Composition of Sovereign Debt and Financial Development: A Dynamic Heterogeneous Panel Approach*

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Abstract

This paper studies the long-run impact of financial development on the composition of sovereign debt in a large sample of developing countries. We use the dynamic heterogeneous panel model to distinguish between long-term and short-term effects and allow for cross-country heterogeneity in time-invariant features and dynamics. Moreover, we control for the presence of unknown common factors that can affect all countries. We find a non-monotonic long-term effect of financial development on the share of domestic debt over total debt. This effect is robust to different proxies of financial development and the inclusion of relevant macroeconomic variables. Inflation has a positive long-run effect on the domestic debt share, which is consistent with the presence of financial repression.

Key words: sovereign debt, domestic, external, financial development, domestic credit, dynamic heterogeneous panel, ARDL, cross-section dependence.
JEL Codes: F30, F34, G15, H63, O16.

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1 Introduction

For long time, economists have studied the determinants of sustainable sovereign debt. However, until recently these studies neglected the composition of government debt and focused on the debt held by foreigners. Lately, a new literature has emerged to explain how the variation in the composition of debt is related with the sustainable government debt levels.[1] New datasets allow us to divide government debt into domestic and external debt. Figure 1 shows a map of the average domestic debt ratio for many developing countries between 1970 and 2010. The share of domestic debt over total debt varies across countries.

A widespread conjecture is that the composition of government debt is related to the development of the domestic financial market. The standard version of this hypothesis is that better financial institutions increase domestic savers' participation in the financial market and that the domestic share of government debt correspondingly increases (see Guscina and Jeanne (2006), Guscina (2008), Forslund et al. (2011) and Kutivadze (2011)). However, Di Casola and Sichlimiris (2015) argue that the relationship ought to be non-monotonic. With better financial institutions, the availability of private assets also increases, and these private assets compete with government bonds for domestic savings. Eventually, on the margin, this competition effect will dominate the participation effect.

We here provide an empirical investigation of the relationship between financial development and the composition of sovereign debt for a large sample of developing countries. By using a dynamic heterogeneous panel approach, we can distinguish between long-run and short-run effects and account for cross-country heterogeneity in time-invariant features and dynamics. Our analysis pays particular attention to common unknown factors that can affect all countries. It is important to take this possibility into account to have unbiased estimates. If we impose a linear relationship on the data, like previous studies, we too conclude that the relationship is positive. However, when we admit non-linearities, we instead find that the level of financial development affects the long-run domestic share of total debt first positively and then negatively. This result is obtained with different measures of financial depth of a country's financial institutions: 1) domestic credit to private sector over GDP; 2) private credit by deposit money banks and other financial institutions over GDP; 3) assets held by deposit money banks over GDP.

We also consider the long-run effect of other relevant variables on the composition of debt. A permanent increase in total debt over GDP has a negative impact on the domestic debt share. A permanent increase in inflation and GDP growth has a positive impact on the domestic debt share. The positive long-run effect of inflation on the composition of debt hints towards financial repression. This positive long-run effect of inflation is obtained only when we distinguish between short-run and long-run dynamics. In fact in many specifications inflation tends to have a negative significant short-run effect.

We use a dynamic heterogeneous panel methodology, because it is well suited for a panel of

[1] See D'Erasmo et al. (2015) for a literature review on the topic.

Average Domestic / Total Sovereign Debt, 1970 - 2010.

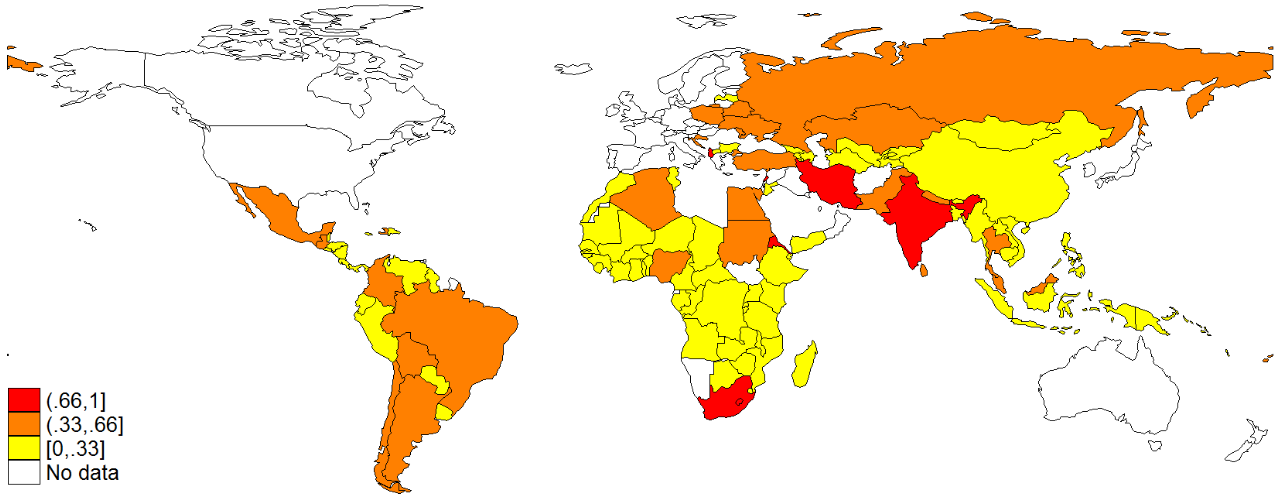

Figure 1: Debt is classified according to place of issuance and legislation. Source: own calculations based on Ugo Panizza's dataset described in Panizza (2008).

many countries and a moderate-to-large time dimension. We use the Autoregressive Distributed Lag model in error-correction formulation to distinguish between short-term and long-term effects. Moreover, we allow for any type of heterogeneity, not only for time-invariant country characteristics, but also in the short-term and long-term dynamics. Finally, we correct for possible cross-section dependence in the residuals, due to unobserved common factors.

Related Literature. There are few papers that have considered the relationship between the composition of government debt and the level of financial development. Claessens et al. (2007) find that institutional factors are significant determinants of the currency composition of government debt and inflation is negatively correlated with the share of debt issued in foreign currency. The study by Forslund et al. (2011) is close to ours in terms of government debt data, because they use the original dataset by Panizza (2008). They study the determinants of the composition of sovereign debt for developing countries. As a proxy for the size of the financial system they use M2 over GDP.[2] They find a positive correlation between the ratio of M2 over GDP and the domestic debt share, but it is not always significant. Moreover, the authors find a significant negative relationship between inflation and domestic debt share only for countries with low capital controls. Guscina and Jeanne (2006) and Guscina (2008) use a smaller dataset (constructed in a similar way as the one by Panizza (2008)), that comprises 19 developing countries. Guscina and Jeanne (2006) find a positive correlation between the average share of domestic debt over total debt and the average level of financial development. Guscina (2008) extends the analysis with a static panel approach with fixed country effects, using various measures of financial development. The only variable delivering significant negative and robust results is the measure of domestic credit to private sector over GDP. Moreover, the results point towards a negative correlation between inflation and domestic debt

[2] We prefer to use measures of domestic credit to private sector because they better represent the ability of financial intermediaries to provide savings instruments. Instead, measures of monetary aggregates represent which levels of transaction services are provided by the financial system, including the central bank.

share. Finally, the paper closest to ours is Kutivadze (2011). The author uses the original dataset from Panizza, that has a smaller time dimension, and various measures of financial development are considered. The results show a positive relationship for higher-income and middle-income countries.

Our paper is the first to investigate a potential non-linear effect of financial development on the composition of government debt, by distinguishing between long-term and short-term effects, and accounting for cross-country heterogeneity and the presence of unobserved common factors.

Outline. The paper continues as follows. Section 2 describes the data used for the analysis and presents some descriptive statistics. Section 3 discusses the stationary properties of the data. Section 4 presents the methodology and the results. Section 5 concludes.

2 Data

We use the dataset on government debt constructed by Ugo Panizza.[3] It is an unbalanced dataset on domestic and external government debt over GDP for 122 developing countries covering the period 1970 - 2010.[4] Debt is distinguished into domestic and external debt according to the place where it is issued and the legislation under which it is issued. There exist other ways to classify sovereign debt into domestic and external component, such as the currency of issuance and the identity of the bondholder. However, as pointed out by Panizza (2008), following the jurisdiction and the place of issuance produces more reliable data. There is also a close connection between this one and the other two possible classifications. Reinhart and Rogoff (2009) argue that for most of the countries and for most of their history, the jurisdiction and place of issuance has been closely connected to the currency denomination and the identity of the bondholder.

As a proxy for the level of domestic financial development we use data on domestic credit to private sector over GDP from the Financial Development and Structure Dataset, described in Beck et al. (2009) and Čihák et al. (2012). This variable refers to financial resources, such as through loans, purchases of nonequity securities, trade credits and other accounts receivable, that establish a claim for repayment, provided to the private sector. This is a measure of financial depth of a country's financial institutions. However, other measures of financial depth exist. This motivates us to repeat the analysis with two other measures of financial depth, provided in the same dataset. First, following Gennaioli et al. (2014)'s measure of financial development, we consider the private credit by deposit money banks and other financial institutions over GDP. Second, we consider total assets held by deposit money banks as a share of GDP. Assets include claims on domestic real nonfinancial sector which includes central, state and local governments, nonfinancial public enterprises and

[3]We thank Ugo Panizza for the updated version of his dataset, described in Panizza (2008). A precise description of all the data and their source is available in Appendix A. We report also the coverage of the dataset by year and geographical region, as specified by World Bank, for domestic sovereign debt (there are more countries and years available for external debt, but for the purpose of the analysis we have to use the more limited set of years and countries for which data on domestic debt is available). We will use a balanced version of this dataset.

[4]In the previous version of the dataset, spanning from 1990 to 2007, there were also data on developed economies. The updated version of the dataset is limited to developing countries.

Table 1: Sovereign debt and financial development in developing countries.

	1985			2000		
	DD/TD	TD/Y	CR/Y	DD/TD	TD/Y	CR/Y
EAP	12.8	41.7	35.5	26.6	61.0	40.5
ECA	28.4	44.3	17.4	21.3	46.7	14.0
LAC	20.9	100.6	31.8	29.2	62.6	39.9
MNA	24.5	65.9	44.3	36.7	70.7	42.8
SAS	32.3	55.9	18.4	39.4	66.3	23.2
SSA	10.9	80.9	16.7	17.9	120.2	16.7
Total	16.5	77.3	26.0	24.8	80.6	27.2

All data are percentage. DD=domestic debt; TD=total debt; Y=GDP; CR=domestic credit to private sector. Regional classification as World Bank: EAP, East Asia and Pacific; ECA, Europe and Central Asia; LAC, Latin America and the Caribbean; MNA, Middle East and Northern Africa; SAS, South Asia; SSA, Sub Saharan Africa.

private sector. Deposit money banks comprise commercial banks and other financial institutions that accept transferable deposits, such as demand deposits.

