査読論文

Crowding Out of Private Credit Caused by Government Borrowing from the Domestic Banking Sector: New Cross-Country Estimates and a Novel Interpretation

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Abstract

A cross-country regression equation is estimated with bank credit to the private sector relative to GDP as dependent variable and government borrowing from the banking system relative to GDP as an independent variable, using five-year-averaged panel data for 73 countries, 1995–2014. The results show that government debt held by banks crowds out bank credit to the private sector dollar-for-dollar, and this is true of developing countries and high-income countries alike. This is consistent with domestic sovereign debt being placed with banks at market prices, and with banks managing their private credit with the aim of maintaining constant capital ratios.

Keywords

Government borrowing, Bank credit, Crowding out, Lazy banks

JEL Classification

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1. Introduction

This study examines the crowding out of private credit caused by government

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borrowing from the domestic banking sector. It estimates a cross-country regression equation with bank credit to the private sector relative to GDP as dependent variable and government borrowing from the banking system relative to GDP as an independent variable, using five-year-averaged panel data for 73 countries, 1995–2014. The results show that government debt held by banks crowds out bank credit to the private sector dollar-for-dollar, and this is true of developing countries and high-income countries alike. This is consistent with domestic sovereign debt being placed with banks at market prices, and with banks managing their private credit with the aim of maintaining constant capital ratios.

In many developing countries, securities markets are thin and access to international funding is limited, so bank lending is the main conduit of financial intermediation. In this instance, domestic sovereign debt must be placed with banks, where it will displace bank lending to the private sector, constrict the already limited flow of funds to businesses, and crowd out private investment (Caballero and Krishnamurthy, 2004). Such a crowding-out effect of government borrowing has been shown to slow the economic growth of developing countries (Adam and Bevan, 2005), as this logic implies. In rich countries too, government bonds held by banks crowd out bank lending, but the alternative sources of funds in these countries, including domestic securities markets and external sources such as Euromarkets, prevent any constriction of private bank credit *per se* from much affecting their macroeconomic investment.

Concern about the harm from domestic sovereign debt crowding out bank credit to the private sectors of the developing countries has prompted empirical study. Several recent papers have estimated the extent of crowding out of bank lending by the domestic government bonds that banks in developing countries hold, including Kumhof and Tanner (2005), Emran and Farazi (2009), Hauner (2009), and Gray et al. (2014). A general finding of these authors is that in developing countries, domestic government bonds placed with banks crowd out bank loans by more than dollar-for-dollar—government bonds "super-crowd out" private credit by banks in developing countries. The common interpretation of this super-crowding out finding is that banks in developing countries that hold domestic government debt are "lazy." In other words, the safe return from holding government bonds enables the banks to shirk in their attentiveness to private lending. One may question this interpretation. A more straight-forward interpretation of super-crowding out is that the government bonds are placed with the banks at above-market price—an example of financial repression, a special tax levied on the banks—and the implied erosion of bank

equity caused by such a tax prompts the banks to retrench their assets. In any case, our estimates do not indicate super-crowding out of bank loans, but dollar-for-dollar crowding out. That is about what one would expect if the government bonds are placed with banks at market prices, that is, without financial repression, whether or not the banks are "lazy."

By the way, we do not dismiss the claim that banks are indeed lazy. But one of our aims in this paper is to clarify exactly what that might mean, by directly tying it to the distorted incentives of the managers of regulated firms, including banks, to dissipate any excessive pecuniary profit by indulging in nonpecuniary emoluments, as explained long ago by Alchian and Kessel (1962). Lack of diligence in extending private loans could be an example of managerial shirking in response to this sort of incentive. But for incentives to shirk to be exacerbated by a bank's holding of government bonds would seem to require that the bonds entail a subsidy rather than a tax.

In the rich countries, it is often suggested that banks wish to hold government bonds to lower their own costs of attaining the minimum capital ratios set by regulators. In the Basel formula, government bonds have a risk weight of zero, which means that banks that hold government bonds do not as a result of doing so face any regulatory mandate to retrench their holdings of other assets or augment their capital (i.e., bank equity). If a bank faces a binding constraint to attain such a minimum capital ratio, then its holding of government bonds entails an implicit subsidy, rather than a tax. By holding government bonds, the bank may avoid the need to rein in its otherwise profitable private lending. Under these circumstances, government bonds held by a bank would not crowd out its private lending dollar-for-dollar, but by something less than that. We find no evidence of this either. For both high-income countries and low-income countries, we find that government bonds crowd-out bank lending dollar-for-dollar, no more and no less. An increase in government bonds held by banks constricts bank loans to the private sector by an equal amount—each added dollar of bond holding by banks induces a decreased dollar of bank lending to the private sector.

2. Bank lending, bank laziness, and crowding out

2.1. Bank lending

Our aim is to measure how banks' holding of government bonds affects their private sector lending. The first step is to think about the main determinants of bank lending. The basic model we will use is one in which each bank adjusts its asset portfolio—including

loans and government bonds—to maintain a capital ratio (equity to assets) that minimizes its overall cost of capital. Modigliani and Miller (1958, and 1963) famously set out conditions under which a firm's cost of capital is unaffected by its capital ratio. A unique privately optimal capital ratio must be premised on deviation from those highly restrictive conditions, and that is the approach we will take here.

The Modigliani-Miller proposition applies to all firms including banks—intermediaries that accept deposits and issue credit (Miller, 1994). That is, if the composition of a bank's liabilities and equity entail no transaction costs, taxes, or subsidies, then such composition has no bearing on the bank's cost of capital. But, as with other firms, so it is with banks: The premise of the Modigliani-Miller proposition is false. It is false because there are agency costs of debt and equity, and because there are taxes and subsidies related to debt and equity. It is costly for depositors to ascertain the risk to which they are subject, and costly for bank stockholders to assure the safety of deposits. Greater bank equity means that bank stockholders themselves have more wealth at stake in the prudential management of bank assets, meaning that they are inclined to behave in ways that make the deposits safer. To just that extent, banks with greater equity will have a lower overall cost of capital—they are avoiding the higher costs associated with alternative ways of assuring the safety of deposits (Holmström and Tirole, 1997). On the other hand, government insurance of bank deposits typically entails a subsidy of the banks that accept or create such deposits. And so a bank with lower equity value and more deposits in relation to its assets may enjoy a lower private overall cost of capital. These considerations and others point to bank choice of a unique privately optimal capital structure (Exley and Smith, 2006). Let us set to one side the interesting question (addressed by Gropp and Heider, 2008) of how such a privately optimal bank capital structure might vary across countries and over time, depending on details of regulations and institutions, and depending on macroeconomic conditions, and assert that each commercial bank adjusts its asset portfolio—including loans and government bonds—so as to maintain a target capital structure.

