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Private sector financing: linear and quadratic effects of domestic public debt on bank credit supply

Sana Zouari

University Côte d'Azur, INSTAR, France - University of Sfax, LED, Tunisia

Dhafer Saidane

*SKEMA Business School - University Côte d'Azur,
France*

Foued Badr Gabsi

*Faculty of Economics and Management of Sfax,
University of Sfax, Tunisia*

Abstract

This paper investigates the impact of domestic public debt on credit supply to the private sector using a panel of 19 banks operating in the Arab Maghreb region over the period 2005-2018. The results confirm the existence of both linear and quadratic effects of domestic public debt on credit supply to the private sector. The estimated threshold found to be around 9.77 % of total assets. The regression results are robust across two alternative specifications excluding public banks and taking into consideration the impact of the Arab Spring on credit supply to the private sector for different levels of domestic public debt.

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Contact: Sana Zouari - sana.zouari93@gmail.com, Dhafer Saidane - Dhafer.SAIDANE@skema.edu, Foued Badr Gabsi - foued.gabsi@fsegs.mu.tn.

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Overall, these studies tend to confirm the crowding out effect of government borrowing on credit to the private sector, and they do not provide an explication to the possible non-linearity in the domestic public debt-credit to the private sector relationship. One exception to this is Benayed and Gabsi (2020) who present empirical evidence on the existence of an inverted-U relationship between domestic public debt and financial development in low-income Sub-Saharan African countries. The non-linear relationship is identified at a macroeconomic level and the estimated threshold is relative to GDP. For this reason, we attempt to provide an explanation to the possible non-linearity in the domestic public debt-credit supply to the private sector relationship by estimating a threshold in relation to total assets of banks. As domestic public debt is included as a bank-specific factor of the supply of credit to the private sector, the estimated threshold allows us to identify the optimal level of domestic public debt that encourage the banking sector to take on more risk and thus increase lending to the risky private sector. To the best of our knowledge, this paper represents a pioneering study identifying the threshold beyond which domestic public debt held only by private banks turns detrimental to credit supply to the private sector and considering the impact of the Arab Spring on credit supply to the private sector for different levels of domestic public debt.

To this end, we estimate a dynamic panel model for a sample of 19 banks operating in the Arab Maghreb region over the period 2005-2018 using the difference-GMM estimator of Arellano and Bond (1991). Our empirical results provide strong evidence of an inverted-U shape relationship between domestic public debt and credit supply to the private sector. More precisely, below the estimated threshold, domestic public debt is positively associated with credit supply to the private sector. However, beyond this threshold, the relationship between domestic public debt and credit supply to the private sector becomes negative. These findings are robust across two alternative specifications.

The remainder of this paper is organized as follows. Section 2 provides a brief literature review on the links between domestic public debt and credit to the private sector. Section 3 introduces the data and the empirical methodology. Section 4 discusses the regression results. In Section 5, we test robustness. Finally, section 6 concludes.

2. Literature review

Existing literature with respect to the domestic public debt-credit to the private sector nexus show that most studies have investigated the linear effect of domestic public debt on credit to the private sector and overall, they tend to confirm the crowding out effect of domestic public debt on credit to the private sector. In support of this view, Emran and Farazi (2009) in a panel of 60 developing countries for the period 1975–2006 find that domestic public debt has significantly crowded out private sector lending. The results indicate that a one US dollar increase in domestic debt results in a 1.34 US dollar reduction in private sector credit. This evidence is in line with that of Christenes (2004) who finds that an expansion in domestic public debt of 1 percent relative to broad money reduces the ratio of lending to the private sector to broad money by about 0.15 percent in a sample of 27 Sub-Saharan African countries, for the period 1980-2000. These results are in line also with Shetta and Kamaly (2014) who use the structural vector autoregressive technique to test the relationship between government debt and credit to the private sector in Egypt over 1970-2009. They find that a persistence increase in government domestic borrowing decreases the amount of credit given to the private sector. Nevertheless, Maana et al. (2008) reject the crowding out hypothesis in Kenya as the study finds no evidence that the growth in domestic debt crowds-out private sector lending for the period 1996–2007. They attribute this to the high levels of financial development. Another stand of literature postulates that holding safe government securities could encourage the

