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Does Compensation Drive Systemic Risk? Evidence from the Tunisian Banking Sector

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Abstract

Weak and ineffective bank governance mechanisms are identified as the main triggers of a financial crisis. One of the main issues raised by researchers is the role of executive compensation in encouraging risk-taking. We conduct this research to determine whether executive compensation is an incentive for risk-taking and contributes to the overall systemic risk for a sample including seven banks from the biggest private Tunisian listed banks over the period 2009-2019. Based on the agency theory and the moral hazard hypothesis, compensation is assumed to be an incentive for interest and risk preferences alignment. Indeed, our results show that managers are willing to take excessive risks that may increase systemic risk levels. Managers tend to be risk seeking to increase bank performance and are motivated to keep their position, and their job opportunities. Surprisingly, the robustness test highlights that only fixed component is related to systemic risk measures suggesting that, provided with fixed wages, managers feel safe and are not reluctant to invest in all projects reporting positive net present value irrespective of their risk which may result in excessive risk taking.

Keywords

Systemic Risk, Executive Compensation, Bank-Risk Taking, Tunisian Banking Sector

1. Introduction

In the aftermath of the global financial crisis of 2008, regulators, bank supervisors and policy makers have argued that executive compensation leading to excessive risk is among the main triggers of the financial crisis (Board of Gover-

nors of the Federal Reserve System, 2009, 2010; Basel Committee on Banking Supervision, 2010).

Indeed, the financial crisis has revealed that excessive risk taking resulting in higher systemic risk has adverse consequences on financial stability, social well-being and economic growth. Generally, compensation package of top managers is designed to alleviate agency problems between managers and shareholders. Nevertheless, with regard to the banking sector, compensation as an incentive may promote excessive risk taking and encourage top managers to be risk-seeking (Bai & Elyasiani, 2013; Gande & Kalpathy, 2017).

A large stream of research addressed the effects of managerial compensation on bank performance and risk taking. Several studies examined how compensation and managerial incentives have affected the riskiness of financial institutions (Gande & Kalpathy, 2017; Bharati & Jia, 2018).

For instance, Guo et al. (2015) examine the link between CEO compensation and risk taking and find that higher default risk and stock return volatility are associated with incentive compensation. Furthermore, DeYoung et al. (2013) and Bai and Elyasiani (2013) argue that compensation is among the key determinants of bank risk taking and bank policies. Their findings indicate that higher levels of systemic risk and idiosyncratic risk are associated with higher CEO compensation sensitivity to stock return volatility. In addition, they argue that banks involving in non-traditional banking activities contribute more to systemic risk levels. Hence, managerial compensation may generate bank instability and lead to higher levels of both idiosyncratic and systemic risk. However, in contrast to previous studies, Bharati and Jia (2018) argue that systemic risk is negatively related to the sensitivity of CEO pay to stock return. They postulate that the link between pay for performance sensitivity and systemic risk does not exist. Overall, it is shown that previous studies report mixed results about whether managers' compensation affects risk taking and systemic risk.

Systemic risk can be described as the risk of the presence of a tough systemic event which can adversely affect financial institutions. It can be also defined as the measure of the independencies between the risk profile of an individual financial institution and the aggregate riskiness of the financial system.

Based on prior literature, we presume that compensation may influence the level of systemic risk. According to the agency theory, compensation is generally designed for interest alignment by increasing managerial risk taking so that managers will undertake risky and value-enhancing investments. Indeed, the agency theory postulates that compensation can reduce the difference between risk preferences of shareholders and those of executives by inducing managers to take more risks (Pathan, 2009). According to Fahlenbrach and Stulz (2010), greater incentive alignment between managers and shareholders can have adverse consequences on financial stability. Given the moral hazard problem which is basically linked to too big to fail phenomenon, government support through implicit or explicit government bailout, the presence of deposits insurance and

even managerial compensation may encourage top managers to adopt risky strategies and decisions that can lead to higher level of systemic risk (Acharya, 2009[1]). Furthermore, it is worth saying that managers and executives of systemically financial institutions do pay attention neither to the adverse consequences that they are responsible for, nor for their excessive risk taking. Hence, compensation may increase not only the individual risk of the financial institution but it contributes to the level of systemic risk and to create negatives externalities on the financial sector. From another perspective, compensation, itself, may not be the prominent determinant of bank risk-taking. Thus, managers may give much importance to their reputation and their positions within banks and care for their job opportunities (Chen & Ebrahim, 2018). Thus, managers may act as risk averse and opt for less risky strategies that reduce the risk profile of the bank.

Accordingly, the main purpose of this study is to provide empirical evidence on the impact of cash-based compensation on systemic risk level in the Tunisian banking sector. It is worth saying that there is an ongoing debate on best practices of banking governance in Tunisia with the purpose to capitalize on the feedback from the actual practices. Indeed, the law of banks and financial institutions n˚2016-48 has already initiated several governance requirements, for instance, related to the setting of the remuneration and nomination committees which its role is to determine the appropriate remuneration policies for the key bank management. Moreover, the Central Bank is working on a new project that tends to rise up some developments in the governance area to align with the international standards.