Table 1 reports the average debt composition and level of domestic credit to private sector in 1985 and 2000 for the different groups of developing countries. We notice that the share of domestic debt over total debt varies significantly across regions, with the highest share in South Asia. Moreover, the share has increased through time, becoming double between 1985 and 2000 in East Asia and Pacific region. The ratio of domestic credit over GDP varies across regions, as well; however, there was not s general pattern across time between 1985 and 2000. These developments will be taken into account in our analysis on the long-run relationship between the composition of debt and the financial development.

3 Properties of the data

The focus of the analysis is to study the long-run effect of financial development on composition of debt. We use a panel Autoregressive Distributed Lag (panel ARDL) model. This approach is appropriate for the type of dataset available and to distinguish between long-run and short-run dynamics. Moreover, we will allow for any type of heterogeneity across countries and for the presence of cross-section dependence, due to unobserved common factors affecting all countries.

Our dataset comprises a long time period and many countries, making it a "macro panel". For the purpose of this analysis,[5] we use a balanced dataset and therefore we have to reduce the size of our sample to 51 countries[6] for the period 1980 - 2008. Once the time dimension is non-trivial, the

[5]In the following analysis we use the STATA command *xtpmg*, described in Blackburne and Frank (2007), the command *xtcd*, based on De Hoyos and Sarafidis (2006) and modified by Markus Eberhardt, the *xtwest* command, described in Persyn et al. (2008).

[6]Our reduced sample contains 14 low income countries, 20 lower-middle income countries and 17 upper-middle income countries.

Table 2: Panel Unit root tests.

Unit Root Test	Null	AR parameter	cross-section dependence
Levin et al. (2002)	unit root	common	NO
Breitung (2000)	unit root	common	NO
Im et al. (2003)	unit root	individual	NO
Fisher type (Choi, 2001)	unit root	individual	NO
Hadri (2000)	stationarity	-	NO
Pesaran (2007)	unit root	individual	YES

The panel unit root tests used assume different null hypotheses on the stationary and the cross-section dependence.

stationarity properties of the series become very important. Hence, we conduct unit root tests on the variables of interest.

3.1 Panel Unit root tests

The econometric literature has produced many unit root tests for panel data under different assumptions and model specifications. Given that it is no clear that one test is superior to others, we use various tests and compare the results. The features of the tests are summarized in Table 2. Most of the tests rely on an AR model in a similar way as the (augmented) Dickey-Fuller test for a single entity.

$$\Delta y_{it} = \rho_i y_{i,t-1} + \sum_{l=1}^{p_i} \lambda_{ij} \Delta y_{i,t-l} + \alpha_i d_{it} + \epsilon_{it} \tag{1}$$

where d_{it} contains the deterministic components. The test is based on whether $\rho_i = 0$ or $\rho_i < 0$.

Both the Levin et al. (2002) and the Breitung (2000) tests are based on a null hypothesis of non-stationarity and assume that the parameters tested are equal across all the panels ($\rho_i = \rho$). This means that the alternative hypothesis to the common unit root is that all the series are stationary. Instead, the Im et al. (2003) and Choi (2001) tests allow for the parameters ρ_i to vary across panels. In this way they allow for an alternative hypothesis of unit roots in some but not necessarily all the series. The Hadri (2000) test is a generalization of the KPSS test for a single time series. It does not require an AR model like (1) and assumes stationarity as null hypothesis. All these tests assume cross-section independence of the errors, but provide a way to possibly mitigate the problem of cross-section dependence by subtracting the cross-section means from the variables. The Pesaran (2007) test is the only test, among the ones we use, that is robust to the presence of cross-sectional dependence in the data, while at the same time allowing ρ_i to vary across panels. The test is based on the (augmented) Dickey Fuller test in (1), but additional factors are included to filter out the effects of unknown common factors. The regression is augmented with the lagged cross-section

Table 3: Results of Panel Unit root tests for level variables.

No Trend					
Unit Root Test	Variables				
	Domratio	Credit	Totdebt	Infl	Gdp-gr
Levin et al. (2002)	N	N	Y	Y	Y
Breitung (2000)	N	N	Y	Y	Y
Im et al. (2003)	N	N	Y	Y	Y
Fisher type (Choi, 2001)	N	N	N	Y/N	Y
Hadri (2000)	Y	Y	Y	Y	Y/N
Pesaran (2007)	N	N	N	Y	Y
With Trend					
Unit Root Test	Variables				
	Domratio	Credit	Totdebt	Infl	Gdp-gr
Levin et al. (2002)	N	N	N	Y/N	Y
Breitung (2000)	N	N	N	Y	Y
Im et al. (2003)	N	Y/N	N	Y	Y
Fisher type (Choi, 2001)	N	N	N	Y	Y
Hadri (2000)	Y	Y	Y	Y	Y
Pesaran (2007)	N	N	N	Y/N	Y

Summary of the results of the tests. N = we cannot reject the null hypothesis. Y = we can reject the null hypothesis. Y/N = mixed results. Notice that only Hadri (2000) test has a different null hypothesis. See Appendix C for detailed results.

mean of the variable and its differences.

The results of the tests are summarized in Table 3 for the variables in levels and in Table 4 for the variables in first difference.[7] Most of the tests in most of the cases suggest that the domestic debt ratio and the domestic credit to GDP are integrated of order one, I(1). Inflation and GDP growth are found stationary, hence I(0). Instead, the results for the total debt over GDP are mixed: only the tests including a trend seem to agree that the variable is integrated of order one. In any case, its fist difference is stationary. The fact that no variable is integrated of order two allows us to use the ARDL model for the variables of interest. Moreover, this methodology permits the study of the relationship between variables that are I(0) and variables that are I(1).

[7] Detailed results are provided in Appendix C.

Table 4: Results of Panel Unit root tests for variables in first difference.

No Trend					
Unit Root Test	Variables				
	D.domratio	D.credit	D.totdebt	D.infl	D.gdp-gr
Levin et al. (2002)	Y	Y	Y	Y	Y
Breitung (2000)	Y	Y	Y	Y	Y
Im et al. (2003)	Y	Y	Y	Y	Y
Fisher type (Choi, 2001)	Y	Y	Y	Y	Y
Hadri (2000)	Y	N	Y	N	N
Pesaran (2007)	Y	Y	Y	Y	Y

With Trend					
Unit Root Test	Variables				
	D.domratio	D.credit	D.totdebt	D.infl	D.gdp-gr
Levin et al. (2002)	Y	Y	Y	Y	Y
Breitung (2000)	Y	Y	Y	Y	Y
Im et al. (2003)	Y	Y	Y	Y	Y
Fisher type (Choi, 2001)	Y	Y	Y	Y	Y
Hadri (2000)	Y	Y	Y	Y	Y
Pesaran (2007)	Y	Y	Y	Y	Y

Summary of the results of the tests. N = we cannot reject the null hypothesis. Y = we can reject the null hypothesis. Y/N = mixed results. Notice that only Hadri (2000) test has a different null hypothesis. See Appendix C for detailed results.

3.2 Panel cointegration tests

Given that we have found strong support for the non-stationarity of the domestic debt ratio and the domestic credit over GDP, we want to investigate whether they are cointegrated. We consider two types of cointegration tests: the test proposed by Pedroni (1999) is a residual-based test, while the test proposed by Westerlund (2007) is a test based on the error-correction form. Pedroni (1999)'s test provides seven residual-based statistics under the null hypothesis of no cointegration. First, one series is regressed on the other one and then the residuals are tested for nonstationarity. Four statistics impose a common coefficient for the autoregressive process of the residuals under the alternative hypothesis (the panel statistics). Three statistics allow the autoregressive coefficient to vary across panels (the group statistics). The results are reported in Table 5 and show that we can reject the null hypothesis of no cointegration for most of the cases.

The test developed by Pedroni does not allow to explicitly correct for cross-section dependence (the series can be demeaned to possibly mitigate this effect). Hence, we run also the test proposed by

Table 5: Pedroni (1999) panel cointegration test.

	(1)	(2)	(3)	(4)
	no trend		trend	
Test statistics	panel	group	panel	group
v	3.572***	.	2.27***	.
rho	-2.892***	-1.253	-3.494***	-1.159
t	-2.614***	-1.891*	-5.563***	-4.951***
adf	-2.047***	-2.384***	-6.737***	-5.704***

Series are demeaned. All test statistics are distributed as N(0,1), under a null of no cointegration, and diverge to negative infinity (save for panel v). The width of the Bartlett kernel window used in the semi-parametric estimation of long-run variances is set to 3, based on the formula $width = 4(T/100)^{2/9}$.

Table 6: Westerlund (2007) panel cointegration test.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	no trend				trend			
	panel		group		panel		group	
lags	2	3	2	3	2	3	2	3
T_t	-8.404***	-9.152 ***	-1.483	-1.476	-11.692**	-11.530***	-1.820	-1.883
T_a	-3.397**	-2.924**	-5.045**	-3.361***	-5.985**	-3.578 ***	-7.051	-4.029***

Critical values are bootstrapped 100 times under the null hypothesis of no cointegration.

Westerlund (2007), that can account for all the types of heterogeneity and cross-section dependence. This test is based on the error-correction form and tests the null hypothesis of no cointegration. The test can handle the cross-section dependence through bootstrap methods. Four statistics are computed: two statistics use the alternative hypothesis that the panel is cointegrated as a whole (the panel statistics), while the other two use the alternative that at least one unit is cointegrated (the group statistics). The results reported in Table 6 show that the null hypothesis of no cointegration can always be rejected when the panel is considered as a whole. The results for the group statistics are mixed.

We should mention one limitation of these results. When the time dimension is small (29 years), the test may be sensitive to the choice of lags, leads and the kernel width. However, this is not a major problem for our analysis. The ARDL model can be written in error-correction form and the existence of the long-term relationship can be tested also by using the parameter that represents the speed of adjustment to the error correction term.

