Correlated lending to government and the private sector: what do we learn from the Great Recession?

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Abstract

The purpose of the study is to investigate the correlation between credit supply to government and credit supply to the private sector to determine whether there is a crowding-out or crowding-in effect of credit supply to government on credit supply to the private sector. The findings show a significant positive correlation between credit supply to government and credit supply to the private sector. There is also a significant positive relationship between credit supply to government and credit supply to the private sector, implying a crowding-in effect of government borrowing on private sector borrowing. The positive correlation between credit supply to government and credit supply to the private sector by banks is stronger and highly significant in the period before the Great Recession, while the positive correlation is weaker and less significant during the Great Recession, and the correlation further weakens after the Great Recession. The regional analyses show that the positive correlation between credit supply to government and credit supply to the private sector by banks is stronger and highly significant in the African region than in the Asian region and the region of the Americas.

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1. Introduction

This paper investigates the correlation between credit supply to government and credit supply to the private sector to determine whether credit supply to the private sector moves in tandem with credit supply to government.

Credit supply to government, which is the same as government borrowing, helps a government to finance its budget deficit and other off-budget expenditures (Nasir et al, 2020). A government may incur new debt from financial institutions to repay its maturing debt obligations, and this can lead to a spiral of budget deficit refinancing (Hasan and Siddique, 2019). In contrast, credit supply to the private sector, or private sector borrowing, refers to loans issued to private sector agents to finance their production, investment and trade activities that contribute to economic growth (Lemmon and Roberts, 2010).

There is a widespread belief that greater government borrowing may crowd-out private sector borrowing. This belief is based on the premise that if the government borrows one dollar more from the banking sector, banks would be left with one dollar less for lending to private sector agents (Emran and Farazi, 2009). This belief has also been championed by the International Monetary Fund (IMF) and the World Bank. The crowding-out effect is expected to be stronger during unfavorable economic conditions, such as during a financial crisis or recession, because lenders would prefer to lend to the government, or hold safe government securities, during bad times due to the government's zero-risk or low-default risk profile, while lenders will refrain from, or reduce, lending to the private sector during bad times due to their high-default risk profile (Emran and Farazi, 2009). The implication is that government borrowing may crowd-out private sector borrowing during bad times. This scenario was witnessed during the 2007-2009 global financial crisis which is also known as the Great Recession. During the crisis, lenders preferred to lend to the government or increase their holdings of safe government securities (Li, 2019). Lenders reduced credit supply to the private sector and did not want to take more risk during the financial crisis due to heightened credit risk and uncertainty (Ramey, 2019; Ozili, 2020). This implies that there is a perceived negative relationship or association between government borrowing and private sector borrowing during bad times.

There is also the expectation of a crowding-in effect or a positive relationship between credit supply to government and credit supply to the private sector. This is because lenders may be more concerned about the general changes occurring in the macroeconomy and less concerned about the risk profiles of government borrowers or private sector borrowers. Consequently, lenders may increase lending to both the private sector and the government during periods of macroeconomic prosperity and decrease lending to both the private sector and the government during economic downturns. Lenders' collective reaction to macroeconomic changes can give rise to a positive correlation between credit supply to the private sector and credit supply to government. The implication is that credit supply to the private sector and the government may be positively correlated when lenders become more concerned about the general changes occurring in the macroeconomy and are less concerned about changes in the risk profile of the two groups of borrowers.

Despite the expectation of a possible negative or positive correlation between government borrowing and private sector borrowing, there is no consensus among studies in the literature on whether government borrowing crowds-out or crowds-in private sector borrowing. Surprisingly, the literature has not examined the association between credit supply to government and credit supply to the private sector during bad times such as during the Great Recession. There is little empirical evidence on the crowding-in or crowding-out effect of credit supply to government and credit supply to the private sector during fluctuating macroeconomic conditions. And there is no cross-country research evidence on the correlation between credit supply to government and credit supply to the private sector during the Great Recession. Existing studies on the crowding-out effect focused on the effect of government deficit and expenditure on economic variables (see, for example Tinkelman and Neely, 2018; Picarelli et al, 2019; Huang et al, 2020; Kumar, 2020). But these studies did not examine the crowding-out or crowding-in effect in terms of the correlation between government borrowing and private sector borrowing. They did not investigate the correlation between credit supply to government and credit supply to the private sector during the Great Recession. Therefore, this study extends the literature by examining the correlation between credit supply to government and credit supply to the private sector. In this study, data for credit supply to the private sector and credit supply to government

were obtained for 43 countries from 1980 to 2019. The data were analyzed using the Pearson correlation methodology. The results reveal a significant positive correlation between credit supply to the private sector and credit supply to government. The positive correlation weakened during the Great Recession and further weakened after the Great Recession.

This study contributes to the economic literature that examines the credit dynamics among economic agents involved in economic activities. The study also contributes to the literature that investigates the crowding-in and crowding-out effects of government and private sector borrowings. The study also contributes to the literature that examines the consequences of financial correlations. It contributes to this literature by showing that macro-financial variables such as credit supply to the private sector and credit supply to government tend to be positively correlated, and such correlation may be driven by changes in the macroeconomy.