The considerations just now related amount to a simple model of bank lending in which each bank aims to maintain a constant capital ratio, here defined as bank equity as a share of bank assets at risk, that is assets other than bank reserves (vault cash and deposits at the central bank). If bank assets at risk comprise both government bonds and loans, then the capital ratio is as follows (with all items understood to be stated at current market value).

$$Bank's\ Capital\ Ratio = \frac{\text{Equity}}{\text{Government Bonds} + \text{Loans}} \quad \text{..... [1]}$$

Rearranging, and presuming that loans do not affect bank equity directly (that is, the overall cost of capital depends on the capital ratio but not on the composition of the bank's assets), and that the bank seeks to maintain a target capital ratio so defined (and marked by an asterisk '*'), leads to a simple model of bank loan behavior.

$$\text{Loans} = \frac{\text{Equity}}{Capital\ Ratio^{*}} - \text{Government Bonds} \quad \text{..... [2]}$$

Here, government bonds on the balance sheets of banks crowd out their private credit (i.e., loans), dollar-for-dollar. This is our basic model, and the cross-country regression estimates we will present here—and which are the main content of this paper—generally support this model. But to understand contrary results reported in some previous literature, we need to place this loan equation in a slightly more general setting.

Consider the possibility that a bank's holding of government bonds affects its equity directly. The effect could be positive or negative. That is, government bonds could be placed with the bank at a below-market price and so entail a subsidy, or could be forced on the bank at an above-market price, a kind of tax. The market value of the bank's equity can be expressed as follows.

$$Equity = \text{Equity}_0 + \gamma\ \text{Government Bonds}, \quad \text{..... [3]}$$

where "Equity_0" is the bank's equity that is unrelated to and unaffected by its holding of government bonds rather than other assets. The parameter γ stands for the implicit tax or subsidy embodied in the placement of government bonds with banks at other than the market price, a tax if $\gamma < 0$, and a subsidy if $\gamma > 0$. Now there is an added effect on loans by a bank that holds government bonds and aims to maintain a constant target capital ratio.

$$\text{Loans} = \frac{\text{Equity}_0}{Capital\ Ratio^{*}} + \gamma \frac{\text{Government Bonds}}{Capital\ Ratio^{*}} - \text{Government Bonds} \quad \text{..... [4]}$$

The new term, $\gamma \frac{\text{Government Bonds}}{Capital\ Ratio^{*}}$, is positive or negative depending on whether government bonds increase bank equity or reduce it. If positive, then there will be less than dollar-for-dollar crowding out of bank loans by government bonds held by banks. If

negative, then there will be more than dollar-for-dollar crowding out of bank loans—'super crowding out.' Super crowding out is what Emran and Farazi (2009) claimed to find in a regression estimated for a panel of 60 developing countries, and asserted as evidence that banks in those countries are "lazy." Already we have a more straight-forward explanation of super-crowding-out of bank credit by the government bonds that these banks hold. It could just mean that the banks are holding the government bonds reluctantly, at the behest of governments; it is a kind of tax that reduces bank equity and thus induces the banks to constrict their total assets to maintain their target capital ratios. The banks that hold government bonds may not be behaving more lazily than other banks, but actually managing their asset portfolios as efficiently. In any case, what would lazy bank behavior mean, and how might it manifest itself?

2.2. Lazy banks

The root idea behind the lazy bank notion seems to be the old claim by Sir John Hicks (1935, p. 8) that "the best of all monopoly profits is a quiet life." In other words, a competitive firm cannot survive unless efficient, but a monopoly may do so, and to just that extent, the monopoly will be less diligent in pursuit of profit. But as further elaborated by Alchian and Kessel (1962), this presumes that there is an absence of competition to be the monopoly. If there is such competition—a perfectly competitive capital market in which firms themselves could be easily traded—then a monopoly and a competitive firm will face the same consequences of failure to maximize profit. Alchian and Kessel go on to argue that where a firm is a monopoly by dint of government protection of entry, then it will indeed face a different constraint than a perfect competitor. The price to the protected firm's managers of indulging in nonpecuniary emoluments is apt to be lower than its true marginal cost, simply because a higher pecuniary profit will invite withdrawal of the government protection. High pecuniary profit is a "no-no" for the government-protected firm, so the price to the managers of dissipating the profit within the firm itself in ways that are wasteful yet pleasing to themselves is lower than it otherwise would be, and the managers will indulge in just that. Banks in whatever country are a clear example of regulated firms protected from entry, precisely the sort of monopolies that Alchian and Kessel have in mind. A regulated bank (every bank) is 'lazy'—lax in its pursuit of pecuniary profit.

So where does holding of government bonds on the balance sheets of banks fit into this? If the government bonds entail a subsidy, that is the bonds are placed with the bank

at below-market price, then they add to the pecuniary profit of the bank, and the bank managers will tend to dissipate that profit by indulging in nonpecuniary emoluments that they value below the social cost. Inattention to the onerous efforts needed to manage private credit could well be one such indulgence. If that is true, then a bank that holds subsidized government bonds would lazily allow its private loans to fall below the level consonant with the value-maximizing capital ratio. We might represent the loans of a bank subject to this 'Alchian-Kessel' phenomenon as follows.

$$\text{Loans} = \frac{\text{Equity}_0}{\textit{Capital Ratio}^*} + (1-\lambda)\gamma\frac{\text{Government Bonds}}{\textit{Capital Ratio}^*} - \text{Government Bonds} \quad \text{..... [5]}$$

The parameter $\lambda \geq 0$ shows the Alchian-Kessel effect on a bank's private credit of any extraordinary changes in its equity resulting from its holding of government bonds placed at other than the market price, so that $\gamma \neq 0$. The Alchian-Kessel effect influences private credit by the bank in the opposite direction of that needed to maintain the target capital ratio. If the Alchian-Kessel effect is large enough, $\lambda > 1$, it dominates the effect on bank loan behavior of whatever implicit tax or subsidy is embodied in the placement of government bonds with banks.