4 ARDL model

The time dimension in macro panels is so large that standard panel data techniques are not well suited for several reasons.[8] The estimators are usually constructed by exploiting the asymptotics in the N dimension. But in macro panels neither N neither T is very large. The estimators used for dynamic panels, known as Difference GMM and System GMM, are not suited for a moderate N and a large T, because of overfitting problems. Moreover, they require stationarity of the variables or at least stationarity in the initial conditions ($t = 0$ for System GMM). In addition, it is standard to assume homogeneity across countries, except for a fixed effect. When we have longer time series, the assumption of homogenous dynamics is usually inappropriate. One way to study series with unit roots by allowing for cointegration among them and heterogeneity is to estimate a panel VEC model. However, a moderate N makes the estimation unfeasible, due to the high number of coefficients to estimate.

Having many countries and many years in the dataset, we allow for heterogeneity not only in the time-invariant features of each country, but also in the dynamics. When the underlying model is heterogeneous, the assumption of homogeneity produces inconsistent estimates. Moreover, to account for unobserved common effects we use estimators that correct for cross-section dependence in the errors. Failure to do so would produce biased estimates. We will distinguish between short-term dynamics and long-term dynamics. This distinction is crucial, because there can be short-term effects from credit to the composition of debt. We will use the Panel Autoregressive Distributed Lag Model, because it allows us to identify short-term and long-term effects by including lags of dependent and independent variables. The ARDL methodology has been shown to be valid regardless of whether the regressors are exogenous or endogenous and irrespective of whether the variables are integrated of order zero or one, but they cannot be integrated of order two.[9] However, this methodology strongly relies on the number of lags included, and this is why we are going to vary the number of lags as robustness check to our analysis.

The ARDL model can be written in the following way.

$$y_{i,t} = \alpha_i + \sum_{j=1}^{p} \beta_{i,j} y_{i,t-j} + \sum_{j=0}^{q} \boldsymbol{\gamma'_{i,j}} \boldsymbol{x_{i,t-j}} + \epsilon_{i,t}. \tag{2}$$

We rewrite the equation in error correction form to highlight the long-term relationship and the short-term adjustment.

$$\Delta y_{i,t} = \alpha_i + \phi_i (y_{i,t-1} - \boldsymbol{\theta'_i x_{i,t}}) + \sum_{j=1}^{p-1} \beta^*_{i,j} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \boldsymbol{\gamma^{*\prime}_{i,j}} \boldsymbol{\Delta x_{i,t-j}} + \epsilon_{i,t}, \tag{3}$$

[8]In Appendix B we conduct a cross-section analysis with the average variables. Hence, we discard the time dimension and try to study the long-run relationship with an instrumental variable approach. However, the instrument does not perform well and we decide to rely on the results from the panel analysis.

[9]This has been shown in Pesaran and Smith (1995), Pesaran (1997) and Pesaran and Shin (1998).

where $\boldsymbol{\theta_i} = \frac{\sum_{j=0}^{j=q} \gamma'_{i,j}}{1-\sum_{j=1}^{j=p} \beta_{i,j}}$ and $\phi_i = -(1 - \sum_{j=1}^{j=p} \beta_{i,j})$. The term $(y_{i,t-1} - \boldsymbol{\theta_i' x_{i,t}})$ is the error correction term, representing the long-run relationship between the dependent variable and the independent variables. The coefficient ϕ_i is the short-run adjustment to the long-term relationship and is an important indicator of the existence of the long-run relationship. In the following analysis we are mostly interested in the parameters $\boldsymbol{\theta_i}$ and ϕ_i.

The standard Dynamic Fixed Effects estimator (DFE) assumes homogeneity in every dimension, except the fixed effects. This estimator is biased when applied to dynamic models, but the size of the bias tends to zero as the time dimension grows (Nickell, 1981). Moreover, this estimator is inconsistent if there is heterogeneity. The estimator that allows for heterogeneity in every dimension is the Mean Group estimator (mg), that is obtained by estimating one equation per group and taking the average across groups. Pesaran and Smith (1995) show that this estimator is consistent, no matter whether the real model is homogeneous or heterogeneous. We also consider the case of heterogeneity in the fixed effects and the short-term dynamics, but with a homogeneous long-term relationship. Hence, we assume that $\theta_i = \theta$, while the short-term coefficients represent averages across countries. The estimator we use is called Pooled Mean Group estimator (pmg) and has been proposed by Pesaran et al. (1999). The authors have developed a maximum likelihood method to estimate the parameters. This estimator is inconsistent if the true model is homogeneous, but it is efficient if the long-term coefficient is homogeneous.

Even if we have accounted for country heterogeneity and time dynamics, we have assumed that the standard errors for each country equation are uncorrelated across them. However, when a panel of countries is analysed, it is important to consider the possibility of cross-sectional dependence of the errors. In fact, the specification of the model may have omitted some common factors that affect all the countries. If these common factors are omitted, they enter the error terms and generate correlation across countries and biased estimates. In the context of static heterogeneous panels Pesaran (2006) proposes to solve this problem by augmenting the regression with with cross-sectional averages of the regressors and the dependent variable. Chudik and Pesaran (2013) extend this work to the case of dynamic heterogeneous panels with weakly exogenous regressors. Hence, we account for the common factors by augmenting the ARDL model with cross-sectional averages of the regressors and the dependent variable and a sufficient number of their lags. The new ARDL model (after some algebra) takes the following form.

$$\Delta y_{i,t} = \alpha_i + \phi_i(y_{i,t-1} - \boldsymbol{\theta_i' x_{i,t}} - \lambda \bar{z}_t) + \sum_{j=1}^{p-1} \beta^*_{i,j} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \gamma^{*\prime}_{i,j} \boldsymbol{\Delta x_{i,t-j}} + \sum_{j=0}^{s-1} \boldsymbol{\psi}'_{i,j} \boldsymbol{\Delta \bar{z}}_{t-j} + \epsilon_{i,t}, \quad (4)$$

where $\bar{z}_t = (\bar{y}_t, \boldsymbol{\bar{x}_t'})'$ and $\boldsymbol{\Delta \bar{z}}_{t-j} = (\Delta \bar{y}_{t-j}, \boldsymbol{\Delta \bar{x}'_{t-j}})'$. The common factors enter the error correction term in levels and appear in first different in the short-term dynamics. The number of lags is the same as the number of lags for the dependent and independent variables. We use the Common Correlated Effects Mean Group estimator (ccemg) proposed by Chudik and Pesaran (2013) and the Common Correlated Effects Pooled Mean Group estimator (ccepmg) proposed by Huang (2011).

These estimators are built on the Mean Group and Pooled Mean Group estimators.

To verify that the CS-ARDL has solved the problem of cross-section dependence, we can run the test of cross-section dependence developed by Pesaran (2004) after running the ARDL and CS-ARDL. This test uses the pairwise correlation coefficients between the residuals of each panel, as shown below.

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \right) \tag{5}$$

Under the null hypothesis of cross-section independence the statistics is distributed as N(0,1). The test is robust to nonstationarity, parameter heterogeneity or structural breaks.

4.1 Linear relationship

First we focus on the long-run linear effect of domestic credit over GDP on domestic-to-total debt ratio. We are mostly interested in the parameter θ that represents the long-run relationship between the two variables, and the parameter ϕ, that represents the short-run adjustment of the domestic debt share to this relationship. The results[10] for the specifications with 2 and 3 lags for the ARDL and CS-ARDL model are reported in Table 7. We also apply the Hausman test to verify which estimator is better between the Pooled Mean Group estimator (pmg) and the Mean Group estimator (mg) and the test suggests the latter. The Hausman test suggests the use of the Common Correlated Effects Pooled Mean Group estimator (ccepmg) rather than the Common Correlated Effects Mean Group estimator (ccemg). Looking at the results for the ARDL model, the long-term relationship between financial development and the domestic-to-total debt share is positive and significant only when the Pooled Mean Group estimator is used. The coefficient in front of the error-correction term is always negative and strongly significant, thus indicating the existence of a long-run relationship. The speed of adjustment to the long-run relationship is low. The long-run effect of a 1 percent increase in domestic credit over GDP is an increase in the domestic debt ratio by 0.6 - 0.66 percent. These results confirm the importance of distinguishing between short-term and long-term effects and different levels of heterogeneity. According to our analysis, the negative correlation found in Guscina (2008) may be due to that fact that dynamic effects have not been distinguished.

In the case of CS-ARDL model, the long-term relationship between domestic debt ratio and credit is positive and significant only for the Common Correlated Effects Pooled Mean Group estimator (ccepmg) and the coefficient decreases when 3 lags are considered. In fact, the coefficient of the cross-section average of the domestic debt ratio becomes larger with 3 lags. We notice that the short-run adjustment to the long-term behaviour is faster than what obtained before. The coefficients for the short-run adjustment are still negative and significant. The CS-ARDL model suggests that the long-run effect of a 1 percent increase in the domestic credit to GDP is a positive increase in

[10] In the rest of the paper we report only the results for the parameters of interest. Whenever there is heterogeneity we report results for the average coefficients, because the individual country estimates are unreliable due to the short time dimension. The detailed results are available from the authors upon request.

Table 7: ARDL and CS-ARDL: linear effect of credit on domestic-over-total debt ratio.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	pmg	pmg	mg	mg	DFE	DFE
lags	2	3	2	3	2	3
credit	0.657***	0.600***	2.136	0.442	0.0938	0.0244
	(0.0799)	(0.0734)	(1.305)	(0.427)	(0.221)	(0.244)
error-corr	-0.187***	-0.176***	-0.268***	-0.281***	-0.103***	-0.107***
	(0.0327)	(0.0383)	(0.0359)	(0.0457)	(0.0180)	(0.0193)
Observations	1,377	1,326	1,377	1,326	1,377	1,326

	(1)	(2)	(3)	(4)
VARIABLES	ccepmg	ccepmg	ccemg	ccemg
lags	2	3	2	3
credit	0.549***	0.377***	0.242	0.0680
	(0.0753)	(0.0418)	(0.318)	(0.361)
error-corr	-0.225***	-0.290***	-0.516***	-0.620***
	(0.0388)	(0.0543)	(0.0466)	(0.0706)
Observations	1,377	1,326	1,377	1,326

The dependent variable measures the ratio of domestic debt over total debt. The independent variable measures the domestic credit to private sector over GDP. The balanced panel covers the period 1980 - 2008. We estimate the Dynamic Fixed Effects estimator (DFE), Pooled Mean Group estimator (pmg), Mean Group estimator (mg), Common Correlated Effects Pooled Mean Group estimator (ccepmg) and Common Correlated Effects Mean Group estimator (ccemg). We report the parameters θ and ϕ. We use robust standard errors (in parenthesis) and cluster the standard errors at country level for the DFE.
*** p<0.01, ** p<0.05, * p<0.1.

