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2016

working paper series

**FINANCIAL STABILITY AND MACRO PRUDENTIAL
REGULATION: POLICY IMPLICATION OF SYSTEMIC
EXPECTED SHORTFALL MEASURE**

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Working Paper No. 985

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Working Paper 985

April 2016

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First published in 2016 by
The Economic Research Forum (ERF)
21 Al-Sad Al-Aaly Street
Dokki, Giza
Egypt
www.erf.org.eg

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Abstract

In this paper we highlighted the importance of systemic risk in the new framework of financial regulation. We employed several macro-economic variables and balance sheets indicators, to underline the degree of vulnerability of Tunisian banking sector. We also applied the Systemic Expected Shortfall measurement for the case of Tunisian financial institutions. Empirically, we showed which variable had a powerful alternative in explaining potential riskiness of Tunisian banking sector during the financial crisis of 2011. Our analytical framework presents a recent essay to evaluate systemic importance of Tunisian banks.

JEL Classification: C21, C58, G01

Keywords: Banking sector, financial stability, systemic risk, macro-prudential regulation, marginal expected shortfall

ملخص

يتم في هذا البحث تسليط الضوء على أهمية المخاطر النظامية في الإطار الجديد للتنظيم المالي. قمنا بتوظيف متغيرات الاقتصاد الكلي و عدة مؤشرات ميزانيات ، للتأكيد على مدى ضعف القطاع المصرفي التونسي. قمنا أيضا بتطبيق الجهازية المتوقعة لقياس العجز في حالة المؤسسات المالية التونسية. تجريبيا، أظهرنا أن متغير كان بديلا قويا في شرح مخاطر المحتملة من القطاع المصرفي التونسي خلال الأزمة المالية لعام 2011. لدينا الإطار التحليلي في هذه الدراسة لتقييم أهمية النظامية من البنوك التونسية.

1. Introduction

The financial crises of 2007-2008 has shown that Basel I and Basel II, are not sufficiently focused on systemic risk and intended only to limit each institution's risk seen in isolation, the review of risk management approach via the analysis of how financial regulation should be redesigned to reduce systemic risk losses and its consequences, become a crucial objective to insure the safety and solidity of financial sector. The implantation of additional prudential requirement presents one of the top priorities for all regulatory authorities to strengthen micro-prudential regulation and supervision, and provide a macro-prudential overlay that includes capital buffers to respond well to the Basel III requirements. As revealed during the recent financial crises, the risk evaluation of a financial institution should not be restricted with an isolated assessment of bank's balance sheet or portfolio composition. Indeed, recent research studies focused on systemic risk measurement using interconnectedness between financial institutions. Adrian et al. (2008) utilize quantile regression in their systemic risk measure, CoVaR that captures value-at-risk of a financial sector conditional on institution is being in distress. Similarly, Huang, Zhou and Zhu (2009) use data on credit default swaps (CDS) of financial firms and stock return correlations across these firms to estimate expected credit losses above a given share of the financial sector's total liabilities. In the same context Acharya et al. (2010) propose a simple applicable measure, SES, which assumed to measure contribution of each institution to systems total risk in case of a financial distress. The subject of this paper is to present an application of systemic expected shortfall (SES) measure in the case of the Tunisian financial market composed by listed banks and leasing companies during the political revolution 2011. The analysis of financial system distress via the SES method can be considered as a new tool of macro-prudential policy which take into consideration all elements of the financial system and how they interact with each other and with the economy as a whole. The SES presents a simple model for the identification, evaluation and warning about systemic risk, since it ameliorate the understanding of the source of this risk and allow a better management of macro-financial risk. This should improve the analytical framework; in Arab countries; of the risk based banking supervision approach.

The objectives of this paper can be summarized as follows. Firstly, we present literature review of financial regulation of systemic risk and investigate the sources of micro-prudential regulation dysfunctions. Then, we adduce the warning signals of systemic risk assessment for Tunisian Banking System on the base of several macro-economic indicators and balance sheet information. We analyze the systemic risk in financial Tunisian sector, through Systemic expected Shortfall method. Finally, we give recommendations for systemic risk governance in Tunisia on the basis of analysis results.