The rest of the paper is structured as follows. Section 2 presents the literature review. Section 3 presents the research methodology. Section 4 presents the results. Section 5 presents the conclusion.

2. Literature review

Emran and Farazi (2009) propose two theories that explain the relationship between government borrowing and private sector borrowing. The theories are the 'risk diversification model of bank behavior' and 'the Lazy bank model of bank behavior'. The risk diversification model of bank behavior states that banks that are allowed to purchase or invest in safe government securities will have incentives to take more risk by increasing lending to the private sector, implying a crowding-in effect that arises from the positive association between government borrowing and private sector borrowing. In contrast, the lazy bank hypothesis states that banks' access to safe government securities create moral hazard by (i) motivating banks to increase lending to government due to the low risk of government securities, (ii) discouraging banks from lending to the risky private sector and (iii) reducing banks' incentives to search for new profitable investment opportunities in the private sector, thereby indicating a crowding-out effect which is

confirmed by the idea that banks are lazy, i.e. the lazy bank model, as shown by the negative association between government borrowing and private sector borrowing (Emran and Farazi, 2009).

The recent literature documents evidence of a negative relationship between credit supply to government and credit supply to the private sector. But these studies did not examine this relationship during the Great Recession. Studies that document a negative relationship between credit supply to government and credit supply to the private sector suggest that the negative relationship indicates a crowding-out effect. For instance, Ahmad, Adeleke and Ujunwa (2019) examine the relationship between government borrowing and private sector growth in Nigeria. They find that government borrowing has an adverse impact on private sector growth in Nigeria. Zhang and Meng (2021) focus on the crowding-out effect in the housing market in China. They develop a mechanism that identifies the negative correlation between housing prices and investment in China. They find that a credit-driven housing boom stimulates constrained commercial banks to allocate more credit to the unproductive household sector instead of allocating more credit to the entrepreneur sector, thereby crowding-out corporate investment.

Picarelli, Vanlaer and Marneffe (2019) argue that the sovereign debt crisis and fiscal consolidation policies implemented in the European Union (EU) hindered economic growth. In their study, they examine the extent to which high public debt reduced public investment in 26 EU countries from 1995 to 2015. They use the GMM estimation method to analyze the data and find that a 1 percent increase in public debt in the EU leads to a 0.03 percent reduction in public investment, and the negative impact of debt on investment is smaller in the Eurozone than in the entire EU. Manda (2019) examines the impact of government borrowing on private sector credit in Zimbabwe using data from 2012 to 2018. The motivation for the study was because the rising public debt in Zimbabwe in 2012 raised concerns about the potential crowding-out effect of government borrowing and spending on private domestic investment in Zimbabwe. Manda (2019) finds a negative but insignificant relationship between credit supply to government and credit supply to the private sector, implying that credit supply to government did not significantly crowd-out private credit.

Zhang, Brookins and Huang (2022) assess the effects of central government debt and local government debt on corporate debt in the domestic financial market in China from 2008 to 2019. They find that both central government debt and local government debt are negatively related to corporate debt. Central government debt affects corporate debt by crowding-out corporate bonds while local government debt affects corporate debt by crowding-out corporate loans. Aghughu, Alenoghena and Amase (2022) investigate the effect of government public domestic borrowing on credit supply to the private sector. They use data from 1980 to 2019 and employ the autoregressive distributed lag (ARDL) model to analyse the data. They find that domestic government borrowing has a significant negative effect on credit supply to the private sector. They also find that interest rate and inflation have a significant negative impact on credit supply to the private sector while real GDP has a weak effect on credit supply to the private sector. Nasir et al (2020) examine the implications of government borrowing for corporate financing and capital structure of firms. They explore the effects of government debt, macroeconomic and firm-specific factors on firm's choice of financing and capital structure. They use stock exchange data obtained from 225 non-financial firms listed on the Ho Chi Minh Stock Exchange from 2007 to 2017. They analyze the data using the system Generalized Method of Moments regression. They find that government borrowing and debt financing for the Vietnamese listed companies have a negative relationship. They also observe that short-term corporate leverage structure is influenced more strongly than the long-term leverage structure.

Kabir and Flath (2020) examine the relationship between bank credit to the private sector and government borrowing from the banking sector. They examine 73 countries during the 1995 to 2014 period. They find that government debt held by banks crowds-out bank credit to the private sector in developing countries and in high-income countries. Akanbi (2020) examines the impact of government domestic borrowing on private sector credit in Nigeria using data from 2009 to 2018. The study finds a negative relationship between government domestic bond issuance and bank credit to the private sector. The study also finds that higher government domestic borrowing led to a reduction in private credit. Mwakalila (2020) examines the impact of government expenditure and domestic borrowing on credit supply to the private sector in Tanzania using data from 2004 to 2018. The study shows that government expenditure and

domestic borrowing crowd-out credit supply to the private sector. The study conclude that the Tanzanian government should reduce its deficit spending and domestic borrowing and look for ways to increase tax revenue using loans from external sources to fund its budget deficit. Anyanwu, Gan and Hu (2018) examine the crowding-out effect of government domestic borrowing in 28 oil-dependent countries from 1990 to 2012. They find that a one percent increase in government borrowing from domestic banks significantly decreases private sector credit by 0.22 percent and has no significant impact on the lending rate that banks charge to the private sector. They conclude that government domestic borrowing led to a reduction in private credit. Eliskovski (2019) examines the crowding-out effect of central government borrowing on the private sector loans issued by banks in Macedonia. The study finds that government borrowing crowds-out the private loans.