Table 8: CD test: linear effect of credit on domestic debt ratio.

	(1)	(2)	(3)	(4)
	pmg	pmg	ccepmg	ccepmg
lags	2	3	2	3
test statistic	8.9	8.33	-2.27	-1.41
p-value	0.0	0.0	0.023	0.159

We run the test for the case of Pooled Mean Group estimator (pmg) and Common Correlated Effects Pooled Mean Group estimator (ccepmg). Under the null hypothesis of cross-section independence the test is distributed as N(0,1).

the domestic debt ratio of the size 0.38 - 0.55 percent. The effect is slightly smaller than before but still sizeable. The results of the CD test for the Pooled Mean Group estimator (pmg) and Common

Table 9: ARDL and CS-ARDL: linear effect of private credit on domestic-over-total debt ratio.

VARIABLES	(1) pmg	(2) pmg	(3) mg	(4) mg	(5) DFE	(6) DFE
lags	2	3	2	3	2	3
priv-credit	0.693***	0.729***	-0.00451	-0.631	0.256	0.257
	(0.0824)	(0.0940)	(0.597)	(1.159)	(0.220)	(0.227)
error-corr	-0.195***	-0.178***	-0.283***	-0.285***	-0.110***	-0.123***
	(0.0345)	(0.0357)	(0.0370)	(0.0408)	(0.0189)	(0.0210)
Observations	1,161	1,118	1,161	1,118	1,161	1,118

VARIABLES	(1) ccepmg	(2) ccepmg	(3) ccemg	(4) ccemg
lags	2	3	2	3
priv-credit	0.648***	0.250***	-0.347	1.400
	(0.0802)	(0.0478)	(0.461)	(2.453)
error-corr	-0.249***	-0.334***	-0.619***	-0.817***
	(0.0411)	(0.0663)	(0.0607)	(0.0920)
Observations	1,161	1,118	1,161	1,118

The dependent variable measures the ratio of domestic debt over total debt. The independent variable is the private credit by deposit money banks and other financial institutions over GDP. The balanced panel covers the period 1980 - 2008. We estimate the Dynamic Fixed Effects estimator (DFE), Pooled Mean Group estimator (pmg), Mean Group estimator (mg), Common Correlated Effects Pooled Mean Group estimator (ccepmg) and Common Correlated Effects Mean Group estimator (ccemg). We report the parameters θ and ϕ. We use robust standard errors (in parenthesis) and cluster the standard errors at country level for the DFE.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 10: CD test: linear effect of private credit on domestic debt ratio.

	(1) pmg	(2) pmg	(3) ccepmg	(4) ccepmg
lags	2	3	2	3
test statistic	7.05	6.96	-2.32	-1.33
p-value	0.0	0.0	0.02	0.184

We run the test for the case of Pooled Mean Group estimator (mpg) and Common Correlated Effects Pooled Mean Group estimator (ccepmg). Under the null hypothesis of cross-section independence the test is distributed as N(0,1).

Correlated Effects Pooled Mean Group estimator (ccepmg) are reported in Table 8. The null hypothesis of the test is the cross-section independence of the residuals. We can notice that the t-statistics decreases substantially when we use the cross-section averages as common factors and we cannot reject the hypothesis of cross-section independence when we use 3 lags.

Now we consider alternative proxies for the level of financial development. First, we consider the private credit by deposit money banks and other financial institutions over GDP. Second, we consider total assets held by deposit money banks as a share of GDP. Due to the limited availability of data for these variables, we are left with a balanced panel of 43 and 42 countries,[11] respectively. For the sake of brevity we do not report the unit root test and cointegration tests, but they are in line with the previous results. Most of the tests suggest that the two variables are integrated of order one, while the results of the cointegration tests are mixed.

We repeat the ARDL and CS-ARDL analysis with both variables. The results for all the estimators with 2 and 3 lags using the private credit are reported in Table 9. The Hausman test suggests the use of the Pooled Mean Group estimator for ARDL and Common Correlated Effects Pooled Mean Group estimator for CS-ARDL. The long-term relationship between financial development and the domestic-to-total debt share is still positive and strongly significant under the assumption of cross-sectional independence. Moreover, the error-correction speed of adjustment is negative and strongly significant. If we had not accounted for the heterogeneity across countries and used only the Dynamic Fixed Effects estimator (DFE), we would not have found a long-term relationship between the variables of interest. Once we account for the possible existence of cross-sectional dependence in the errors, we still find a positive and significant long-run relationship and the short-term adjustment is faster than before. The coefficients under the Mean Group specification are not significant. According to the Common Correlated Effects Pooled Mean Group estimator (ccepmg) the long-run effect of a 1 percent increase in the private credit over GDP is an increase in the domestic debt share by 0.25-0.65 percent.

Table 10 reports the cross-section test for the case of Pooled Mean Group estimator (pmg) and Common Correlated Effects Pooled Mean Group estimator (ccepmg) with the variable of private credit. As before, we can notice that we can reject the null hypothesis of cross-section dependence for the ARDL model. The test statistics improves with the CS-ARDL model and we cannot reject the hypothesis of cross-section independence when we use 3 lags.

The results with the banks'assets for all the estimators with 2 and 3 lags are reported in Table 11. Here the results are mixed. Under the assumption of cross-sectional independence the Hausman test suggests the use of the Pooled Mean Group estimator with 2 lags and the use of Mean Group estimator with 3 lags. The long-term relationship between financial development and the domestic-to-total debt share is positive and significant only with the Pooled Mean Group estimator (pmg). Moreover, the coefficient becomes negative with 3 lags for the Mean Group estimator (mg) case. The coefficient in front of the error correction term is always negative and significant and represents the short-term adjustment. Once we account for the possible existence of cross-sectional dependence

[11] Our reduced sample for the measure of private credit contains 10 low income countries, 16 lower-middle income countries and 17 upper-middle income countries. Our reduced sample for the measure of banks' assets contains 10 low income countries, 15 lower-middle income countries and 17 upper-middle income countries.

in the errors, the results improve. We find a positive and significant long-run relationship with the Pooled Mean Group estimator, that is also suggested by the Hausman test. The coefficients of bank's assets in the error correction term are smaller than before, but the short-term adjustment is faster. According to the Common Correlated Effects Pooled Mean Group estimator (ccepmg) the long-run effect of a 1 percent increase in the private credit over GDP is an increase in the domestic debt share by 0.25-0.69 percent.

Table 12 reports the cross-section test for the case of Pooled Mean Group estimator (pmg) and Common Correlated Effects Pooled Mean Group estimator (ccepmg) with the variable of banks' assets. We reject the null hypothesis of cross-section dependence for the ARDL model. The test statistics improves with the CS-ARDL model but the results here are mixed. When 3 lags are used we can reject the hypothesis of cross-section independence only at 10 percent level.

Table 11: ARDL and CS-ARDL: linear effect of banks' assets on domestic-over-total debt ratio.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	DFE	DFE	pmg	pmg	mg	mg
lags	2	3	2	3	2	3
banks-assets	0.374**	0.405**	0.942***	1.072***	1.619	-0.0631
	(0.186)	(0.195)	(0.0696)	(0.0765)	(1.020)	(0.524)
error-corr	-0.123***	-0.139***	-0.199***	-0.190***	-0.296***	-0.316***
	(0.0199)	(0.0218)	(0.0375)	(0.0425)	(0.0392)	(0.0444)
Observations	1,134	1,092	1,134	1,092	1,134	1,092
	(1)	(2)	(3)	(4)		
VARIABLES	ccepmg	ccepmg	ccemg	ccemg		
lags	2	3	2	3		
banks-assets	0.685***	0.249***	1.450	0.393		
	(0.0590)	(0.0503)	(1.623)	(0.583)		
error-corr	-0.231***	-0.333***	-0.623***	-0.782***		
	(0.0392)	(0.0634)	(0.0597)	(0.101)		
Observations	1,134	1,092	1,134	1,092		

The dependent variable measures the ratio of domestic debt over total debt. The independent variable measures the total assets held by deposit money banks as a share of GDP. The balanced panel covers the period 1980 - 2008. We estimate the Dynamic Fixed Effects estimator (DFE), Pooled Mean Group estimator (pmg), Mean Group estimator (mg), Common Correlated Effects Pooled Mean Group estimator (ccepmg) and Common Correlated Effects Mean Group estimator (ccemg). We report the parameters θ and ϕ. We use robust standard errors (in parenthesis) and cluster the standard errors at country level for the DFE.
*** p<0.01, ** p<0.05, * p<0.1.

Looking at the results across all the specifications, the consistent and efficient estimator is the one

Table 12: CD test: linear effect of banks' assets on domestic debt ratio.

	(1)	(2)	(3)	(4)
	pmg	pmg	ccepmg	ccepmg
lags	2	3	2	3
test statistic	6.66	6.47	-2.37	-1.82
p-value	0.0	0.0	0.018	0.069

We run the test for the case of Pooled Mean Group estimator (mpg) and Common Correlated Effects Pooled Mean Group estimator (ccepmg). Under the null hypothesis of cross-section independence the test is distributed as N(0,1).

allowing for cross-country heterogeneity in intercepts and short-term dynamics, but restricting the long-term relationship to be homogeneous across countries. With the three measures of financial development there is robust evidence of positive long-run effect from financial development to domestic debt share. A recent model on sovereign debt composition by Di Casola and Sichlimiris (2015) shows that this relationship is hump-shaped. Hence, in the next section we investigate a particular type of non-linearity (concavity), by adding the squared value of the proxy for financial development as additional regressor.

4.2 Non-linear relationship

We show that the relationship between the composition of sovereign debt and the level of financial development is non-linear. This non-linearity could be due to other determinants of the composition of debt left out of the analysis. Therefore, we include inflation, GDP growth and debt-to-GDP ratio in the models we estimate.[12] In this way we account for possible feedback effects between these variables and the composition of debt and verify the robustness of the non-monotonic relationship. We present results only from the Pooled Mean Group estimator (pmg) and the Common Correlated Effects Pooled Mean Group estimator (ccepmg). The Hausman test between the mean group and the pooled mean group estimators does not reject the latter as the efficient estimator.

