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Domestic public debt and financial development in Sub-Saharan Africa: Is there an inverted-U relationship?

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Abstract

This paper assesses the nonlinear effect of domestic public debt on financial development using a panel of 20 low-income Sub-Saharan African countries over the period 2000-2010. Based on the framework proposed by Lind and Mehlum (2010), our analysis confirms the existence of an inverted-U relationship between domestic public debt and bank credit to the private sector with a threshold of about 52 % of GDP. The regression results are robust across different specifications and diverse estimation techniques.

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1. Introduction and theoretical background

During the global financial crisis of 2008, the implementation of fiscal stimulus packages and the decline in foreign aid have contributed to a sharp increase in domestic public debt levels in many low-income Sub-Saharan African countries (Bua et al., 2014). In fact, public domestic debt in Sub-Saharan Africa increased from 15 percent of GDP on average over 1995-2000 to over 22 percent in the 2001-2008 period (Chauvin and Golitin, 2010). Not all countries have experienced the same increase, and cross-country differences exist. Whereas the variation in domestic public debt as percentage of GDP was equal to 54.3 during 1996-2011 in Eritrea, it was 3.3 in Togo over the same period (Bua et al., 2014).

Domestic government debt is essentially held by domestic banks, which are hindered by the weakness of the legal system that is unable to protect property and creditor rights (Andrianaivo and Yartey, 2009). Indeed, poor governance has limited the role of African banks in financing the risky private sector. As a result, they become the main underwriters of government securities, which are considered as risk-free assets. The higher exposure of African banks to government debt has raised many questions regarding the potential effects of domestic public debt on bank credit to the private sector.

In the theoretical literature, one can distinguish between two opposing views regarding the impact of government borrowing on bank credit to the private sector. The first claims that holding safe government securities could encourage the banking system to take on more risk and thus increase lending to the risky private sector if the legal system is weak (Chirwa and Mlachila, 2004; Kumhof and Tanner, 2005 ; Hauner, 2006). According to the second one, a higher government borrowing from the banking system may cause the reduction of bank credit to the private sector, as banks investing in government debt are more likely to benefit from a limited number of financial transactions and bank branches (Hauner, 2009).

Surprisingly, only a few empirical studies have examined the effects of domestic public debt on bank credit to the private sector (Abuka and Egesa, 2007; Emran and Farazi, 2009; De Bonis and Stacchini, 2013). Overall, they tend to confirm the crowding out effect of government borrowing on bank credit to the private sector. However, no empirical studies in Africa or elsewhere have attempted to investigate the potential nonlinear relationship between domestic public debt and financial development measured by banks credit to the private sector. Such an attempt is the purpose of this paper.

Our main hypothesis tries to reconcile the two aforementioned views. In fact, we hypothesize that the relationship between domestic public debt and bank credit to the private sector is not a linear one, but a "U inverted" type one.

This study tries to contribute to the existing literature in several ways. To the best of our knowledge, this paper is the first to identify the existence of an inverted-U relationship between domestic public debt and financial development. To do this, we apply the new test proposed by Lind and Mehlum (2010). The superiority of their statistical method is that it provides the statistical significance of the presence of an inverted-U relationship given the estimates of a regression model. Second, our empirical analysis focuses only on low-income Sub-Saharan African countries to mitigate the potential sample heterogeneity. The choice of the sample is also motivated by the fact that many of these countries benefited from the Heavily Indebted Poor Countries (HIPC) initiative debt relief programs, but the rapid increase in the level of debt observed during these last years is raising concern about public debt sustainability in the region. Third, our study is based on the new data compiled by Presbitero (2012).

The remainder of the paper is organized as follows: Section 2 illustrates the empirical methodology. Section 3 describes the data. Estimation results are presented in section 4. In Section 5, we test robustness. Finally, section 6 provides some policy recommendations and concludes.

2. Empirical methodology

In order to assess the nonlinear relationship between domestic public debt and financial development, we employ the following quadratic specification:

$$Credit_{it} = \phi\, Credit_{-1} + \alpha\, domdebt_{it} + \beta\, domdebt_{it}^2 + \gamma Z_{it} + \nu_{it} + \varepsilon_{it} \qquad (1)$$

Where *Credit* represents the domestic credit to the private sector by banks for the country i in period t; *domdebt* is the stock of domestic public debt as a share of GDP while $domdebt^2$ is its quadratic term; Z_{it} is a vector of explanatory variables; ν_{it} is the country-specific fixed effect and ε_{it} is the error term.

The traditional approach supposed that, if both *domdebt* and $domdebt^2$ have the right sign and are individually significant, and if the extreme point is within the data range, it is possible to conclude the presence of an inverted-U. However, Lind and Mehlum (2010) argue that this criterion will be misleading if the estimated extremum point is too close to the upper bound of the data range.