banking system to take on more risk and thus increase lending to the risky private sector. According to this view, Kutivadze (2011) investigates the relation between public debt and financial development in countries grouped by income levels for the period 1994 to 2007. The results confirm that domestic debt positively correlates with the level of financial development. Finally, only Benayed and Gabsi (2020) investigate the potential non-linear relationship between domestic public debt and financial development at a macroeconomic level. For a panel of 20 Sub-Saharan African countries and a sample period of 2000-2010, their results provide empirical evidence on the existence of an inverted-U relationship between domestic public debt and financial development with a threshold of about 52 % of GDP.

This paper contributes to the existing literature by empirically estimating domestic public debt threshold at a microeconomic level as the estimated threshold is relative to total assets of banks. This allows us to identify the optimal level of domestic public debt that encourages banks from supplying credit to the risky private sector and would fulfill their mission of financial intermediaries. Surprisingly, the literature studying the relationship between domestic public debt and credit supply to the private sector in the Arab Maghreb region is conspicuously absent. So, this paper is one of the first to attempt to fill the gap in this field.

3. Data and empirical methodology

3.1 Data

The data set used spans the period 2005-2018 covering the economic conjuncture related to the Arab Spring. The sample includes a panel of 19 banks operating in the Arab Maghreb countries, namely Tunisia, Morocco, and Algeria (See Appendix for the bank list). The choice of countries and banks rests on the availability of data. The use of annual data is essentially due to unavailability of quarterly data, particularly for institutional variables. Table 6 in Appendix contains a detailed description of the sources of all the variables used in the empirical analysis.

Besides domestic public debt (*Debt*), we include bank liquidity (*Liquidity*) and bank profitability (*ROAA*) as two others bank specific factors determining the supply of credit to the private sector (*Credit*). *Liquidity* and *ROAA* are envisaged to have a positive effect on *Credit*. More liquid banks can relatively easily protect its loan portfolio and expand their supply of credit to the private sector (Kashyap and Stein, 2000). Similarly, a high profits of banking systems and banks' strong appetite for risk would cause a substantial increase in the domestic credit supply (Gunjy and Yuan, 2010). Institutional environment is examined through the introduction of two pertinent institutional variables, namely corruption perception index (*Corruption*), and political stability and absence of violence/terrorism index (*Political Stability*). *Corruption* is an abuse of entrusted public power for private benefits and represents an important social, political, and economic issue. It constitutes an alarming obstacle in the good allocation and mobilization of financial resources (Swaleheen, 2008). *Political stability* measures perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including terrorism. A country's political stability determines her willingness and capacity to build and maintain property and investor protection institutions. It constitutes a robust predictor of financial development (Ashraf, 2017). The macroeconomic environment is analyzed by several variables that influence the supply of credit to the private sector. We employ log nominal GDP per capita (*LGDPk*) that is widely accepted measure of economic development in the literature. During period of high economic growth, there are more funds available in the form of savings. This will urge banks to be more incentivized to offer more credit because deposits are more likely to increase (Vo, 2018). The macroeconomic variable set also includes broad money growth annual % (*M2*) and money market rate as a proxy to lending rate (*Lending rate*). These variables are often used in the

financial development literature as indicators of the depth and the efficiency of the banking sector (Barth et al., 2004).

Table 7 (in Appendix) reports the descriptive statistics of the variables employed in this paper over the sample period. With regards to the behavior of our variables of interest, the mean of *Debt* for the sample is 5.6 percent annually, while the mean of *Credit* for the sample is 66.2 percent of the total value of the bank's assets. Interestingly, the overall standard deviation of *Credit* reveals heterogeneity in the levels of credit supply to the private sector provided by Maghreb banks.