We present the results for the long-run coefficients and short-run adjustment to the long-run equilibrium from the ARDL and CS-ARDL models in Table 13 - 18.[13] The CS-ARDL model is augmented with cross-section averages of all the variables and their lags. The number of lags of the cross-section averages equals the number of lags of the regressors. The majority of the models we have considered across different proxies of financial development predict a hump-shaped relationship. For low levels of financial development a permanent increase in the level of financial development leads to a higher domestic debt share. For high levels of financial development the

[12] We have omitted this part of the analysis when we investigated the linear relationship. We want to place more focus on the non-linear part as a more realistic assumption.

[13] In the following analysis we provide the results for the CS-ARDL model with 3 lags only with a maximum of 2 independent variables, because the maximum likelihood procedure run in Stata does not converge with more regressors.

effect is negative. These results can be consistent with the following idea. For low levels of financial development there is less competition among different asset classes in the economy. All in all, this would lead to higher domestic debt share to reflect the favourable domestic conditions. On the other hand, above some threshold permanent increases of financial development will decrease the domestic debt share to reflect the increased competition of assets in the domestic market. We are able to refer to this long-run behaviour of the variables, because our methodology distinguishes the short-run and the long-run dynamics. By comparing the results between the models that assume away any common factors (ARDL) and the ones that take into account the presence of common factors (CS-ARDL), the qualitative properties remain the same.

Considering the effects of the other variables on the composition of debt, given that these variables can have different impact in the short run and in the long run. The long-run effect of total debt is found to be negative. A permanent increase in the total debt over GDP implies a larger share issued in the external market and a smaller share issued in the domestic market. Inflation and GDP growth have a positive long-run effect on the domestic debt share. A permanent increase in inflation implies a larger share of debt issued locally. This results is in contrast with the results found in Forslund et al. (2011). The authors find no relationship between domestic debt share and inflation in countries with high capital controls and find a negative relationship in countries with low capital controls. However, their dataset is shorter and does not allow them to distinguish short-term from long-term effects. A positive long-run effect of inflation on the domestic share of government debt is consistent with the presence of financial repression. Captive domestic savers would be forced to buy government assets. Without some form of financial repression, a high inflation would imply higher costs for the government to issue debt locally, hence a lower share of domestic debt in the long run. This would imply a negative long-run effect of inflation, the opposite of our result.

There are various forms of financial repression[14] and it is difficult to measure the effective level of financial repression in a country. Restrictions on capital flows are one tool to obtain financial repression. We can look at measures of financial liberalization to verify that some form of financial repression is in place in the countries we consider. One such measure is the normalized index of financial liberalization constructed by Abiad et al. (2008). For the period 1973-2005 the index is equal to 0.42 for non-advanced economies, in contrast to 0.69 for advanced economies. Another measure is the average index of capital controls constructed by Fernández et al. (2013). For the period 1995-2011 the average value is 0.35 for emerging economies and 0.54 for low-income countries, in contrast to 0.07 for developed economies.

The positive effect of GDP growth may be interpreted in the following way. Higher GDP growth may imply higher domestic savings, that can be saved abroad or within the country. Our results

[14]We refer to the following definition for financial repression provided by Kirkegaard et al. (2011). Financial repression includes directed lending to the government by captive domestic audiences (such as pension funds or domestic banks), explicit or implicit caps on interest rates, regulation of cross-border capital movements, and (generally) a tighter connection between government and banks, either explicitly through public ownership of some of the banks or through heavy "moral suasion". Financial repression is also sometimes associated with relatively high reserve requirements (or liquidity requirements), securities, transaction taxes, prohibition of gold purchases (as in the US from 1933 to 1974), or the placement of significant amounts of government debt that is nonmarketable.

Table 13: ARDL: non-monotonic effect of credit on domestic-over-total debt ratio.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			**2 lags**			
Credit	0.976***	0.880***	-0.342**	-0.146	0.749***	-3.218***
	(0.213)	(0.233)	(0.137)	(0.163)	(0.212)	(0.656)
Credit^2	-1.833***	-2.237***	1.251***	1.025***	-1.329***	3.645***
	(0.340)	(0.391)	(0.209)	(0.217)	(0.367)	(0.827)
Totdebt		-0.0951***			-0.196***	-0.0439
		(0.0221)			(0.0179)	(0.0366)
Inflation			-0.00485		0.160***	
			(0.0411)		(0.0519)	
GDP growth				0.187***		4.176***
				(0.0621)		(0.607)
error-corr	-0.175***	-0.177***	-0.194***	-0.196***	-0.194***	-0.0747***
	(0.0291)	(0.0280)	(0.0358)	(0.0349)	(0.0386)	(0.00962)
Observations	1,377	1,377	1,326	1,326	1,326	1,326
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			**3 lags**			
Credit	0.326**	0.260**	-0.439***	0.579***	0.385***	-1.143***
	(0.129)	(0.119)	(0.117)	(0.0851)	(0.0954)	(0.128)
Credit^2	-0.383***	-0.339***	1.238***	-0.338***	-0.459***	0.470***
	(0.123)	(0.0933)	(0.164)	(0.0557)	(0.0923)	(0.0681)
Totdebt		-0.0976***			-0.0839***	-0.0762***
		(0.0198)			(0.0130)	(0.0150)
Inflation			-0.0312*		0.746***	
			(0.0175)		(0.0778)	
GDP growth				0.325***		1.430***
				(0.0569)		(0.133)
error-corr	-0.176***	-0.177***	-0.226***	-0.178***	-0.149***	-0.129***
	(0.0340)	(0.0398)	(0.0542)	(0.0419)	(0.0461)	(0.0271)
Observations	1,326	1,326	1,275	1,275	1,275	1,275

The dependent variable measures the ratio of domestic debt over total debt. The independent variables are domestic credit over GDP, squared value of domestic credit over GDP, total debt over GDP, inflation rate and growth rate. The balanced panel covers the period 1980 - 2008. We estimate the Autoregressive Distributed Lag (ARDL) model with 2 and 3 lags with the Pooled Mean Group estimator (pmg). We report the parameters $\boldsymbol{\theta}'$ and ϕ. We use robust standard errors (in parenthesis).
*** p<0.01, ** p<0.05, * p<0.1.

suggest that they are invested in government assets. It is possible that domestic savers are forced to hold a portfolio of government bonds or that these assets represent better opportunities than investments abroad. Given the presence of some type of capital controls in these countries, we tend to favour the explanation that savers are forced to hold government assets in their portfolios.

Table 14: CS-ARDL: non-monotonic effect of credit on domestic-over-total debt ratio.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES				**2 lags**			**3 lags**
Credit	0.132	-0.136	0.563***	-0.334***	-0.445***	-4.969***	0.698***
	(0.165)	(0.103)	(0.0918)	(0.116)	(0.107)	(0.874)	(0.0628)
$Credit^2$	0.516**	-0.108	-0.307***	1.394***	0.0475	2.558***	-0.512***
	(0.235)	(0.0943)	(0.0869)	(0.167)	(0.0614)	(0.531)	(0.0441)
Totdebt		0.0190*			-0.0665***	1.688***	
		(0.0112)			(0.0179)	(0.291)	
Inflation			0.198***		0.0449**		
			(0.0430)		(0.0221)		
GDP growth				-0.00911		12.21***	
				(0.0403)		(1.913)	
error-corr	-0.223***	-0.312***	-0.238***	-0.215***	-0.288***	-0.0301***	-0.357***
	(0.0431)	(0.0808)	(0.0586)	(0.0528)	(0.0646)	(0.00569)	(0.0682)
Observations	1,377	1,377	1,326	1,326	1,326	1,326	1,326

The dependent variable measures the ratio of domestic debt over total debt. The independent variables are domestic credit over GDP, squared value of domestic credit over GDP, total debt over GDP, inflation rate and growth rate. The balanced panel covers the period 1980 - 2008. We estimate the Common Correlated Effects Pooled Mean Group estimator (ccepmg) with 2 or 3 lags. We report the parameters $\boldsymbol{\theta}'$ and ϕ. We use robust standard errors (in parenthesis).
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 15: ARDL: non-monotonic effect of private credit on domestic-over-total debt ratio.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			**2 lags**			
priv-credit	0.859***	-0.989***	1.027***	-0.524**	-0.000259	-2.937***
	(0.127)	(0.214)	(0.123)	(0.258)	(0.181)	(0.532)
priv-credit^2	-0.677***	2.158***	-0.692***	1.584***	-1.150**	4.094***
	(0.143)	(0.414)	(0.112)	(0.436)	(0.525)	(0.732)
Totdebt		-0.0614***			0.00111	0.228***
		(0.0235)			(0.0234)	(0.0669)
Inflation			0.140**		-0.118***	
			(0.0655)		(0.0397)	
GDP growth				0.425***		4.524***
				(0.0794)		(0.659)
error-corr	-0.202***	-0.183***	-0.182***	-0.204***	-0.190***	-0.0742***
	(0.0347)	(0.0352)	(0.0378)	(0.0357)	(0.0339)	(0.0131)
Observations	1,161	1,161	1,118	1,118	1,118	1,118

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			**3 lags**			
priv-credit	1.093***	1.047***	1.270***	0.665***	-0.448	0.589***
	(0.106)	(0.145)	(0.130)	(0.0983)	(0.317)	(0.0924)
priv-credit^2	-0.697***	-0.741***	-0.787***	-0.399***	-0.169	-0.447***
	(0.0783)	(0.0823)	(0.0868)	(0.0610)	(0.238)	(0.0531)
Totdebt		-0.235***			-2.690***	-0.171***
		(0.0188)			(0.342)	(0.0171)
Inflation			0.729***		-0.259***	
			(0.0993)		(0.0586)	
GDP growth				0.534***		0.00856
				(0.0766)		(0.0781)
error-corr	-0.179***	-0.150***	-0.135**	-0.206***	-0.0430*	-0.162***
	(0.0404)	(0.0553)	(0.0534)	(0.0479)	(0.0243)	(0.0600)
Observations	1,118	1,118	1,075	1,075	1,075	1,075

The dependent variable measures the ratio of domestic debt over total debt. The independent variables are private credit over GDP, squared value of private credit over GDP, total debt over GDP, inflation rate and growth rate. The balanced panel covers the period 1980 - 2008. We estimate the Common Correlated Effects Pooled Mean Group estimator (ccepmg) with 2 or 3 lags. We report the parameters $\boldsymbol{\theta}'$ and ϕ. We use robust standard errors (in parenthesis).
*** p<0.01, ** p<0.05, * p<0.1.