Government bonds placed at below-market price, entailing a subsidy at the rate $\gamma > 0$ would super-crowd out private credit only if the Alchian-Kessel effect was very strong, so that $\lambda > 1$.

$$\frac{\Delta\text{Loans}}{\Delta\text{Govt Bonds}} = \frac{(1-\lambda)\gamma}{\textit{Capital Ratio}^*} - 1 \quad \text{..... [6]}$$

$$\begin{aligned} &< -1, \quad \text{if } \gamma > 0 \text{ and } \lambda > 1. \quad \textit{super crowding out} \\ &> -1, \quad \text{if } \gamma > 0 \text{ and } \lambda = 0. \quad \textit{less than complete crowding out} \end{aligned}$$

Maintaining a target capital ratio, one that presumptively minimizes the bank's cost of capital (consonant with $\lambda = 0$, no Alchian-Kessel effect), would imply less than complete crowding out by government bonds that entail a subsidy, not super-crowding out as would be implied by a strong Alchian-Kessel effect. This seems to be the Emran and Farazi (2009) line of argument. They find super-crowding out and take that as evidence of bank laziness—in the language we have adopted, a 'strong Alchian-Kessel effect.' But what if the government bonds are placed with the banks at above-market price—financial repression—rather than below-market price as Emran and Farazi apparently assumed?

If the government bonds entail a tax rather than a subsidy (so that $\gamma < 0$), then their forced placement on the bank balance sheet (at above-market price) would raise the price of laziness for the bank's managers. A lazy bank that reluctantly holds government bonds would expand its total asset portfolio. The government bonds would crowd out private credit incompletely, that is less than dollar-for-dollar—and in the presence of a very strong Alchian-Kessel effect, $\lambda > 1$, would even expand private credit. In the absence of any Alchian-Kessel effect, $\lambda = 0$, the bank would maintain a target capital ratio, which would mean shrinking its asset portfolio if it includes government bonds placed at above-market price, implying that the bonds super-crowd out the bank's private credit.

$$\frac{\Delta \text{Loans}}{\Delta \text{Govt Bonds}} = \frac{(1-\lambda)\gamma}{Capital\ \ Ratio^{*}} - 1 \quad \text{..... [7]}$$

$$\begin{aligned} &< -1, \qquad \text{if } \gamma < 0 \text{ and } \lambda = 0. \quad \textit{super crowding out} \\ &> -1, \qquad \text{if } \gamma < 0 \text{ and } \lambda > 1. \quad \textit{less than complete crowding out} \end{aligned}$$

It seems that to identify evidence of lazy bank behavior it is necessary to know whether government bonds are placed with banks at market price, below-market price, or above-market price. About the only result that would be completely neutral with respect to the lazy bank thesis is dollar-for-dollar crowding out of private credit by government bonds, and that is the result we find. It is consistent with government bonds placed with banks at market price, and so not affecting the price of "laziness" by the bank managers. Banks might be lazy—and based on the Alchian and Kessel (1962) argument presumably they are lazy—but their proclivity for laziness seems to be unaffected by the presence of government bonds on the bank balance sheets.

In the remaining sections of the paper, we estimate a cross-country regression relating private credit by banks to the banks' holdings of domestic sovereign debt. The principle aim is to determine whether government bonds placed with banks in developing countries super-crowd out the banks' private credit. We find that they do not. This result also relates to the question of whether government bonds placed with banks represent either a government subsidy of banks, or a special tax placed on banks—financial repression. It seems from our results that, averaged over a broad set of developing countries, government bonds held by banks entail neither a subsidy nor a tax.

3. Empirical Model

3.1. Estimating Equation

The estimating equation of this paper is derived from Eq. [5] above, repeated here.

$$\text{Loans} = \frac{\text{Equity}_0}{Capital\ \ Ratio^*} + (1-\lambda)\gamma \frac{\text{Govt Bonds}}{Capital\ \ Ratio^*} - \text{Govt Bonds} \quad \text{..... [5]}$$

This describes the loan behavior of a single bank, while the data for our estimating equation are aggregated by country. In aggregating the private sector loans of all banks, i, in a country, let us suppose that their target capital ratios are similar to those of one another (the target capital ratios presumably do vary across countries).

$$\sum_i \text{Loans}_i = \frac{\sum_i \text{Equity}_{0i}}{Capital\ \ Ratio^*} + (1-\lambda)\gamma \frac{\sum_i \text{Govt Bonds}_{\ i}}{Capital\ \ Ratio^*} - \sum_i \text{Govt Bonds}_{\ i} \quad \text{..... [8]}$$

For comparison of bank loan behavior across countries, j, let us scale variables in relation to GDP.

$$\frac{\sum_i \text{Loans}_{ij}}{GDP_j} = \frac{\sum_i \text{Equity}_{0ij} / Capital\ \ Ratio_j^*}{GDP_j} + (1-\lambda)\gamma \frac{\sum_i \text{Govt Bonds}_{\ ij} / Capital\ \ Ratio_j^*}{GDP_j} - \frac{\sum_i \text{Govt Bonds}_{\ ij}}{GDP_j} \quad \text{..... [9]}$$

This equation is the basis for our econometric analysis.

We will estimate a cross-country regression equation with ***Private bank loans as a percent of GDP*** as dependent variable and ***Government bonds held by banks as a percent of GDP*** as independent variable. Based on Eq. [9], we also include ***Government bonds held by banks relative to their target capital ratios, as a percent of GDP***.

Control variables in the regression include correlates of the first term in Eq. [9], $\frac{\sum_i \text{Equity}_{0ij} / Capital\ \ Ratio_j^*}{GDP_j}$, the amount of assets at risk as a percentage of GDP that banks as a group in each country j would seek to maintain, absent any extraordinary taxes or subsidies. These control variables are: ***the natural logarithm of Per-capita Real GDP, Bank deposits relative to GDP***, and an index of ***Institutional quality***. In the next section we describe all the variables and comment on why we chose them.

3.2. Data

The dataset is an unbalanced panel for 73 countries, averaged over four successive five-year periods, 1995–2014. It includes both high-income countries and developing countries. The list of countries, and the time periods in which variables are observed for each, are reported in the appendix Table A1. Our focus is on equilibrium relationships between government bonds held by banks and the private loans by banks, not on the short-run dynamics that led to such an equilibrium. Therefore, we have followed a standard procedure and averaged the variables over successive five-year intervals.

