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How does corruption undermine banking stability? A threshold nonlinear framework

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ABSTRACT

This study assesses the effect of corruption on the occurrence of banking crises for a sample of 38 countries over the period 2000–2017. We consider both the direct and the indirect channels through which corruption might affect the occurrence of banking crises. We also check, using a threshold regression approach, for the existence of a corruption threshold driving a regime switching in our sample countries for both high-income and low-income countries. Estimation outcomes suggest that; overall, corruption increases the probability of banking crises. The indirect effect estimation suggests that corruption negatively affects the banks' lending through excessive risk rather than through their profitability. The panel threshold analysis provides evidence of a nonlinear corruption-banking stability relationship with the existence of two corruption-banking stability regimes. The study also provides evidence that corruption matters more for low-income than for high-income countries with regard to their banking system stability.

1. Introduction

In most economies, banks play a major role in savings mobilization and capital allocation (Demirgüç-Kunt and Levine, 1999). The link between a well-functioning banking system and economic growth is argued to be positive (Greenwood and Jovanovic, 1990; King and Levine, 1993; Beck et al., 2000; Demirgüç-Kunt and Levine, 2001). Indeed, credit provided by banks is at the core of the economic growth process (Ben Ali et al., 2016; Sassi and Ben Ali, 2014). With the recent crises, this issue caught more the attention of researchers and policymakers. This increase in interest stems from the fact that the banking system is the sector most badly affected during crisis periods. In this regard, many studies highlight that the performance of banks does not depend only on factors specific to the banking system. It also depends on the quality of institutions (Huang and Wei, 2006; Barth et al., 2007). As regulatory powers battle to establish an institutional environment that intermediates more effectively, corruption often acts as a hindering force for banking activity. Corruption can take different forms in bank lending.[1] When pervasive, corruption may hinder the efficient intermediation of capital, forcing some borrowers without bank connections to reject sound financial projects, which may reduce their growth (Beck et al., 2005), while borrowers with such ties may have easier access to funding (Laeven, 2001; Charumilind et al., 2006). Borrowers who have good connections in the banking system may have a higher default rate and therefore a lower average recovery rate than non-connected ones (La Porta et al., 2003). As reported in numerous studies, the stability of the banking system is a pre-condition for economic stability and a basis for sustained growth (Aghion et al., 2010; Fernández et al., 2016). This is why banking systems are the focus of policy makers and academicians worldwide.

From a broader framework, an extensive literature has developed on the adverse effects of corruption on different aspects of the economy (Swaleheen et al., 2019; Murphy et al., 1993; Mauro, 1995; Ben Ali and Mdhillat, 2015; Wei, 2000; Park, 2012; Ben Ali and Sassi, 2016; Saha and Ben Ali, 2017; Ben Ali and Saha, 2016). Literature on the relationship between corruption and the soundness/stability of banks is however not copious. Studies investigating the impact of corruption on banking systems consider both corruption by bank officials (*endogenous factor*) and corruption in the judiciary and legal institutions (*exogenous*

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[1] Such as: Bribery — the act of giving something of value in exchange for influencing official action; Graft — the use of a position of trust to gain personal profits; Extortion — the use of force, threats or undue demands to get something; Kickback — the act of paying or demanding a commission in return for some service; Cronyism — the employment of someone unqualified for a role because they are a relative or close friend; and Embezzlement — the act of dishonestly withholding the employer's money.

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factor). Corruption's endogenous factor for banks concerns both the supply and the demand sides of bank funding. On the supply side, theory show that corrupt bankers might accept bribes in exchange for dealing favorably with high-risk loan applications. On the demand side, corrupt defaulters might give bribes to lessen their penalties, hence increasing the likelihood of loan defaults (Goel and Hasan, 2011, p. 456). Levin and Satarov (2000) point out that during the crisis in the 1990s in Russia, borrowers were obliged to give large amounts of money to banks' officials in order to get loans. Similarly, in China, Barth et al. (2008) state that in 2005, 461 bank fraud cases were reported. Corruption in bank lending may also arise when politicians use their power to induce banks' officials to divert the flow of funds to borrowers connected with them, in order to maximize their own political gain rather than the goodwill of the nation (Beck et al., 2006). This is particularly the case when banks are state owned. This can lead to greater funding being directed to politically desirable projects, thus maximizing the private gain of politicians rather than maximizing the social welfare (La Porta et al., 2002; Sapienza, 2004; Khwaja and Mian, 2005; Houston et al., 2011; Barry et al., 2016). Using data from 90000 Pakistani firms over the period 1996–2002, Khwaja and Mian (2005) find that politically connected firms – whose managers are involved in politics and with elections – receive considerable preferential treatment in bank funding. Even though they have a default rate that is 50 percent higher than average, politically connected firms receive 45 percent larger loans. In a similar setting, Claessens et al. (2008) find evidence that Brazilian firms that contributed to the presidential campaigns in 1998 and 2002 received more bank funding than other firms.