This study will consequently extend our understanding of whether the remuneration of top managers triggers systemic risk level. Doing so, in our empirical analysis, we selected seven biggest Tunisian private banks from eleven listed banks on the Tunisian stock exchange from 2009 to 2019. Public banks are excluded because of their divergent governance culture and remuneration gap between private banks' managers and those of public banks. Following prior literature such as those of Choi (2014) and Ghrab et al. (2021), we measure CEO compensation as the cash based compensation since the data on the variable component is not available. We follow prior studies (e.g., Iqbal et al., 2015, 2019; Acharya, 2009; Acharya et al., 2017) and we use market-based approach to measure systemic risk level using the marginal expected shortfall (MES) and SRISK for robustness check as proposed by Acharya et al. (2012, 2017) and Brownlees and Engle (2017). Furthermore, to alleviate the small size of our sample, we referred to the bootstrap technique

While it contributes to the extant literature, to the best of our knowledge, the current paper is the first that questions the relationship between cash-based compensation and systemic risk in the Tunisian banking sector. From a comprehensive view, Tunisia is among the bank-based financial structure countries

[1]For more details, Acharya (2009) provides a discussion on how moral hazard problem leads to systemic risk.

where financing is dominated by banks. Borrowers are fully dependent on bank lending and the financial market has less chance to be developed in the financial intermediation process. During the banking crises, bank-dependent firms may undergo larger and heavy losses and declines in its profitability. Hence, systemic risk is assumed to be more severe for bank-based financial structures rather than market-based financial structures. Bats and Houben (2020) argue that systemic risk rises more than proportionally when bank financing increases relative to market financing. Thus, it will be very useful to assess if Tunisian banks is running high risks that could develop a systemic risk. Furthermore and to control for statistical bias, we referred to the bootstrap technique in order to alleviate the small size of our sample.

The remainder of this paper proceeds as follows. Section 2 reviews the related literature on the linkage between managerial compensation and systemic risk. Section 3 presents the data and the variables used in our empirical analysis. Section 4 describes the method and reports the findings. Finally, Section 5 summarizes the results and concludes the paper.

2. Related Literature

After the global financial crisis, policymakers and regulators argued that executive compensations at banking institutions can generate risk-taking and are qualified among the contributors of crisis development (Kirkpatrick, 2009; Basel Committee on Banking Supervision, 2010). Moreover, the financial crisis has shown the adverse consequences of both excessive risk-taking incentives and systemic risk on economic growth, financial stability, and societal well fair.

Our study is based on several strands of research. In addition to those examining the link between managerial compensations to firm performance and risk-taking behavior, our study will draw on a large view to take systemic risk into consideration instead of only examining the individual bank risk.

Non-financial institutions are fundamentally different from financial institutions with regard to their business models, the degree of opaqueness, their exposure to authority supervision, and their due to respect several micro and macro prudential policies. In addition, within the banking industry, the high concern is drawn to the existence of a deposit insurance system, regarded as depositors' protection. Furthermore, compared to non-financial companies, managerial compensation seems to be more regulated in the banking regulatory framework in the sense that banks should implement remuneration committee in order to fix the adequate compensation plan for the top management position. Hence, many pieces of research are warranted on the implication of managerial compensation on the stability of the financial institution and on the banking industry, at large.

With regard to the Tunisian banking sector and based on the circular 2016-48, banks should implement remuneration committees that can design properly the compensation package of managers and set fixed and variables components of

the remuneration. It is worth noting that managers of private banks receive a high remuneration compared to public banks and are generally indexed to targets achievements, especially with regard to bank performance.

Based on the literature review, top executives' compensations are supposed to mitigate agency problems and to align the interest between managers and shareholders. However, the compensation package may generate excessive risk-taking in the banking industry (Gande & Kalpathy, 2017), and thus, the question of whether executive compensation increases the level of systemic risk is raised. Generally, stakeholders including depositors are focusing on risk minimization, whereas shareholders are more likely to accept the risk to maximize their claims. With the purpose to minimize the divergence of interest, the agency theory proposes a range of incentive alignment and it recommends the design of executives' compensation packages. Indeed, the agency theory postulates that compensation can reduce the difference between the risk preferences of shareholders and those of executives by inducing managers to take more risks (Pathan, 2009).

For a deep analysis, in contrast to shareholders who opt for risk-seeking strategies, managers may prefer less risk for several reasons. Unlike investors, the wealth of managers is mostly based on the bank they manage and, hence, they are constrained by their bank-specific investments. Consequently, managers are supposed to protect it internally by selecting safe assets or by diversification (Smith & Stulz, 1985). Furthermore, shareholders are more likely to diversify their portfolio risk in the financial market, whereas managers are more dedicated to doing so at the bank level (May, 1995). From another conjecture, the cost of bankruptcy may induce bank managers to select safe assets rather than risky projects (Parrino et al., 2005). To mitigate this agency problem, bank shareholders will incentivize managers to invest in all projects reporting net present value irrespective of their risk (May, 1995); and thus, the design of compensation as an incentive may help align the interests between the agent and the principles.

Moreover, bank managers can act differently with regard to risk-taking incentives. In fact, when managers receive fixed wages, they are less likely to take risks because they will have a little gain if the bank does well but they may lose their job if the bank goes bankrupt (Saunders & Cornett, 2006).