Other studies analyse the crowding out effect in the financial sector. Zhang (2022) investigates the impact of the People's Bank of China's green loan policy on pollution and firm performance using a sample of Chinese firms 2010 to 2017. They find that the green loan policy increases investments that curb pollution and encourages firms to reduce emissions, introduce new energy sources, and demonstrate greater environmental responsibility. The study further shows that investment in pollution control crowds out investment in fixed and intangible assets due to the financial constraint mechanism. Layaoen and Takahashi (2022) examine whether microfinance lending increases or decreases the likelihood and amount of credit that households demand from informal lenders. They find that microfinance lending 'crowds out' informal lending from both moneylenders and relatives and friends. Deng (2022) investigates the crowding-out effect of formal finance on the P2P lending market using the credit records of the borrowers from a peer-to-peer (P2P) lending platform in China. The findings show that, as formal finance develops, high-quality borrowers become less likely to turn to P2P lending, implying that formal finance crowds-out P2P lending as formal finance develops. Ha et al (2022) examine the linkages between foreign and domestic investment at sector level in Vietnam during the 2010 to 2015 period, and show that foreign direct investment in Vietnam positively motivates domestic private investment in the same sector. The findings suggest a crowding-in effect from foreign investment to domestic private investment in Vietnam. Audretsch and Fiedler (2022) argue that an entrepreneurial state

can crowd out entrepreneurship. They analyse the context of Singapore, and find that coordinated policies that prioritize and target capital, knowledge, and human capital accumulation in particular industries, sectors, technologies, and firms created a formidable societal knowledge filter that impedes endogenous entrepreneurial activity. Jin et al (2022) examine whether the relationship between corporate financialization and fixed investment rate is heterogeneous among China's listed non-financial enterprises. They find a negative relationship between corporate financialization and fixed investment rate, implying that corporate investment in financial assets crowd out fixed investment.

Other studies examine the consequences of credit supply to government. Cooray (2019) investigates the crowding-out effect of public borrowing from domestic sources on private investment in Sri Lanka. The author analyses Sri Lankan credit supply data from 1960-2014 and find a long-run relationship between public borrowing, interest rate and gross domestic product. Huang, Pagano and Panizza (2020) analyse Chinese local public debt and find that local public debt crowds-out the investment of private firms by tightening their funding constraints while State-owned firms' investment was unaffected. They also find that private firms invest less in cities with more public debt; furthermore, they find that the reduction in investment is larger for firms located farther from banks in other cities or firms that are more dependent on external funding. Hasnat and Ashraf (2018) investigate financial crowding-out in the long-term debt market in India. The study used the corporate bond market as a proxy for the long term debt market in India. The study finds evidence of interest rate sensitivity in the corporate bond market, and the interest rates are induced by fiscal deficit, implying the possibility of financial crowding-out in the Indian debt market segment. Although the literature has examined the relationship between credit supply to government and the private sector, the existing literature has not examined the correlation between credit supply to the private sector and credit supply to government during the Great Recession. This study fills this gap in the literature.

3. Research Methodology

3.1. Data

Multi-country data were collected from the World Bank's Global Financial Development indicators (GFDI). The data obtained from the GFDI indicators are the ratio of credit to government and state owned enterprises to GDP (hereafter, the CG variable), the ratio of domestic credit to private sector to GDP (hereafter, the CP variable), the ratio of private credit by deposit money banks and other financial institutions to GDP (hereafter, the CPBO variable), and the ratio of private credit by deposit money banks to GDP (hereafter, the CPB variable). These four variables are macro-financial indicators of aggregate credit supply in the economy (see table 1). Several studies have used these macro indicators to measure aggregate credit dynamics in various contexts such as Lane and McQuade (2014), Gozgor (2014) and Ozili et al (2022). The sample period is from 1980 to 2019 which is a 39-year period. A large sample period was chosen to ensure that the data capture at least two full economic cycles. Normally, a 10-year period is a full economic cycle. This means that the 39-year sample period captures almost four full economic cycles. Data were collected for 60 countries across several regions. Some countries had incomplete reported data in the GFDI database. The affected countries were excluded from the analysis. Only 43 countries had complete data over the sample period. The countries are Algeria, Australia, Belize, Botswana, Burkina Faso, Burundi, Cote d'Ivoire, Dominica, Egypt, Gabon, Ghana, Grenada, Haiti, Iceland, India, Jamaica, Jordan, Kenya, Korea republic, Lesotho, Madagascar, Malaysia, Myanmar, Nepal, Niger, Nigeria, Pakistan, Paraguay, Philippines, Rwanda, Senegal, Singapore, Sri Lanka, St. Kitts, St. Lucia, St. Vincent and the Grenadines, Suriname, Sweden, Togo, Trinidad and Tobago, United States, Uruguay and Vanuatu.