Whatever its forms, corruption in the banking industry may ultimately hinder efficient capital allocation and undermine economic growth. For example, corruption on the part of bank officials may decease bank lending through the additional amounts claimed by corrupt bankers for granting credit; amounts that act as extra costs for borrowers. Thus, borrowers without connections may assign valuable funds to establishing political links, while connected ones with easy access to bank credit are less likely to invest funds efficiently (Houston et al., 2011). Evidence of this negative effect is reported by an extensive survey of more than 9000 firms in 80 countries as detailed in the World Business Environment Survey (WBES) conducted by the World Bank. In this survey, firm managers were questioned on whether corruption on the part of bank officials was an obstacle to the growth of their businesses. Based on this survey, Batra et al. (2004) report that 20%–30% of firms outside OECD countries consider the corruption of banks' officials to be a major or moderate obstacle to getting credit. Beck et al. (2006, p. 938) find a negative relationship between corruption and bank lending, even if the "*corruption of bank officials they reported was rated as only a minor obstacle*" in lending. They pointed out that half of the surveyed firms did not find the corruption of banks' officials a determinant obstacle in bank lending. This observation was interpreted by referring to the "*grease the wheels*" hypothesis of an otherwise deficient institutional banking framework. The possible positive "*greasing the wheels*" effect may help to reduce costs caused by redundant bureaucratic activities (Méon and Sekkat, 2005; Dreher and Gassebner, 2013) thereby raising bank lending, hence investment and potentially growth. However, corruption remains harmful elsewhere (Leff, 1964; Leys, 1965; Huntington, 1968). This hypothesis considers that ill-functioning institutions constitute a major obstacle for investment and growth that a dose of "greasing" money may help avoid (Weill, 2011a). Otherwise, the incentive to give bribes increases for borrowers whose loan applications are more likely to be rejected, when banks are highly risk averse and unwilling to grant credit. When banks' risk aversion increases, the incentives to obtain loans through bribes will increase as well. Nevertheless, this observation does not mean that it is linked to gains in welfare. According to Weill (2011a,b) and Ahmad (2013), the suggestion of Stiglitz and Weiss (1981) is consistent with the perception that corruption may increase the supply of credit by supporting banks' risk-taking, which increases in turn the share of 'bad' loans in banks' balance sheets. As high-risk borrowers ('bad' borrowers) are more willing to pay higher interest rates, all the borrowers with incentives to pay a bribe to obtain credit should be bad borrowers (the adverse selection problem). Lizal and Kocenda (2001) found that corruption in the Czech Republic increased the volume of bad loans and drove banks to collapse. Also, while using microeconomic data to analyze the effect of corruption on banks' risk-taking in the emerging economies for the period 2000–2012, Chen et al. (2015) show that banks in corrupt economies are more risk-taking and have more Non-Performing Loans (NPLs). In a similar context, and using macroeconomic data from 76 countries, both less developed and developed, over the period 2002–2004, Park (2012) provides evidence that corruption diverts the allocation of bank funds from low risk projects to high risk ones and therefore exacerbates problems with bad loans in the banking system, which in turn leads to lower economic growth. According to Park (2012, p. 908), corruption was one of the factors that contributed to the 2008 worldwide financial crisis through its adverse effect on banks' balance sheets. Bhargava and Bolongaita (2004) argue that during the East-Asian financial crises of 1997–1998, prevalent corruption was considered to be a contributing factor. Other studies provide evidence that corruption indirectly reduces banks' soundness through several channels. According to Swaleheen (2008), corruption reduces both the incentives and the ability to save, thus decreasing the rate of gross national saving. He shows that corruption adversely affects the saving rate through the real interest rate channel. In the same line of thought, Weill (2011b) uses bank-level data and shows that corruption affects bank lending in Russia. He reports that its detrimental effect is only reflected in loans to firms and households, and not in loans to government. Similarly, Boudriga et al. (2009) show that lower NPLs ratios are associated with lower corruption, better enforcement of law and more free speech and accountability.

Actually many studies in the literature showed that defective institutions exogenously affect the banking system. According to La Porta et al. (1997), corruption in legal institutions should hamper banks extending credit, while strong legal institutions protecting banks and enforcing contracts may increase bank lending. In fact, when banks are assured that in case of debtors' default, the legal system will ensure repayment by seizing collateral or even taking control of the borrower, they will be inclined to lend more. However, uncertainty regarding the enforcement of their claims against debtors' default should diminish the banks' willingness to lend and results in a decrease in bank loans and an increase in the banks' riskiness in terms of NPLs. Empirical evidence supports the role of law enforcement in banks' financial records (reduction of loan losses) and increase in bank lending. In this regard, Djankov et al. (2007) use credit data on 129 countries over a 25 year period and show that legal protection for creditors – and information sharing amongst institutions – results in an increase in bank lending and a decrease in the levels of NPLs. Their study was later extended by Barth et al. (2009), who find that a strong legal system enhances the competition among firms and reduces the corruption in bank lending. Similarly, Qian and Strahan (2007) investigate the legal determinants of loan contract characteristics and find that stronger protection of creditors leads to lower interest rates being charged by banks. Goel and Hasan (2011) use a large sample of over 100 countries with annual data to investigate the impact of institutional corruption on NPLs and report that the higher the corruption, the higher is the level of

NPLs. Thus, countries with poor legal systems and bad governance might have a weaker banking system due to corruption. Fernandez and Gonzalez (2005) show that the probability of a banking system crisis is positively linked to weaker institutions. According to Özkan-Günay et al. (2013), the 2008 financial crisis demonstrated the importance of regulation and supervision in the financial system on both the national and international levels. Overall, regardless of the forms of corruption in bank lending, it is likely to exert a first-order effect on banking system stability and then on systemic banking crises in a given economy.