From another conjecture, the agency problem may be more severe in the banking sector for a couple of reasons. Firstly, the opacity and the long maturity of the assets help easily covering the misallocation of resources, at least in the short term. Secondly, the wide dispersion of bank debt among small and uninformed investors may weaken discipline on banks. Thus, since banks can behave less prudently without being easily detected, they have incentives to take risks than other firms in other industries. Furthermore, powerful managers may receive from weak shareholders rents benefits greater than those obtained from the arm's length leading (Bebchuk et al., 2003). Consequently, managers may peruse

excessive risk to maximize their short-term wealth at the expense of long term shareholders' value (March & Shapira, 1987).

Empirically, a recent study by Iqbal et al. (2019) examines the link between systemic risk and top executives' compensation sensitivity to changes in stock price and return volatility. While using a sample of US financial institutions, they find a negative link between systemic risk and the sensitivity of compensation to stock return volatility. However, during the peak of the financial crisis, managerial risk-taking incentives are found to be positively related to systemic risk level. Furthermore, Bai and Elyasiani (2013) and Bharati and Jia (2018) investigate whether CEO incentives generate a bank's default risk, systemic risk, and idiosyncratic risk. While Bai and Elyasiani (2013) postulate that the higher CEO compensation sensitivity to stock returns volatility, the higher are the idiosyncratic risk and systemic risk; Bharati and Jia (2018) find no conclusive evidence between CEO incentives and bank risk-taking.

Furthermore, a stream of research has employed the contracting theory to design optimal managerial compensation. In fact, based on the contracting hypothesis, banks that report greater growth opportunities are more likely to set equity-based incentives in the manager's compensation package. Thus, compensation may induce executives to engage in more risky activities. This argument gives insight into the extent of agency conflicts, especially between shareholders and deposit insurer. In fact, bank depositors feel safe when a bank gets insolvent simply because their deposits are federally protected. With regard to this federal safety, bank shareholders and even managers will appreciate excessive risk-taking, even if this risk is not deemed to be safe and sound. This is a kind of moral hazard problem that may increase the likelihood of loss exposure. Indeed, Houston and James (1995) suggest that moral-hazard conflict is severe for troubled and for too big to fail banks. In fact, shareholders are less likely to lose in case of bank failure. In addition, too big to fail institutions may receive subsidies to take a greater risk. Overall, the extent of a government bailout is seen to limit the control of depositors and debt holders, and therefore banks will take a greater risk.

With regard to the Tunisian banking system, it is commonly argued that it is plagued with several weaknesses and problems related to under-capitalization, weak reporting and disclosures, deficiencies in the supervisory process, and management risk (Jebnoun, 2015). Based on the argument listed under the agency theory, the moral hazard hypothesis and the arm's length contracting approach, banks may take a greater risk; and managers' compensation can promote risk-taking that contributes to the level of systemic risk. Thus, our hypothesis is formulated as follows:

Managers' compensation is tied to banks' contribution to systemic risk.

3. Data and Variables

Our sample is drawn from 7 biggest private listed Tunisian banks on the Tuni-

sian stock exchange (TSE) between 2009 and 2019. These banks are selected according to their total assets and represent roughly 30% of market capitalization (from 41% of market capitalization represented by 11 listed banks). We attempted to exclude public banks because of the divergence in the remuneration policy and in governance culture. Overall, our sample consists of 77 firm-year observations. The period is chosen with reference to data availability. In fact, it is noticed that the remuneration of the managing directors is publicly disclosed from 2009, from which we start collecting data. Data on CEO compensation of listed banks are collected manually from the financial statements. Control variables are collected either from the Tunisian central bank or from banks' annual reports and financial documents. As for systemic risk measures, we follow the methodology of Acharya et al. (2012; 2017) and Brownlees and Engle (2017).

Thus, our variables and its measures are presented as follows:

- **Systemic risk measures**

With regard to systemic risk measures, several risk metrics approaches have been suggested in the literature. These alternatives could be classified into two groups know as accounting-based and market-based systemic risk measures. The first alternative is based on balance sheet variables and oriented backward-looking. While the second alternative uses market data and provides a timelier estimate of the risk. Unlike Khiari et al. (2018) who use the Covar estimation as a proxy of systemic risk, we attempt to use in our study the market-based measure as the marginal expected shortfall (MES) suggested by Acharya et al. (2012, 2017) and Brownlees and Engle (2017). This measure is built from publicly available stock market data and tries to assess the capital shortfall of each bank based on its return volatility and correlation with the market. In our study, we use the average of daily MES as our dependent variables.

Acharya et al. (2012) define MES as the loss of equity capital during a market stress period. The authors postulate that MES can be defined as the daily percentage decrease in equity value when the stock market declines by a certain threshold (C). In other words, in the case of a bank recording a high level of MES, the latter may be bankrupt and almost its capital equity will be depleted during a crisis. Brownlees and Engle (2017) argue that undercapitalized financial institutions are the main contributors to systemic risk. Thus, evaluating systemic risk will be as follow:

$$MES_{i,t+h/t}(C) = -E(R_{i,t+h/t} | R_{m,t+h/t} < C)$$

where $R_{i,t}$ is the bank stock return, $R_{m,t}$ denotes the return of TUNBANK between t and $t+h$, C is the historical Value at risk (threshold of market decline). We take the daily return on the bank index and the daily return on the bank stock. We set t measured in days and h is equal to one day and C equal to −1.743% at a 99% confidence level. So, we obtain daily MES over the period 2009-2019 and it is the one-day loss if the market index declines by 1.743%. The literature suggests a range of modeling alternatives to calculate the MES. Thus, we follow previous studies (Brownlees & Engle, 2012) and we use the multiva-

riate DCC-GARCH modeling to capture the time-varying dependencies.

