THE IMPACT OF DOMESTIC INVESTORS' PARTICIPATION IN GOVERNMENT DEBT ON BANK LOANS TO THE PRIVATE SECTOR: A CROSS-COUNTRY STUDY

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ABSTRACT

This study analyzes the impact of domestic investors' participation in government debt on bank loans to the private sector in advanced and emerging countries. We find that domestic bank participation in government debt has a more profound negative impact on bank loans to the private sector in advanced than in emerging countries. Meanwhile, domestic non-bank participation in government debt only negatively impacts bank loans to the private sector in emerging countries. While both domestic bank and non-bank participation in government debt have a negative impact on bank loans to the private sector in emerging countries, the latter has a weaker impact.

I. INTRODUCTION

This study analyzes the impact of domestic investors' participation in government debt on bank loans to the private sector in advanced and emerging countries. Domestic investors' participation in government debt, which has dominated almost two-thirds of total government debt from the 19th century to 2010, has been increasing in advanced and emerging countries, as noted by Reinhart and Rogoff (2011). This trend has continued recently, with an average share of domestic investors' participation in total government debt rising to around 57% in advanced and 62% in emerging countries from 2005 to 2018 (Arslanalp and Tsuda, 2014a, b). However, the increase in domestic investor' participation could potentially reduce bank loanable funds available to the private sector, since the government becomes the primary borrower in the domestic financial market (Ismihan and Ozkan, 2012).

Several recent studies, such as Christensen (2004), De Bonis and Stacchini (2013), Gennaioli *et al.* (2018), Hauner (2009), Ismihan and Ozkan (2012), and Mbate (2013), have widely discussed the negative impact of domestic investor' participation in government debt on bank loans to the private sector.[1] Nevertheless, the current literature has not explored the impact of domestic non-bank participation in government debt on bank loans to the private sector. This is possibly due to the limited data on domestic non-bank participation in government debt. Unlike banks, non-bank investors comprise various financial and non-financial institutions, such as insurance companies, pension funds, investment funds, non-financial corporations, and individual investors. To address this research gap, we use an updated data of sovereign debt investor base compiled by Arslanalp and Tsuda (2014a, b) to compare the impact of domestic bank and non-bank participation in government debt on bank loans to the private sector in advanced and emerging countries.

Our study is motivated by the high participation of domestic non-bank investors compared to domestic bank investors in government debt. In advanced countries, domestic bank and non-bank participation represented 39% and 51% of total domestic government debt, respectively, while in emerging countries they represented 41% and 47%, on average, from 2005 to 2018 (Arslanalp and Tsuda, 2014a, b). In addition, our study is motivated to compare the impact of the domestic investors' participation in government debt on bank loans to the private sector between advanced and emerging countries because prior studies documented inconclusive findings. For instance, De Bonis and Stacchini (2013) and Gennaioli *et al.* (2018) show the negative impact is greater in more developed than less developed countries due to a higher volume of government debt in more developed countries. However, Ismihan and Ozkan (2012) show theoretically that the negative impact is greater in a country with a lower depth financial market, which is identical to a less developed country. Understanding the impact of each group of domestic investors' participation in government debt on bank loans to the private sector is essential for supporting policy formulation to diversify the domestic investors in government debt. Diversifying the investor base is crucial in promoting market stability, enhancing market efficiency (World Bank, 2001), and reducing monopoly, cost, and roll-over risks (Christensen, 2004).

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[1] See Appendix (Table A.1) for the summary of related studies.

To analyze the impact of domestic bank and non-bank participation in government debt on bank loans to the private sector, we use quarterly data on domestic bank and non-bank participation in government debt, bank loans to the private sector, and bank deposits in 23 advanced and 23 emerging countries from 2005Q1 to 2018Q4. We utilize an updated data of sovereign debt investor base compiled by Arslanalp and Tsuda (2014a, b), which contains data on domestic bank and non-bank participation in government, for our analysis. This dataset provides the disaggregation of investor holdings of government debt in major advanced and emerging countries, and is ideal for our analysis. To empirically test the impact of domestic bank and non-bank participation in government debt on bank loans to the private sector, we adopt the theoretical framework proposed by Ismihan and Ozkan (2012), which is extended to include domestic non-bank investors. Our nonstationary dynamic panel model regresses bank loans to the private sector on domestic bank participation in government debt, domestic non-bank participation in government debt, and bank deposits. As the robustness check, we separately regress the bank loans to the private sector on domestic bank and non-bank participation in government debt. In addition, we also estimate the main model using Dynamic Ordinary Least Squares (DOLS) and Fully Modified Ordinary Least Squares (FMOLS).