It is worth noting that existing studies examine mainly the direct effect of corruption on the banking system (Munshi, 1999; Park, 2012; Bougatef, 2015; Toader et al., 2018; Ho et al., 2018), and very little has been done to investigate the indirect effect of corruption on banks (Swaleheen, 2008; Wilhelm, 2002). To the best of our knowledge, there is no serious study that has investigated how these potential channels can interfere in the corruption-banking crisis nexus. This paper takes further steps and aims to fill this gap in the literature, by exploring both the direct and indirect effects of corruption on the stability of the banking system for a sample of 38 countries for the period 2000–2017. It is driven by three main motivations and therefore makes three corresponding contributions to the literature. First, it builds on the most recent studies, namely those of Toader et al. (2018) and Ho et al. (2018), whilst extending the analysis for a larger sample. It offers an investigation of both the direct and indirect effects of corruption on banking stability, which so far have been ignored in the literature. After the 2008 financial crisis, bank lending declined sharply (Ivashina and Scharfstein, 2010) and corruption was considered to be a factor in the crisis (Park, 2012, p. 908). It is then important to examine its different effects on the banking system. This could help us to gain more insight into what caused the crisis and how future crises can be avoided. Second, the effect of corruption on banking stability is analyzed for a more recent period (2000–2017), which allows taking into consideration both turbulence periods such as the 2008 subprime crisis and relatively stable periods. This will help in better understanding how corruption affects the banking system, and in designing a regulatory power to combat corruption in order to improve bank lending activity and overall economic growth. Third, our empirical framework considers the potential existence of a nonlinear relationship between corruption and the occurrence of banking crises in our sample countries. Indeed, most empirical studies dealing with the relationship between corruption and banking crises deal exclusively with a linear framework. That is, studies ignore the potential existence of a nonlinear relationship in the corruption-banking crisis nexus.

The rest of this paper is organized as follows. Section 2 describes the dataset and the empirical methodology. Section 3 presents and discusses the results. Section 4 concludes and suggests some policy implications.

2. Model, methodology and data description

This study empirically assesses the impact of corruption on banking sector stability/instability. Our dependent variable is the banking crisis ($BCRISIS$) driven by a set of bank-specific, industry-specific and macroeconomic control variables (X). We first consider the potential direct effect of corruption on the occurrence of banking crises by considering the following linear model:

$$BCRISIS_{it} = \alpha_0 + \alpha_1 NIM_{it} + \alpha_2 ROA_{it} + \alpha_3 CONC_{it} + \alpha_4 INS_{it} + \alpha_5 COC_{it} + \theta X_{it} + \varepsilon_{it} \quad (1)$$

Banking crisis is a binary variable taking the value of 1 for the years of the occurrence of a crisis in a given country and where i and t denotes countries and time, respectively. Data on banking crises in different countries of our sample were extracted from Laeven and Valencia (2018), and from Bankscope and Orbis Bank Focus databases. Our sample is a balanced panel data set covering 38 countries over the period 2000–2017. The list of countries of our sample is presented in Table 6 in the Appendix. Bank-specific variables are proxied by the Net Interest Margin (NIM) employed to assess the efficiency of a banks' lending activities, and by the Return On Assets (ROA) to express banks' profitability (Ben Khediri et al., 2010). We expect profitability to be negatively linked to crises, as more profitability induces more banking stability and therefore fewer banking crises. Actually, banks and financial institutions accumulating non-performing loans ($NPLs$) would be more vulnerable to financial instability and crises (Demirgüç-Kunt, 1989). Previous studies argue that NPLs can be employed to mark the start of a banking crisis (Reinhart and Rogoff, 2011; Park, 2012). The net interest margin (the excess of interest income over interest expense scaled by total asset) is expected to be positively linked to crises, as a high value of this margin indicates that the bank's investment strategy pays more interest than it costs, leading to sounder banks. The increasing cost of banking intermediation undermines economic growth (Kasman et al., 2010), which in turn affects the profitability of banks and therefore decreases their efficiency as a whole (García-Herrero et al., 2009). The lower the ratio, the more efficient is the banking system. We use two banking industry specific variables, namely the concentration ($CONC$) – measured by the assets of the three largest banks as a proportion of the total banking system assets (Ben Ali et al., 2018), and the insurance (INS) – proxied by a binary variable indicating if a given country has a deposit insurance scheme or not (Beck et al., 2013). As macroeconomic variables, we consider the GDP and the one year lagged inflation rate, as displayed in the matrix (X). These data are taken from the World Bank's World Development Indicators (WDI) database and from other financial data sources, mainly from Laeven and Valencia (2018), and from Bankscope and Orbis Bank Focus databases.