The matrix of correlation coefficients between variables employed in the analysis is shown in Table 8 (in Appendix). All the correlation coefficients are less than 0.8 thereby, confirming there is no problem of multicollinearity in regression estimation.

3.2 Empirical methodology

Using this broad and detailed data set, we investigate the linear effect of domestic public debt on credit supply to the private sector by estimating the following dynamic model:

$$Credit_{it} = \phi Credit_{it-1} + \alpha Debt_{it} + \gamma Specific_{it} + \delta Institutionnal_{it} + \varphi Macroeconomic_{it} + \varepsilon_{it} \quad (1)$$

Where *Credit_{it}* represents the supply of credit to the private sector as a percentage of total assets of bank *i* in period *t*; *Debt_{it}* is the ratio of treasury bills as a percentage of total assets; *Specific_{it}*, *Institutionnal_{it}*, *Macroeconomic_{it}* are vectors of specific, institutional and macroeconomic explanatory variables, respectively, and ε_{it} is the error term.

As discussed above, we acknowledge the possible non-linear relationship between domestic public debt and credit supply to the private sector. Thus, to capture this non-linearity, we include a squared term of domestic public debt in Eq. (1):

$$Credit_{it} = \phi Credit_{it-1} + \alpha Debt_{it} + \beta Debt_{it}^2 + \gamma Specific_{it} + \delta Institutionnal_{it} + \varphi Macroeconomic_{it} + \varepsilon_{it} \quad (2)$$

The Eq. (2) represents a quadratic function, where the expected sign for α is positive and β is negative, suggesting a U-shape relationship between domestic public debt and credit supply to the private sector. Based on a general framework initially developed by Sasabuchi (1980), Lind and Mehlum (2007 and 2010), show that in order to test appropriately the presence of an inverted-U relationship, it is important to formulate the following joint null hypothesis:

$$H_0 : (\alpha + 2\beta Debt_{min} \leq 0) \cup (\alpha + 2\beta Debt_{max} \geq 0) \quad (3)$$

$$H_1 : (\alpha + 2\beta Debt_{min} > 0) \cap (\alpha + 2\beta Debt_{max} < 0) \quad (4)$$

Where *Debt_{min}* and *Debt_{max}* are the minimum and maximum values of *Debt*, respectively.

When examining the effect of domestic public debt on the supply of credit to the private sector, we must address the endogeneity problem related to reserve causality running from credit supply to the private sector on domestic public debt. In fact, the development of the banking sector could create additional demand for government securities which contribute to the accumulation of domestic public debt. The endogeneity problem can also arise as a result of measurement errors, omitted variable bias and the presence of lagged dependent variable among

the explanatory variables. Endogeneity can lead to inconsistent estimates and incorrect inferences, which can yield misleading conclusions and inappropriate theoretical interpretations. To mitigate endogeneity, we estimate our specifications using the difference-GMM estimator of Arellano and Bond (1991). This estimator allows controlling for the endogeneity of explanatory variables through the use of lagged levels of these variables as instruments.

4. Estimation results

4.1 Domestic public debt: linear effect on credit supply to the private sector

Table 1 displays the panel linear regression results for the effect of domestic public debt on the supply of credit to the private sector using difference-GMM estimator of Arellano and Bond (1991) reporting various specifications of specific, institutional, and macroeconomic determinants of the supply of credit to the private sector.

Column (1) features in addition to *Credit₋₁* and *Debt*, two specific variables as determinants of the supply of credit to private sector: *ROAA* and *Liquidity*. Column (2) reports *Corruption* and *Political stability* as institutional variables on the explanatory variables used in the model of Column (1). Column (3) and (4) report on the explanatory variables used in the regression estimation in Column (2) other macroeconomic variables: *LGDPk*, *M2*, and *Lending rate*, respectively.