Our estimations deliver the following findings. First, domestic bank participation in government debt negatively impacts bank loans to the private sector, with the impact being more profound in advanced than in emerging countries. Second, domestic non-bank participation only negatively impacts bank loans to the private sector in emerging countries but not in advanced countries. Third, although domestic bank and non-bank participation in government debt have a negative impact on bank loans to the private sector in emerging countries, domestic non-bank participation has a weaker impact. Our findings are robust to various robustness checks. As an implication, it is essential to diversify the domestic investment in government debt to include participants other than domestic banks, since non-bank participation in government debt has no (or a weak) negative impact on bank loans to the private sector as compared to bank participation.

Prior studies have theoretically and empirically discussed the impact of domestic investor participation in government debt on bank loans to the private sector. Ismihan and Ozkan (2012) show theoretically that a negative association exists between domestic bank participation in government debt and bank loans to private sectors using the two-period model. Several empirical studies have also confirmed the negative association between domestic investors' participation in government debt and bank loans to the private sector. However, they mainly focus on the impact of total domestic participation (Christensen, 2004; De Bonis and Stacchini, 2013; Mbate, 2013) or only domestic bank participation (Bouis, 2019; Gennaioli *et al.*, 2018; Hauner, 2009) in government debt on bank loans to the private sector. Our study differs from these studies and contributes to the literature in two ways. First, we analyze the impact of domestic non-bank participation in government debt on bank loans to the private sector. Second, we offer a new insight into how the impact of domestic investors' participation in government

debt on bank loans to the private sector differs by domestic bank and non-bank investors' participation in advanced and emerging countries.

The rest of this paper is organized as follows. Section II discusses methodology and data. Section III discusses the empirical analysis and robustness test, and a conclusion in Section IV closes the paper.

II. METHODOLOGY AND DATA
A. Methodology
This study uses the theoretical framework proposed by Ismihan and Ozkan (2012), which describes the relationship between the government and banks in government debt, along with its impact on bank loans to the private sector. The demand for government bonds is the optimization result between the government and the central bank. In the original model, the banks are the only investors in government bonds. Banks obtain funds from deposits, and then use it to maximize profit by buying government bonds or giving loans to the private sector. According to the model, bank loans to the private sector will decrease when the government issues more bonds due to banks using more of their funds to buy such bonds. Furthermore, the lower depth of financial markets will lead to a greater negative effect on bank loans to the private sector.

We extend this model by adding domestic non-bank investors in the form of insurance or pension fund companies (see Appendix, Section A.II.). We assume that non-bank investors are the source of bank deposits. To maximize their profit, such investors can buy government bonds or place their funds as bank deposits. The conclusion from this extended model remains the same as that derived from the original. However, non-bank investors decision may now impact the bank since they act as the source of bank deposits, the banks' loanable funds. Bank loans to the private sector decline as non-bank investors choose to increase their purchases of government bonds and decline deposits in banks. Figure 1 explains the relation between the original and the extended theoretical framework.

Figure 1.
The Diagram of the Theoretical Framework

This figure shows the theoretical framework based on Ismihan and Ozkan (2012). The solid-line boxes represent the original model, while the dash-line box represents the extended model.
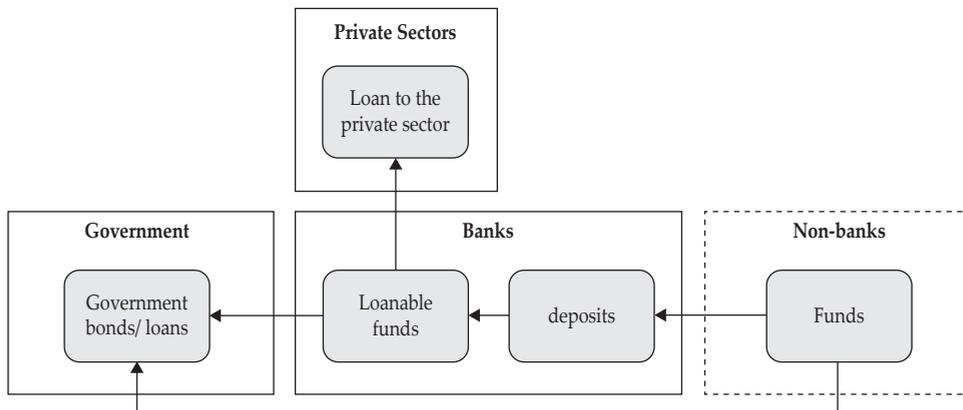
Based on the model, this study examines several variables that influence the supply of loanable funds for bank loans to the private sector. We proxy the domestic investors' participation in government bonds in the theoretical model by their participation in government debt, namely domestic bank participation in government debt and domestic non-bank participation in government debt. Domestic bank and non-bank participation in government debt are expected to have a negative relationship with loans to the private sector. We also include bank deposits as main supply of loanable funds, which is expected to have a positive relationship with such loans.