Different measures are used in the literature to assess the level of corruption (Ben Ali and Sassi, 2016). We use the World Bank Control of Corruption Index (COC) (Kaufmann et al., 2008). It is the most commonly used dataset for government effectiveness.[2] The COC ranges from −2.5 (totally corrupt) to 2.5 (corruption free); i.e. the higher the index, the less the corruption. We use a second corruption measure, namely the International Country Risk Guide (ICRG) index, to control for the robustness of our results. We included both low-income and high-income countries whilst taking into consideration the data limitation constraint. Since our model is a qualitative one, we perform a qualitative Logit model estimation. In a second step, our empirical framework includes performing an estimation to control for the potential existence of an indirect effect of corruption on banking crises. We consider two different channels, the profitability and the net interest margin channels. We suspect that in the first channel more corruption can induce less profitability in the banking system, which might then both induce a deterioration of the financial situation and therefore lead to more financial vulnerability and crises. We suspect that in the second channel, the additional amounts claimed by corrupt bankers for granting credit would act as extra costs that would mean higher interest

[2] As indicated in Ben Ali and Sassi (2016), different measures are used in the literature to proxy countries' levels of corruption. Transparency International's Corruption Perception Index is one of the measures most often used in the literature. This index aggregates the results of different surveys into one common "corruption perceptions score" ranging from 0 (totally corrupt) to 100 (corruption free country). Unfortunately, this index is not comparable over time since its aggregation methodology changed starting from 2012.

rates for borrowers, which may eliminate the low-risk borrowers. Therefore, we define the two different models detailing these two channels:

$$ROA_{it} = \beta_0 + \beta_1 ROA_{it-1} + \beta_2 COC_{it} + \beta_3 CONC_{it} + \beta_4 CIR_{it} + \beta X_{it} + \varepsilon_{it} \quad (2)$$

Similarly,

$$NIM_{it} = \delta_0 + \delta_1 NIM_{it-1} + \delta_2 COC_{it} + \delta_3 CONC_{it} + \delta_4 CIR_{it} + \delta X_{it} + \varepsilon_{it} \quad (3)$$

As in Athanasoglu et al. (2008), we include the inflation rate and the GDP as a set of macroeconomic variables (X). We also consider the one year lagged profitability (ROA) and the cost to income ratio (CIR) as bank specific variables and the concentration ratio as a banking system specific variable (Bretschger et al., 2012). Models (2) and (3) are a dynamic panel regressions used to study the dynamic behavior of entities. However, the fixed effects estimator is inconsistent, at least if it is held finite. This is because the sample mean of lagged dependent variable (ROA_{it-1} *or* NIM_{it-1}) is correlated with that of ε_{it}. The standard approach to estimating a dynamic panel is to combine first-difference with the IV instrumental variables estimation method or with the generalized method of moments (GMM). In this study, we estimate these two channels (models) using the Blundell-Bond (1998) estimator – a GMM estimator used to estimate dynamic panel data models – in order to get their estimated values that will be included in our first model:

$$BCRISIS_{it} = \alpha_0 + \alpha_1 \widehat{ROA}_{it} + \alpha_2 \widehat{NIM}_{it} + \alpha X_{it} + \varepsilon_{it} \quad (4)$$

In the third step of our estimation methodology, we check for the existence of a non-linear relationship in the corruption-banking crisis nexus. This framework is intended to potentially determine a corruption threshold above which corruption in a given country might undermine the situation of the banking system and create more vulnerability to the occurrence of banking crises. To this end, we use Hansen's (1999) threshold regression approach, which potentially allows splitting the equation into different regimes depending on the corruption threshold value. The existence of at least one threshold value implies that the relationship between corruption and banking crises is nonlinear. According to Hansen (1999), the panel threshold model is defined as follows:

$$y_{it} = \mu_i + \beta_1' x_{it}\,(q_{it} < \gamma) + \beta_2' x_{it}\,(q_{it} \geq \gamma) + e_{it} \quad (5)$$

where q_{it} is the threshold variable, and γ is the threshold parameter that can potentially split the equation into two different regimes with the coefficients β_1 and β_2, respectively. The regressor x_{it} is a K vector. This equation can be written as follows:

$$y_{it} = \mu_i + \beta' x_{it}(\gamma) + e_{it} \quad (6)$$

where $\beta = (\beta_1', \beta_2')$ and $x_{it}(\gamma) = \begin{pmatrix} x_{it} I(q_{it} < \gamma) \\ x_{it} I(q_{it} \geq \gamma) \end{pmatrix}$

$I(.)$ is the indicator function, which take the value 1 if the argument (the argument is $(q_{it} < \gamma)$) is true and zero otherwise.