Table 16: CS-ARDL: non-monotonic effect of private credit on domestic-over-total debt ratio.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES			**2 lags**				**3 lags**
priv-credit	2.372***	0.398***	0.261**	0.378***	-0.375***	-	2.526***
	(0.157)	(0.0678)	(0.119)	(0.114)	(0.0180)	-	(0.124)
priv-credit^2	-1.458***	-0.473***	-0.00112	-0.318***	-0.0107	-	-1.576***
	(0.104)	(0.0443)	(0.116)	(0.0766)	(0.0122)	-	(0.0801)
Totdebt		-0.00868			0.186***	-	
		(0.0139)			(0.00463)	-	
Inflation			-0.545***		-0.547***		
			(0.0810)		(0.0168)		
GDP growth				0.257***		-	
				(0.0394)		-	
error-corr	-0.176***	-0.236***	-0.213***	-0.231***	-0.0862**	-	-0.196**
	(0.0491)	(0.0547)	(0.0515)	(0.0431)	(0.0439)	-	(0.0845)
Observations	1,161	1,161	1,118	1,118	1,118	-	1,118

The dependent variable measures the ratio of domestic debt over total debt. The independent variables are private credit over GDP, squared value of private credit over GDP, total debt over GDP, inflation rate and growth rate. The balanced panel covers the period 1980 - 2008. We estimate the Common Correlated Effects Pooled Mean Group estimator (ccepmg) with 2 or 3 lags. We report the parameters $\boldsymbol{\theta'}$ and ϕ. Column (6) has missing values because the maximum likelihood procedure did not converge. We use robust standard errors (in parenthesis).
*** p<0.01, ** p<0.05, * p<0.1.

Table 17: ARDL: non-monotonic effect of banks' assets on domestic-over-total debt ratio.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			**2 lags**			
Banks-assets	0.740***	-0.128	1.076***	2.286***	0.943***	1.512***
	(0.148)	(0.133)	(0.137)	(0.220)	(0.245)	(0.342)
Banks-assets^2	0.177	-0.129	-0.626***	-0.996***	-1.850***	0.0446
	(0.158)	(0.105)	(0.0863)	(0.128)	(0.448)	(0.291)
Totdebt		-0.128***			-0.196***	0.223***
		(0.0247)			(0.0224)	(0.0463)
Inflation			-0.0437		0.115**	
			(0.0439)		(0.0529)	
GDP growth				1.118***		3.146***
				(0.148)		(0.347)
error-corr	-0.207***	-0.211***	-0.197***	-0.162***	-0.199***	-0.110***
	(0.0384)	(0.0315)	(0.0326)	(0.0278)	(0.0401)	(0.0171)
Observations	1,134	1,134	1,092	1,092	1,092	1,092
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			**3 lags**			
Banks-assets	1.341***	1.008***	1.353***	1.556***	1.071***	0.949***
	(0.123)	(0.134)	(0.118)	(0.0955)	(0.325)	(0.0840)
Banks-assets^2	-0.756***	-0.644***	-0.770***	-0.729***	-1.016***	-0.569***
	(0.0657)	(0.0810)	(0.0613)	(0.0531)	(0.286)	(0.0383)
Totdebt		-0.186***			-1.370***	-0.0429***
		(0.0163)			(0.0995)	(0.0152)
Inflation			-0.0275		-0.0827	
			(0.0239)		(0.0564)	
GDP growth				0.907***		0.320***
				(0.0942)		(0.0678)
error-corr	-0.211***	-0.224***	-0.228***	-0.227***	-0.0997**	-0.245***
	(0.0400)	(0.0534)	(0.0459)	(0.0414)	(0.0444)	(0.0593)
Observations	1,092	1,092	1,050	1,050	1,050	1,050

The dependent variable measures the ratio of domestic debt over total debt. The independent variables are banks' assets over GDP, squared value of banks' assets over GDP, total debt over GDP, inflation rate and growth rate. The balanced panel covers the period 1980 - 2008. We estimate the Common Correlated Effects Pooled Mean Group estimator (ccepmg) with 2 or 3 lags. We report the parameters $\boldsymbol{\theta'}$ and ϕ. We use robust standard errors (in parenthesis).
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 18: CS-ARDL: non-monotonic effect of banks' assets on domestic-over-total debt ratio.

VARIABLES	(1)	(2)	(3) 2 lags	(4)	(5)	(6)	(7) 3 lags
Banks-assets	1.648***	1.442***	0.313***	0.869***	0.226***	-	1.702***
	(0.151)	(0.141)	(0.0338)	(0.0679)	(0.0537)	-	(0.0737)
Banks-assets^2	-0.757***	-0.967***	-0.158***	-0.429***	-0.178***	-	-0.804***
	(0.139)	(0.110)	(0.0459)	(0.0779)	(0.0286)	-	(0.0758)
Totdebt		-0.143***			0.00350	-	
		(0.0323)			(0.0129)	-	
Inflation			0.0977***		0.0365***		
			(0.0204)		(0.0138)		
GDP growth				0.426***		-	
				(0.0104)		-	
error-corr	-0.231***	-0.145***	-0.266***	-0.228***	-0.173***	-	-0.308***
	(0.0519)	(0.0508)	(0.0583)	(0.0478)	(0.0446)	-	(0.0789)
Observations	1,134	1,134	1,092	1,092	1,092	-	1,092

The dependent variable measures the ratio of domestic debt over total debt. The independent variables are banks' assets over GDP, squared value of banks' assets over GDP, total debt over GDP, inflation rate and growth rate. The balanced panel covers the period 1980 - 2008. We estimate the Common Correlated Effects Pooled Mean Group estimator (ccepmg) with 2 or 3 lags. We report the parameters $\boldsymbol{\theta}'$ and ϕ. Column (6) has missing values because the maximum likelihood procedure did not converge. We use robust standard errors (in parenthesis).
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

5 Conclusion

We have studied the long-term effect of financial development of the composition of debt in a large sample of developing countries. We have used a dataset that distinguishes domestic and external debt depending on the place of issuance and jurisdiction. We have considered three proxies for the level of financial development. The analysis is based on dynamic heterogeneous panel models. Hence, it takes into account cross-country heterogeneity and allows to distinguish between a long-term behaviour and a short-term behaviour. Furthermore, the presence of cross-section dependent errors due to unobserved common factors is taken into account.

We find a non-monotonic long-term relationship between financial development and the domestic debt share. Up to a given level of financial development, a permanent increase in financial development produces a permanent increase in the domestic share of government debt. This relationship turns negative after a certain threshold. These results are robust to the introduction of relevant macroeconomic variables, such as inflation, GDP growth and total debt over GDP. We find a negative long-term effect of total debt on the domestic debt share. Inflation and GDP growth have a positive long-run effect on the share of government debt issued domestically. This positive effect of inflation is consistent with the presence of financial repression in the domestic market.

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Appendix A Description of Data

Table A.1: List of countries by region.

EAP	ECA	LAC	MENA	SAS	SSA
Vietnam	Latvia	Chile	Yemen	Bhutan	Guinea
Solomon Islands	Bosnia Herz.	Guatemala	Egypt	Sri Lanka	Côte d'Ivoire
Cambodia	Bulgaria	Dominica	Lebanon	Bangladesh	Madagascar
Phillipines	Georgia	Panama	Iran	India	Togo
Vanuatu	Belarus	Ecuador	Tunisia	Nepal	Botswana
Samoa	Russia	Haiti	Algeria	Maldives	Angola
Indonesia	Macedonia	Mexico	Jordan	Pakistan	Malawi
Papua N. Guinea	Moldova	Grenada	Morocco		Cape Verde
Laos	Uzbekistan	St.Vincent Grens	Djibouti		Cameroon
Malaysia	Poland	Peru			Senegal
China	Croatia	Guyana			Sudan
Thailand	Azerbaijan	Paraguay			Central Africa
Tonga	Ukraine	St.Kitts & Nevis			Niger
Mongolia	Turkmenistan	Uruguay			Gambia
Myanmar	Kazakhstan	Honduras			Ghana
Fiji	Kyrgyz. Rep.	Dominican Rep.			Eritrea
	Romania	Bolivia			Mali
	Albania	El Salvador			Uganda
	Tajikistan	Brazil			Ethiopia
	Armenia	Nicaragua			Congo Dem
	Turkey	Venezuela			Swaziland
		Costa Rica			Congo Republic
		Argentina			Chad
		Jamaica			São Tomé Príncipe
		Colombia			Zambia
		St.Lucia			Kenya
		Belize			Mozambique
					Nigeria
					Mauritania
					Benin
					Zimbabwe
					Gabon
					Sierra Leone
					Rwanda
					Lesotho
					Tanzania
					Seychelles
					Burkina Faso
					Burundi
					Guinea Bissau
					Liberia
					South Africa
					Mauritius

Regional classification as World Bank: EAP, East Asia and Pacific; ECA, Europe and Central Asia; LAC, Latin America and the Caribbean; MNA, Middle East and Northern Africa; SAS, South Asia; SSA, Sub Saharan Africa.

Table A.2: Countries for which data on domestic debt is available.

Year	EAP	ECA	LAC	MNA	SAS	SSA	Total
1970	5	1	18	5	4	29	62
1971	5	1	18	5	4	29	62
1972	5	1	18	5	4	29	62
1973	6	0	18	5	4	29	62
1974	6	0	18	5	4	28	61
1975	6	0	18	5	4	29	62
1976	6	1	19	5	5	31	67
1977	6	1	20	5	5	30	67
1978	6	1	21	5	5	30	68
1979	6	1	21	5	5	31	69
1980	8	1	20	6	5	33	73
1981	9	1	22	6	5	34	77
1982	10	1	22	6	5	34	78
1983	10	1	22	6	4	34	77
1984	11	1	22	6	4	35	79
1985	12	1	22	6	5	35	81
1986	12	1	23	6	5	36	83
1987	12	1	23	6	5	35	82
1988	12	1	22	6	5	35	81
1989	13	1	24	6	5	36	85
1990	13	2	25	7	5	36	88
1991	13	2	26	6	5	37	89
1992	15	4	25	7	5	39	95
1993	14	8	25	9	6	39	101
1994	14	13	26	9	7	40	109
1995	15	17	26	9	7	41	115
1996	16	17	26	9	7	41	116
1997	16	17	26	9	7	41	116
1998	16	19	27	9	7	42	120
1999	16	20	27	9	7	42	121
2000	16	19	27	9	7	42	120
2001	16	20	27	9	7	42	121
2002	16	20	27	9	7	42	121
2003	16	20	27	9	7	41	120
2004	16	20	27	9	7	42	121
2005	16	20	27	9	7	43	122
2006	16	20	27	9	7	40	119
2007	16	20	26	9	7	39	117
2008	13	19	27	9	6	40	114
2009	9	14	23	8	4	25	83
2010	7	13	19	8	4	22	73

Regional classification as World Bank: EAP, East Asia and Pacific; ECA, Europe and Central Asia; LAC, Latin America and the Caribbean; MNA, Middle East and Northern Africa; SAS, South Asia; SSA, Sub Saharan Africa.