2. The Importance of Systemic Risk in the New Financial Regulation Framework

Despite the differences in the definition of systemic risk are clearly important from a policymaking perspective, we notice that each definition underlines the relation between financial stability and systemic risk. **Bartholomew and Whalen (1995)** defined systemic risk as an event that has an effect on the entire banking, financial and economic system, rather than just one or a few institutions. For **De Bandt and Hartmann (2000)**, a systemic crisis can be defined as a systemic event that affects a considerable number of financial institutions or markets in a strong sense, thus severely impairing the general well-functioning of the financial system. **Davis (2001)** discussed Systemic risk and financial instability issue in relation to financial crises. He suggested a definition where the financial crisis is apprehended as a collapse of the financial system so powerful that it has become unable to provide payment services or to allocate credit to the most productive investment opportunities. **Moinescu (2006)** considered that a crucial element of systemic risk definition consists of an initially shock and transmission mechanism. As to **Brunnermeier et al. (2009)**, they describe requirements for a systemic risk measure: "A systemic risk measure should identify the risk on the system by

individually systemic institutions, which are so interconnected and large that they can cause negative risk spillover effects on others, as well as by institutions which are systemic as part of a herd.”¹

The systemic crisis of 2007-2009 has interrupted the normal functioning of the financial system and has generated a relatively important macroeconomic disruption. The instauration of a new prudential regulation framework analysis is important, to understand recent banking crisis, and deficiencies in functioning of existing prudential regulation. The principal aim of this new framework is to limit occurrences of financial distress which cause significant macroeconomic losses. Indeed, several analysis have linked the failure in functioning of actual regulatory framework to the absence of crucial element in financial stability which is macro-prudential aspect. Under the new macro-prudential regulation, the authorities of supervision have to regulate banking financial activities and supervise financial institutions that threaten the interests of the banking system and can lead to cause a systemic crisis.

2.1. From micro-prudential to macro-prudential regulation: Importance of correlation between financial institutions

The recent crisis of 2007-2009 demonstrates that systemic risk spreads globally across markets and financial institutions. In fact, this crisis initiated in the market of mortgage-backed securities and spread rapidly across the credit market and then to the capital market as a whole with a severe effect on the soundness of the international banking system. This crisis showed the effect of interconnection and common exposure² of financial institutions which accelerated the expansion of shock in the financial system via interconnected transactions, what contributed to systemic risk in financial sector. The Size and interconnectedness of financial institutions represent important contribution of systemic risk, therefore, they can adversely affect on stability of financial system. Existing regulatory and supervisory framework should be adapted to recent financial trends and have to focus on regulation of the financial banking sector.

For Kaufman (2003), systemic risk in banking sector is the risk of chain reactions that cause collapse of interconnected institutions. Consequently, inter-linkages among financial institutions especially between banks could spread both through negative externalities or fundamental shocks (as well as liquidity, volatility spirals, or network effects). These finding are recently analyzed more explicitly by Brunnermeier and Pedersen (2009), Brunnermeier (2009), Danielsson and Zigrand (2008), Danielsson, Shin, and Zigrand (2009), Battiston et al. (2009), and Castiglionesi, Periozzi, and Lorenzoni (2009).

Hence, it is so important to map out relationships between financial institutions when studying financial fragility and systemic risk (Allen, 2001)³, because more interconnected architecture increases the resilience of the system to the insolvency of any individual bank. As shown by Vivier-Lirimont(2006), a dense interconnections may present a destabilizing force and pave the way for systemic failures. This fact is also shared by Blume et al. (2011, 2013) who modeled interbank contagion as an epidemic.

Based on research of De Bandt and Hartmann (2000), the contagion occurs through two channels. The first one is the information channel which can play a negative role that resulting from massive and contagious cash withdrawals (bank runs) by depositors imperfectly informed

¹ See « The Fundamental Principles of Financial Regulation, Geneva Reports on the World Economy 11, Markus Brunnermeier, Andrew Crocket, Charles Goodhart , Avinash D. Persaud and Hyun Shin , p26

² Direct common exposures on counterparties outside the given set of financial institutions (eg, households and corporations) play a much more important role in financial instability (Borio (2003)). Empirical work is consistent with this view (eg, Elsinger et al (2006)).