Table 1. Linear specification

Variables	(1)	(2)	(3)	(4)
<i>Credit₋₁</i>	0.649*** (0.000)	0.454*** (0.000)	0.485*** (0.000)	0.537*** (0.000)
<i>Debt</i>	-0.253*** (0.003)	-0.334*** (0.001)	-0.382*** (0.000)	-0.329*** (0.000)
<i>ROAA</i>	0.319*** (0.001)	0.505** (0.021)	0.503*** (0.008)	0.508*** (0.000)
<i>Liquidity</i>	-0.151*** (0.000)	-0.470*** (0.000)	-0.489*** (0.000)	-0.400*** (0.000)
<i>Corruption</i>	–	-0.335*** (0.003)	-0.366*** (0.000)	-0.330*** (0.000)
<i>Political stability</i>	–	0.144*** (0.000)	0.153*** (0.000)	0.140*** (0.000)
<i>LGDPk</i>	–	–	9.385 (0.194)	–
<i>M2</i>	–	–	–	0.103* (0.054)
<i>Lending rate</i>	–	–	–	0.299** (0.038)
Number of banks	19	19	19	19
F-stat (p-value)	0	0	0	0
AR (2) (p-value)	0.463	0.579	0.603	0.616
Hansen J test (p value)	0.528	0.387	0.406	0.506

Notes: GMM estimators use robust p-value clustered by banks. The Hansen and AR (2) tests indicate that we cannot reject the validity of our instruments. * Significant at 10%; ** significant at 5%; ***significant at 1%.

Results derived from the linear model indicate a negative and statistically significant effect of *Debt* on *Credit*, which suggests that there is a crowding out effect of private financing following the increase in domestic public debt. This shows that holding domestic public debt has discouraged Maghreb banks to finance the private sector in these countries.

With regards to specific variables, *ROAA* is positively and significantly associated to *Credit*. This positive relationship between *ROAA* and *Credit* was established by Gunjy and Yuan (2010) who support that bank with higher profitability can easily obtain financing from the interbank market even if a tighter monetary policy leads to a reduction of deposits. So, most profitable banks do not reduce their loans to the private sector. The estimates suggest the existence of a negative and significant relationship between *Liquidity* and *Credit*. This means that banks have not increased the supply of credit to the private sector because they may use liquidity to buy government assets. This finding is counterintuitive but accord with Chowdhury et al. (2018) who indicate that when the government borrows from the banking sector, bank liquidity declines significantly. The results suggest as well that *Corruption* is negatively and significantly associated with the supply of credit to the private sector. This result is in line with the view that corruption hampers bank lending as it is associated with less protection of creditors (Weill, 2010; Bahoo, 2020). *Political stability* turns out to be positive and statistically significant. In fact, an increase of political stability and an absence of violence provide stronger foundations for financial development since a stable political environment helps in building a coherent and continuous path for sustainable development (Ashraf, 2017). The estimates indicate that *M2* affects positively and significantly credit supply to the private sector. This highlights that the increase in the amount of the money supply encourages the agents to consume or to invest. On the contrary, a decline in the amount of money in circulation causes a contraction of economic activity by the lack of liquidity (Gazgor, 2014). *Lending rate* has a positive and significant impact on the supply of credit to the private sector. This result is in line with the view that the lending rate, which proxies the rate return of bank's assets, positively influences its supply (Jung, 2020). The results show that *LGDPk* has statistically insignificant effect on the supply of credit to the private sector. Hence, it is plausible to assume that the fragile economic context that followed the Arab Spring predicts a difficult financial situation for the banking sector, but it seemed until there to have been a good start in its growth momentum since banks hold safe and profitable government bonds.

4.2 Domestic public debt: quadratic effect on credit supply to the private sector

Table 2 reports the results derived from the quadratic model. Across specifications, the results indicate that both *Debt* and *Debt*² are statistically significant. While the coefficient associated with the linear term is positive, the quadratic term is negative, indicating a nonlinear (inverted-U shape) relationship between domestic public debt and credit supply to the private sector. This supports our hypothesis that domestic public debt has some positive impact on the supply of credit to the private sector, up to a certain point, beyond which domestic public debt may start to be detrimental for the private sector financing.