To examine the robustness of our results, we attempt to conduct additional analyses. We attempt to include an additional variable named SRISK. It extends the MES to take into consideration the size and the liabilities of the financial institutions. The SRISK reflects the expected capital shortfall of the financial institution, conditional on a market stress period or on a financial crisis that affects the whole financial system. The authors argue that the higher the SRISK is (equal to greater capital shortfall), the more is the contribution to the overall systemic risk. Hence, the banks which record higher SRISK are assumed to be systemically risky. According to Acharya et al. (2012, 2017), SRISK is estimated as follows:

$$SRISK_{i,t} = E_{i,t}\left[k\left(Debt_{i,t} + Equity_{i,t}\right) - Equity_{i,t} \middle| Crisis\right]$$

$$SRISK_{i,t} = k\left(Debt_{i,t}\right) - (1-k)\left(1 - LRMES_{i,t}\right) Equity_{i,t}$$

where *k* refers to the prudential capital ratio which is taken to be 10% (8% before 2013, 9% in 2014, and 10% from 2014), LRMES[2] is the long-run marginal expected shortfall, Equity is the market capitalization, and Debt is bank liabilities. Hence, SRISK is the equity capital amount required by a financial institution within a crisis period in which the value of equity falls with regard to the LRMES while the level of liabilities remains constant. Note that, in the calculation of SRISK, we will ignore banks that record capital surplus (negative value of SRISK) and will take the value of null (Alexey et al., 2017; Acharya et al., 2012). In our empirical analysis, we used the natural logarithm of SRISK.

- **Managers' compensation**

As we will be focusing on managers' compensation as a governance mechanism in the Tunisian banking context, we consider the logarithm of cash-based compensation as a proxy for executive pay collected from annual financial statements.

- **Control variables**

In our empirical analysis, several control variables are employed to account for the potential effects of the banks' specific features on the level of systemic risk. Hereafter, we will be presenting the measure and its potential signs.

- **Firm size (size)** is among the important control variables, especially when comparing between financial institutions. Different sized institutions have different strategies, corporate governance mechanisms, characteristics, range of products, and services (Palvia et al., 2015). Furthermore, the larger institutions are, the more they have greater systemic importance. Following prior literature, the size is measured by the natural logarithm of total assets (Iqbal et al., 2019). With respect to systemic risk, prior studies find mixed results. While Iqbal et al. (2015) postulate that systemic risk is high for larger institu-

[2]The long-run marginal expected shortfall (LRMES) is defined as the long-run MES measured over a period of six months. This risk measure postulates that the banks recording the highest level of LRMES during a given period are the most contributors to the systemic risk and, thus, qualified as systemic risk drivers. Acharya et al. (2012) suggest a proxy using the daily MES as follows: $LRMES_{it} = 1 - \exp(-k * MES_{it})$.

tions, Mayordomo et al. (2014) find no significant link between bank size and systemic risk.

- **Capital ratio (*CapR*)** is calculated as the ratio of equity capital to weighted total assets. Acharya et al. (2016) posit that capital ratio is a predominant factor in explaining the systemic risk. Furthermore, Brownlees and Engle (2017) argue that the level of systemic risk is reflected by the degree of undercapitalization of institutions.
- **ROA** as a performance of the financial institution and calculated as the ratio of net income to total assets. Profitability can be a proxy of management quality and more profitable financial institutions are more likely to set capital buffers and to reduce the systemic risk. Recent studies, such as those of Iqbal et al. (2015) and Berger et al. (2016), find a negative link between systemic risk and profitability.
- **Loans to assets (LTA):** we follow previous studies like those of Iqbal et al. (2015, 2019) and we include loans to assets ratio (*LTA*) to control for the business model and the asset structure of the financial institution. Logically, granting loans results in bank risk increase and thus we hypothesize that the LTA ratio is positively linked to systemic risk.
- **Deposits to assets ratio (*DTA*):** alike prior recent studies such as those of Iqbal et al. (2015, 2019), we include deposits to assets ratio (*DTA*) to control for the funding structure of the financial institutions. This ratio indicates the relative portion of assets funded by deposits. Furthermore, when banks have deposits, they are more likely to grant loans and to invest which increases the bank's risk. Thus, a positive sign between the DTA and systemic risk is expected.

The definitions of variables are presented in Table 1.

Table 1. Variables definitions and measures.

Variable	Definition	Measures
MES	Marginal Expected Shortfall	See Acharya et al. (2012, 2017)
SRISK	Bank's contribution to systemic risk	$SRISK_{i,t} = k\,(Debt_{i,t}) - (1 - k)\,(1 - LRMES_{i,t})\,Equity_{i,t}$
CEOPay	CEO compensation	Cash compensation
Size	Bank size	Logarithm of total assets
CapR	Capital ratio	Equity capital divided by total assets
ROA	Return on assets	Net income scaled by total assets
LTA	Loans to assets	Loans divided by assets
DTA	Deposits to assets	Deposits divided by assets

4. Empirical Results

4.1. Descriptive Statistics

Table 2 summarizes the descriptive statistics of independent, control, and dependent variables used in our empirical analysis.