Table A.3: Variables used.

VARIABLE	DESCRIPTION AND SOURCE
Domestic debt	Domestic debt over GDP. The debt is issued locally and under domestic jurisdiction. Source: Panizza.
External debt	External debt over GDP. The debt is issued abroad and under foreign jurisdiction. Source: Panizza.
Total debt	Total debt over GDP. Source: Panizza.
GDP	Real GDP. Source: World Bank.
Inflation	Annual inflation calculated from CPI index. Source: World Bank.
Real Exchange rate	Source:World Bank.
Credit	Domestic credit to private sector over GDP. This variable refers to financial resources, such as through loans, purchases of nonequity securities, trade credits and other accounts receivable, that establish a claim for repayment, provided to the private sector. Source: Financial Development and Structure Dataset.
Private Credit	Private credit by deposit money banks and other financial institutions over GDP. Source: Financial Development and Structure Dataset.
Banks' assets	Total assets held by deposit money banks as a share of GDP. Assets include claims on domestic real nonfinancial sector which includes central, state and local governments, nonfinancial public enterprises and private sector. Deposit money banks comprise commercial banks and other financial institutions that accept transferable deposits, such as demand deposits. Source: Financial Development and Structure Dataset.
Creditor rights index	An index aggregating creditor rights, following La Porta et al. (1998). A score of one is assigned when each of the following rights of secured lenders are defined in laws and regulations: First, there are restrictions, such as creditor consent or minimum dividends, for a debtor to file for reorganization. Second, secured creditors are able to seize their collateral after the reorganization petition is approved, i.e., there is no automatic stay or asset freeze. Third, secured creditors are paid first out of the proceeds of liquidating a bankrupt firm, as opposed to other creditors such as government or workers. Finally, if management does not retain administration of its property pending the resolution of the reorganization. The index ranges from zero (weak creditor rights) to four (strong creditor rights) and is constructed as of January for every year from 1978 to 2003. Source: Djankov et al. (2007).

Appendix B Cross-section analysis

For the cross-section analysis we average the variables across time. In this way we drop out the variations across time and we focus on the long-term behaviour of the variable. Hence, our unit of observation is the country.

In order to take into account the possibility of reverse causality from the domestic-to-total debt ratio to the credit over GDP, we proceed with an instrumental-variable regression. As instrument for credit we use the creditors right index computed by Djankov et al. (2007), extending the methodology by La Porta et al. (1998). This indicator measures the power of secured lenders in bankruptcy and varies between 0 (poor creditor rights) and 4 (strong creditor rights). It is considered a good predictor of credit market development, but the data are limited to the period 1978 - 2003. Hence, we run the instrumental variable regression on a reduced dataset, consisting of 92 countries.[15]

We consider the creditor rights index a good instrument because it is related to the legal origins and credit institutions of the countries and should not be an important determinant of the composition of sovereign debt, except through the level of financial development. Moreover, we use the average inflation rate, the average log GDP, the average log GDP per capita and the average total debt as additional control variables. The inflation can account for a channel related to the currency composition of government debt, the GDP can account for the size of the economy, the GDP per capita can account for the wealth of the country and the total debt represents the general level of the country's indebtedness .[16]

The results are reported in Table B.1 and confirm a significant positive relationship between the average credit over GDP and the average domestic-to-total debt ratio. The OLS regression shows that average credit is positively related to the average composition of debt, but the coefficient is not significant when control variables are included. Once the measure of credit is instrumented with the creditor rights index to account for endogeneity, the coefficient of domestic credit to private sector becomes larger and significant, even with control variables, in the range (1.22-1.24). The first-stage regression reveals also that the creditor rights index is positively correlated with the domestic credit to private sector, as suggested by previous studies. The goodness of the instrument is confirmed by the high R^2 of the first-stage regressions and its significance, reported in Table B.2.

However, it appears that the OLS regression produces a large underestimation of the causal effect of credit on the domestic debt ratio. The difference between the coefficient for the OLS and the IV regression is sizeable (in the basic regression the IV coefficient is 4 times larger than the OLS coefficient). The standard error increases substantially (in the basic regression the IV standard error is 5 times larger than the OLS standard error). This differences could be due to the measurement error in the data on domestic credit over GDP. It might also be the case that the countries that have

[15] Our reduced sample contains 33 low income countries, 33 lower-middle income countries and 26 upper-middle income countries.

[16] We also tried to include the average change in real exchange rate and the average GDP growth to account for the channels related to the currency composition of government debt and the growth of the economy, but the results are similar.

Table B.1: Average credit and average domestic-over-total debt ratio.

DEPENDENT VARIABLE	Av Dom/Total Debt					
VARIABLES	OLS	IV	OLS	IV	OLS	IV
av credit	0.341***	1.224**	0.132	1.239*	0.139	1.230*
	(0.119)	(0.542)	(0.154)	(0.634)	(0.157)	(0.638)
av infl			-0.003	0.353	0.003	0.369
			(0.086)	(0.243)	(0.086)	(0.240)
av lgdp			0.037*	-0.015	0.035*	-0.021
			(0.020)	(0.042)	(0.020)	(0.044)
av lgdp-pc			0.031	-0.037	0.029	-0.044
			(0.022)	(0.050)	(0.023)	(0.054)
av totdebt					-0.018	-0.089
					(0.035)	(0.065)
Constant	0.144***	-0.071	-0.103	0.131	-0.076	0.253
	(0.031)	(0.127)	(0.114)	(0.214)	(0.133)	(0.279)
Observations	92	92	92	92	92	92
R^2	0.126		0.262		0.263	

The dependent variable measures the average ratio of domestic debt over total debt. The independent variable measures the average domestic credit to private sector over GDP. It is instrumented with the creditor rights index. The data are average over the period 1978 - 2003. Additional controls used are log GDP, log GDP per capita, inflation and total debt over GDP. We use robust standard errors (in parenthesis).
*** p<0.01, ** p<0.05, * p<0.1.

a stronger link between domestic credit and creditor rights index are also the ones where domestic credit affects more strongly the composition of government debt. Hence, the instrument produces an upward bias to the coefficient of domestic credit to GDP. Djankov et al. (2007) find that the creditor rights index is more important for rich countries than poor countries as a determinant of private credit. Even if the instrument is valid, we cannot rely on the size of the coefficient estimated. In our case the sample size is too small to have reliable estimates by splitting the analysis across the dimension of wealth of the country.

We could investigate the non-linear relationship with the instrumental variable regression, but the squared value of the creditor rights index is not a good instrument. It is not highly correlated with the domestic credit and the squared value of domestic credit. Given the limitations of the cross-section analysis, we rely more on the panel methodology.

Appendix C Additional Results

Tables C.1 - C.6 report the detailed results of the panel unit root tests conducted on the domestic debt ratio and the level of credit over GDP.

Table B.2: First-stage regression for IV analysis.

DEPENDENT VARIABLE	Av credit		
VARIABLES			
av credit-rights-index	0.042**	0.033**	0.034**
	(0.018)	(0.015)	(0.138)
av infl		-0.327***	-0.342***
		(0.079)	(0.074)
av lgdp		0.046***	0.051***
		(0.017)	(0.017)
av lgdp-pc		0.059***	0.064***
		(0.020)	(0.021)
av totdebt			0.066*
			(0.037)
Constant	0.174***	-0.244**	-0.336**
	(0.027)	(0.114)	(0.138)
Observations	92	92	92
R^2	0.057	0.447	0.462

The dependent variable measures the average domestic credit to private sector over GDP. The independent variable measures the average creditor rights index. The data are average over the period 1978 - 2003. Additional controls used are log GDP, log GDP per capita, inflation and total debt over GDP. We use robust standard errors (in parenthesis).
*** p<0.01, ** p<0.05, * p<0.1.

Table C.1: Levin et al. (2002) unit root test.

Levin et al. (2002)		
	t-statistic	p-value
domratio	.58319541	.72011912
credit	361.05592	1
totdebt	-2.9389525	.00164662
infl	-74.465001	0
gdp-gr	-20.393239	0
d.domratio	-14.705643	0
d.credit	-14.990251	0
d.totdebt	-21.976553	0
d.infl	-25.412144	0
d.gdp-gr	-29.739291	0
Levin et al. (2002) minus cross-section means		
	t-statistic	p-value
domratio	1.3244115	.90731678
credit	-.79654348	.21285811
totdebt	-4.5498243	2.685e-06
infl	-3.6610949	.00012557
gdp-gr	-22.550663	0
d.domratio	-19.236875	0
d.credit	-14.663422	0
d.totdebt	-18.318794	0
d.infl	-26.397929	0
d.gdp-gr	-21.293853	0
Levin et al. (2002) with trend		
	t-statistic	p-value
domratio	1.9782247	.97604832
credit	-.16618908	.43400408
totdebt	-.8597728	.19495715
infl	-44.216383	0
gdp-gr	-18.349679	0
d.domratio	-9.5865589	0
d.credit	-12.264312	0
d.totdebt	-19.238167	0
d.infl	-18.888311	0
d.gdp-gr	-21.395062	0
Levin et al. (2002) with trend, minus cross-section means		
	t-statistic	p-value
domratio	1.6946879	.95493268
credit	-.80096239	.21157671
totdebt	-.04831372	.48073311
infl	.77376087	.78046389
gdp-gr	-19.571759	0
d.domartio	-14.473795	0
d.credit	-11.347806	0
d.totdebt	-13.368717	0
d.infl	-16.276564	0
d.gdp-gr	-12.19578	0

The null hypothesis is the presence of unit root

Table C.2: Breitung (2000) unit root test.