$$\begin{matrix} \text{bank loans to} \\ \text{the private sector} \end{matrix} = f \left(\begin{matrix} \text{domestic bank participation in government debt,} \\ \text{domestic non} - \text{bank participation in government debt,} \\ \text{bank deposits} \end{matrix} \right) \quad (1)$$

This study uses a nonstationary dynamic panel method to analyze the long-run relationship between domestic investors' participation in government debt and bank loans to the private sector, which is illustrated in Figure 1.[2] This method is more appropriate for estimating data in the presence of Cross-Section Dependence (CSD).

The estimation begins with a CSD test to assess data dependency, followed by a panel unit root test to determine the stationarity degree of every variable. Most variables are expected to be stationary in $I(1)$ since they are presented at level. Then, the panel cointegration test is carried out to determine whether all variables are cointegrated in the long run. The model estimation for each country group uses the most common lags from AutoRegressive Distributed Lag (ARDL) from each country within the country group. Blackburne and Frank (2007) explained that three methods can be used to estimate nonstationary dynamic panel data, namely the mean average (MG) based on Pesaran and Smith (1995), the pooled mean average (PMG) based on Pesaran *et al.* (1999), and the Dynamic Fixed-Effects (DFE). The difference between the three methods is the parameter restriction. The MG estimator does not restrict the same short- and long-run parameters for all countries. The final parameters are the unweighted average of individual parameters. The PMG estimator restricts the long-run to be the same for all countries, while DFE restricts the short- and long-run parameters to be the same, except the intercept. The best estimator is selected based on the Hausman test (Hausman, 1978).

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[2] Several previous studies use the nonstationary panel method to estimate panel data with large N and T, where N can be a country, state, region, etc. See, among others, Ciarlone (2011), Eberhardt and Presbitero (2015), Feld *et al.* (2020), and Fuinhas *et al.* (2015).

B. Data

We use quarterly data of 23 advanced and 23 emerging countries, grouped based on the IMF classification, from 2005Q1 to 2018Q4.[3] The country list is presented in Table 1. The data for domestic bank and non-bank participation in government debt are based on the updated sovereign debt investor base data compiled by Arslanalp and Tsuda (2014a, b).[4] In the original data sources, domestic investors' participation in government debt is disaggregated into bank, non-bank, and central bank. We exclude the central bank, as its role in government debt is usually part of monetary policy to stabilize crisis conditions.

Based on Arslanalp and Tsuda (2014a, b), banks comprise depository corporations other than central banks, while non-banks consist of financial and non-financial institutions. Non-bank financial institutions consist of insurance companies, pension funds, and investment funds. Meanwhile, non-financial institutions consist of non-financial corporations, and individual investors (households).

Table 1.
List of Sample Advanced and Emerging Countries

This table reports the country list used in this study.

Advanced Countries		Emerging Countries	
Australia	Japan	Argentina	Malaysia
Austria	Korea	Brazil	Mexico
Belgium	Netherlands	Bulgaria	Peru
Canada	Norway	Chile	Poland
Czech Republic	Portugal	China	Romania
Denmark	Slovenia	Colombia	Russia
Finland	Spain	Egypt	South Africa
France	Sweden	Hungary	Thailand
Germany	Switzerland	India	Turkey
Greece	United Kingdom	Indonesia	Ukraine
Ireland	United States	Latvia	Uruguay
Italy		Lithuania	

The data for bank loans to the private sector and bank deposits are obtained from CEIC data. The definition of bank loans to the private sector is all loans to domestic customers, excluding loans to the government. Meanwhile, bank deposits are defined as all deposits from domestic customers. All data are in the nominal local currency, divided by the inflation index to convert to real data, and

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[3] The start date is restricted to 2005Q1 due to data availability for all countries. The end date is set at 2018Q4 to avoid massive distortion from the COVID-19 pandemic, which may bias the results. Some recent studies indicate that the pandemic has increased government debt significantly, affecting the sovereign credit risk (Andrieş *et al.*, 2021; Augustin *et al.*, 2022). Meanwhile, bank loans have decreased in the countries more affected by health crises (Çolak and Öztekin, 2021).