³Allen and Gale (2000) underlined that in a more densely interconnected financial network, the losses of a distressed bank are divided among more creditors, reducing the impact of negative shocks to individual institutions on the rest of the system. See « Systemic Risk and Stability in Financial Networks »,Daron Acemogluy Asuman Ozdaglarz Alireza Tahbaz-Salehix , p1

about the type of shocks affecting banks. The second one is exposure channel results from real exposures in the interbank market. Insolvency problems of one bank can set off a chain reaction leading to other bank failures and causing the emergence of "domino effect".

In sight of the increasing interconnection of financial institutions the wrong conduct based on a micro-prudential regulation, was considered insufficient to control the risk of increased financial vulnerabilities. Consequently, a new architecture for prudential supervision was set up to provide for a framework in which the new prudential rules, micro and macro is developed, harmonized and implemented. For micro-prudential policy, considered as a "bottom-up" approach, the objective is to assess the financial soundness⁴ of the individual banks and financial institutions, notably those whose difficulties would lead to systemic risk for the global financial system. Regarding the macro-prudential regulation, it represents an orientation or perspective of regulatory and supervisory arrangements following a "top-down approach", which calibrate all regulation from a system-wide or systemic perspective, rather than from that of the safety and soundness of individual institutions on a stand-alone basis. The proximate objective of macro-prudential approach under the regulation and supervision framework is to limit the risk of episodes of system-wide financial distress; its ultimate aim is to avoid or cover the costs they generate for the real economy (Borio, 2003)⁵.

Thus, it is so important that macro-prudential policy makers are able to define and use adequate prudential tools to limit systemic or system-wide financial risk, given that they must carry out for basic conditions, as the ability to identify imbalances before they become a problem, decide how to calibrate (data and modeling) and time the intervention, select the appropriate prudential tool, or tools, co-ordinate all the responsible regulators and supervisors to bring it about, including achieving political support for the action⁶.

2.2 Basel III, systemically important financial institutions and warning signals

Growth of international banking activity has led banks to become too big and too interconnected and in terms of supervisory authorities too important for financial stability, therefore, it is important to use macro-prudential approach, in order to make vulnerabilities in financial systems more successfully discovered (Gauthier, Lehar and Souissi, 2009). In fact, the crucial mission of macro-prudential regulation is to indicate which institutions are systemically important, because until today, the individual risk of every institution has not been investigated or defined (Acharya, 2011).

In general, an institution is systemically important if a failure or a malfunction causes a large problem and have significant adverse effects on the financial system and the entire economy. The Basel Committee on Banking Supervision defines systemically important banks as "dangerous financial institutions due to the size, complexity and systemic interconnection, unable to leave the market without triggering a catastrophe of proportion".

The Basel committee on banking supervision developed a methodology for identifying systemically important banks (global systemically important banks G-SIBs)⁷ based, first on their size - banks too big to accept their collapse "too big to fail" TBTF, second on their close connections - banks too interconnected to accept their collapse "too interconnected to fail"

⁴ In this context European supervisory authorities working under the control of the European System of Financial Supervision (ESFS), is responsible for strengthening micro-prudential supervision in Europe in the three sectors comprising banking (European Banking Authority), insurance (European Insurance and Occupational Pensions Authority) and the securities markets (European Securities and Market Authority)

⁵ See "Implementing a macro-prudential framework: Blending boldness and realism", C.Borio, Bank for International Settlements, July 2010, p20.

⁶ See the report of The Financial Stability Board (FSB), "Policy Measures to Address Systemically Important Financial Institutions", November 2011.

⁷ Mutu, 2012 identified several features that are found in all documents prepared by supervisors.

TITF, and finally on their importance - banks too important to allow their bankruptcy "too important To be allowed to fail" TITAF.

A Basel III capital surcharge is one of the tools of this macro-prudential philosophy (BCBS (2011)). In fact, the policymakers need to measure systemic importance, that is, a systemically important financial institution could lead losses that damage the real economy (Drehmann and Tarashev (2011), Tarashev et al (2010)). Therefore, the more systemically important a financial institution, the stricter its regulatory requirements should be.