A possible explanation for these empirical results is that domestic public debt is helpful for financial development up to a threshold, beyond which it becomes harmful. In fact, for limited shares of domestic public debt, credit supply to the private sector seems to be supported by safe government bonds, if the legal system and institutional infrastructure are weak. However, investing massively in domestic public debt may discourage banks from lending to the risky private sector and they would no longer fulfill their mission of financial intermediaries.

As it can be seen from Table 2, the estimated threshold, beyond which domestic public debt turns detrimental to the supply of credit to the private sector, is computed using Eq. (2) as $Debt_{threshold} = -\alpha/2\beta$ and found to be around 9.77 percent of total assets. Below this threshold, domestic public debt is positively associated with credit supply to the private sector. However, beyond this threshold, domestic public debt negatively affects the supply of credit to the private sector. More than 80% of the domestic public debt as a percentage of total assets observations in our sample are below the estimated threshold. This reflects that Maghreb banks hold only the necessary amount of safe government assets that allow them to finance the risky private sector.

Table 2. Quadratic specification

Variables	(1)	(2)	(3)	(4)
<i>Credit</i> ₋₁	0.388*** (0.000)	0.347*** (0.000)	0.344*** (0.001)	0.689*** (0.000)
<i>Debt</i>	1.263* (0.068)	1.985** (0.011)	2.186*** (0.006)	0.994*** (0.001)
<i>Debt</i> ²	-0.068*** (0.005)	-0.098*** (0.000)	-0.103*** (0.000)	-0.050*** (0.000)
<i>ROAA</i>	0.984** (0.028)	1.019** (0.040)	1.098** (0.029)	0.930*** (0.005)
<i>Liquidity</i>	-0.297*** (0.000)	-0.689*** (0.000)	-0.701*** (0.000)	-0.471*** (0.000)
<i>Corruption</i>	–	-0.352*** (0.000)	-0.337*** (0.002)	-0.258* (0.089)
<i>Political stability</i>	–	0.249** (0.012)	0.249** (0.015)	0.142*** (0.006)
<i>LGDPk</i>	–	–	3.731 (0.702)	–
<i>M2</i>	–	–	–	0.218** (0.035)
<i>Lending rate</i>	–	–	–	1.567*** (0.000)
Number of banks	19	19	19	19
F-stat (p-value)	0	0	0	0
AR (2) (p-value)	0.867	0.713	0.694	0.714
Hansen J test(p-value)	0.396	0.474	0.573	0.377
Debt turning point				9.77
95% Confidence interval, Delta method				[8.37; 11.18]

Notes: GMM estimators use robust p-value clustered by banks. The Hansen and AR (2) tests indicate that we cannot reject the validity of our instruments. * Significant at 10%; ** significant at 5%; ***significant at 1%.

Table 3 reports the results of the Sasabuchi-Lind-Mehlum test for inverse U-shaped relationship. This table displays that the lower bound slope of *Debt* is positive and significant at 1 %, while the upper bound slope of *Debt* is negative and significant at 1%. Similarly, the extreme point and also the Fieller confidence interval for the extreme point are contained within the lower and upper bounds of the dataset. Furthermore, the overall t-test for the presence of an "inverted-U" shaped is significant at 1% and thus indicates that the negative effect of domestic

public debt on credit supply to the private sector is not systematic and holds only after reaching a certain threshold.

The results of the quadratic estimation imply that the sign and the significance of specific, institutional and macroeconomic variables remain intact compared with the linear regression. The Hansen and AR (2) tests indicate that we cannot reject the validity of our instruments (Arellano and Bond, 1991). Moreover, the lagged dependent variable is positive and significant in explaining the dependent variable which justifies the use of dynamic model and indicates that the behavior of the supply of credit is persistent.