Table 1. Variable definition and source		
Variable	Indicator Name	Data source
CG	The ratio of credit to government and state owned enterprises to GDP (%)	GFDI
CP	The ratio of domestic credit to the private sector (% of GDP)	GFDI
CPBO	The ratio of private credit by deposit money banks and other financial institutions to GDP (%)	GFDI
CPB	The ratio of private credit by deposit money banks to GDP (%)	GFDI

3.2. Descriptive statistics

Table 2 reports the average regional values for the variables. The average CG variable for the full sample is 9.15 percent. The average CG variable for the Asian region (13.5 percent) and the region of the Americas (9.24 percent) region is higher than the average CG variable in the full sample, while the average CG variable in the European, African and Oceania regions is less than the average CG variable in the full sample. The average CP variable for the full sample is 39.1 percent. The average CP variable in the Asian, the Americas, European and Oceania regions is higher than the average CP variable in full sample, while the average CP variable in the African region is less than the average CP variable in the full sample. The average CPBO variable for the full sample is 39.46 percent. The average CPBO variable in the Asian, the Americas, European and Oceania regions is higher than the average CPBO variable in full sample, while the average CPBO variable in the African region is less than the average CPBO variable in the full sample. The average CPB variable for the full sample is 35.6 percent. The average CPB variable in the Asian, the Americas, European and Oceania regions is higher than the average CPB variable in full sample, while the average CPB variable in the African region is less than the average CPB variable in the full sample. Overall, the regional averages show that the average credit supply to government and the private sector in Africa is low compared to the average credit supply to government and the private sector in other regions.

Table 2: Country-specific Descriptive Statistics				
Statistic:	CG	CP	CPBO	CPB
Full sample	9.15	39.1	39.46	35.6
The Americas	9.24	45.44	46.4	37.8
Oceania	4.1	64.9	64.7	63.3
Africa	7.3	17.4	16.4	16.3
Asia	13.5	51.47	50.8	48.6
Europe	6.9	83.4	96.6	83.7

Variables description. CG = the ratio of credit to government and state owned enterprises to GDP (%). CP = the ratio of domestic credit to private sector (% of GDP). CPBO = ratio of private credit by deposit money banks and other financial institutions to GDP (%). CPB = the ratio of private credit by deposit money banks to GDP (%).

3.3. Pearson correlation – an empirical test for association

Pearson correlation is a statistical technique used to measure the non-causal linear association between variables. Pearson correlation tests the degree to which two or more variables move together. The Pearson correlation estimator assumes that the data has a linear trend. The assumption of linear trend in the data means that the Pearson correlation estimator only measures the linear correlation between specific variables. Hence, it does not consider non-linear dependencies. The Pearson correlation method has been used by several studies to measure financial correlations in the finance and economics literature. Such studies include Kim et al (2015), Tumminello et al (2010) Ozili (2018) and Ozili et al (2023). Accordingly, the Pearson correlation method was used in this study to analyse the linear correlation between credit supply to government and credit supply to the private sector. In this study, the results are interpreted based on the reported coefficient sign and the magnitude of the statistical significance of the estimated Pearson correlation coefficients. The Pearson correlation results are reported in the next section.

4. Empirical Results

4.1. Full sample analysis (1980 to 2019)

The Pearson correlation result for the full sample is reported in table 3. It shows that there is a significant positive correlation between the CG variable and the three indicators of credit supply to the private sector (CP, CPBO and CPB). This result indicates that higher government borrowing is associated with higher private sector borrowing, which supports the risk diversification model of bank behavior. The correlation is significant for the three indicators of credit supply to the private sector. The statistical significance, or t-statistic, is higher for the correlation between the CG and CPB variables while the statistical significance, or t-statistic, is weaker for the correlation of CG with CP or CPBO as indicated by the t-statistic and p-value in table 3. This suggests that private credit supply by banks has a strong significant positive correlation with credit supply to government.

Table 3. Pearson correlation: Full Sample

Variables	CG	CP	CPBO	CPB
CG	**1.00**			

CP	**0.17*** **	1.00		
	(7.17)	-----		
	((0.00))	-----		
CPBO	**0.17*** **	0.97***	1.00	
	(7.38)	(193.94)	-----	
	((0.00))	((0.00))	-----	
CPB	**0.21*** **	0.89***	0.89***	1.00
	(9.01)	(82.79)	(81.38)	-----
	((0.00))	((0.00))	((0.00))	-----

T-statistics are reported in single parenthesis. P-values are reported in double parenthesis. *** denote statistical significance at 1% level.

4.2. Before the Great Recession (1980 to 2006)

The Pearson correlation result for the period before the 2007-2009 Great Recession is reported in table 4 which shows that there is a significant positive correlation between credit supply to government (CG) and the three indicators of credit supply to the private sector (CP, CPBO and CPB). This result indicates that lenders simultaneously increase (or decrease) lending to government and the private sector as a risk diversification strategy prior to the 2008 Great Recession. The correlation is significant for the three indicators of credit supply to the private sector (CP, CPBO and CPB). The statistical significance, or t-statistic, is stronger for the correlation between the CG and CPB variables while the statistical significance, or t-statistic, is weaker for the correlation of CG with CP and CPBO as indicated by the t-statistic and p-value in table 4. This suggests that private credit supply by banks has a strong significant positive correlation with credit supply to government in the period before the Great Recession.