[4] Initially, there are 24 advanced and 24 emerging countries, as in Arslanalp and Tsuda (2014a, 2014b). We do not include New Zealand, as data for bank investors before 2013 are unavailable, and the Philippines, as data for bank loans include loans to the government. The data for advanced countries can be found in https://www.imf.org/~/media/Websites/IMF/imported-datasets/external/pubs/ft/wp/2012/Data/_wp12284.ashx, and for emerging countries can be found in https://www.imf.org/~/media/Websites/IMF/imported-datasets/external/pubs/ft/wp/2014/Data/wp1439.ashx.

transformed to a natural logarithmic (ln). The inflation index for all countries is equated to 100 in 2010Q1.

III. EMPIRICAL ANALYSIS
A. Empirical Results
Table 2 provides the descriptive statistics for all variables in this study. $l_{t,i}$ is bank loans to private sectors, $b\_g_{t,i}$ is domestic bank participation in government debt, $nb\_g_{t,i}$ is domestic non-bank participation in government debt, and $d_{t,i}$ is bank deposits. Variable in difference is denoted by delta (Δ).

Table 2.
Descriptive Statistics
This table provides descriptive statistics of all variables considered in this study.

Variables	Advanced Countries					Emerging Countries				
	Obs	Mean	Std.Dev	Min	Max	Obs	Mean	Std.Dev	Min	Max
$\ln l_{t,i}$	1,288	9.57	2.28	5.03	16.54	1,288	9.77	3.01	4.26	17.37
$\ln b\_g_{t,i}$	1,288	7.49	2.63	2.75	15.24	1,288	7.96	3.23	1.21	15.38
$\ln nb\_g_{t,i}$	1,288	7.79	2.81	0.25	15.19	1,288	8.13	3.27	1.28	15.41
$\ln d_{t,i}$	1,288	9.45	2.38	5.10	16.55	1,288	9.81	3.05	3.85	17.40
$\Delta\ln l_{t,i}$	1,265	0.01	0.02	-0.14	0.21	1,265	0.02	0.04	-0.28	0.21
$\Delta\ln b\_g_{t,i}$	1,265	0.01	0.13	-1.12	2.19	1,265	0.02	0.10	-0.42	1.03
$\Delta\ln nb\_g_{t,i}$	1,265	0.00	0.23	-2.56	2.88	1,265	0.01	0.24	-3.85	3.91
$\Delta\ln d_{t,i}$	1,265	0.01	0.02	-0.15	0.24	1,265	0.02	0.04	-0.23	0.92

Table 3 shows all variables have CSD within their country group. The presence of CSD indicates that countries have the same reaction to shock or implement similar policies, a situation known as global interdependence (Moscone and Tosetti, 2010). Similar policy decisions also lead to the presence of correlation among countries. Therefore, the model will be estimated using the nonstationary dynamic panel method to obtain efficient parameters.

Table 3.
Cross-section Dependence Test
This table reports the CSD test under the null hypothesis of cross-section independence.

Variables	Advanced Countries				Emerging Countries			
	CD-test	*p*-value	corr	abs(corr)	CD-test	*p*-value	corr	abs(corr)
$\ln l_{t,i}$	39.90	0.00	0.34	0.54	62.36	0.00	0.52	0.72
$\ln b\_g_{t,i}$	44.01	0.00	0.37	0.53	63.61	0.00	0.53	0.63
$\ln nb\_g_{t,i}$	9.43	0.00	0.08	0.50	32.94	0.00	0.28	0.51
$\ln d_{t,i}$	69.62	0.00	0.59	0.80	97.27	0.00	0.82	0.82
$\Delta\ln l_{t,i}$	31.58	0.00	0.27	0.30	25.09	0.00	0.21	0.28
$\Delta\ln b\_g_{t,i}$	13.14	0.00	0.11	0.16	6.09	0.00	0.05	0.13
$\Delta\ln nb\_g_{t,i}$	3.22	0.00	0.03	0.13	2.64	0.01	0.02	0.13
$\Delta\ln d_{t,i}$	19.93	0.00	0.17	0.21	15.24	0.00	0.13	0.20

The panel unit root test was carried out using three types of tests, namely the Im-Pesaran-Sim (IPS) based on Im *et al*. (2003), the Augmented Dickey-Fuller (ADF) Fisher based on Choi (2001), and the Cross-sectional IPS (CIPS) based on Pesaran (2007). Table 4 reveals that only a few variables are stationary in level, while variables in difference are commonly stationary.

Table 4.
Panel Unit Root Tests

This table reports panel unit root test results using IPS, ADF Fisher and CIPS. All tests use lag 4. *P*-value is presented in parentheses. ***, **, and * represent significance level at $p<0.01$, $p<0.05$, and $p<0.1$ respectively.