Table 3. Sasabushi-Lind-Mehlum test for inverse U-shaped relationship (benchmark specification)

Dependent variable : <i>Credit</i>	
Data range [$Debt_{min}$; $Debt_{max}$]	[0 ; 25.95]
Slope at $Debt_{min}$	0.99*** (3.39)
Slope at $Debt_{max}$	-1.64*** (-4.51)
Sasabushi-Lind-Mehlum test for inverse U-shaped relationship	3.40*** (0.000)
Extremum point	9.77
95% Confidence interval, Fieller method	[8.37; 11.18]

Note: t-statistics are in parentheses

5. Robustness Check

In our baseline regression, we addressed the non-linear effect of domestic public debt on the supply of credit to the private sector in a dynamic panel data using both public and private banks without taking into account the impact of the Arab Spring on this relationship.

In this section, we summarize the implications of two robustness checks. First, we test the robustness of our results by excluding public banks from the sample to leave doubts on the generalizability of our results. Second, we evaluate the effect of domestic public debt on the supply of credit to the private sector by considering the impact of the Arab Spring. To do this, we interact both domestic public debt terms with a dummy variable that indicates period of pre- and post-Arab Spring.

5.1 Excluding public banks

Examining private banks in terms of holding domestic public debt is cumbersome in developing market economies because these banks may operate differently. In fact, the development of private banks has been much faster than that of public banks. Private banks are showing appreciable growth in terms of their net incomes. These banks have always taken part of a winning strategy which consists in being more selective in granting credit so that they improve the quality of their portfolios.

As can be seen from Table 4, this exercise does not alter our main results obtained from the benchmark specification as it reveals positive and statistically significant estimates for $Debt$ and negative and significant estimates for $Debt^2$. These estimates suggest that there is an

inverted-U shape relationship between domestic public debt held only by private banks and credit granted by them to the private sector.

Table 4. Alternative specification: excluding public banks

Variables	
<i>Credit</i> ₋₁	0.622*** (0.000)
<i>Debt</i>	1.064*** (0.004)
<i>Debt</i> ²	-0.045*** (0.002)
<i>ROAA</i>	0.821** (0.039)
<i>Liquidity</i>	-0.532*** (0.000)
<i>Corruption</i>	-0.338* (0.053)
<i>Political stability</i>	0.165*** (0.007)
<i>M2</i>	0.237** (0.020)
<i>Lending rate</i>	1.328*** (0.000)
Number of banks	14
F-stat (p-value)	0
AR (2) (p-value)	0.805
Hansen J test(p-value)	0.656
Debt turning point	11.59
95% Confidence interval, Delta method	[10.01; 13.17]

Notes: GMM estimators use robust p-value clustered by banks. The Hansen and AR (2) tests indicate that we cannot reject the validity of our instruments. * Significant at 10%; ** significant at 5%; ***significant at 1%.

More specifically, the results illustrated in Table 4, suggest that in the case of private banks, when domestic public debt is below the 11.59 debt threshold, it is positively associated with the supply of credit to the private sector and beyond this threshold, the relationship between domestic public debt and credit supply to the private sector becomes negative. Considering these findings, the debt threshold of private banks is higher than that for banks in the benchmark specification which is estimated to equal 9.77 percent of total assets. Approximately more than 95% of domestic public debt as a percentage of total assets observations in our sample are less than the 11.59 domestic public debt thresholds. Thus, it is likely that private banks adopt a strategy of income diversification via an orientation towards treasury bills that encourage them to take on more risk and thus increase lending to the risky private sector.

5.2 Examining the impact of the Arab Spring

As is well known, the Arab Spring which began in Tunisia in 2011 and overcome the Arab Maghreb countries, has led to several political changes ranging from governmental overthrow in some countries, to the establishment of new legal frameworks and political reforms in other countries. The consequences of the conflicts and violence associated with the Arab Spring contributed to the deterioration of both institutional and governance quality.