Taking the average of Eq. (6) over time produces:

$$\bar{y}_i = \mu_i + \beta' \bar{x}_i(\gamma) + \bar{e}_i \quad (7)$$

where $\bar{y}_i = \frac{1}{T}\sum_{t=1}^{T} y_{it}$ and similar notations apply to other variables. Taking the difference between (6) and (7) produces the following equation:

$$y_{it}^* = y_{it} - \bar{y}_i = \beta' x_{it}^*(\gamma) + e_{it}^* \quad (8)$$

In order to determine the thresholds value, least square is suggested by Hansen (1999).

$$\hat{\beta}(\gamma) = \left(X^*(\gamma)' X^*(\gamma)\right)^{-1} X^*(\gamma)' Y^* \quad (9)$$

The residuals vector is $e^*(\gamma) = Y^* - X^*(\gamma)\hat{\beta}(\gamma)$ and S_1 is the sum of squared errors given by the following equation:

$$S_1(\gamma) = e^*(\gamma)' e^*(\gamma) \quad (10)$$

The least squares estimator of γ is given by:

$$\hat{\gamma} = \text{argmin}\,(S_1(\gamma)) \quad (11)$$

The threshold is the value that minimizes the residual sum of squared. It is important to determine whether the threshold effect is statistically significant or not. Therefore, we set the following two hypotheses: $H_0: \beta_1 = \beta_2$ and $H_1: \beta_1 \neq \beta_2$. Under the null hypothesis of no threshold, the model is:

$$y_{it} = \mu_i + \beta_1' x_{it} + e_{it} \quad (12)$$

After the fixed-effect transformation is done, we obtain the following equation:

$$y_{it}^* = \beta_1' x_{it}^* + e_{it}^* \quad (13)$$

$S_0 = e^{*\prime} e^*$ is the sum of squared errors. Also, the likelihood ratio test of H_0 is:

$$F_1 = \frac{S_0 - S_1(\hat{\gamma})}{S_1(\hat{\gamma})/nT} \quad (14)$$

F_1 Has a nonstandard asymptotic distribution. We rely on the bootstrapping procedure to determine the distribution. Descriptive statistics of our variables are presented in Table 7 in the Appendix. They shows important differences across income level especially for the variables inflation, NIM, and ROA.

3. Results and discussion

3.1. Direct and indirect effects and stability of the relationship

As discussed above, we start our estimation by investigating the direct effect of corruption on the occurrence of banking crises. Table 1 display the results of the direct effect estimation. Results show that the profitability and the interest margins seem to be the most important variables driving the occurrence of banking crises. The coefficient related to the profitability variable displays a negative and significant sign, suggesting that more profitability is negatively linked to the occurrence of banking crises. Consistent with previous studies (Goldweski, 2005; Louzis et al., 2012), our results provide evidence that the higher the profitability displayed by a bank, the lower is the probability of its financial distress and therefore fragility. That is, more banking profitability would increase the stability of banks and therefore mitigate their fragility.

Estimation outcomes also report the existence of a positive relationship between the net interest margin and banking crises. This result shows that higher interest rates charged by banks to customers would probably attract the most risky borrowers – the adverse selection problem (Stiglitz and Weiss, 1981) – and induce an excessive risk taking by banks, that might consequently impact their vulnerability (García-Herrero et al., 2009; Weill, 2011b; Ahmad, 2013).

As regards the concentration-instability nexus, two main strands of studies highlight the relationship between concentration and the stability of the banking system (Ben Khediri et al., 2010). The first one, namely the concentration-fragility hypothesis, supports the idea that banking concentration has a destabilizing effect while the second one, the concentration-stability hypothesis, supports the existence of positive relationship between concentration and financial stability. Neither the first nor the second strand of literature holds for our sample

Table 1
Logit estimation - direct effects (Dependent variable: Crisis).

	Full sample	High income countries
ROA	−1.08***	−1.02***
	(−4.86)	(−3.63)
NIM	0.52*	0.5*
	(1.66)	(1.69)
CONC	−0.03	−0.01
	(−1.42)	(−1.51)
INS	−11.9	−7.3
	(−0.01)	(−0.38)
Inflation	0.37***	0.22***
	(4.12)	(3.98)
GDP	0.00003	0.00008
	(0.68)	(0.84)
Corruption	−1.85*	−1.33*
	(−1.8)	(−1.74)
LR-test	65.58***	55.52***

*, **, and ***, indicate significance at 10%, 5%, and 1% significance levels. T-statistics are between parentheses.

countries. Indeed, concentration does not seem to exert a noticeable impact on the occurrence of banking crises. This result is consistent with previous studies in the literature (Laeven and Valencia, 2008; Bretschger et al., 2012). The coefficient of the insurance deposit is negative but also insignificant, showing that it is not a determinant factor that might explain the occurrence of crises. As detailed in numerous studies, the existence of these deposits as explicit guarantees would induce excessive risk taking by non-accountable banks and could create more instability (Maggie et al., 2014). Numerous studies in the literature, in line with the moral hazard theory, support such an argument (Maggie et al., 2014). Estimation results of the macroeconomics variables considered show that the inflation coefficient is negatively and significantly influencing banking crises occurrence. This result is consistent with previous studies that considered inflation to be an important factor contributing to financial instability and leading to banking crises (Demirgüç-Kunt and Detragiache, 2011; Calmes and Theoret, 2014; Caglayan and Xu, 2016). When inflation increases, banks tend to increase their lending rates beyond the expenses and costs, which might involve banks in suspicious lending activity and excessive risk taking, inducing by these means more banking fragility.