The names, units of measurement, and sources of all the variables are reported in Table 1. The sources include the World Bank World Development Indicators, International Country Risk Guide, and the World Bank Global Financial Development Database.

Table 1. Variable definitions and Data Sources

Variables	Description	Source*
Loans/ GDP	The financial resources provided to the private sector by domestic money banks as a percent of GDP. Domestic money banks comprise commercial banks and other financial institutions that accept transferable deposits, such as demand deposits.	WDI
Govt Bonds/ GDP	Credit by domestic money banks to the government and to state-owned enterprises as a percent of GDP.	GFDD
Capital/ Assets	Ratio of bank capital to bank total assets, expressed as a percent. Capital includes funds contributed by owners, retained earnings, and general and special reserves and provisions.	GFDD
ln Per-capita Real GDP	Natural logarithm of per capita Gross Domestic Product (constant 2010 US$).	WDI
Deposits/ GDP	Demand, time and saving deposits as a percent of GDP.	GFDD
Law and Order	Law and order are assessed separately, with each sub-component comprising zero to three points. The law sub-component is an assessment of the strength and impartiality of the legal system, while the order subcomponent is an assessment of popular observance of the law. The index varies from 0 to 6 and higher values represent better judicial systems.	International Country Risk Guide

*WDI - World Bank, World Development Indicators

GFDD - The Global Financial Development Database, World Bank

3.2.1. Private Credit

The dependent variable of the estimating equation is ***Bank loans/ GDP***, defined as credits to the private sector by domestic money banks as a percent of GDP.

3.2.2. Government credit

The first main explanatory variable of interest is ***Government Bonds/ GDP***, defined as credit by domestic money banks to government and state-owned enterprises as a percent of GDP. This study is focused on general government borrowing from commercial banks. To compute that, we follow Hauner (2009) and add together two items to capture the amount of commercial banks' holdings of debt issued by the entire public sector. They are credit extended by the domestic money banking system (1) to the general government,[1] and (2) to state-owned enterprises.

A second main variable of interest, related to the one just mentioned, is ***Government Bonds/ GDP ÷ Capital/Assets***, government bonds held by banks as a percent of GDP relative to their target capital ratios. In constructing this variable, we used as a proxy for the target capital ratios of banks in each country, in each five-year period, the ratio of commercial bank capital to bank total assets. Here 'capital' means bank equity as reported on the balance sheet.

3.2.3. Correlates of baseline bank assets as a percent of GDP

Here we describe our control variables related to the amount of assets at risk as a percentage of GDP that banks as a group in each country *j* would seek to maintain, absent any extraordinary taxes or subsidies.

As shown by Eq. [9], countries in which the target capital ratios of banks incline them as a group to hold more assets at risk as a percent of GDP, *ceteris paribus*, will have more private bank loans relative to GDP. This suggests the importance of control variables related to the baseline scale of the banking industry in each country. Countries differ from one another both in the extent to which financial intermediation is occurring at all, and also differ from one another in the share of total intermediation that is performed by banks rather than by other intermediaries. Bank assets as a percent of GDP thus reflect both the overall economic development of a country and the relative efficiency there of banks compared to other financial intermediaries.

Variables related to the overall economic development of each country, and to development of the financial system in particular, include the **natural logarithm of per-capita real GDP**, and a widely used measure of the quality of institutions—an index of the extent of **'law and order'** as judged by the International Country Risk Guide. The variable related to the relative efficiency of banks compared to other financial intermediaries is **Deposits/GDP**, defined as the ratio of bank deposits (demand + time + saving) to GDP,

expressed as percent.

We believe that all of these variables taken together are a reasonable proxy for the basic underlying extent of banking activity in relation to each country's GDP. Including the natural log of per-capita real GDP reflects the high correlation between development of the banking system and development of the economy. The other variables pick up factors that could affect the relative viability of banks, taking as given the scale of the economy itself. A country with better institutions is likely to have more financial intermediation, *ceteris paribus*. And a country with more bank deposits as a percent of GDP is likely to have more efficient banks.

3.2.4. Summary Statistics and Correlation Matrix

The descriptive statistics for each variable are displayed in Table 2 and the correlation matrices in Tables 3a and 3b.

Table 2. Means of variables and numbers of observations, by income class and period of observation.

	Obs	Loans/ GDP %	Govt Bonds/ GDP %	Per-Capita Real GDP 2010 USD	Law and Order index	Deposits/ GDP %	Capital/ Assets %	Govt Bonds/ GDP ÷ Capital/ Assets %
High income, 30 countries								
1995–99	25	54.8	11.7	24,158	5.2	55.3	8.6	174.3
2000–04	28	63.8	11.5	27,137	4.8	62.8	8.4	165.3
2005–09	28	74.0	10.4	30,382	4.7	70.6	8.4	151.9
2010–14	20	80.1	13.0	31,580	4.5	89.2	10.0	168.4
1995–2014	101	67.4	11.5	28,106	4.8	68.0	8.8	164.5
Developing, 43 countries								
1995–99	27	37.1	8.1	2,961	3.7	34.2	9.7	102.5
2000–04	38	33.0	9.7	3,362	3.1	35.4	10.5	129.7
2005–09	41	36.1	9.3	4,040	3.1	38.0	10.7	108.0
2010–14	38	41.2	11.2	4,160	3.0	41.1	10.9	119.0
1995–2014	144	36.8	9.7	3,691	3.2	37.4	10.5	115.6

Table 2 shows the means of each variable, separately for high-income countries and for developing countries, for each five-year interval and for the whole period of observation. It is evident from the table that financial intermediation by banks is substantially less in developing countries than in high-income ones, as shown by the smaller values of ***Loans/ GDP***, and ***Deposits/ GDP***. At the same time, the placement of government bonds with

banks relative to GDP—***Govt Bonds /GDP***—is only slightly less in the developing countries than in the high-income ones. Unsurprisingly, developing countries have substantially lower ***Per-Capita Real GDP*** than the high-income countries, and worse legal systems as shown by the ***Law and Order*** index. All of the variables show monotonic trends consonant with increasing income per person, with some exceptions: In the high-income countries, bank ***Capital /Assets*** ratios were lower in the intervals 2000–09 than in 1995–99, possibly reflecting the Lehman shock. And in the developing countries, ***Loans /GDP*** were lower in the interval 2000–04 than in 1995–99, possibly reflecting the Asian financial crisis of 1998.