We specifically focus on the domestic public debt-credit supply to the private sector link in the Arab Spring context by adding a corresponding dummy variable (*Arab Spring*), which takes the value 1 for the post-Arab Spring period and 0 otherwise, as well as two interaction terms with the domestic public debt and its squared term.

Table 5. Alternative specification: examining the impact of the Arab Spring

Variables	
<i>Credit</i> ₋₁	0.642*** (0.000)
<i>Debt</i>	0.551* (0.095)
<i>Debt</i> ²	-0.029** (0.037)
<i>Arab Spring</i>	-3.834** (0.044)
<i>Debt. Arab Spring</i>	.0506* (0.061)
<i>Debt</i> ² . <i>Arab Spring</i>	-0.014 (0.161)
ROAA	0.649* (0.051)
<i>Liquidity</i>	-0.253*** (0.000)
<i>Corruption</i>	-0.508*** (0.001)
<i>Political stability</i>	0.156*** (0.001)
<i>M2</i>	0.288*** (0.009)
<i>Lending rate</i>	0.765*** (0.003)
Number of banks	19
F-stat (p-value)	0
AR (2) (p-value)	0.745
Hansen J test(p-value)	0.346
Debt turning point	9.20
95% Confidence interval, Delta method	[6.52; 11.89]

Notes: GMM estimators use robust p-value clustered by banks. The Hansen and AR (2) tests indicate that we cannot reject the validity of our instruments. * Significant at 10%; ** significant at 5%; ***significant at 1%.

Once again, the results derived from Table 5 provide strong evidence of an inverted U shape relationship between domestic public debt held by banks and credit supply to the private sector in the Maghreb region. This exercise does not alter our main findings obtained from the benchmark specification as the estimated threshold is almost the same (9.20 % of total assets).

As it can be seen from Table 5, Arab Spring (*Arab Spring*)'s influence on the supply of credit to the private sector is generally negative. Conversely, portraying Arab Spring' effect on the supply of credit to the private sector for different levels of domestic public debt, our results indicate that the interaction between *Arab Spring* and *Debt* matters for the supply of credit to

the private sector below the domestic public debt threshold level (9.20 % of total assets). More specifically, below this threshold, holding safe government securities allows the banks to mitigate the extent of political instability associated with the *Arab Spring* and therefore magnify the supply of credit to the private sector. However, this relationship turns out to be negative and insignificant once domestic public debt exceeds the estimated threshold. This may be attributed to the fact that political instability is usually associated with high level of domestic public debt. In fact, large debt is considered as one possible implication of political instability (Miller, 1997), such that domestic public debt is not able to cancel out the *Arab Spring*'s effect.

6. Conclusion

This paper contributes to the existing literature on the determinants of private sector financing by investigating the effects of domestic public debt on credit supply to the private sector for a sample of 19 Maghreb banks over the period 2005-2018. Interestingly, two main results are obtained. On one hand, the results suggest a negative linear relationship between domestic public debt and credit supply to the private sector. On the other hand, we find that domestic public debt has a significant non-linear effect on the supply of credit to the private sector with a threshold of about 9.77% of total assets. The effect is positive only for a lower value of domestic public debt, but it becomes negative when domestic public debt is beyond the threshold of 9.77 percent of total assets. These results are robust across two alternative specifications excluding public banks and taking into account the impact of the Arab Spring on credit supply to the private sector for different levels of domestic public debt.

In the case of emerging and developing economies such as Maghreb countries, our results have the following policy implications: setting up sound institutions is of crucial importance to avoid public debt-overhang episodes. For this, it is necessary to ensure that the amount of domestic public debt held by banks is an increasing function of the supply of credit to the private sector since holding safe government securities could encourage the banking system to take on more risk and thus increase lending to the risky private sector. This will guarantee that domestic public debt is not considered by the banking sector as a substitute of credit to the private sector but rather as a complement. However, the amount of domestic public debt held by Maghreb banks should not exceed the 9.77 percent of total assets since beyond this threshold, domestic public debt negatively affects the supply of credit to the private sector. To that end, a coordinated regional framework is crucial in building capacity for better debt management strategy by creating an independent fiscal authority responsible for checking and evaluating the transparency of the budget process as well as providing the necessary infrastructure to ensure a sound economic and institutional environment which is conducive for the development of institutions.