Our variable of interest displays the highest coefficient among all variables. The negative and significant sign finds robust support for the suggestion that corruption plays an important role in explaining the occurrence of banking crises. This argument is in line with the recent findings of Chen et al. (2015) who show that banks in corrupt economies are more risk-taking and have more Non-Performing Loans (NPLs). In addition, in country setting framework, Lizal and Kocenda (2001) found that corruption in the Czech Republic increased the volume of bad loans and drove banks to collapse. In addition, while using microeconomic data to analyze the effect of corruption on banks' risk-taking in the emerging economies for the period 2000–2012. Although this result shows that a high rate of corruption could undermine the stability of the banking system and create more crises, it does not show through which channel this could happen. To investigate this issue in more depth, we consider two different channels through which corruption could impact the probability of occurrence of banking crises, namely the profitability (ROA) and the interest rate channel (NIM). Table 2 displays the channels' estimations from the models 2 and 3. These estimations will be used to get the outcome of the indirect effect from the estimation of the model 4 (Table 3). Results of the estimations show that – as previously – the concentration does not show any significance in our model. This suggests that the occurrence of banking crises does not heavily depend on the degree of concentration of the banking system. Estimation outcomes of the other variables show that some coefficients display the same signs reported in the previous estimations or no significance for the other variables. Corruption is still producing a significant and positive effect for both the profitability and the interest margin channels. Our results suggest therefore that curbing corruption can reduce the probability of currency crises. A possible explanation for transmission mechanism is that when banking institutions accumulate high non-performing assets, the net interest margin will go down, since the earned assets will be undermined by these non-performing loans, considered as risky assets that do not generate income. A high level of corruption will push banks to display higher interest rates (the additional amounts claimed by corrupt bankers for granting credit) and engage in excessively risky activity that will accumulate high non-performing assets, undermining the stability of the banking sector (Demirgüç-Kunt, 1989; Reinhart and Rogoff, 2011). Therefore, curbing corruption induces better NIM that can reduce the occurrence of crises. Estimation results also show that the profitability channel still exists but with less effect. Improvement in the institutional framework can induce upward movements of the net interest margin earned by banks, minimize the non-performing loans, and create less vulnerability to crises. That is, the lower the corruption level, the fewer the crises are. As reported previously, inflation is still producing a positive and significant sign on the occurrence of banking crises.

Numerous studies report the existence of a nonlinear relationship between corruption and countries' level of income (Saha and Gounder, 2013; Saha and Ben Ali, 2017). Therefore, to check for the stability of this relationship for different levels of income, we estimate the direct impact of our model while considering countries' income. Estimation results presented in Table 1 show that higher corruption creates more banking instability. High-income countries usually have better institutions, allowing better control of corruption (La Porta et al., 1999; Svensson, 2005). The other variables still have the same signs and coefficients as previously. Estimation of the indirect effects of corruption on both channels (the profitability and the interest rate) for this high-income countries subsample shows the same results as previously (Table 3).

3.2. Threshold effects in the corruption-banking crisis nexus

To account for the potential existence of a threshold, we estimate the model (1) detailed above. Before estimating the Hansen (1999)'s model, we transformed the binary crisis variable to a continuous variable and we approximate by the probability of realization of crises π_i (if $BCRISIS_i = 1$, we obtain π_i, and if $BCRISIS_i = 0$, we obtain $1 - \pi_i$).[3] Estimation outcomes report the existence of two different regimes for corruption: a lower and an upper regime (Table 4). Indeed, it can be clearly seen that the null hypothesis of no threshold can be rejected at least at the 1% significance level, indicating a significant presence of a nonlinear threshold effect of corruption on banking crises. The corruption cut-point between the two regimes is −0.18 on a −2.5/2.5 scale for the full sample. Below this threshold value, corruption displays a positive impact on the risk of banking crises and increases their probability. The results show that any corruption level below the −0.18 cutoff point induces more fragility of the banking system. Also, with a high-level corruption coefficient (converging to −2.5), a 1 percent increase in ROA may increase the probability

[3] The Logit transformation is one-to-one. The inverse transformation is sometimes called the antilogit, and allows us to go back from logits to probabilities $\pi_i = \frac{e^{Z_i}}{1+e^{Z_i}}$ with $Z_i = \text{logit}(\pi_i) = X'_i\beta$.

Table 2
Blundell-Bond estimator — channels estimations.

	Dependent variable: ROA		Dependent variable: NIM	
	Full sample	High income countries	Full sample	High income countries
ROA{-1}	0.23***	0.26***		
	(3.79)	(3.59)		
NIM{-1}			0.18***	0.17**
			(2.89)	(3.68)
CONC	0.007	0.001	0.008	−0.004
	(0.73)	(0.13)	(1.18)	(−0.71)
CIR	−0.02***	−0.02***	0.005	0.012**
	(−2.81)	(−2.93)	(0.8)	(2.21)
GDP	−0.00003	−0.00002	−0.0001**	−0.00005***
	(−1.37)	(−1.25)	(−2.33)	(−4.14)
Inflation	0.032***	0.06**	0.05**	0.05***
	(2.81)	(2.04)	(2.32)	(3.74)
Corruption	0.87**	0.22*	2.02***	1.18***
	(2.4)	(1.78)	(4.1)	(3.88)
constant	1.88*	1.7	2.59	1.72***
	(1.75)	(1.17)	(1.41)	(2.99)
Wald-test	130.6***	174.03***	72.44***	73.88***

*, **, and ***, indicate significance at 10%, 5%, and 1% significance levels. T-statistics are between parentheses.