Variables	Advanced Countries			Emerging Countries		
	IPS	ADF Fisher	CIPS	IPS	ADF Fisher	CIPS
$\ln l_{t,i}$	-1.52*	87.11***	-0.48	-3.00***	107.78***	-1.99
	(0.06)	(0.00)		(0.00)	(0.00)	
$\ln b\_g_{t,i}$	-0.24	52.72	-2.12**	-1.04	50.54	-2.45
	(0.41)	(0.23)		(0.15)	(0.30)	
$\ln nb\_g_{t,i}$	0.78	37.51	-1.62	0.13	39.96	-2.12
	(0.78)	(0.81)		(0.55)	(0.72)	
$\ln d_{t,i}$	0.00	62.73*	-1.77	-3.41***	102.73***	-2.26
	(0.50)	(0.05)		(0.00)	(0.00)	
$\Delta\ln l_{t,i}$	-9.75***	76.47***	-4.71***	-10.93***	116.24***	-4.54***
	(0.00)	(0.00)		(0.00)	(0.00)	
$\Delta\ln b\_g_{t,i}$	-20.00***	122.72***	-5.09***	-25.91***	178.84***	-5.83***
	(0.00)	(0.00)		(0.00)	(0.00)	
$\Delta\ln nb\_g_{t,i}$	-25.99***	163.85***	-5.79***	-24.63***	201.39***	-5.71***
	(0.00)	(0.00)		(0.00)	(0.00)	
$\Delta\ln d_{t,i}$	-13.73***	123.80***	-5.85***	-13.32***	135.92***	-5.36***
	(0.00)	(0.00)		(0.00)	(0.00)	

Since only a few variables are stationary in level (see Table 4), we proceed to the cointegration test using the Westerlund test (Westerlund, 2007) with a robust *p*-value from 800 iterations. The tested variables for cointegration are bank loans, domestic bank and non-bank participation in government debt, and bank deposits. Based on the robust *p*-value, the cointegrations exist in advanced and emerging countries, both in the group-mean and panel tests, as shown in Table 5. However, the cointegration only appears in one of two of the panel tests ($P\tau$ and $P\alpha$). The cointegration will be reconfirmed from the error correction term in the estimation.

Table 5.
Panel Cointegration Test

This table reports the panel cointegration test using the Westerlund (2007) test.

Statistic	Advanced Countries				Emerging Countries			
	Value	Z-value	P-value	Robust P-Value	Value	Z-value	P-value	Robust P-Value
$G\tau$	-2.453	-1.120	0.131	0.045	-2.557	-1.647	0.050	0.010
$G\alpha$	-10.414	0.377	0.647	0.048	-13.907	-2.005	0.023	0.000
$P\tau$	-10.724	-1.432	0.076	0.095	-9.599	-0.367	0.357	0.215
$P\alpha$	-5.594	1.364	0.914	0.389	-8.912	-1.062	0.144	0.013

Before estimating the model, we obtain the number of common lags for each country group, determined by the most common lag used in the ARDL model for each country. The maximum lag for each variable is set to four, since the data are in quarterly format. Table 6 shows the optimal lags for each country. The most common lags for both advanced and emerging countries are ARDL(1,0,0,1), with variable orders in the model are bank loans to the private sector, domestic bank participation in government debt, domestic non-bank participation in government debt, and bank deposits.

Table 6.
Auto-Regressive Distributed Lag Specification

This table reports the ARDL lags for each country, with the most common lag in the last line. Lag selection in the ARDL model is based on the Bayesian Information Criterion

Advanced Countries					Emerging Countries				
Country	$\ln lt,i$	$\ln b\_g_{t,i}$	$\ln nb\_gt,i$	$\ln d_{t,i}$	Country	$\ln lt,i$	$\ln b\_g_{t,i}$	$\ln nb\_gt,i$	$\ln d_{t,i}$
Australia	2	2	2	1	Argentina	2	1	0	1
Austria	1	3	1	0	Brazil	1	3	0	4
Belgium	1	2	3	1	Bulgaria	2	0	0	4
Canada	1	0	1	0	Chile	3	1	0	2
Czech Rep.	2	0	0	2	China	1	0	0	2
Denmark	1	0	2	2	Colombia	1	2	1	0
Finland	1	0	1	1	Egypt	1	0	0	1
France	1	0	0	3	Hungary	1	0	0	1
Germany	1	0	0	1	India	1	2	0	1
Greece	2	0	0	0	Indonesia	1	0	0	1
Ireland	2	0	0	0	Latvia	2	0	1	1
Italy	1	0	0	0	Lithuania	1	0	0	0
Japan	4	0	1	4	Malaysia	2	4	0	0
Korea	4	1	0	1	Mexico	1	0	0	1
Netherlands	4	0	0	1	Peru	4	0	0	0
Norway	1	0	0	1	Poland	1	0	0	1
Portugal	1	2	0	0	Romania	1	1	0	1
Slovenia	1	0	0	0	Russia	4	0	2	2
Spain	3	3	0	2	South Africa	1	0	4	0
Sweden	1	1	0	1	Thailand	1	0	0	1
Switzerland	2	1	0	1	Turkey	1	1	0	1
United Kingdom	1	1	1	1	Ukraine	1	1	1	1
United States	1	0	0	2	Uruguay	2	0	0	1
Most common lags	1	0	0	1		1	0	0	1