Table 2. Summary statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Panel A: Systemic risk measures					
MES (%)	77	0.231	0.09138	0.0979	0.4257
SRISKMD	77	55.231	95.786	0	349.588
Panel B: Independent variable					
CEOPay (mDT)	77	928.744	420.285	254.045	2129
Panel C: Control variables					
ROA (%)	77	1.227	0.5316	0.1	2.4
Size (mDT)	77	6336.126	3142.81	2082.971	17990.95
CapR	77	11.239	2.173	4.4	18.2
LTA	77	0.674	0.106	0.0931	0.845
DTA	77	0.661	0.0612	0.528	0.771

This table provides the summary statistics of all variables used in model specifications. Panel A presents descriptive statistics of our key variables systemic risk measures (MES and SRISK). Panel B contains descriptive statistics of the interest variable, CEO pay. Finally, Panel C presents summary statistics of our control variables. The details of variables' description as well as their measures are reported in **Table 1**.

Panel A presents the descriptive statistics of systemic risk measures, named MES, and SRISK. MES records a minimum of 0.0979% and a maximum of 0.4257% over the period 2009-2019. It is evident that the higher the systemic risk measure is, the more is the contribution of the bank to systemic risk. From this output, our sample seems to be heterogeneous and contains banks that show different levels of systemic risk. This joins the findings of Mselmi and Regaieg (2018). The examined sample recording an average of 6% of SRISK (%) over the period 2006-2013 and the authors argue that the banking sector is sensitive to political interference that triggers stock price volatility.

Panel B presents the descriptive statistics of the independent variable. The panel shows up the high disparity in CEO pay over the period 2009-2019 between private banks with a minimum of 254 mDT and a maximum of 2129 mDT.

Panel C presents the descriptive statistics of the control variables. Our sample is divergent and contains different bank sizes. The amount of total assets ranges from 2,082,971 mDT to 17,990,945 mDT. It is recorded that the biggest bank with reference to total assets is BIAT and the smallest bank in our sample is UBCI. Turning to the profitability measure, ROA varies substantially from 0.1% to 2.4%. Almost this performance measure indicates the disparities existing between our sampled banks which are shown through wide spreads. Our Tunisian sampled banks show relatively low performance with an average performance of 1.22%. The panel shows up that the capital ratio varies from 4.4% to 18.2%. Tunisian banks should respect a capital ratio of 10% from 2014 (it was equal to 8% before 2013 and 9% in 2013). This finding indicates the high disparity between banks which display good soundness and stability and which display bad risk

management.

LTA presents a mean of 67%, a minimum of 9.3% and a maximum of 84%. Furthermore, the descriptive statistics report a DTA average of 66%, a minimum of 52% and a maximum of 77%. We could note that deposits constitute the greater part of the funding sources in the Tunisian banks.

Overall, the descriptive statistics, presented above, suggest that our sample is sufficiently composed of a mixture of large and small banks. Thus, it will minimize the potential problem of sample selection bias (Cuddeback et al., 2004).

For additional analyses, the **Figure 1** attempts to present over the period 2009-2019 the contribution of each listed banks to the overall average MES. As expected, 2011 records the higher average MES showing that political turmoil has greatly affected the bank stability leading them to contribute more to the aggregate systemic risk. Moreover, it is worth noting that private banks, even they record equity decrease, show low levels of average MES that vary between 1.4592% in 2012 and 1.8870% in 2011[3].

Furthermore, we attempt to measure SRISK as the individual contribution of each bank to the aggregate systemic risk (Acharya et al., 2012). The output is presented in **Figure 2**. Indeed, in 2009 and 2010, global SRISK is null suggesting