Breitung (2000)		
	t-statistic	p-value
domratio	-.95296174	.17030473
credit	2.2712965	.98843548
totdebt	-2.8153658	.00243609
infl	-9.2235031	0
gdp-gr	-14.107693	0
d.domratio	-12.37981	0
d.credit	-15.496888	0
d.totdebt	-14.970442	0
d.infl	-15.899142	0
d.gdp-gr	-17.694952	0
Breitung (2000) minus cross-section means		
	t-statistic	p-value
domratio	-1.2494267	.10575452
credit	1.7348487	.95861619
totdebt	-3.5669611	.00018057
infl	-11.891499	0
gdp-gr	-14.661204	0
d.domratio	-12.364815	0
d.credit	-15.857338	0
d.totdebt	-16.226915	0
d.infl	-17.671258	0
d.gdp-gr	-18.262284	0
Breitung (2000) with trend		
	t-statistic	p-value
domratio	4.4911898	.99999646
credit	4.3643441	.99999362
totdebt	5.471039	.99999998
infl	-3.3878427	.00035222
gdp-gr	-13.905294	0
d.domratio	-9.7000995	0
d.credit	-14.104725	0
d.totdebt	-14.9532	0
d.infl	-16.423312	0
d.gdp-gr	-21.93958	0
Breitung (2000) with trend, minus cross-section means		
	t-statistic	p-value
domratio	3.4758767	.99974541
credit	2.6660533	.99616262
totdebt	2.2596427	.98807828
infl	-7.9684044	0
gdp-gr	-15.220659	0
d.domartio	-9.3851907	0
d.credit	-15.186203	0
d.totdebt	-15.084609	0
d.infl	-19.309776	0
d.gdp-gr	-21.979401	0

The null hypothesis is the presence of unit root.

Table C.3: Im et al. (2003) unit root test.

Im et al. (2003)		
	W_{t-bar}-statistic	p-value
domratio	.92459158	.8224108
credit	2.0518305	.97990693
totdebt	-2.6206932	.00438756
infl	-22.73323	0
gdp-gr	-20.01415	0
d.domratio	-19.120949	0
d.credit	-19.350763	0
d.totdebt	-21.829939	0
d.infl	-29.901069	0
d.gdp-gr	-35.631082	0
Im et al. (2003) minus cross-section means		
	W_{t-bar}-statistic	p-value
domratio	.4252884	.66468678
credit	.72664997	.76627979
totdebt	-2.2937154	.01090343
infl	-5.706592	0
gdp-gr	-23.298154	0
d.domratio	-23.631861	0
d.credit	-18.585888	0
d.totdebt	-20.85044	0
d.infl	-29.305609	0
d.gdp-gr	-32.801034	0
Im et al. (2003) with trend		
	W_{t-bar}-statistic	p-value
domratio	.12026139	.54786195
credit	-.12760796	.44922961
totdebt	-.99332542	.1602757
infl	-15.637252	0
gdp-gr	-17.881482	0
d.domratio	-17.603431	0
d.credit	-18.14359	0
d.totdebt	-21.478782	0
d.infl	-25.065619	0
d.gdp-gr	-30.177074	0
Im et al. (2003) with trend, minus cross-section means		
	W_{t-bar}-statistic	p-value
domratio	-.39582447	.34611726
credit	-2.2114145	.01350357
totdebt	-.64879932	.25823405
infl	-12.265988	0
gdp-gr	-21.642098	0
d.domartio	-20.783664	0
d.credit	-16.032097	0
d.totdebt	-18.142078	0
d.infl	-24.516672	0
d.gdp-gr	-27.750101	0

The null hypothesis is the presence of unit root.

Table C.4: Fisher type (Choi, 2001) unit root test.

Fisher type (Choi, 2001)		
	Z-statistic	p-value
domratio	2.6922337	.99645124
credit	1.9656974	.97533321
totdebt	-1.1833613	.11833299
infl	-4.8189888	0
gdp-gr	-5.9343839	0
d.domratio	-7.2151685	0
d.credit	-7.0735737	0
d.totdebt	-6.5417363	0
d.infl	-14.027615	0
d.gdp-gr	-16.451702	0
Fisher type (Choi, 2001) minus cross-section means		
	Z-statistic	p-value
domratio	1.9589422	.97494022
credit	1.4423141	.92539311
totdebt	-.68565602	.24646502
infl	-.02244076	.49104819
gdp-gr	-9.1222192	0
d.domratio	-7.9447857	0
d.credit	-7.9575096	0
d.totdebt	-7.3846628	0
d.infl	-22.765397	0
d.gdp-gr	-18.047627	
Fisher type (Choi, 2001) with trend		
	Z-statistic	p-value
domratio	1.6049376	.94574623
credit	2.7263966	.9967985
totdebt	2.2706418	.98841567
infl	-1.8574854	.03162106
gdp-gr	-2.6087725	.00454338
d.domratio	-6.5029939	0
d.credit	-5.011164	0
d.totdebt	-5.3760657	0
d.infl	-9.4842602	0
d.gdp-gr	-11.502265	0
Fisher type (Choi, 2001) with trend, minus cross-section means		
	Z-statistic	p-value
domratio	1.5031201	.93359596
credit	.50607499	.693598
totdebt	2.1875172	.98564761
infl	-5.8374379	0
gdp-gr	-5.4344175	0
d.domartio	-5.5084761	0
d.credit	-4.2326518	0
d.totdebt	-4.4435297	0
d.infl	-18.028145	0
d.gdp-gr	-13.283229	0

The null hypothesis is the presence of unit root.

Table C.5: Hadri (2000) unit root test.

Hadri (2000)		
	Z-statistic	p-value
domratio	16.892135	0
credit	18.106703	0
totdebt	13.224425	0
infl	9.6153869	0
gdp-gr	3.5013849	.00023142
d.domratio	3.8082531	0
d.credit	.83136563	.20288355
d.totdebt	5.9010442	0
d.infl	v -3.4202496	.99968718
d.gdp-gr	-2.9952433	.99862887
Hadri (2000) minus cross-section means		
	Z-statistic	p-value
domratio	15.815512	0
credit	17.621789	0
totdebt	15.108246	0
infl	8.5316573	0
gdp-gr	.41671278	.33844425
d.domratio	2.3134059	.01035017
d.credit	1.0814032	.13975891
d.totdebt	2.2321161	.01280365
d.infl	-3.4867902	.99975557
d.gdp-gr	-3.1130395	.99907414
Hadri (2000) with trend		
	Z-statistic	p-value
domratio	15.408155	0
credit	13.048097	0
totdebt	15.163644	0
infl	5.46942	0
gdp-gr	3.8719824	.00005398
d.domratio	4.7484904	0
d.credit	4.2705496	0
d.totdebt	5.304077	0
d.infl	2.4305502	.00753796
d.gdp-gr	2.2184412	.01326238
Hadri (2000) with trend, minus cross-section means		
	Z-statistic	p-value
domratio	14.611436	0
credit	13.272915	0
totdebt	13.860766	0
infl	5.3898597	0
gdp-gr	3.108143	.00094133
d.domartio	4.7665312	0
d.credit	4.4253335	0
d.totdebt	5.5356395	0
d.infl	2.1187772	.01705465
d.gdp-gr	2.1070215	.01755786

The null hypothesis is the stationarity of the series.

Table C.6: Pesaran (2007) unit root test.

Pesaran (2007) No Trend			
Variable	Lags	Z_{t-bar}-statistic	p-value
domratio	0	-2.5946029	.00473501
	1	-.39994623	.34459806
	2	.93970198	.82631478
	3	.67100573	.74889156
credit	0	4.0109869	.99996977
	1	3.0716192	.99893549
	2	3.4602546	.99973017
	3	3.7840426	.99992285
totdebt	0	-2.5946029	.00473501
	1	-.39994623	.34459806
	2	.93970198	.82631478
	3	.67100573	.74889156
infl	0	-13.174019	0
	1	-7.7123238	0
	2	-2.7987971	.00256467
	3	-4.7164483	1.200e-06
gdp-gr	0	-21.320837	0
	1	-12.329589	0
	2	-5.3986308	0
	3	-5.3649516	0

Pesaran (2007) With Trend			
Variable	Lags	Z_{t-bar}-statistic	p-value
domratio	0	-3.2202757	.00064034
	1	-.38530977	.35000396
	2	2.4223672	.99229012
	3	2.4068543	.99195471
credit	0	4.6433646	.99999829
	1	3.6561732	.999872
	2	3.8559757	.99994237
	3	4.493087	.99999649
totdebt	0	-3.2202757	.00064034
	1	-.38530977	.35000396
	2	2.4223672	.99229012
	3	2.4068543	.99195471
infl	0	-9.416948	0
	1	-3.6574096	.00012739
	2	1.2167503	.88815038
	3	-.86165315	.19443921
gdp-gr	0	-18.640997	0
	1	-9.7057566	0
	2	-2.7937627	.00260493
	3	-3.514939	.00021993

The null hypothesis is the presence of unit root.

Table C.7: Pesaran (2007) unit root test.

Pesaran (2007) No Trend			
Variable	Lags	Z_{t-bar}-statistic	p-value
d.domratio	0	-24.520834	0
	1	-15.335755	0
	2	-7.584939	0
	3	-5.0542882	0
d.credit	0	-18.782786	0
	1	-10.88078	0
	2	-5.6355699	0
	3	-3.784674	.00007696
d.totdebt	0	-20.440494	0
	1	-11.54881	0
	2	-4.8076378	0
	3	-4.2490421	.00001073
d.infl	0	-27.928094	0
	1	-19.759101	0
	2	-9.5305697	0
	3	-7.1258622	0
d.gdp-gr	0	-31.629324	0
	1	-26.957364	0
	2	-14.065386	0
	3	-9.6984147	0

Pesaran (2007) With Trend			
Variable	Lags	Z_{t-bar}-statistic	p-value
d.domratio	0	-21.782734	0
	1	-12.172104	0
	2	-4.1400832	.00001736
	3	-2.7752908	.00275762
d.credit	0	-17.147085	0
	1	-8.9460876	0
	2	-4.1895696	.00001397
	3	-3.1351035	.00085897
d.totdebt	0	-17.529069	0
	1	-9.1541277	0
	2	-2.5954243	.00472371
	3	-2.9073691	.00182241
d.infl	0	-25.701628	0
	1	-16.343147	0
	2	-5.7671959	0
	3	-3.5641625	.00018251
d.gdp-gr	0	-29.846539	0
	1	-23.871549	0
	2	-10.327698	0
	3	-5.6251007	0

The null hypothesis is the presence of unit root.