Based on a general framework initially developed by Sasabuchi (1980), Lind and Mehlum (2010), show that in order to test appropriately the presence of an inverted-U relationship, it is essential to formulate the following joint null hypothesis:

$$H_0 : (\alpha + 2\beta\, domdebt_{min} \leq 0) \cup (\alpha + 2\beta\, domdebt_{max} \geq 0) \qquad (2)$$

$$H_1 : (\alpha + 2\beta\, domdebt_{min} > 0) \cap (\alpha + 2\beta\, domdebt_{max} < 0) \qquad (3)$$

Where $domdebt_{min}$ and $domdebt_{max}$ are the minimum and maximum values of domdebt, respectively.

The composite null hypothesis is that the relationship is increasing at the low value of the data range [$domdebt_{min}$; $domdebt_{max}$] interval and/or is decreasing at high values of the data range. This test can be performed via usual t-test. Moreover, to be sure that the inverted-U relationship is not only a marginal phenomenon, the Fieller (1954) confidence interval[1] for the estimated threshold must also be contained within the data range [$domdebt_{min}$; $domdebt_{max}$].

3. Data

This paper uses data for a panel of 20 Sub-Saharan African countries, over the period 2000-2010. As shown in Table 5, most of the variables come from the African Development Indicators (ADI) database of the World Bank. Domestic public debt data are obtained from the dataset compiled by Presbitero (2012). To take into account the institutional framework, we use the measure of overall governance: The Country Policy and Institutional Assessment (CPIA) provided by the World Bank. The CPIA assesses the quality of a country's present policy and institutional framework against a set of 16 criteria grouped in four clusters: (a) economic management; (b) structural policies; (c) policies for social inclusion and equity; and

[1] Confidence interval using the delta method may be biased in finite samples.

(d) public sector management and institutions. Countries are rated on a scale of 1 (low) to 6 (high).

4. Estimation results

We use different econometric techniques (OLS, Fixed effect, Diff-GMM, and Sys-GMM) to estimate equation (1). Our preferred estimating method is the system generalized method of moments estimator (Sys-GMM) well suited to deal with the potential endogeneity (Blundell and Bond, 1998), of the right-hand side variables including the lagged dependent variable and domestic public debt. We assume that domestic public debt is potentially endogenous and a higher reliance on domestic public debt may positively depend on the level of financial development. A theoretical reason behind this assumption is that domestic public debt may affect bank credit to private sector, but at the same time, the development of the banking sector could create additional demand for government securities which contribute to the accumulation of domestic public debt.

Table 1. Domestic public debt: quadratic effect on credit to private sector (baseline specification)

	(1)	(2)	(3)	(4)
VARIABLES	**OLS**	**Fixed Effect**	**Diff-GMM**	**Sys-GMM**
credit$_{-1}$	0.927***	0.592***	0.606***	0.902***
	(0.0277)	(0.114)	(0.0987)	(0.0935)
domdebt	0.0425	0.173*	0.465***	0.237***
	(0.0289)	(0.0875)	(0.0913)	(0.0598)
domdebt^2	-0.000408	-0.00169	-0.00590***	-0.00225***
	(0.000250)	(0.00133)	(0.00116)	(0.000524)
gdp$_{-1}$	-0.195	7.052	5.466	-2.055
	(0.381)	(4.410)	(3.443)	(1.277)
inflation	-0.0895***	-0.0737***	-0.0352***	-0.117***
	(0.0125)	(0.0220)	(0.0107)	(0.0232)
trade	0.0275***	0.0705**	0.117***	0.0455***
	(0.00810)	(0.0311)	(0.0188)	(0.0149)
CPIA	1.168***	8.910***	12.78***	1.774***
	(0.361)	(2.971)	(2.153)	(0.586)
Constant	-2.448	-68.82***		2.022
	(1.854)	(25.42)		(5.367)
F-stat (p-value)	0	0	0	0
AR(2) test (p-value)			0.444	0.705
Hansen J test (p-value)			0.329	0.654
Number of instruments			19	17
Number of countries			20	20
Debt turning point				52.72
95 % Confidence Interval, Delta method				[46.66 ; 58.78]

Notes: GMM estimators use robust standards errors clustered by countries. We employ the two-step GMM estimator with the Windmeijer (2005) finite sample correction for standard errors. The Hansen and AR(2) tests indicate that we cannot reject the validity of our instruments. * Significant at 10%; ** significant at 5%; significant at 1%.