Based on the optimal common lags, Equation (2) shows the equation for ARDL(1,0,0,1) of Equation (1), which is then reparametrized into the error correction model as in Equation (3).

$$l_{t,i} = \alpha_{0,i} + \gamma_i l_{t-1,i} + \beta_{10,i} b\_g_{t,i} + \beta_{20,i} nb\_g_{t,i} + \beta_{30,i} d_{t,i} + \beta_{31,i} d_{t-1,i} + \varepsilon_{t,i} \quad (2)$$

$$\Delta l_{t,i} = \alpha_{0,i} + \varphi_i \left(l_{t-1,i} - \alpha_{1,i} b\_g_{t,i} - \alpha_{2,i} nb\_g_{t,i} - \alpha_{3,i} d_{t,i} \right) - \beta_{31,i} \Delta d_{t,i} + \varepsilon_{t,i} \quad (3)$$

Subsequently, Equation (3) is estimated using MG, PMG, and DFE estimators. The results in Table 7 show that estimation using DFE is the most efficient and consistent, which is confirmed by the Hausman test.

Table 7.
Estimation Results

This table reports the estimation results. The dependent variable is $\Delta l_{t,i}$, loan to the private sector. All models are based on ARDL(1,0,0,1). *P*-value is presented in parentheses. ***, **, and * represent significance level at $p<0.01$, $p<0.05$, and $p<0.1$ respectively.

Variables	Advanced Countries			Emerging Countries		
	MG	PMG	DFE	MG	PMG	DFE
ln $b\_g_{t,i}$	-0.09	-1.25***	-0.59***	-0.01	-0.09***	-0.41***
	(0.64)	(0.00)	(0.00)	(0.97)	(0.00)	(0.00)
ln $nb\_g_{t,i}$	0.17	-0.04	0.18***	0.28	0.14***	-0.22**
	(0.42)	(0.13)	(0.00)	(0.24)	(0.00)	(0.00)
ln $d_{t,i}$	0.11	-0.99***	0.41**	0.76***	1.03***	0.94***
	(0.78)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
ECT	-0.14***	-0.01***	-0.02***	-0.16***	-0.07***	-0.04***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total observations		1265			1265	
Number of countries		23			23	
Hausman test						
	PMG vs MG	Chi2(3)=386.63***		MG vs PMG	Chi2(3)=0.95	
		(0.00)			(0.81)	
	PMG vs DFE	Chi2(3)=0.00		PMG vs DFE	Chi2(3)= 0.36	
		(1.00)			(0.95)	

The estimation results confirm that domestic bank participation in government debt may potentially reduce bank loans to the private sector, as found by several previous studies (Bouis, 2019; Christensen, 2004; De Bonis and Stacchini, 2013; Gennaioli *et al.*, 2018; Hauner, 2009; Mbate, 2013). Furthermore, the negative impact is greater in advanced than in emerging countries due to greater nominal government debt in advanced countries, a finding which confirms Gennaioli *et al.*, (2018).

However, domestic non-bank participation in government debt does not always have a negative impact on bank loans to the private sector: it is negative in emerging countries but positive in advanced ones. The more developed financial

market in advanced than in emerging countries provides many investment options for non-bank investors aside from bank deposits. Therefore, the decision of such investors to participate more in government debt may not directly disturb the supply of bank loanable funds. In contrast, limited investment choices and funds in emerging countries may cause asset reallocation from bank deposits to government debt, which may decrease loans to the private sector.

The results further show that domestic bank participation in government debt in emerging countries has a more negative impact than domestic non-bank participation, even though the share of the latter is greater than of the former. Thus, the addition of domestic non-bank investors brings the empirical results in line with the theoretical model proposed by Ismihan and Ozkan (2012). The total negative impact of domestic investors' participation on bank loans to the private sector in emerging countries is more profound than in advanced countries.

In addition, bank deposits have a positive effect on bank loans to the private sector in emerging and advanced countries. The effect is higher in emerging countries since banks operate more traditionally and rely more on deposits as their main source of loanable funds.