Table 3
Logit estimation — indirect effects (Dependent variable: Crisis).

	Full sample	High income countries
Inflation	0.4***	0.45***
	(3.64)	(4.02)
GDP	−0.0001*	−0.00009*
	(−1.88)	(−1.74)
$\widehat{ROAES}$	−0.65**	−0.83***
	(−2.17)	(2.56)
$\widehat{NIMES}$	−1.31*	−1.31**
	(−1.86)	(2.46)
LR-test	29.3***	20.77***

*, **, and ***, indicate significance at 10%, 5%, and 1% significance levels. T-statistics are between parentheses.

of crises by 0.019 percent, while with a low-level corruption coefficient (converging to 2.5) it may decrease the probability of crises by 0.13 percent. This finding shows that when corruption is pervasive, it significantly aggravates the problem of adverse selection and creates more bad loans. In addition, it can induce a distortion allocation of banks' funds from profitable to suspicious ones that may create more banking distress.

Table 6 provides the list of countries below/above the threshold for our last year of study (the year 2017). This supports the idea that, for the countries in the left-hand side column of Table 6, any increase in the control of corruption coefficient avoids a banking crisis. Numerous studies in the literature support such an argument for different countries, such as Claessens et al. (2008) for Brazil, Wedeman (2012) for China, Quah (2008) for India, Morris and Klesner (2010) for Mexico, Weill (2011b) for Russia, Corke et al. (2014) for Turkey.

As reported in Table 4, estimation results for the high-income countries subsample still report the existence of a nonlinear relationship between corruption and banking crises, with a corruption cutoff threshold of −0.09 between the low and the high corruption regimes. Below this threshold value, corruption increases the probability of banking crises. More results show that the corruption coefficient for this subsample is significant and positive (3.8), suggesting that the higher the corruption level, the higher the fragility of the banking system. These results confirm our previous finding and support further evidence that countries' banking systems are not similarly impacted by corruption. That is, only pervasive corruption has a deleterious effect on the stability of banks.

More estimation outcomes show that with a low level of the corruption l (converging to 2.5), a 1 percent increase in the ROA can decrease the probability of crises by 0.07 percent.

3.3. Robustness check: direct and threshold effects

So far, we have used the World Bank corruption index. The results have provided evidence of a significant nonlinear relationship between corruption and banking crises. For a robustness check, we use in this section the ICRG corruption index.

As displayed in Table 5, estimation outcomes of the model 1 using the ICRG index as proxy for corruption report similar results as previously. Indeed, the panel threshold analysis provides evidence of a significant nonlinear relationship between corruption (ICRG) and banking crises. The cutoff point for corruption is around 2.5 for the full sample. Moreover, we confirm our previous results as corruption appears to exert a significant and negative effect on the probability of banking crises only when it is below a certain threshold level of corruption. The impact of the coefficients of inflation, ROA and NIM is confirmed as being the same as in the first estimation. The results reported in Table 5 support the same impact of inflation, ROA and corruption in increasing the probability of banking crises.

4. Conclusion and policy implications

We assess in this study the impact of corruption on the stability of the banking system for a sample of 38 countries over the period 2000–2017. We first consider the direct impact of corruption on the stability of the banking system. Estimation outcomes show that a high level of corruption leads to less stable banks and therefore a high probability of crises in the banking system. To further investigate this impact we hypothesize two main channels through which corruption could undermine the stability of the banking system, namely the profitability channel - through the return on assets measure (ROA), and the interest rate channel - through the net interest margin (NIM). Estimation outcomes show robust support for the suggestion that corruption influences the interest margin channel more than the profitability one. Corruption induces excessive risk taking to increase the interest margin, which will attract more risky borrowers, increasing to the same extent the non-performing loans and inducing therefore a higher probability of crises.

Numerous studies in the literature report a nonlinear relationship between corruption and countries' income levels. Therefore,

Table 4
Panel threshold regression for probability of banking crisis — corruption.

	Full sample		High income countries		Low income countries	
Threshold ($\hat{\tau}$)	−0.18***		−0.09***		−0.03*	
	(156.97)		(206.17)		(48.34)	
Constant	0.83***		0.66***		0.93***	
	(10.55)		(12.06)		(5.95)	
CONC	−0.005***		−0.005***		−0.005***	
	(−11.12)		(−16.69)		(−4.4)	
Inflation	0.018***		0.059***		0.006***	
	(13.87)		(37.29)		(3.18)	
GDP	0.00003		0.059***		−0.00005	
	(0.19)		(37.29)		(−0.46)	
	Low regime ($\leq \tau$)	High regime ($> \tau$)	Low regime ($\leq \tau$)	High regime ($> \tau$)	High regime ($\leq \tau$)	High regime ($> \tau$)
ROA	−0.019**	−0.13***	−0.07***	−0.15***	−0.02**	−0.07***
	(−2.11)	(−24.1)	(−5.96)	(−45.38)	(−2.14)	(3.09)
NIM	0.01***	0.07***	0.27***	0.07***	0.037***	0.01**
	(2.59)	(11.36)	(3.65)	(14.71)	(3.09)	(2.16)
Corruption	0.16**	0.01	3.8***	0.02	0.02*	−0.36
	(2.41)	(0.43)	(2.87)	(1.31)	(1.66)	(−0.72)

*, **, and ***, indicate significance at 10%, 5%, and 1% significance level. T-statistics are between parentheses.