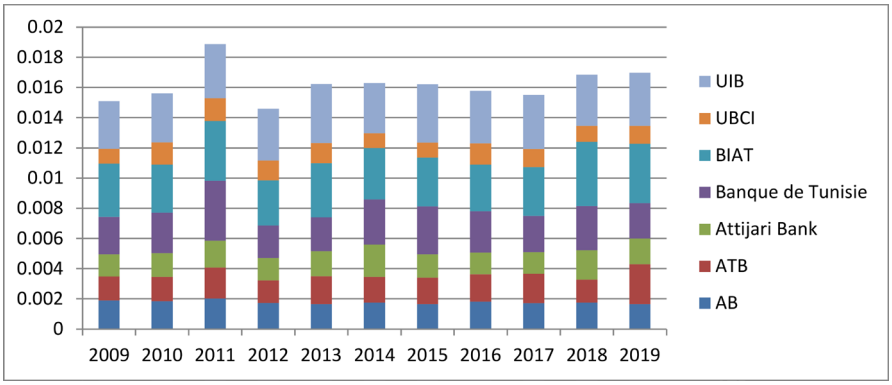

Figure 1. Average MES over the period 2009-2019 of Tunisian private listed banks

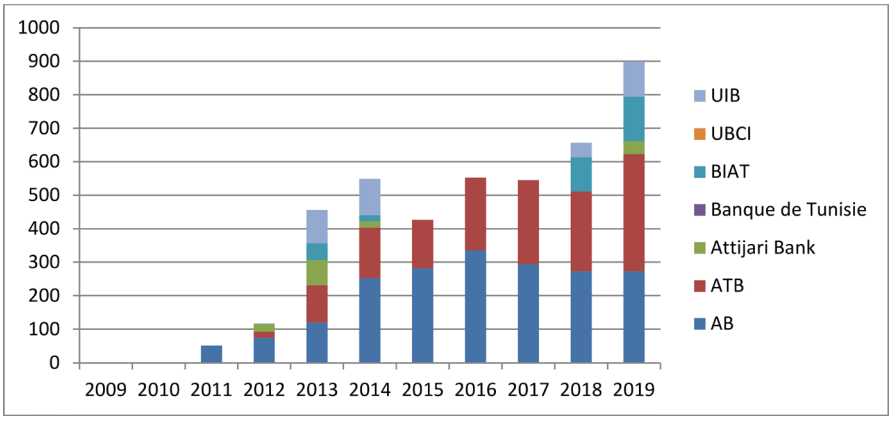

Figure 2. Individual contribution to systemic risk over the period 2009-2019

[3]Data are available under request.

that private banks did not record capital inadequacy. However, in 2011, AB is the only bank that contributes to the systemic risk and records approximately 51.052 MDT of capital inadequacy. As argued previously, the post-revolution period has revealed the unstable situation of banks and the impairment of the Tunisian banking sector. Moreover, almost all private Banks are likely to join the list of systemic risk contributors from 2012. Moreover and more recently, Khiari et al. (2019) attempt to measure the systemic risk of Tunisian listed banks and try to rank them according to their risk involvement. Unsurprisingly, public banks and the two largest private banks occupy the top places and contribute the most to the systemic risk. These banks are less sensitive to other banks but are more likely to contribute to others' distress.

After examining the systemic risk measures individually, we will be trying to rank the Tunisian banks according to their contribution to systemic risk. The ranking is presented in Table 3.

Table 3. Ranking of private Tunisian banks.

Bank	SRISK	SRISK (%)
AB	1953.349	45.93%
ATB	1482.638	34.86%
UIB	357.391	8.40%
BIAT	302.778	7.12%
Attijari Bank	156.601	3.68%
Banque de Tunisie	0.000	0.00%
UBCI	0.000	0.00%

As reported in the table above, according to the SRISK measure, AB and ATB are assumed to be the first contributors to the overall systemic risk over the period 2009-2019. The banks BT and UBCI are in the safe zone and don't show capital inadequacy. This may be explained by the risk differences attitudes of top managers, from whom are risk averse and risk-seeking. Furthermore, the most contributors are relatively large in size, in contrast to BT and UBCI which have small size. Thus, bank size plays a focal role in assessing the contributions to systemic risk level.

4.2. Multivariate Analysis

Based on a recent study, Akbar et al. (2017) argue that endogeneity matters in recent corporate governance research. Empirically, Yu et al. (2014) consider that CEO cash compensation and risk-taking are endogenous and thus they use the simultaneous equation models (SEMs) to overcome the endogeneity problem. Hence, we attempted to use the Hausman test to ensure the presence of endogeneity problem between CEO compensation and systemic risk measures (MES and SRISK). Indeed, the test did not show an endogeneity problem between tested variables[4]. From another perspective and from a theoretical approach, si-

[4]The output will be given under request.

multaneous bias will be ignored. Furthermore, according to Abdul Wahab et al. (2015) updating corporate governance mechanisms with each change in operating environment is not an easy matter and naturally takes time. Further, Larcker et al. (2007) prove the difficulty of setting an optimal corporate structure and maintaining it at all times. In the light of this argument, it is advanced that the impact of compensation on systemic risk is not instant and naturally takes time (Choi, 2014). Thus, all independent variables are lagged.

Doing so, we will be using a GLS panel estimator with a bootstrap technique to alleviate the small size of our sample and our regression model is applied as follows:

$$\text{Risk Measure}_{it} = \beta_0 + \beta_1 \text{lCEOpay}_{it-1} + \beta_2 \text{lROA}_{it-1} + \beta_3 \text{lCapR}_{it-1} + \beta_4 \text{lSize}_{it-1} + \beta_5 \text{lLTA}_{it-1} + \beta_6 \text{lDTA}_{it-1} + \varepsilon_{it} \quad (1)$$

As presented above, the columns (1) and (2) refer respectively to MES and SRISK linear regressions. The results are quite similar. As highlighted in the table, there is a positive and significant link between compensation and systemic

Table 4. Regression results from a Bootstrap estimation.

VARIABLES	(1) MES	(2) SRISK
lCEOPay	0.000663**	0.951*
	(0.000332)	(0.524)
lROA	0.000342	0.158
	(0.000215)	(0.357)
lSize	0.00114***	0.907*
	(0.000171)	(0.498)
lCapR	5.71e−06	0.370**
	(5.92e−05)	(0.152)
lLTA	−3.55e−05**	0.0770*
	(1.44e−05)	(0.0454)
lDTA	1.14e−05	−0.136***
	(9.44e−06)	(0.0367)
Constant	0.00892***	−13.45***
	(0.00246)	(5.184)
Observations	77	77
Number of years	11	11
Bootstrap replication	1000	1000
R squared	28%	41%

Table 4 provides the regressions' results for all systemic risk measures. Note that, CEO compensation and bank characteristics are measured at the end of the prior year. The numbers in parenthesis are corresponding to Standard errors. *, **, and *** refer to significance at the 10%, 5% and 1% levels, respectively. The definitions of variables are provided in **Table 1**.

risk level. It means the higher the compensation is, the higher will be the level of systemic risk. In relation to our hypothesis, we expected either a positive or negative link between managers' compensation and systemic risk with regard to the moral hazard problem that can result in risk aversion or risk-taking.