Table 4. Pearson correlation: Before the Great Recession (1980-2006)

Variables	CG	CP	CPBO	CPB
CG	**1.00**			

CP	**0.17*****	1.00		
	(5.96)	-----		
	((0.00))	-----		
CPBO	**0.17*****	0.96***	1.00	
	(6.14)	(124.64)	-----	
	((0.00))	((0.00))	-----	
CPB	**0.21*****	0.89***	0.88***	1.00
	(7.42)	(70.05)	(66.34	-----
	((0.00))	((0.00))	((0.00))	-----

T-statistics are reported in single parenthesis. P-values are reported in double parenthesis. ***, ** denote statistical significance at 1% and 5% level respectively.

4.3. During the Great Recession (2007 to 2009)

The Pearson correlation result during the 2007-2009 Great Recession is reported in table 5. The result in table 5 shows that there is a significant positive correlation between credit supply to government (CG) and the three indicators of credit supply to the private sector (CP, CPBO and CPB). This result supports the risk diversification model of bank behavior, which suggests a positive association between government borrowing and private sector borrowing during the Great Recession.

The statistical significance, or t-statistic, is higher for the correlation between the CG and CPB variables while the statistical significance, or t-statistic, is weaker for the correlation of CG with CP and CPBO as indicated by the t-statistic and p-value in table 5. This suggests that private credit supply by banks has a strong significant positive correlation with credit supply to government during the Great Recession.

Table 5. Pearson correlation: During the Great Recession (2007-2009)

Variables	CG	CP	CPBO	CPB
CG	**1.00**			

CP	**0.18****	1.00		
	(2.07)	-----		
	((0.03))	-----		
CPBO	**0.18****	0.98***	1.00	
	(2.11)	(74.03)	-----	
	((0.04))	((0.00))	-----	
CPB	**0.22*****	0.89***	0.90***	1.00
	(2.64)	(22.67)	(23.69)	-----
	((0.00))	((0.00))	((0.00))	-----

T-statistics are reported in single parenthesis. P-values are reported in double parenthesis. ***, ** denote statistical significance at 1% and 5% level respectively.

4.4. After the Great Recession (2010 to 2019)

The Pearson correlation result for the period after the 2007-2009 Great Recession is reported in table 6. The result in table 6 shows that there is a significant positive correlation between credit supply to government (CG) and credit supply to the private sector by banks (CPB) in the period after the Great Recession. This result indicates that there is higher government borrowing and private sector borrowing from banks possibly as a risk diversification strategy after the 2007-2009 Great Recession. However, there is an insignificant correlation of CG with CP and CPBO.

Table 6. Pearson correlation: After the Great Recession (1980-2006)

Variables	CG	CP	CPBO	CPB
CG	**1.00**			

CP	**0.07**	1.00		
	(1.49)	-----		
	((0.13))	-----		
CPBO	**0.07**	0.99***	1.00	
	(1.62)	(175.84)	-----	
	((0.10))	((0.00))	-----	
CPB	**0.11****	0.87***	0.87	1.00
	(2.21)	(37.08)	(37.89)	-----
	((0.02))	((0.00))	((0.00))	-----

T-statistics are reported in single parenthesis. P-values are reported in double parenthesis. *, **, *** denote statistical significance at 10%, 5% and 1% level respectively.

4.5. Correlation comparison

This section compares the correlation coefficients for the period before, during and after the Great Recession. The result is reported in table 7. The result shows that the correlation between credit supply to government (CG) and credit supply to the private sector by banks and other financial institutions (CP and CPBO) were highly significant before the Great Recession. The significance of the correlation weakened during the Great Recession and further weakened in the period after the Great Recession. This suggests that the events that occurred during and after the Great Recession weakened the positive correlation between credit supply to government (CG) and credit supply to the private sector by banks and other financial institution (CPBO). However, the correlation between credit supply to government (CG) and credit supply to the private sector by banks alone (CPB) remained significant in the period before, during and after the Great Recession.

Table 7. Comparing correlation: before, during and after the Great Recession			
Variables	Before Great Recession	During Great Recession	After Great Recession
	CG	CG	CG
CP	0.17***	0.18**	0.07
	(5.96)	(2.07)	(1.49)
	((0.00))	((0.03))	((0.13))
CPBO	0.17***	0.18**	0.07
	(6.14)	(2.11)	(1.62)
	((0.00))	((0.04))	((0.10))
CPB	0.21***	0.22***	0.11**
	(7.42)	(2.64)	(2.21)
	((0.00))	((0.00))	((0.02))

T-statistics are reported in single parenthesis. P-values are reported in double parenthesis. ***, ** denote statistical significance at 1% and 5% level respectively.

4.6. Regional Correlation Analysis

4.6.1. African region

The Pearson correlation result for the African region is reported in table 8. The result shows that there is a significant positive correlation between credit supply to government (CG) and the three indicators of credit supply to the private sector (CP, CPBO and CPB). The statistical significance, or t-statistic, is higher for the correlation between the CG and CPB variables while the statistical significance, or t-statistic, is weaker for the correlation of CG with CP and CPBO as indicated by the t-statistic and p-value in table 8. This suggests that private credit supply by banks has a strong significant positive correlation with credit supply to government in African countries. This result suggests that African banks increase lending to both government and the private sector, and the positive correlation supports the risk diversification model of bank behavior.