As we can see in the last two columns of Table 1 of the appendix (Diff-GMM and Sys-GMM), we find that both domdebt and $domdebt^2$ are statistically significant. While the coefficient associated with the linear term is positive, the quadratic term is negative, indicating a nonlinear (inverted-U shape) relationship between domestic public debt and credit to the private sector. This supports our hypothesis that domestic public debt has some positive contribution to financial intermediation, up to a certain point, beyond which domestic public debt may start to be a drag on financial development.

A possible explanation for these empirical results is that, when domestic public debt is kept at a certain level, the holding of safe government assets could allow the banks to take more risk and thus facilitate financial intermediation, if the legal system and institutional infrastructure are weak. However, investing massively in government bonds may discourage banks from lending to the risky private sector.

As it can be seen from Table 1, the estimated threshold, beyond which domestic public debt turns detrimental to financial development, is computed using Equation 1 as $Domdebt_{max} = -\alpha / 2\beta$ and found to be around 52.72 percent of GDP. The estimated turning point and the confidence intervals are calculated using the delta method as implemented in Stata with the "nlcom" command.

Table 2. Sasabushi-Lind-Mehlum test for inverse U-shaped relationship (benchmark specification)

Dependent variable*: credit*	
Data range [$domdebt_{min}$; $domdebt_{max}$]	[1.1 ; 143.5]
Slope at $domdebt_{min}$	0.32***
	(3.95)
Slope at $domdebt_{max}$	-0.4***
	(-4.37)
Sasabushi-Lind-Mehlum test for inverse U-shaped relationship	(3.95)***
Extremum point	52.72
95% Confidence interval, Fieller method	[44.37 ; 59.31]

t-statistics are in parentheses

Table 2 reports the results of the Sasabuchi-Lind-Mehlum test for inverse U-shaped relationship. As we can see from this table, the lower bound slope of domdebt is positive and significant at 1 %, while the upper bound slope of domdebt is negative and significant at 1%. Similarly, the extreme point and also the Fieller confidence interval for the extreme point are contained within the lower and upper bounds of the dataset. Further, the overall t-test for the presence of an "inverted-U" shaped is significant at 1% and thus indicates that our results are consistent with the presence of a non-monotone relationship between domestic public debt and banks credit to the private sector. We indicate here that computations of the Sasabuchi-Lind-Mehlum test and the Fieller interval for the extreme point are obtained using the STATA module "UTEST" provided by Lind and Mehlum (2007).

With regard to the control variables, inflation is negatively and significantly related to bank credit to private sector. This result could be explained by theoretical models based on

imperfect credit markets. According to Huybens and Smith (1998, 1999), an increase in the rate of inflation drives down the real rate of return on savings. As a result, the financial sector makes fewer loans. The estimates also suggest that trade affect positively banks credit. In fact, an increase in imports and exports is generally associated with an increase in demand for financial services. CPIA turns out to be positive and statistically significant. This result is in line with the view that sound institutional framework that ensures the enforcement of contracts and the rule of law is beneficial for financial development (Law and Azman-Saini, 2012).

5. Robustness check

As a robustness check, we re-estimate equation (1) using an alternative specification**.** Once again, the results, illustrated in Table 3, suggest that there is strong evidence of a nonlinear relationship between domestic public debt and bank credit to the private sector in low income Sub-Saharan African economies. As can be seen from Table 3, this exercise does not alter our main results obtained from the benchmark specification as the estimated turning point is almost the same (52.56% of GDP). Further, Table 4 indicates that the slopes are positive and negative at the lower and upper bounds, respectively. Table 4 also shows that the tipping point and the Fieller confidence interval for the tipping point are within the lower and upper bounds of the data range. Moreover, we noted that the Sasabuchi-Lind-Mehlum test rejects the null hypothesis of a monotone relationship.

Table 3. Robustness check: alternative specification

VARIABLES	(1) **OLS**	(2) **Fixed Effect**	(3) **Diff-GMM**	(4) **Sys-GMM**
credit$_{-1}$	0.900***	0.674***	0.855***	0.78***
	(0.0325)	(0.0668)	(0.0593)	(0.11)
domdebt	0.0111	0.0461	0.115***	0.0617***
	(0.0195)	(0.0343)	(0.0297)	(0.0159)
domdebt^2	-0.000502*	-0.000197	-0.000620***	-0.000587***
	(0.000279)	(0.000431)	(0.000185)	(0.000102)
growth	0.0189	0.0299	-0.0185	-0.00461
	(0.0398)	(0.0438)	(0.0216)	(0.0190)
popgrowth	-0.00641	-0.674	0.374	-0.997
	(0.327)	(0.589)	(0.739)	(0.759)
m2	0.0445*	0.152***	0.122***	0.00660
	(0.0239)	(0.0406)	(0.0264)	(0.0208)
extdebt	-1.297***	-1.853***	-1.623***	-0.963***
	(0.449)	(0.560)	(0.372)	(0.293)
agriculture	-0.0166	0.00882	0.0526	-0.0538
	(0.0147)	(0.0584)	(0.0447)	(0.0355)
Constant	1.931	2.395		5.137
	(1.222)	(2.930)		(3.227)
F-stat (p-value)	0	0	0	0
AR(2) test (p-value)			0.898	0.898
Hansen J test (p-value)			0.255	0.987