In fact, consistent with moral hazard hypothesis, it seems that high paid managers tend to take risks in order to increase bank performance. Indeed they feel safe in the presence of government bailout. Furthermore, deposit insurance attempts to protect the interest of depositors by limiting the likelihood of systemic risk events. From another conjecture, consistent with agency theory, compensation serves as an incentive alignment between the interests of managers and shareholders and so it influences bank risk. Hence, because shareholders are more willing to take risks than mangers, compensation will induce them to take higher risk (Felício et al., 2018). Within the Tunisian context, disclosures on the remuneration components are not transparent and incomplete. This asymmetric information leads us think about the extent of compensation camouflage with the purpose to extract greater rents from shareholders. The camouflage may be generated to surpass the outrage constraints and could take many forms. For instance, variable components can be easily camouflaged simply because they are reported neither in banks' report nor in public report. In addition, managers may even receive some perks which also are not publicly disclosed, as the case of banking Tunisian context. The rude competition between banks and even the purpose to report high performance lets board members to select and attract good and competent managers through setting favorable package plan. However, none information have proved that the compensation is based on risk taking but targets achievements. Moreover, managers' position, achievements and their reputation may be determinants of risk-taking behavior. Our result does not join those of Iqbal et al. (2019) who find that managerial risk-incentives do not contribute to the level of systemic risk, but joins those of Choi (2014) who finds weak evidence that cash in compensation structure has a positive link with systemic risk. From another perspective, Tunisian reforms do not present clearly the tenure of elected managers. Thus, Tunisian banks are characterized by low managers' turnover and the latter are likely to be entrenched. Indeed, their reputation and their job opportunities may be determinate to keep their positions and may explain the risk-taking attitudes of managers. A recent study of Salehi et al. (2021) finds that an increase in CEO entrenchment may give rise to risk-taking that could be due to the investment projects impairing the long run performance.

Furthermore, while the impact of loans to assets ratio (LTA) reports mixed results with regard to MES (negatively related) and SRISK (positively related), the table shows a positive and significant link between bank size and systemic risk suggesting that larger banks contribute more to the overall systemic risk. Large banks are more involved in market-based transactions and are more organizationally complex than small banks. Consequently, they can be more fragile

and sensitive to economic shocks. These banks are not individually risky but they contribute more to systemic risk. The bankruptcy of large banks is more disruptive to the financial system than smaller ones since it will generate liquidity stress and its activities cannot be easily replaced by small banks. The situation willmore harmful when banks have low capital ratios and unstable funding. Hence, it is worth saying thattargeting bank complexity and activities is needed to be undertaken with the macro-prudential framework (Laeven et al., 2014). With regard to the Tunisian context, Amen bank and Arab Tunisian Bank are among the biggest private banks and hence it is proved that they contribute more to the overall systemic risk; an interpretation that joins the analysis of the positioning of banks regarding its contribution to systemic risk (Section 2).

Moreover and with regard to control variables, capital ratio exerts a positive impact only on SRISK suggesting that, banks showing high level of capital ratio contribute more to the overall systemic risk. Our result is inconsistent with our prediction, which postulates a negative sign between capital ratio and systemic risk. Capital ratio is assumed to reduce the systemic impact of banks' default, but from what is found, it does not reduce the aggregate systemic risk. With reference to the Tunisian banking sector, it has known a progress in reforms to enhance the stability of the banking system and for a better risk management. From a recent study of Kanzari and Mraihi (2017), capital requirement has a negative and significant effect on the stability of the Tunisian banking sector. Furthermore, Guizani (2014) postulates that Tunisian banking supervision is week in reducing banks' overall risk and he argues that it is needed to be strengthened.

Overall, our hypothesis is supported. Indeed, cash-based compensation and systemic risk are positively associated suggesting that managers of private banks are willing to take excessive risks with the purpose to increase bank performance and to keep their reputation and their positions.

5. Robustness Checks

After analyzing the effect of the remuneration on systemic risk, we attempt to test the robustness of our results for a couple of reasons. Firstly, we have used the aggregate amount of the compensation as reported in the financial statements. We recall that banks report only the total amount of compensation without decomposing it into fixed and variable components. With reference to the bank's annual financial statements, the managing director receives an annual remuneration that includes a variable net annual bonus that corresponds to 100% of the variable annual component and depends on the achievement rate of objectives defined by the board of directors. Secondly, from previous findings, it is hard to assess exactly which component is effectively the trigger of the systemic risk; the variable or the fixed component. Under the hypothesis that the fixed component is more likely to vary rigidly over time, we agreed to test the impact of the difference of compensation on systemic risk variation. Thus, we will be running the model as follows:

$$\Delta \text{Risk Measure}_{it} = \beta_0 + \beta_1 \Delta \text{CEOpay}_{it-1} + \beta_2 \Delta \text{ROA}_{it-1} + \beta_3 \Delta \text{CapR}_{it-1} + \beta_4 \Delta \text{Size}_{it-1} + \beta_5 \Delta \text{LTA}_{it-1} + \beta_6 \Delta \text{DTA}_{it-1} + \varepsilon_{it}$$

Table 5 presents the results of our robustness test. Surprisingly, there is a non significant relationship between the variation of cash compensation and systemic risk measures. Indeed, the variable component has no effect on the level of systemic risk and we conclude that the positive sign found between the total compensation and systemic risk stems from the fixed component of managers' compensation. Hence, an increase in the fixed salary is associated with high level of systemic risk.