Table 8. Pearson correlation: the African Region

Variables	CG	CP	CPBO	CPB
CG	**1.000**			

CP	**0.30*****	1.00		
	(8.01)	-----		
	((0.00))	-----		
CPBO	**0.33*****	0.96***	1.00	
	(8.91)	(100.04)	-----	
	((0.00))	((0.00))	-----	
CPB	**0.33*****	0.97***	0.99***	1.00
	(9.01)	(108.41)	(323.79)	-----
	((0.00))	((0.00))	((0.00))	-----

T-statistics are reported in single parenthesis. P-values are reported in double parenthesis. *** denote statistical significance at 1% level.

4.6.2. Region of the Americas

The Pearson correlation result for the region of the Americas is reported in table 9. The result shows that there is a significant positive correlation between credit supply to government (CG) and the three indicators of credit supply to the private sector (CP, CPBO and CPB) in the region. The statistical significance, or t-statistic, is higher for the correlation between the CG and CPB variables while the statistical significance, or t-statistic, is weaker for the correlation of CG with CP and CPBO as indicated by the t-statistic and p-value in table 9. This suggests that private credit supply by banks has a strong significant positive correlation with credit supply to government in countries in the region of the Americas. This result suggests that banks in the region of the Americas, to a larger extent, increase lending to both government and the private sector, and the observed positive correlation supports the risk diversification model of bank behavior.

Table 9. Pearson correlation: Region of the Americas

Variables	CG	CP	CPBO	CPB
CG	**1.00**			

CP	**0.14*****	1.00		
	(3.28)	-----		
	((0.00))	-----		
CPBO	**0.14*****	0.99***	1.00	
	(3.39)	(173.96)	-----	
	((0.00))	((0.00))	-----	
CPB	**0.35*****	0.63***	0.64***	1.00
	(8.54)	(18.75)	(19.11)	-----
	((0.00))	((0.00))	((0.00))	-----

T-statistics are reported in single parenthesis. P-values are reported in double parenthesis. *** denote statistical significance at 1% level.

4.6.3. Asian region

The Pearson correlation result for the Asian region is reported in table 10. The results show that there is a significant positive correlation between credit supply to government (CG) and the three indicators of credit supply to the private sector (CP, CPBO and CPB) in table 10. The statistical significance, or t-statistic, is higher for the correlation between the CG and CPB variables while the statistical significance, or t-statistic, is weaker for the correlation of CG with CP and CPBO as indicated by the t-statistic and p-value in table 10. This suggests that private credit supply by banks has a strong significant positive correlation with credit supply to government in countries in the Asian region. This result suggests that there is higher government borrowing and private sector borrowing from Asian banks, and the observed positive correlation in the Asian region supports the risk diversification model of bank behavior.

Table 10. Pearson correlation: Asian region

Variables	CG	CP	CPBO	CPB
CG	**1.00**			

CP	**0.18***	1.00		
	(3.65)	-----		
	((0.00))	-----		
CPBO	**0.19***	0.97***	1.00	
	(3.98)	(89.85)	-----	
	((0.00))	((0.00))	-----	
CPB	**0.22***	0.98***	0.99***	1.00
	(4.44)	(106.79)	(191.73)	-----
	((0.00))	((0.00))	((0.00))	-----

T-statistics are reported in single parenthesis. P-values are reported in double parenthesis. *** denote statistical significance at 1% level.

4.6.4. European region

The Pearson correlation result for the European region is reported in table 11. The result shows that there is a significant positive correlation between credit supply to government (CG) and CPBO. This indicates that greater credit supply to government by European banks and other financial institutions is significantly associated with greater credit supply to the private sector by banks and other financial institutions in Europe. This result suggests that financial sector agents in European countries increase lending to government and the private sector and vice versa, and the observed positive correlation in the European region supports the risk diversification model of bank behavior.

Table 11. Pearson correlation: the European region

Variables	CG	CP	CPBO	CPB
CG	**1.00**			

CP	**0.07**	1.00		
	(0.65)	-----		
	((0.51))	-----		
CPBO	**0.23****	0.91***	1.00	
	(2.14)	(19.13)	-----	
	((0.04))	((0.00))	-----	
CPB	**0.07**	0.99***	0.91***	1.00
	(0.66)	(482.88)	(19.02)	-----
	((0.51))	((0.00))	((0.00))	-----

T-statistics are reported in single parenthesis. P-values are reported in double parenthesis. **, *** denote statistical significance at 5% and 1% level respectively.

4.6.5. Oceania region

The Pearson correlation result for the Oceania region is reported in table 12. The result shows that the correlation coefficients between the variables are very low. The correlation coefficients of CG with CP, CPBO and CPB are also negative and insignificant. This suggests that there is no significant correlation between credit supply to government (CG) and the three indicators of credit supply to the private sector (CP, CPBO and CPB) in the Oceania region.

