6.205)	(2.153)
VIX^2	-3.168***	1.490***	-3.662***	1.436***	-2.374**	1.517***
	(0.972)	(0.340)	(0.965)	(0.333)	(0.998)	(0.348)
ibs_all_curr_loans_all_all	-5.455***	-3.886***				
	(0.985)	(0.451)				
ibs_all_curr_loans_all_banks			1.871*	-2.107***		
			(1.112)	(0.478)		
ibs_all_curr_loans_all_non-banks					-7.046***	-3.563***
					(0.685)	(0.328)
Observations	1,917	1,917	1,917	1,917	1,917	1,917
Log-likelihood	-1346.445	-1346.445	-1382.019	-1382.019	-1288.734	-1288.734
R^2	0.197	0.197	0.175	0.175	0.231	0.231

Note: The table summarises the results of the estimation of Equation (1) using a multinomial probit model and "normal times" as the baseline case (or outcome). It reports the coefficients associated with the different variables considered in *Debt_Dim*, namely, *ibs_all_curr_loans_all_all*, *ibs_all_curr_loans_all_banks* or *ibs_all_curr_loans_all_non-banks*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

Credit cycles and lending/borrowing sector, multinomial probit model

Table A7

	Booms	Busts	Booms	Busts	Booms	Busts	Booms	Busts
GDP growth	-0.382***	0.093***	-0.324***	0.087**	-0.391***	0.057	-0.388***	0.070**
	(0.073)	(0.035)	(0.072)	(0.035)	(0.072)	(0.036)	(0.071)	(0.035)
Long-term interest rate	0.191***	0.015	0.270***	0.052**	0.219***	0.007	0.240***	0.043*
	(0.043)	(0.025)	(0.045)	(0.025)	(0.040)	(0.026)	(0.041)	(0.025)
Property price growth	-0.157***	0.066***	-0.179***	0.072***	-0.193***	0.069***	-0.186***	0.073***
	(0.042)	(0.022)	(0.041)	(0.022)	(0.041)	(0.022)	(0.041)	(0.022)
Inflation rate	-0.574***	0.253***	-0.513***	0.281***	-0.645***	0.217***	-0.636***	0.259***
	(0.137)	(0.065)	(0.140)	(0.064)	(0.134)	(0.066)	(0.134)	(0.065)
Effective exchange rate	2.251	-0.302	0.489	-0.329	0.088	-0.525	0.058	-0.537
	(1.657)	(0.578)	(1.545)	(0.564)	(1.510)	(0.589)	(1.503)	(0.577)
VIX	22.519***	-8.719***	21.995***	-8.699***	22.448***	-8.567***	23.703***	-8.596***
	(6.162)	(2.056)	(6.086)	(2.042)	(6.042)	(2.048)	(6.103)	(2.040)
VIX^2	-3.614***	1.408***	-3.527***	1.403***	-3.644***	1.375***	-3.834***	1.383***
	(0.988)	(0.332)	(0.976)	(0.330)	(0.970)	(0.330)	(0.979)	(0.329)
ids_all_curr_debt_b_b_all4	-10.272***	-1.443***						
	(1.778)	(0.250)						
ids_all_curr_debt_b_nb_all4			3.336***	0.497**				
			(0.664)	(0.201)				
ids_all_curr_debt_nb_nb_all4					0.689	1.106***		
					(0.520)	(0.172)		
ids_all_curr_debt_nb_b_all4							-1.967**	-0.711***
							(0.777)	(0.176)
Observations	1,917	1,917	1,917	1,917	1,917	1,917	1,917	1,917
Log-likelihood	-1351.573	-1351.573	-1377.427	-1377.427	-1374.134	-1374.134	-1384.525	-1384.525
R^2	0.193	0.193	0.178	0.178	0.180	0.180	0.174	0.174

Note: The table summarises the results of the estimation of Equation (1) using a multinomial probit model and "normal times" as the baseline case (or outcome). It reports the coefficients associated with the different variables considered in *Debt_Dim*, namely, *ibs_all_curr_debt_b_b_all4*, *ibs_all_curr_debt_b_nb_all4*, *ibs_all_curr_debt_nb_nb_all4* or *ibs_all_curr_debt_nb_b_all4*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