Number of instruments	18	16
Number of countries	20	20
Debt turning point		52.56
95 % Confidence Interval, Delta method		[32.52 ; 72.6]

Notes: GMM estimators use robust standards errors clustered by countries. We employ the two-step GMM estimator with the Windmeijer (2005) finite sample correction for standard errors. The Hansen and AR(2) tests indicate that we cannot reject the validity of our instruments. * significant at 10%; ** significant at 5%; significant at 1%.

Table 4. Sasabushi-Lind-Mehlum test for inverse U-shaped relationship (alternative specification)

Dependent variable*: credit*	
Data range [$domdebt_{min}$; $domdebt_{max}$]	[1.1 ; 143.5]
Slope at $domdebt_{min}$	0.06***
	(3.82)
Slope at $domdebt_{max}$	-0.1***
	(-4.79)
Sasabushi-Lind-Mehlum test for inverse U-shaped relationship	(3.83)***
Extremum point	52.56
95% Confidence interval, Fieller method	[29.77 ; 59.31]

t-statistics are in parentheses

In light of these findings, we can conclude that the negative effect of domestic public debt on financial development is not systematic and holds only after reaching a certain threshold. Below this threshold, additional debt facilitates financial intermediation. Table 3 also shows a significant negative effect of external public debt on bank credit to private sector. A possible explanation for this result is that a high debt is usually associated with high economic uncertainty and instability, which may harm the development of financial intermediaries (Hwang et al., 2010).

6.Conclusion

This study examined the nonlinear effect of domestic public debt on financial development in 20 low-income sub-Saharan African countries over the period 2000-2010. To that end, we estimated a quadratic regression using diverse estimation techniques. In addition to that, we apply the test proposed by Lind and Mehlum (2010), which gives the exact necessary and sufficient conditions for the test of an inverted-U shaped relationship. The empirical results confirm the existence of an inverted-U relationship between domestic public debt and bank credit to the private sector with a threshold of about 52 % of GDP. This means that, beyond the threshold of 52 percent of GDP, domestic public debt crowd out bank credit to the private sector. Below this threshold, domestic public debt facilitates financial intermediation.

In the case of low income Sub-Saharan African countries, our findings highlight the need to set up sound institutions in order to avoid public debt-overhang episodes. It is also crucial to implement some institutional reforms to improve financial intermediation.

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APPENDIX

List of countries

Benin, Burkina Faso, Burundi, Central African Republic, Comoros, Eritrea, Ethiopia, The Gambia, Ghana, Guinea, Kenya, Madagascar, Malawi, Mali, Mozambique, Rwanda, Senegal, Togo, Uganda, Zambia.

Table 5. Variables description and data sources

Variables	Description	Source
growth	per capita real GDP growth	African Development Indicators, World Bank
gdp	per capita real GDP	
trade	Imports plus exports divided by GDP	
inflation	Growth of GDP deflator	
credit	Domestic credit to private sector by banks as % of GDP	
M2	Money and quasi money (M2) as % of GDP	
agriculture	Agriculture, value added (% of GDP)	
extdebt	the ratio of external public debt stock to GDP	
popgrowth	Population growth	
CPIA	Country policy and institutional assessment overall score (IDA resource allocation index)	World Development indicators, World Bank
domdebt	The ratio of domestic public debt stock to GDP	(Presbitero, 2012)

Table 6. Summary statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
growth	220	1.581713	3.827859	-16.14518	16.63733
gdp	220	305.6809	123.0671	123.2537	660.2438
trade	219	59.00822	19.1327	22.35385	116.0484
inflation	220	9.421704	10.2919	-9.823833	80.75014
credit	213	14.7945	6.733879	3.785495	33.82579
m2	213	29.50575	24.16942	6.791698	148.7119
agriculture	215	32.62816	10.1728	11.57575	59.71275
extdebt	220	.5614598	.3452296	.0645841	1.595387
popgrowth	220	2.684355	.5653911	1.428432	6.576903
CPIA	119	3.309034	.491495	2.208333	3.95
domdebt	203	19.92621	22.77244	1.1	143.5