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Appendix

Bank list (19 Maghreb banks)

ABC Bank; Amen Bank; Arab Tunisian Bank; Attijari Bank; Attijariwafa Bank; Banque de l'Habitat; Banque de Tunisie; Banque Internationale Arabe de Tunisie; Banque Marocaine pour le Commerce et l'Industrie; BMCE Bank of Africa; Banque Populaire; Banque Nationale Agricole; CIH Bank; Crédit agricole du Maroc; Crédit du Maroc; Société Générale Algérie; Société Tunisienne de Banque; Union Internationale de Banque; Union Bancaire pour le Commerce et l'Industrie.

Table 6. Variables description and data sources

Variables	Description	Source
<i>Credit</i>	Credit to the private sector as a % of total assets	
<i>Debt</i>	Total amount of Treasury bills held by banks as a % of total assets	Bankscope and banks' annual reports
<i>ROAA</i>	Return on average assets	
<i>Liquidity</i>	Liquidity as a % of total assets	
<i>Corruption</i>	Corruption Perception Index. Scores are on a scale of 0-100, where 0 means that a country is perceived as highly corrupt	Transparency International
<i>Political stability</i>	Political stability and absence of violence/terrorism. Performance scores are distributed from 0 to 100. The higher the value of the index refers to better political stability and absence of violence.	Worldwide Governance Indicators, World Bank
<i>LGDPk</i>	Log nominal GDP per capita	World Development Indicators, World Bank
<i>M2</i>	Broad money growth (annual %)	World Development Indicators, World Bank
<i>Lending rate</i>	Money market interest rate	International Financial Statistics, IMF

Table 7. Summary statistics

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
<i>Credit</i>	266	66.29376	14.71731	7.231951	92.56300
<i>Debt</i>	266	5.610595	5.497926	0	25.95350
<i>ROAA</i>	266	1.192949	1.504353	-9.92	12.59
<i>Liquidity</i>	266	6.583569	8.898257	-12.89322	38.28352
<i>Corruption</i>	266	38.68797	4.899404	28	50
<i>Political stability</i>	266	30.41637	11.59546	11.42857	52.65701
<i>LGDPk</i>	266	3.541448	0.905863	3.304	3.747
<i>M2</i>	266	9.644296	4.289411	0.297131	23.09074
<i>Lending rate</i>	266	3.818684	1.187616	0.47	6.5

Table 8. Correlation matrix

	<i>Credit</i>	<i>Debt</i>	<i>ROAA</i>	<i>Liquidity</i>	<i>Corruption</i>	<i>Political stability</i>	<i>LGDPk</i>	<i>M2</i>	<i>Lending rate</i>
<i>Credit</i>	1.0000								
<i>Debt</i>	-0.2365	1.0000							
<i>ROAA</i>	0.0549	0.0266	1.0000						
<i>Liquidity</i>	-0.3525	-0.1044	0.1841	1.0000					
<i>Corruption</i>	0.4381	0.0927	-0.0417	-0.1780	1.0000				
<i>Political stability</i>	0.0234	0.0234	-0.1416	0.2852	0.3607	1.0000			
<i>LGDPk</i>	0.1993	-0.2222	0.0815	0.1694	0.2312	-0.1215	1.0000		
<i>M2</i>	-0.0814	-0.2004	-0.0887	-0.1904	-0.4822	-0.1258	-0.6364	1.0000	
<i>Lending rate</i>	0.4448	0.0081	-0.0352	-0.2254	0.6529	0.1117	0.2408	-0.6273	1.0000