B. Robustness Tests

We performed robustness tests to verify the empirical analysis results from the main models. The two first robustness models estimate domestic bank and non-bank participation in government debt separately, while the rest estimate them combined. Models (1) and (2) use the same method as the main model. Meanwhile model (3) uses DOLS, and model (4) uses FMOLS. Tables 8 and 9 summarize the robustness models for advanced and emerging countries, respectively.

Table 8. Robustness Models for Advanced Countries

This table reports the robustness models for advanced countries. The dependent variable is $\Delta l_{t,i}$, bank loan to the private sector. Models (1) and (2) are based on ARDL(1,0,1). Model (3) uses leads and lags based on Akaike Information Criterion. *P*-value is presented in parentheses. ***, **, and * represent significance level at $p<0.01, p<0.05$, and $p<0.1$ respectively.

Variables	(1) Only Bank	(2) Only Non-bank	(3) DOLS	(4) FMOLS
$\ln b\_g_{t,i}$	-0.60***		-0.14***	-0.12***
	(0.00)		(0.00)	(0.00)
$\ln nb\_g_{t,i}$		0.22	0.04***	0.04***
		(0.17)	(0.01)	(0.00)
$\ln d_{t,i}$	0.49**	-1.87	0.79***	0.76***
	(0.01)	(0.12)	(0.00)	(0.00)
ECT	-0.02***	-0.01***		
	(0.00)	(0.03)		
Total Observation	1265	1265	1228	1265
Number of countries	23	23	23	23

Table 9.
Robustness Model for Emerging Countries

This table reports the robustness models for emerging countries. The dependent variable is $\Delta l_{t,i}$, bank loan to the private sector. Models (1) and (2) are based on ARDL(1,0,1). Model (3) uses leads and lags based on Akaike Information Criterion. *P*-value is presented in parentheses. ***, **, and * represent significance level at *p<0.01*, *p<0.05*, and *p<0.1* respectively.

Variables	(1)	(2)	(3)	(4)
	Only Bank	Only Non-bank	DOLS	FMOLS
ln $b\_g_{t,i}$	-0.47***		-0.15***	-0.12***
	(0.00)		(0.00)	(0.00)
ln $nb\_g_{t,i}$		-0.46***	0.04*	0.01
		(0.00)	(0.07)	(0.48)
ln $d_{t,i}$	0.87***	0.44**	1.18***	1.17***
	(0.00)	(0.01)	(0.00)	(0.00)
ECT	-0.04***	-0.03***		
	(0.00)	(0.00)		
Total Observation	1265	1265	1230	1265
Number of countries	23	23	23	23

Robustness models confirm that domestic bank participation in government debt have negative impact on bank loans to the private sector in advanced than emerging countries. Meanwhile, the positive impact of domestic non-bank participation in government debt on bank loans to the private sector in advanced countries is largely confirmed. The negative impact of domestic non-bank participation in emerging countries is confirmed by the separated domestic non-bank participation model. Thus, the robustness models mostly support the main models.

IV. CONCLUSION

This study investigates the impacts of domestic bank and non-bank investors' participation in government debt on bank loans to the private sector in 23 advanced and 23 emerging countries from 2005Q1 to 2018Q4, using a nonstationary dynamic panel method. The findings show that domestic bank participation in government debt negatively impacts bank loans to the private sector, with the impacts being more profound in advanced than in emerging countries. Meanwhile, domestic non-bank participation only negatively impacts loans to the private sector in emerging countries but not in advanced countries. Moreover, non-bank participation in government debt has a less negative impact than bank participation in emerging countries since it does not always have a direct impact on bank loanable funds. The involvement of non-bank investors brings the empirical results more in line with the theoretical model. The negative impact from domestic non-bank investors, which only occurs in emerging countries, causes the total negative impact of domestic investors' participation in government debt on bank loans to the private sector in emerging countries to become greater than in advanced countries.

The findings of this study have several relevant policy implications related

to domestic investor diversification in government debt. First, diversification of domestic investors other than banks is required since, compared to bank participation, non-bank participation in government debt have a less negative impact on bank loans to the private sector. Second, the government in emerging countries should deepen financial markets since the involvement of non-bank investors in advanced countries, which tend to have a deeper financial market, has less or no negative impact on bank loans to the private sector.

Our study has limitations, as it does not consider the effects of the economic and financial crises. Crises may lead governments to increase financing through debt, aligning with a decline in economic activities which slows banking intermediation. Further studies may address this limitation to obtain more comprehensive results.

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The Impact of Domestic Investors' Participation in Government Debt on Bank Loans to the Private Sector: A Cross-country Study

289

APPENDIX

Table A.1.
Summary of Literature Review

A.1. Summary of Literature Review

This table summarizes the main literature review in this study.