The Tables 3a and 3b correlation matrices show that many of the variables are statistically correlated with one another, some more strongly than others. ***Loans/ GDP*** is negatively correlated with bank ***Capital /Assets*** ratios, positively correlated with the ***Law and Order*** index, with the natural log of ***per-capita real GDP***, and with ***Deposits/ GDP***. This comports with our rationale for including these variables, as explained above. To put it another way, variables presumptively related to the scale of the banking sector are correlated with loans to the private sector by banks as a percent of GDP.

Government Bonds/ GDP is positively correlated with ***Loans/ GDP***, which is perhaps because governments borrow more from banks in countries where the scale of the banking sector is itself large. Where the banking sector of a country is large, its banks make more private loans and also hold more government bonds. To measure the crowding out of private credit caused by government borrowing from domestic banks will require not just

Table 3a. Correlation coefficients. High-income countries.*

	Loans/ GDP	Govt Bonds/ GDP	Govt Bonds/ GDP ÷ Capital/ Assets	ln Per-Capita Real GDP	Per-Capita Real GDP	Law and Order	Deposits/ GDP
Govt Bonds/ GDP	**0.307**						
	0.002						
Govt Bonds/ GDP ÷ Capital/ Assets	**0.384**	**0.899**					
	0.000	0.000					
ln Per-Capita Real GDP	**0.673**	**0.199**	**0.254**				
	0.000	0.046	0.011				
Per-Capita Real GDP	**0.601**	**0.140**	**0.207**	**0.952**			
	0.000	0.162	0.038	0.000			
Law and Order	**0.547**	**0.101**	**0.158**	**0.651**	**0.607**		
	0.000	0.316	0.114	0.000	0.000		
Deposits/GDP	**0.782**	**0.637**	**0.631**	**0.519**	**0.422**	**0.331**	
	0.000	0.000	0.000	0.000	0.000	0.001	
Capital/Assets	**–0.393**	**–0.140**	**–0.365**	**–0.344**	**–0.352**	**–0.357**	**–0.258**
	0.000	0.162	0.000	0.000	0.000	0.000	0.009

*p-values below coefficients. Number of observations = 101 for all.

Table 3b. Correlation coefficients. Developing countries.*

	Loans/ GDP	Govt Bonds/ GDP	Govt Bonds/ GDP ÷ Capital/ Assets	ln Per-Capita Real GDP	Per-Capita Real GDP	Law and Order	Deposits/ GDP
Govt Bonds/ GDP	**0.152**						
	0.069						
Govt Bonds/ GDP ÷ Capital/ Assets	**0.160**	**0.896**					
	0.055	0.000					
ln Per-Capita Real GDP	**0.313**	**0.109**	**–0.006**				
	0.000	0.195	0.940				
Per-Capita Real GDP	**0.252**	**0.149**	**0.007**	**0.909**			
	0.002	0.074	0.932	0.000			
Law and Order	**0.254**	**–0.039**	**0.000**	**–0.095**	**–0.123**		
	0.002	0.643	0.997	0.256	0.142		
Deposits/GDP	**0.765**	**0.469**	**0.447**	**0.267**	**0.217**	**0.149**	
	0.000	0.000	0.000	0.001	0.009	0.076	
Capital/Assets	**–0.294**	**–0.299**	**–0.509**	**0.046**	**0.028**	**0.039**	**–0.354**
	0.000	0.000	0.000	0.588	0.742	0.643	0.000

*p-values below coefficients. Number of observations = 144 for all.

correlation, but multiple regression.

The extremely high correlation between ***Government Bonds/ GDP*** and ***Government Bonds/ GDP ÷ Capital/Assets***—around 0.9 both for high-income countries and developing countries—is unsurprising but has an important implication for our analysis. Because the two variables are collinear, it will be difficult to precisely measure the separate effects of each of them on the ***Loans/ GDP*** ratios. We will follow two strategies to overcome this. The first is to test their joint effect on ***Loans/ GDP***, not just their individual effects. The second is to assert prior knowledge based on our reasoning that the linear coefficient on ***Government Bonds/ GDP*** in an equation explaining ***Loans/ GDP*** is minus one, in order to more precisely estimate the coefficient on ***Government Bonds/ GDP ÷ Capital/Assets***.

4. Econometric model

This section presents regression estimates of the crowding out of private credit caused by government borrowing from the domestic banking sector. Sequential five-year averages of the underlying annual panel data, for 1995–2014, are used, which gives a maximum of four observations per country, t = 1, .., 4. As shown in appendix Table A1, the dataset is an unbalanced panel. The whole sample has data for 73 countries, j = 1, .., 73. Of these, 30 are high-income counties and 43 are developing countries.

Our estimating equation is based directly on Eq. [9], but with a stochastic error term, u_{jt}, and observable variables replacing the theoretical ones.

$$\frac{\sum_i \text{Loans}_{ij}}{GDP_j} = -\frac{\sum_i \text{Govt Bonds}_{ij}}{GDP_j} + (1-\lambda)\gamma \frac{\sum_i \text{Govt Bonds}_{ij} / Capital\ \ Ratio_j^*}{GDP_j} + \frac{\sum_i \text{Equity}_{0ij} / Capital\ \ Ratio_j^*}{GDP_j} \quad \text{..... [9']}$$

$$\frac{Loans}{GDP} = \beta_1 \frac{Govt\ \ Bonds}{GDP} + \beta_2 \frac{Govt\ \ Bonds / GDP}{Capital / Assets} + \beta_0 + \beta_3 \ln \begin{matrix} per\ capita \\ Real\ GDP \end{matrix} + \beta_4 \begin{matrix} Law\ and \\ Order \end{matrix} + \beta_5 \frac{Deposits}{GDP} + u_{jt} \quad \text{..... [10]}$$

The parameters to be estimated are β_0, ... β_5. Based on Eq. [9], we might expect that in Eq. [10], $\beta_1 = -1$ and $\beta_2 = (1 - \lambda)\gamma$. The other parameters in Eq. [10] map the variables ***In Per Capita Real GDP, Law and Order*** and ***Deposits/GDP*** onto the latent variable $\frac{\sum_i \text{Equity}_{0ij} / Capital\ \ Ratio_j^*}{GDP_j}$.