Table 12. Pearson correlation: the Oceania region

Variables	CG	CP	CPBO	CPB
CG	**1.00**			

CP	**-0.03**	1.000		
	(-0.29)	-----		
	((0.76))	-----		
CPBO	**-0.03**	0.99	1.00	
	(-0.29)	(110.49)	-----	
	((0.76))	((0.00))	-----	
CPB	**-0.04**	0.99	0.99	1.000
	(-0.36)	(220.88)	(167.97)	-----
	((0.71))	((0.00))	((0.00))	-----

T-statistics are reported in single parenthesis. P-values are reported in double parenthesis.

4.6.6. Regional correlation comparison

This section compares the correlation coefficients for the regions. The result is reported in table 13. There is a significant positive correlation between credit supply to government (CG) and the three indicators of credit supply to the private sector (CP, CPBO and CPB) in most of the regions. More importantly, the results show that the magnitude and statistical significance of the correlation between credit supply to government (CG) and the three indicators of credit supply is higher in the African region than in the Asian region and the Americas region as indicated by the high correlation coefficient, large t-statistic and large p-value in table 13. This leads to the conclusion that the correlation between credit supply to government and credit supply to the private credit is more significant in Africa than in other regions.

Table 13. Comparing regional correlations					
Variables	Europe	Africa	Asia	Oceania	Americas
	CG	CG	CG	CG	CG
CP	0.07	0.30***	0.18***	-0.03	0.14***
	(0.65)	(8.01)	(3.65)	(-0.29)	(3.28)
	((0.51))	((0.03))	((0.00))	((0.76))	((0.00))
CPBO	0.23**	0.33***	0.19***	-0.03	0.14***
	(2.14)	(8.91)	(3.98)	(-0.29)	(3.39)
	((0.04))	((0.00))	((0.00))	((0.00))	((0.00))
CPB	0.07	0.33***	0.22***	-0.24	0.35***
	(0.66)	(9.01)	(4.44)	(-0.36)	(8.54)
	((0.51))	((0.00))	((0.00))	((0.71))	((0.00))

4.7. Robustness test

To verify the robustness of the results, a two-stage least squares (2SLS) regression coefficient matrix analysis was conducted to examine the causal relationship between the CG, CP, CPBO and CPB variables with a focus on the variable coefficient signs and the statistical significance of the variables in a univariate regression model setup. The purpose of the 2SLS regression coefficient matrix analysis is to determine whether the coefficients of the variables confirm the association in the Pearson correlation results, following the approach used in Ozili (2022). The results in tables 14 and 15 confirm that all the variables report a positive and significant coefficient and indicate that the variables have a significant positive relationship with one another in the full sample and during the pre-, during- and post- Great Recession period. This indicates that credit supply to government has a significant and positive association with credit to the private sector and vice versa. The positive correlation results are consistent with the risk diversification model of bank behavior. Similarly, the results in tables 16, 17 and 18 confirm that all the variables report a significant positive relationship with one another in the regional 2SLS regression estimations, indicating that credit supply to government has a significant positive association with credit to the private sector and vice versa.

Table 14. Two-Stage Least Square Regression Coefficient Matrix: Full Sample and Pre-Crisis Analyses

	Full sample analysis (1980 to 2019)				Before the Great Recession (1980 to 2006)			
	CG	CP	CPBO	CPB	CG	CP	CPBO	CPB
	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)
CG	-	4.270*** (0.00)	4.313*** (0.00)	3.892*** (0.00)	-	2.239*** (0.00)	2.291*** (0.00)	2.063*** (0.00)
CP	0.234*** (0.00)	-	1.009*** (0.00)	0.911*** (0.00)	0.148*** (0.00)	-	1.006*** (0.00)	0.833*** (0.00)
CPBO	0.232*** (0.00)	0.990*** (0.00)	-	0.903*** (0.00)	0.145*** (0.00)	0.962*** (0.00)	-	0.810*** (0.00)
CPB	0.257*** (0.00)	1.097*** (0.00)	1.108*** (0.00)	-	0.179*** (0.00)	1.096*** (0.00)	1.115*** (0.00)	-
*** statistical significance at the 1% level								

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Table 15. Two-Stage Least Square Regression Coefficient Matrix: During Crisis and Post-Crisis Analyses

	During the Great Recession (2007 to 2009)				After the Great Recession (2010 to 2019)			
	CG	CP	CPBO	CPB	CG	CP	CPBO	CPB
	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)
CG	-	2.754*** (0.00)	2.689*** (0.00)	2.552*** (0.00)	-	2.343*** (0.00)	2.371*** (0.00)	2.227*** (0.00)
CP	0.122*** (0.00)	-	0.970*** (0.00)	0.831*** (0.00)	0.154*** (0.00)	-	1.001*** (0.00)	0.857*** (0.00)
CPBO	0.125*** (0.00)	1.019*** (0.00)	-	0.855*** (0.00)	0.155*** (0.00)	0.993*** (0.00)	-	0.856*** (0.00)
CPB	0.147*** (0.00)	1.085*** (0.00)	1.063*** (0.00)	-	0.180*** (0.00)	1.052*** (0.00)	1.059*** (0.00)	-
*** statistical significance at the 1% level								