Table 5
Panel threshold regression for probability of banking crisis — ICRG.

	Full sample		High income countries		Low income countries	
Threshold ($\hat{\tau}$)	2.5*		2.00***		2.50**	
	(20.55)		(119.22)		(18.5)	
Constant	0.83***		0.629***		0.80***	
	(9.52)		(10.42)		(6.22)	
CONC	−0.0039***		−0.0033***		−0.004***	
	(−7.28)		(−9.42)		(−4.26)	
Inflation	0.013***		0.053***		0.009***	
	(10.39)		(32.52)		(5.60)	
GDP	−0.0001		0.0001***		−0.0001	
	(−0.60)		(4.12)		(−0.39)	
	Low regime ($\leq \tau$)	High regime ($> \tau$)	Low regime ($\leq \tau$)	High regime ($> \tau$)	High regime ($\leq \tau$)	High regime ($> \tau$)
ROA	−0.082***	−0.11***	−0.073***	−0.139***	−0.053***	−0.126*
	(−16.78)	(−8.67)	(−14.01)	(−35.68)	(−3.60)	(−1.89)
NIM	0.041***	0.08***	0.025**	0.053***	0.034***	0.041**
	(6.42)	(7.34)	(1.90)	(9.88)	(3.35)	(2.34)
Corruption (ICRG)	0.054***	0.018	2.014*	−0.002	0.056*	−0.02
	(3.24)	(1.58)	(1.76)	(−0.33)	(1.70)	(−0.75)

*, **, and ***, indicate significance at 10%, 5%, and 1% significance level. T-statistics are between parentheses.

Table 6
List of countries below/above the threshold.

Countries below the threshold	Countries above the threshold		
Brazil	Austria	Greece	Norway
China	Belgium	Hungary	Poland
India	Bulgaria	Ireland	Portugal
Macedonia FYR	Croatia	Italy	Romania
Mexico	Czech Republic	Japan	Slovak Republic
Russian Federation	Denmark	Korea. Rep	Slovenia
Turkey	Estonia	Latvia	Spain
	Finland	Lithuania	Sweden
	France	Luxembourg	Switzerland
	Germany	Netherlands	United Kingdom
			United States

we estimate our model for various subsamples to check for the stability of this relationship. Our results also report the existence of a nonlinear relationship defining two different regimes: a lower regime and an upper one, with a threshold cutoff point for corruption.

Robustness check of our model, using a second corruption measure (the International Country Risk Guide index) confirms our previous results. The panel threshold analysis gives evidence of a significant nonlinear relationship between this new corruption measure and banking crises.

Numerous policy implications emerge from our paper. Corruption decreases bank profitability and increases interest margin – by acting as an additional cost that attracts more risky borrowers and makes the banking system more vulnerable to crises. Corruption could be a serious cause of banking systems crises. This will help in better understanding how corruption affects the banking system, and in designing a regulatory power to combat corruption in order to improve bank-lending activity. In addition, the threshold analysis conducted give more insights to the level of corruption below/above which countries banking systems' begin to be exposed to a high risk of stability/instability. A way to curb the adverse effects of corruption on bank lending is to have an effective regulatory system.

Table 7
Descriptive statistics.

	Mean	Std. Dev.	Min	Max
Full sample				
GDP	29 327.18	21 313.78	971.22	91 617.18
Inflation	2.828	2.854	−4.478	15.53
NIM	2.55	1.573	0.124	8.762
CONC	63.27	18.52	20.48	100
ROA	0.624	1.154	−8.52	4.24
Corruption	3.34	1.14	1.5	5.5
High income countries				
GDP	35 840.92	20 246.4	9949.25	91 617.28
Inflation	1.95	1.96	−4.47	15.4
NIM	1.952	0.976	0.124	4.977
CONC	68.36	16.86	29.85	100
ROA	0.428	1.187	−8.52	4.241
Corruption	3.68	1.07	2	5.5
Low income countries				
GDP	8157.52	3477.12	971.22	14 936.4
Inflation	5.65	3.42	−1.54	15.53
NIM	4.49	1.57	1.44	8.76
CONC	46.71	13.3	20.48	99.93
ROA	1.26	0.74	−1.92	2.95
Corruption	2.21	35.36	1.5	3

CRediT authorship contribution statement

Mohamed Sami Ben Ali: Data curation, Formal analysis, Methodology, Investigation, Writing, Review, Editing. **Fredj Fhima:** Conceptualization, Investigation, Writing, and review. **Ridha Nouira:** Methodology, Software, Formal analysis.

Appendix

See Tables 6 and 7.

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(5) "The limits of social identity impact on economic preferences" [Journal of Behavioral and Experimental Finance, 2019; 24C: 100239] https://doi.org/10.1016/j.jbef.2019.100239.
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