We next need to consider the properties of the error term in Eq. [10]. We will adopt a one-way random-effects specification. We will suppose that the error term has two parts, one that varies across countries in our dataset and the other that varies both across countries and over time in each country.

$$u_{jt} = v_j + e_{jt}. \quad \text{..... [11]}$$

We further suppose that both components of the error term are each identically independently distributed, have a zero mean, and have a zero covariance both with each other and with the observed variables included in the regression. Under this specification, based on the Gauss-Markov theorem, the efficient estimator is the GLS estimator with weights constructed from the sample variance in each component of the regression error term. We have two reasons for adopting this specification.

First, the coefficient $\beta_2 = (1 - \lambda)\gamma$ can be reasonably considered to itself vary across observations. The parameter stands for the implicit tax or subsidy embodied in the placement of government bonds with banks at other than the market price. If, as we suppose, such parameter is statistically independent of the observed explanatory variables, then its random effects are well-represented by the specification of the error term shown in Eq. [11].

Second, the Hausman specification test—shown in the last rows of Table 4—establishes the preferability of the one-way random-effects specification over a one-way fixed-effects specification. The upshot of the test is that the estimated coefficients differ little between the fixed-effects and random-effects estimates, meaning that the greater efficiency of the random-effects estimator outweighs the possible bias that results from not controlling for 'fixed effects'—unobserved variables that do not vary over the period of observation.

4.1. Results

The result of random-effects estimation are displayed in the leftward columns of Table 4. The standard errors are displayed below each coefficient estimate. The *p*-value for the χ^2-test of difference from −1 of the coefficient on ***Govt Bonds /GDP*** is displayed beneath the point estimate. Also displayed is the *p*-value for the χ^2-test of difference from −1 of the

Table 4. Random-effects regression estimates. Dependent variable= Loans/GDP.*

	High–income countries	Developing countries		High–income countries	Developing countries
Govt Bonds/ GDP	**–1.606** (0.452)	**–0.570** (0.315)	# **Constrained:**	**–1.000** ———	**–1.000** ———
# H_0: (Govt Bonds/ GDP = −1) χ^2 (1) Prob > χ^2	 1.80 0.180	 2.07 0.150	# *p*-value	0.193	0.178
Govt Bonds/ GDP ÷ Capital/ Assets	**0.054** (0.028)	**0.002** (0.020)			
# H_0: (Govt Bonds/ GDP + Govt Bonds/ GDP ÷ Cap/Assets = −1) χ^2 (1) Prob > χ^2	 1.65 0.199	 2.07 0.150	# *p*-value:	**0.024** (0.017) 0.176	**0.022** (0.014) 0.116
ln Per-Capita Real GDP	**15.928** (5.892)	**5.978** (2.684)		**16.413** (5.730)	**6.373** (2.653)
Law and Order	**5.707** (3.131)	**5.118** (1.470)		**6.216** (3.115)	**4.963** (1.471)
Deposits/GDP	**0.603** (0.088)	**0.923** (0.094)		**0.583** (0.084)	**0.951** (0.092)
Constant	**–150.781** (52.816)	**–56.560** (21.815)		**–158.613** (50.677)	**–58.404** (21.676)
Adjusted R^2	0.607	0.540		0.613	0.534
$\rho = \sigma_v^2/(\sigma_v^2 + \sigma_e^2)$	0.507	0.811		0.470	0.805
Observations Countries	101 30	144 43		101 30	144 43
Hausman test: χ^2 (5) Prob > χ^2	9.99 0.076	3.56 0.615		4.51 0.341	3.27 0.514

*Coefficient estimates in bold type. Standard errors in parentheses below coefficient estimates.

summed coefficients on ***Govt Bonds /GDP*** and ***Government Bonds/ GDP ÷ Capital/Assets***. The *p*-values for both tests show absence of statistical significance, both for high-income countries and for developing countries. Because of the collinearity between ***Govt Bonds / GDP*** and ***Government Bonds/ GDP ÷ Capital/Assets***, the test of their joint effect on ***Loans/ GDP*** is of particular interest and the *p*-values for the difference from −1 of their joint effect are 0.20 for high-income countries and 0.15 for developing countries, both indicating absence of statistical significance by the conventional standard. The hypothesis that government bonds held by banks crowd out private credit by banks, dollar-for-dollar, is not rejected by the data. This is our main finding. The data do not support the notion that government bonds are in general placed with banks at prices uniformly either below the market level, or above it. Neither for high-income countries, nor developing countries. There is no support here for the view that government bonds held by banks either worsen or relax the incentives of a preponderance of bank managers to wastefully divert pecuniary profit to nonpecuniary emoluments.

Collinearity impedes our precisely estimating the separate coefficients on ***Govt Bonds /GDP*** and ***Government Bonds/ GDP ÷ Capital/Assets***. Nevertheless, as we have already noted, the data fail to reject the null hypothesis, implied by our model, that the coefficient on ***Govt Bonds /GDP*** equals −1. The *p*-values shown in Table 4 are 0.18 for the high-income countries and 0.15 for the developing countries. By asserting prior knowledge based on our reasoning that the true coefficient is indeed −1, and imposing that as a constraint, we may more precisely estimate the coefficient on ***Government Bonds/ GDP ÷ Capital/Assets***. These estimates are displayed in the rightward columns of Table 4. As can be seen there, the estimated coefficient on ***Government Bonds/ GDP ÷ Capital/Assets*** exhibits no statistically significant deviance from zero, neither for the high-income countries nor the developing countries. The standard errors of the estimated coefficients and *p*-values are displayed below the coefficients on this variable. Notice that the *p*-value of the coefficient estimate for the high-income countries is 0.18 and for developing countries is 0.12. There is no support here for $\beta_2 = (1 - \lambda)\gamma \neq 0$ for the high-income countries nor for the developing countries—no systematic pattern of placement of government debt with banks at prices uniformly either below the market level, or above it.