Credit cycles and currency

Multinomial probit model

Table A8

	Busts	Booms	Busts	Booms	Busts	Booms
GDP growth	-0.262***	0.079**	-0.257***	0.077**	-0.276***	0.088**
	(0.071)	(0.035)	(0.071)	(0.035)	(0.071)	(0.035)
Long-term interest rate	0.314***	0.021	0.320***	0.016	0.320***	0.028
	(0.044)	(0.024)	(0.044)	(0.024)	(0.044)	(0.025)
Property price growth	-0.126***	0.080***	-0.118***	0.078***	-0.146***	0.084***
	(0.041)	(0.021)	(0.041)	(0.021)	(0.040)	(0.021)
Inflation rate	-0.306**	0.241***	-0.301**	0.233***	-0.343**	0.267***
	(0.140)	(0.064)	(0.139)	(0.064)	(0.139)	(0.065)
Effective exchange rate	1.496	-0.041	1.089	0.011	1.958	-0.002
	(1.475)	(0.536)	(1.490)	(0.537)	(1.457)	(0.537)
VIX	5.947	-6.753***	6.001	-6.776***	6.585	-6.924***
	(5.104)	(1.982)	(5.108)	(1.980)	(5.092)	(1.988)
VIX^2	-1.129	1.125***	-1.143	1.129***	-1.238	1.155***
	(0.831)	(0.321)	(0.832)	(0.321)	(0.830)	(0.322)
ibs_usd_all_curr_all_all	-3.022***	0.468*				
	(0.571)	(0.240)				
ibs_usd_all_curr_all_banks			-3.130***	0.679***		
			(0.556)	(0.242)		
ibs_usd_all_curr_all_non-banks					-2.663***	0.032
					(0.546)	(0.223)
Observations	1,972	1,972	1,972	1,972	1,972	1,972
Log-likelihood	-1463.340	-1463.340	-1457.448	-1457.448	-1470.264	-1470.264
R^2	0.154	0.154	0.157	0.157	0.150	0.150

Note: The table summarises the results of the estimation of Equation (1) using a multinomial probit model and "normal times" as the baseline case (or outcome). It reports the coefficients associated with the different variables considered in *Debt_Dim*, namely, *ibs_usd_all_curr_all_all, ibs_usd_all_curr_all_banks* or *ibs_usd_all_curr_all_non-banks*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

Credit cycles and maturity

Multinomial probit model

Table A9

	Busts	Booms	Busts	Booms
GDP growth	-0.342***	0.079**	-0.341***	0.102***
	(0.077)	(0.036)	(0.078)	(0.036)
Long-term interest rate	0.203***	0.038	0.238***	0.024
	(0.045)	(0.025)	(0.045)	(0.025)
Property price growth	-0.197***	0.064***	-0.187***	0.063***
	(0.046)	(0.022)	(0.046)	(0.022)
Inflation rate	-0.560***	0.268***	-0.552***	0.289***
	(0.143)	(0.065)	(0.146)	(0.065)
Effective exchange rate	1.794	-0.210	3.210	0.209
	(1.939)	(0.594)	(2.115)	(0.601)
VIX	21.128***	-8.996***	18.632***	-9.169***
	(6.251)	(2.063)	(6.306)	(2.095)
VIX^2	-3.398***	1.433***	-3.008***	1.467***
	(1.000)	(0.333)	(1.010)	(0.338)
itc_st_all	-6.368***	-0.945**		
	(1.063)	(0.409)		
itc_st_resid_all			-11.908***	-2.966***
			(1.630)	(0.446)
Observations	1,800	1,800	1,793	1,793
Log-likelihood	-1314.603	-1314.603	-1280.174	-1280.174
R^2	0.176	0.176	0.196	0.196

Note: The table summarises the results of the estimation of Equation (1) using a multinomial probit model and "normal times" as the baseline case (or outcome). It reports the coefficients associated with the different variables considered in *Debt_Dim*, namely, *itc_st_all* or *itc_st_resid_all*. Robust standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For brevity, constant term is omitted.

Tables A3–A9 summarise the main results, which are similar to those of our preferred econometric framework. The main qualitative differences refer to two dimensions of debt composition, where we did not find a significant effect (ie currency and maturity). In the case of currency, the multinomial probit model results show that an increase in the share of debt denominated in US dollars in total debt is significantly associated with a lower probability of credit busts (vis-à-vis "normal times") and a higher probability of credit booms (compared to "normal times"). We uncover the same finding when the counterparty sector in the banking sector, but for non-banks the effect is not significant in the case of credit booms. The empirical evidence is weak in the case of the multinomial logit model, as we still observe a lack of statistical significance of the different variables capturing the dynamics of the currency of the external debt composition.