Author(s) and year	Title	Sample	Methodology	Main findings
Bouis (2019)	Banks' Holdings of Government Securities and Credit to the Private Sector in Emerging Market and Developing Economies	80 emerging market and developing economies from 2001 to 2006	Panel data	Negative relationship between bank participation in government debt and private sector loans which caused by banks portfolio rebalancing toward safer, more liquid public assets in stress time.
Christensen (2004)	Domestic Debt Markets in Sub-Saharan Africa	27 countries in sub-Saharan Africa from 1980 to 2000	Panel data	Domestic debt negatively impacts the private sector lending (both variables were in percent of broad money).
De Bonis and Stacchini (2013)	Does Government Debt Affect Bank Credit?	23 OECD countries and 20 non-OECD countries from 1970 to 2010	Panel data	Classic crowding-out channel between ratio of government debt to GDP and the growth of bank loans, rather than due to the financial repression channel or the risk channel.
Gennaioli et al. (2018)	Banks, Government Bonds, and Default: What do the Data Say?	Sovereign bond holding by 20,000 banks in 191 countries, and 20 sovereign defaults from 1998 to 2012	Panel data	Negative correlation between bank's holding of domestic government bonds and ratio loan to asset during a sovereign default.
Hauner (2009)	Public Debt and Financial Development	73 developing countries from 1980 to 2004	Panel data	Ratio of bank credit to the private sector to GDP had a negative relationship to the share of public sector credit in the total credit.
Ismihan and Ozkan (2012)	Public Debt and Financial Development: A Theoretical Exploration	-	Theoretical model	An increase in government borrowing from banks reduces bank lending to the private sector. Furthermore, the lower depth of the financial market will lead to a larger negative effect in bank loans to the private sector.
Mbate (2013)	Domestic Debt, Private Sector Credit and Economic Growth in Sub-Saharan Africa	21 countries in sub-Saharan Africa over 1985 – 2010	Panel data	Domestic debt as a percentage of GDP had a negative relationship with private sector credit as a percentage of GDP.

A.II. Model Extension – Adding Domestic Non-bank Investors.
We add non-bank agent to the model to analyze the impact of non-bank investors in government bonds on loans to the private sector. Non-bank investors face the option of placing their funds in bank deposits or government bonds in order to maximize their profits. Non-bank is illustrated as an insurance or pension fund companies where they must provide a portion of γ of the collected funds (f_t) to customers as insurance claims or pension funds. The remaining funds are then managed by investing in government bonds (b_t^{nb}) and/or as deposits in banks (z_t). f_t is assumed as exogenous.

$$f_t + r_{t-1}^z z_{t-1} + r_{t-1} b_{t-1}^{nb} = \gamma f_t + z_t + b_t^{nb} \tag{A.1}$$

Non-bank companies also face fee c_{nb}, related to the ownership of assets. Furthermore, it is also assumed that all bank deposits come from non-bank. Thus, the problem faced by non-bank institutions is as follows:

$$V_t^{nb} = r_t^z z_t + r_t b_t^{nb} - \gamma f_t - \frac{c_{nb}}{2} \left(z_t + b_t^{nb} \right)^2 \tag{A.2}$$

$$s.t. \ f_t + r_{t-1}^z z_{t-1} + r_{t-1} b_{t-1}^{nb} = \gamma f_t + z_t + b_t^{nb}$$
$$z_t = A + \eta r_t^z \tag{A.3}$$

where Equation (A.3) is a total supply of deposits to the banks.
The equilibrium of b_t^{nb} in *t*=1 is as follow

$$b_1^{nb} = \frac{1}{c_{nb}} \left(r_1 - \frac{\gamma}{1-\gamma} \right) - A - \eta r_1^z$$

Now the supply of government bonds has two sources, from bank and non-bank. The supply of government bond from bank, b_t^i, then re-notated as b_t^{bi}, so that $b_t = b_t^b + b_t^{nb}$.
The equilibrium of supply and demand of government bonds is still the same as before with addition of assumption for demand of government bonds from non-bank, $\frac{\partial r_1}{\partial b_1^{nb}} < 0$.
The addition of non-bank investors shows the similar relationship as before. The increase of government demand borrowing harms loan to private sectors $\frac{\partial l_1^T}{\partial d_1} < 0$, through deposit channel $\frac{\partial z_1}{\partial b_1^{nb}} < 0$, since $\frac{\partial z_1}{\partial r_1^z} > 0$, $\frac{\partial r_1^z}{\partial r_1} > 0$, and $\frac{\partial r_1}{\partial b_1^{nb}} < 0$. Therefore, non-bank participation as domestic investor in government bonds also have potential negative impact on bank loans to the private sector.