All of the regressions we have just described and that are reported in Table 4 are estimated using one-way random effects. In the last row of the Table we report the results of the Hausman test for which the null hypothesis is that of no difference in the coefficients estimated using the random effects specification and those estimated using a fixed-effects

specification. For the estimates with ***Govt Bonds /GDP*** set equal to –1, the *p*-value for the Hausman test is 0.34 for the high-income countries and 0.51 for the developing countries, which fail to reject the null hypothesis and lead us to favor the greater efficiency of the random-effects estimate over the unbiasedness of the fixed-effect estimate. We also report the Hausman test results for the unconstrained regressions (which afford less support for random-effects estimates for the high-income countries). We think the constrained regressions have the least biased coefficients.

The coefficients on the control variables have the expected signs and are statistically significant in all the regressions. To interpret these coefficients, note that the ***Loans/ GDP*** ratios of the developing countries in our sample are on average about half as great as for the high-income countries—in the most recent period 2010–14, around 40 pct compared to 80 pct. The average per-capita real GDP of developing countries in our sample is around $1/8^{th}$ that of the high-income countries. Based on the estimated coefficients on ***In Per Capita Real GDP*** which are around 6 for the developing country sub-sample, per-capita real GDP explains pretty much all of the average difference in ***Loans/ GDP*** between the developing countries and high-income countries.

The ***Law and Order*** index averages near 3 for the developing countries, and between 4 and 5 for the high-income countries. Based on the estimated coefficients on ***Law and Order*** which are around 5 for the developing countries, an increase in the index by one unit in the developing countries would increase their ***Loans/ GDP*** by around 5 percentage points which is only a small portion of the 40 percentage point average difference in ***Loans/ GDP*** between developing countries and high-income ones.

Deposits/ GDP are about half as great in developing countries as in high-income ones—45 pct compared to 90 pct. Based on our estimated coefficient on ***Deposits/ GDP*** which is about 0.9 for the developing country sub-sample, a doubling of the bank deposits of developing countries would increase their ***Loans/ GDP*** ratio by about 40 percentage points, closing the 40 percentage point difference in ***Loans/ GDP*** between developing and high-income countries. Finally, the overall goodness-of-fit of the regressions is quite good as judged by the adjusted R^2.

4.2. Robustness check

As a check on our findings we report in Table 5 the result of estimating our model using only the mean values of each variable for each country—a ‘between-effects’ OLS regression. This is the regression equation from which were extracted the sample variances

of error terms that were used to weight observations in the random-effects regressions shown in the last two columns of Table 4. In the between-effects regression of Table 5, the numbers of observations equal the numbers of countries. The regression is estimated with the restriction that the coefficient on ***Govt Bonds /GDP*** is set equal to –1. The *p*-values for the test of this restriction are 0.711 for the high-income countries and 0.998 for the developing countries—failure to reject the null hypothesis that the restriction is true, indicating that the restriction is consonant with the data for which the equation is estimated. Furthermore, the coefficient on ***Government Bonds/ GDP ÷ Capital/Assets*** exhibits no statistically significant deviance from zero. Its *p*-value is 0.510 for the high-income countries and 0.700 for the developing countries. The control variables have the same signs as in the random-effects regression but with larger standard errors. The coefficient on ***In Per Capita Real GDP*** is not statistically significant. ***Law and Order*** is statistically significant for the high-income countries but not for the developing countries. Nevertheless, the adjusted R^2 of 0.88 for the high-income countries and 0.637 for the developing countries show the goodness of fit of the equation. These results strengthen our confidence in thinking that government bonds placed with banks, on average across the broad spectrum of countries, crowd out bank loans to the private sector approximately dollar-for-dollar.

Table 5. Between-effects regression estimates. Dependent variable= Loans/GDP.*

		High–income countries	Developing countries
Govt Bonds/ GDP	# Constrained:	**–1.000**	**–1.000**
# H_0: (Govt Bonds/ GDP = –1)	# *p*-value	0.711	0.998
Govt Bonds/ GDP ÷ Capital/ Assets	# *p*-value:	**0.013** (0.020) 0.510	**0.010** (0.026) 0.700
In Per-Capita Real GDP		**8.526** (7.650)	**3.465** (3.283)
Law and Order		**11.187** (5.675)	**3.835** (2.919)
Deposits/GDP		**0.624** (0.097)	**0.945** (0.136)
Constant		**–105.039** (97.735)	**–30.203** (28.104)
Adjusted R^2		0.833	0.637
Observations Countries		30 30	43 43

*Coefficient estimates in bold type. Standartd errors below coefficient estimates.

5. Conclusion

The possible crowding out of private credit by government borrowing from the domestic banking sector, and its negative effects on private investment, are widely discussed in the economic development literature. This study offers new cross-country estimates of the crowding out of bank loans to the private sector caused by government borrowing from banks. The estimates cannot reject the hypothesis that government borrowing from domestic banks, on average, crowds out the banks' credit to the private sector, dollar-for-dollar. This holds for developing countries and for high-income countries.

Concern about the possible adverse effects of excessive government borrowing from domestic banks in developing countries has congealed around the 'lazy bank' thesis. This is the notion that government borrowing from banks may weaken the incentives of the banks to properly attend to their private sector lending. One contribution of this paper has been to clarify the precise logic underlying the lazy bank thesis. We have argued that it reprises the Alchian and Kessel (1962) claim that regulated firms face an implicit or *de facto* maximum profit constraint. If pecuniary profit of such a regulated firm threatens to become too large, the managers of the firm will have an enhanced incentive to wastefully divert the pecuniary profit to nonpecuniary emoluments that they value less than the cost. If government bonds are placed with private, regulated banks at below-market prices, and so entail a subsidy, they boost the pecuniary profit of the banks and so will trigger such an effect. This is the essence of the lazy bank thesis.

Here, we have adopted the view that each bank has a target capital ratio—a ratio of equity to assets at risk that attains a minimum cost of capital to the bank, unrelated to the composition of its assets. In this view, government bonds that are placed with banks at market prices have no effect on bank equity, and so would displace bank loans to the private sector, dollar-for-dollar. Our estimates are consistent with this situation. The lazy bank behavior would manifest itself only if government bonds were placed with banks at below- (or above-) market prices, and so affect the bank equity, and alter the incentive to divert pecuniary profit to nonpecuniary emoluments. For example, if government bonds were placed with banks at below-market prices, and the Alchian-Kessel effect was very strong, the banks would constrict their private loans by more than the increase in government bond-holdings.