As for maturity, we find that, in the case of the multinomial probit model, a rise in the share of short-term debt in total debt is significantly and negatively associated with the likelihood of both credit booms and credit busts compared to "normal times". This result suggests that maturity composition acts as an important incentive mechanism device. In countries where there is a large fraction of external debt issued at short-term maturity, the probability of anomalies in the credit market (ie periods

of prolonged and persistent growth in real credit to the private nonfinancial sector or periods of temporary and sharp declines in real credit growth) is dampened.

A.2.A rare events logit model

One concern is that estimates may be biased because some phases of the credit cycle (in particular, credit busts) are "rare events". Similarly, one could claim that the length of our sample period is not long enough to identify a reasonably large number of credit boom episodes, because these are often very long and persistent. In these circumstances, credit booms would also fill the definition of a "rare event".

To correct for the small sample and rare events bias, we estimate a rare events logit model (King and Zeng (1999a, 1999b, 2001)). This econometric framework is similar to the standard logit model described by Equation (A1). The relevant parameters are estimated using maximum likelihood, while the variance of the estimated coefficients can be defined as $Var\left(\widehat{\boldsymbol{\vartheta}}\right) = (\boldsymbol{Z'VZ})^{-1}$, where $\boldsymbol{V}$ is a diagonal matrix, with diagonal entries equal to $\Phi(\cdot) \cdot [1 - \Phi(\cdot)]$.

For rare events such as the ones that we are analysing, $\Phi(\cdot)$ can be fairly small. However, King and Zeng (1999a, 1999b, 2001) highlight that the estimates of $\Phi(\cdot)$ and $\Phi(\cdot) \cdot [1 - \Phi(\cdot)]$ among observations for which rare events are observed (ie credit busts or $Cycle\_phase_{it}=1$ with $Cycle\_phase=\{Bust\}$) are larger than those among observations for which rare events are not observed (ie credit booms or "normal times" or $Cycle\_phase_{it}=1$ with $Cycle\_phase=\{Boom, Normal\}$). As a result, their contribution to the variance is smaller, which implies that additional 'rare' events provide more information than other, more 'frequent', events. Consequently, we regress a rare events logit model with a sampling that is random or conditional on $\boldsymbol{Z}_{it}$.

The results are reported in Table A10 and corroborate our previous findings. Thus, the type of instrument and the lending-borrowing relationship remain particularly relevant; the currency composition of external debt is not statistically significant; and the evidence suggests that maturity plays some role in explaining the likelihood of credit busts. All in all, if anything, the magnitude of the estimated coefficients associated with debt composition is larger than in the case of the probit model, only to confirm the importance of these variables for credit cycles.

Rare events logit model

Table A10

	Booms	Busts	Normal
Type of instrument (bonds) (I)			
ibs_all_curr_debt_all_all	4.048**	2.005	-4.191**
ibs_all_curr_debt_all_banks	3.842*	-2.977	-2.772
ibs_all_curr_debt_all_non-banks	2.140**	2.590	-2.692**
Type of instrument (bonds) (II)			
ibs_all_curr_debt_dl_all	3.533**	1.393	-3.557*
ibs_all_curr_debt_dl_banks	3.000	-3.238	-1.982
ibs_all_curr_debt_dl_non-banks	2.046*	2.408	-2.545**
Type of instrument (derivatives)			
ibs_all_curr_other_all_all	-2.801	4.266	1.572
ibs_all_curr_other_all_banks	-1.024	-0.928	1.188
ibs_all_curr_other_all_non-banks	-1.223	5.783***	-0.424
Type of instrument (loans)			
ibs_all_curr_loans_all_all	-3.425	-3.697	3.914*
ibs_all_curr_loans_all_banks	-2.328	2.625	1.432
ibs_all_curr_loans_all_non-banks	-2.599*	-5.185***	3.957***
Lender/borrower sector			
ids_all_curr_debt_b_b_all4	-1.273	-9.453*	1.635
ids_all_curr_debt_b_nb_all4	0.274	3.092*	-0.771
ids_all_curr_debt_nb_nb_all4	1.093	0.226	-1.023
ids_all_curr_debt_nb_b_all4	-0.655	-1.602	0.765
Currency			
ibs_usd_all_curr_all_all	0.771	-3.145	0.015
ibs_usd_all_curr_all_banks	1.010	-3.338	-0.096
ibs_usd_all_curr_all_non-banks	0.283	-2.601	0.289
Maturity			
itc_st_all	-0.433	-5.825*	1.545
itc_st_resid_all	-2.781	0.877	1.646

Note: The table summarises the results of the estimation of Equation (1) using a rare events logit model. It reports the coefficients associated with the different variables considered in *Debt_Dim*. *** p<0.01, ** p<0.05, * p<0.1.

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