Generally, fixed income is independent from managers' performance. Managers receive the same salary regardless of their contributions. Indeed, they will not earn higher (less) if they do a good (bad) job. There may be no effort exertion to increase rationally bank performance and to preserve bank stability eliciting managers to adopt risk-increasing strategies. In other words, managers may not be reluctant to invest in all projects reporting positive net present value irrespective of their risk. Doing so, managers' fixed salaries do not exhibit downward

Table 5. Regression results from the bootstrap estimation.

VARIABLES	(1) lnvSRISK	(2) VarMES
lnvarCEO	0.0323	0.00131
	(0.132)	(0.00299)
varROA	−0.866	−0.0142
	(0.961)	(0.0114)
varsize	0.648*	0.00392*
	(0.377)	(0.0119)
varcapr	−0.354	−0.00282
	(0.282)	(0.00317)
varLTA	−0.0612	0.00239*
	(0.108)	(0.00144)
varDTA	0.00222	−0.00175
	(0.0645)	(0.00197)
Constant	−7.195	−0.0527
	(4.763)	(0.149)
Observations	70	70
Number of Banque	7	7
R squared	0.14	0.17
Bootstrap replication	1000	1000

Table 5 provides the regressions' results using the bootstrap technique for all systemic risk measures. Note that, CEO compensation and bank characteristics are measured at the end of the prior year. The numbers in parenthesis are corresponding to Standard errors. *, **, and *** refer to significance at the 10%, 5% and 1% levels, respectively. The definitions of variables are provided in Table 1.

because the board of directors is unable to cut fixed remuneration in case of poor performance or excessive risk taking but rely on cutting bonuses if the bank is performing poorly (Houston & James, 1995). Furthermore, managers feel safe and are likely to be risk-seeking for a couple of reasons. Firstly, depositors are protected since deposit insurance is designed to protect the interest of the public by limiting the likelihood of systemic risk events. Secondly, the Central Bank of Tunisia plays a crucial role in avoiding the occurrence of systemic events because it is known for being the lender of last resort.

With regard to control variables, only bank size is robust and exerts a positive impact on SRISK and MES respectively. Indeed, larger banks are the most contributors of systemic risk in Tunisia.

6. Conclusion

International financial regulators and bank supervisors have highlighted the focal role of executive compensation in the development of the financial crisis of 2008-2009. Thus, such managerial incentive is correlated with excessive risk-taking that may create negative externalities on the banking sector. Our study takes part in this stream of research and attempts to examine the linkage between cash-based compensation and systemic risk using a context of 7 largest private listed Tunisian banks on the TSE over the period 2009-2019.

Our empirical findings indicate that cash-based compensation of managers is positively tied to both measures of systemic risk. Indeed, top managers of private banks are interested in their reputation, their positions and their job opportunities and hence they tend to adopt risky investments with the purpose to achieve bank targets. Hence, they are more likely to preserve their image of good managers who report higher performance.

We attempted furthermore to assess whether the variation of compensation as a proxy of variable components exerts an impact on systemic risk level. Surprisingly, there are no significant links suggesting that the fixed component is assumed to increase the risk preferences of managers. Indeed, managers feel safe and are not reluctant to invest in all projects reporting positive net present value irrespective of their risk.

Our work is of practical interest. In fact, understanding the link between cash-based compensation and systemic risk enables us to further determine systemic risk drivers. Thus, this study makes several noteworthy managerial implications. Firstly, it gives insight into how bank regulators sensitively should react to mitigate systemic risk or to control for the contagious link between banks. Furthermore, the results could be helpful to call more for transparency when dealing with compensation plan of top management. Some components are hidden and are served through interpersonal relationships. The significant link between compensation and systemic risk can explain indirectly that the remuneration is not adjusted with risk-taking, even worse the overall systemic risk increased with an increase of managers' compensation. Thus designing an op-

timal compensation structure is needed to prevent banks from taking "imprudent risk" and reduce any potential negative externalities on the financial system.

To ensure compliance with good standards, the Central Bank of Tunisia should align the executives' goals with the long-term interests of the bank they work for. Hence, banks should define, implement, and maintain a compensation structure in alignment with the couple performance-prudent risk.

It is worth mentioning that our study contains some limits that can be addressed in future research. For instance, the sample size is small as we carried out the research for only private biggest listed banks. Despite such limit, we recall that our sample is representative and represents roughly 30% from 41% of market capitalization for all listed banks. Furthermore, we could divide our sample into different groups; we could capture the externalities by comparing banks according to size, or liabilities, or even according to non-traditional banking activities.

Several research perspectives can be suggested. For instance, additional analyses are needed to assess systemic risk. A common thought argues that macro-prudential and micro-prudential policies can protect bank capital; however, extant studies highlight the importance of governance as it is the mirror of the bank's soundness. So that it is up to further research to determine the main systemic risk triggers and to examine in which way governance mechanisms can enhance the resilience of financial institutions to systemic risk.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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