The study highlights an issue which has not been fully studied, how bank loan behavior responds to government subsidy. This paper finds that banks behave as though

the government bonds they hold have no positive or negative effect on their equity. This is based on a straightforward model in which each bank adjusts its asset portfolio to maintain a constant capital ratio. If government bonds crowd out dollar-for-dollar the private loans of banks that maintain constant target capital ratios, then the banks are behaving as though the government bonds they hold entail neither a subsidy nor a tax. And that is precisely what we found.

The model of bank asset-holding presented here may have application beyond the analysis of effects of government bonds on bank balance sheets. The Fed, the Bank of Japan and the European Central Bank have all now set interest rates that they pay on commercial bank excess reserves. By adjusting that rate, a central bank effects either a subsidy or a tax on the portion of commercial bank assets held as excess reserves. If the interest rate is negative, as it has been in the US and in Japan, it is a tax on bank reserves. One effect on bank loan behavior of changes in the interest rate on excess reserves occurs because of the changes in bank equity such interest rate adjustments induce. That is the same channel by which government bonds held by banks can affect their loan behavior as modeled here.

Our model, in which banks have optimal capital ratios that influence their asset-holding, can be applied to the analysis of the effects on bank behavior of changes in the interest rate on reserves. Ours is perhaps the simplest model for representing such a channel of central bank monetary control, and variants of it have already appeared in the literature. For example, Gertler and Kiyotaki (2010) advance an argument in which banks have optimal capital ratios because increased bank equity weakens the price to bank managers of diverting funds, which raises the cost of external funds and constrains bank lending. Bank profits replace external funds and relax this constraint. Eggertsson et al. (2017) develop this model still further, in a New-Keynesian model of a macroeconomy, and show that lower bank profits increase banks' financing costs, thereby reducing credit supply. Gambacorta and Shin (2018) show that for a sample of major international banks in high-income countries, bank assets do indeed move in proportion to the market value of bank equity.

We found that for a broad cross-section of countries, including both high-income countries and developing countries, aggregate bank assets at risk are little affected by the banks' holdings of government bonds. The most straightforward interpretation is that the bonds neither add much to the banks' equity, nor subtract from it.

Notes

1 General government includes all levels of government and extra budgetary funds, but not central banks.

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Appendix.

Table A1. Unbalanced panel dataset.

High-income countries (30)

Country	Income group	1995–99	2000–04	2005–09	2010–14
Argentina	1	ARG	ARG	ARG	ARG
Australia	1	AUS	AUS	AUS	AUS
Brunei Darussalam	1			BRN	BRN
Canada	1	CAN	CAN	CAN	
Switzerland	1	CHE	CHE	CHE	CHE
Chile	1	CHL	CHL	CHL	CHL
Czech Republic	1	CZE	CZE	CZE	
Denmark	1	DNK	DNK		
Estonia	1	EST	EST		
Hong Kong SAR, China	1	HKG	HKG	HKG	HKG
Croatia	1	HRV	HRV	HRV	HRV
Hungary	1	HUN	HUN	HUN	
Iceland	1	ISL	ISL	ISL	ISL
Israel	1	ISR	ISR	ISR	ISR
Japan	1	JPN	JPN	JPN	JPN
Korea, Rep.	1	KOR	KOR	KOR	KOR
Kuwait	1	KWT	KWT	KWT	KWT
Lithuania	1	LTU	LTU	LTU	
Latvia	1	LVA	LVA	LVA	
Norway	1	NOR	NOR	NOR	
New Zealand	1			NZL	NZL
Oman	1		OMN	OMN	OMN
Poland	1	POL	POL	POL	
Russian Federation	1	RUS	RUS	RUS	RUS
Singapore	1	SGP	SGP	SGP	SGP
Slovak Republic	1	SVK	SVK	SVK	
Sweden	1		SWE	SWE	
Uruguay	1	URY	URY	URY	URY
United States	1	USA	USA	USA	USA
Venezuela, RB	1	VEN	VEN	VEN	VEN

Table A1. (cont'd)

Developing countries (43)

(Income group 2= 'low income,' and Income group 3= 'middle income' as defined by the World Bank. Here, both are categorized as developing countries)

Country	Income group	1995–99	2000–04	2005–09	2010–14
Albania	2		ALB	ALB	ALB
Armenia	2	ARM	ARM	ARM	ARM
Azerbaijan	2			AZE	AZE
Bangladesh	2	BGD	BGD		BGD
Bulgaria	2	BGR	BGR	BGR	
Belarus	2		BLR	BLR	BLR
Bolivia	2	BOL	BOL	BOL	BOL
Brazil	2	BRA	BRA	BRA	BRA
China	2	CHN	CHN	CHN	CHN
Colombia	2	COL	COL	COL	COL
Costa Rica	2	CRI	CRI	CRI	CRI
Dominican Republic	2	DOM	DOM	DOM	DOM
Algeria	2			DZA	DZA
Ecuador	2	ECU	ECU	ECU	
Egypt, Arab Rep.	2	EGY	EGY	EGY	EGY
Gabon	2		GAB	GAB	
Guatemala	2		GTM	GTM	GTM
Honduras	2	HND	HND	HND	HND
Indonesia	2		IDN	IDN	IDN
India	2	IND	IND	IND	IND
Jordan	2	JOR	JOR	JOR	JOR
Kenya	2	KEN	KEN	KEN	KEN
Morocco	2	MAR	MAR	MAR	
Moldova	2		MDA	MDA	MDA
Mexico	2	MEX	MEX	MEX	MEX
Mozambique	3		MOZ	MOZ	MOZ
Malaysia	2	MYS	MYS	MYS	MYS
Namibia	2		NAM	NAM	NAM
Nigeria	2	NGA	NGA	NGA	NGA
Panama	2		PAN	PAN	
Peru	2	PER	PER	PER	PER
Philippines	2	PHL	PHL	PHL	PHL
Paraguay	2	PRY	PRY	PRY	PRY
Romania	2		ROM	ROM	ROM

Country	Income group	1995–99	2000–04	2005–09	2010–14
Sierra Leone	3		SLE	SLE	SLE
Serbia	2		SRB	SRB	SRB
Thailand	2	THA	THA	THA	THA
Tanzania	3	TZA			TZA
Uganda	3	UGA	UGA	UGA	UGA
Ukraine	2	UKR	UKR	UKR	UKR
Vietnam	2			VNM	VNM
Yemen, Rep.	2			YEM	YEM
South Africa	2	ZAF	ZAF	ZAF	ZAF