Table 16. Two-Stage Least Square Regression Coefficient Matrix: African and Region of the Americas

	African region				Region of the Americas			
	CG	CP	CPBO	CPB	CG	CP	CPBO	CPB
	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)
CG	-	2.378*** (0.00)	2.248*** (0.00)	2.220*** (0.00)	-	4.917*** (0.00)	5.023*** (0.00)	4.094*** (0.00)
CP	0.420*** (0.00)	-	0.945*** (0.00)	0.933*** (0.00)	0.203*** (0.00)	-	1.022*** (0.00)	0.833*** (0.00)
CPBO	0.445*** (0.00)	1.058*** (0.00)	-	0.987*** (0.00)	0.199*** (0.00)	0.979*** (0.00)	-	0.815*** (0.00)
CPB	0.450*** (0.00)	1.071*** (0.00)	1.013*** (0.00)	-	0.244*** (0.00)	1.200*** (0.00)	1.227*** (0.00)	-
*** statistical significance at the 1% level								

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Table 17. Two-Stage Least Square Regression Coefficient Matrix: Asian and European Region Analyses

	Asian region				European region			
	CG	CP	CPBO	CPB	*CG*	*CP*	*CPBO*	*CPB*
	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	*Coefficient (p-value)*	*Coefficient (p-value)*	*Coefficient (p-value)*	*Coefficient (p-value)*
CG	-	3.826*** (0.00)	3.776*** (0.00)	3.613*** (0.00)	*-*	*8.773*** (0.00)*	*10.614*** (0.00)*	*8.807*** (0.00)*
CP	0.261*** (0.00)	-	0.987*** (0.00)	0.944*** (0.00)	*0.059*** (0.00)*	*-*	*1.054*** (0.00)*	*1.003*** (0.00)*
CPBO	0.265*** (0.00)	1.013*** (0.00)	-	0.957*** (0.00)	*0.061*** (0.00)*	*0.895*** (0.00)*	*-*	*0.897*** (0.00)*
CPB	0.277*** (0.00)	1.059*** (0.00)	1.045*** (0.00)	-	*0.059*** (0.00)*	*0.997*** (0.00)*	*1.050*** (0.00)*	*-*
	*** statistical significance at the 1% level							

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Table 18. Two-Stage Least Square Regression Coefficient Matrix: Oceania Region Analysis

	CG	CP	CPBO	CPB
	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)
CG	-	15.954*** (0.00)	15.904*** (0.00)	15.578*** (0.00)
CP	0.063*** (0.00)	-	0.997*** (0.00)	0.976*** (0.00)
CPBO	0.063*** (0.00)	1.003*** (0.00)	-	0.979*** (0.00)
CPB	0.064*** (0.00)	1.024*** (0.00)	1.021*** (0.00)	-
	*** statistical significance at the 1% level			

5. Conclusion

This paper investigated the correlation between credit supply to government and credit supply to the private sector to determine whether there is crowding-out or crowding-in effect. The study used a single indicator of credit supply to government and three indicators of credit supply to the private sector. Pearson correlation analysis was used to analyse the correlation between credit supply to government and the three indicators of credit supply to the private sector.

The empirical results show a significant positive correlation between credit supply to government and credit supply to the private sector. There is also a significant positive relationship between credit supply to government and credit supply to the private sector, implying a crowding-in effect of government borrowing on private sector borrowing. The positive correlation between credit supply to government and credit supply to the private sector by banks is stronger and highly significant in the period before the Great Recession, while the positive correlation is weaker and less significant during the Great recession and the correlation further weakens after the Great Recession. The regional analyses show that the positive correlation between credit supply to government and credit supply to the private sector by banks is stronger and highly significant in the African region than in the Asian region and the region of the Americas.

The implication of the findings is that there is a crowding-in effect of government borrowing on private sector borrowing. The observed positive correlation means that an increase in government borrowing may not lead to a decrease in private sector borrowing, rather it can lead to an increase in private sector borrowing. Therefore, it is expected that a decrease in lending to the private sector would be correlated with a decrease in lending to government when lenders are more concerned about the deteriorating macroeconomic condition during a recession.

Policymakers should introduce regulations that encourage the simultaneous increase in credit supply to government and the private sector during a financial crisis or a recession. Such regulations should ensure that lenders increase credit supply during a recession. Such regulations should also weaken a negative correlation between government borrowing and private sector borrowing during bad times. Policymakers need to also pay attention to events that diminish or weaken the desirable positive correlation between credit supply to government and credit supply

to the private sector, and assess the consequences of such events in order to provide the necessary safeguards against such events.

One limitation of the study is that correlation analysis only shows the linear correlation among the credit variables. It does not imply causality or causation. Therefore, it should not be assumed that credit supply to government predicts credit supply to the private sector or that credit supply to the private sector predicts credit supply to government.

Future studies can assess whether changes in credit supply to government is correlated with shortfalls in government revenue or budget deficit financing. Future studies can also examine the correlation between credit supply to government and credit supply by Fintech and Bigtech companies. Future studies can also examine the correlation between credit supply to the private sector and credit supply by Fintech and Bigtech companies. Future studies can also examine the correlation between credit supply to government and credit supply to the private sector during the COVID-19 pandemic.

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