The new prudential rules for banking system envisage a set of capital-based macro-prudential instruments. One of the key capital-based macro-prudential instruments is the countercyclical capital buffer (CCB). Actually, the global systemically important institutions (G-SII) buffer⁸ represents new prudential rules for the EU banking system, this instrument is a mandatory capital buffer for banks identified as being of global systemic importance. Another instrument proposed by EU banking system is -The other systemically important institutions (O-SII) buffer⁹ -enables authorities to impose capital charges on domestically important institutions.

Systemic risk assessment methodology should contain variable that will represent the exposure of the financial institution to different risks such as liquidity risk and credit risk, give picture of its balance sheet indicators and other variables that could reflect its financial risk activities, in order to identify systemically important financial institution.

Several research were based on financial soundness indicators (FSIs), various studies have proposed early warning indicators of distress in banking systems (e.g., Demirgüç-Kunt and Detragiache, 1998, 1999, 2005; Hardy and Pazarbaşıoğlu, 1999; Gonzalez-Hermasillo, 1998; Hutchinson and McDill, 1999; Hutchinson, 2002; European Central Bank, 2005). S.Tao (2011)¹⁰ found that indicators on leverage, liquidity, and business scope can help identify the differences between the intervened and non-intervened financial institutions during the subprime crisis.

In conclusion, financial indicators or warning signals which can identify the key characteristics of the financial institutions are representing a new tool allowing the detection of distress financial situations and this from bank balance sheet data by focusing on different systemic risk spillover factors such as sovereign risk, overall risk aversion and the country-specific macro-economic indicators. These indicators give the possibility to understand and measure the implications or the contribution of financial institutions in the systemic risk. In addition, these indicators could be helpful in identifying macro-financial linkages, promoting ongoing financial reforms, and designing crisis prevention initiatives.

3. Viability of Systemic Risk Assessment for Financial Supervision

The last financial crisis of 2007-2009 showed that financial institutions may be vulnerable to systemic risk and that they cannot assess their risk independently from the rest of the financial system of which they are a part. The development of several measures for systemic risk has been an important topic in the literature in recent years especially since the last financial crisis. The actual literature on systemic risk includes different models, that look for, a rigorous assessment of systemic risk which permits the evaluation of the impact of such risk.

⁸ The surcharge will be between 1% and 3.5% of risk-weighted assets and will be gradually phased in between 1 January 2016 and 1 January 2019

⁹ The O-SII buffer can be applied from 1 January 2016. Before this date, the SRB can already be applied to deal with the risks stemming from systemically important financial institutions

¹⁰ see " Identifying Vulnerabilities in Systemically-Important Financial Institutions in a Macrofinancial Linkages Framework" , IMF Working Paper , May 2011

Some Authors have utilized measures based on market data (Hollo, et al, 2010, 2012), balance sheet data and macroeconomic indicators (Morris, 2010) or a combination of the above (Louzis and Vouldis, 2011; Cevik et al, 2011) in the modeling of systemic risk.

At the macro level, the early literature on systemic risk assessment primarily focused on economy wide aggregates, such as Standard macroeconomic variables (GDP growth, Inflation, unemployment, FDI,..). More recent literature has tried to address this concern by looking at sector balance sheet data (e.g., Rosenberg and others (2005)). Recently, Prat (2007) has made such an analysis for the banking sector.

Regarding the banking sector, the stability issue has received attention especially about the policy of the prudential regulation. The principal key to maintain stability is the early identification of sources of banking vulnerabilities. The need to monitor the safety of financial institutions and markets with several tools is in fact designed to assess the strengths and weaknesses of financial systems. This aim led to efforts to define financial soundness indicators (FSIs). Indeed, the IMF coordinates efforts of national authorities of regulation to compile and disseminate internationally comparable financial soundness indicators FSIs (Sundararajan et al., 2002).

This section surveys the different indicators available in the economic and financial literature to evaluate the level of systemic risk since the start of the social Tunisian revolution of January 2011.

3.1 Risk-based supervision: the macroeconomic and balance sheet vulnerability indicators:

We have the possibility to derive, from macro-economic ratios and bank's balance sheet, some indicators of risk taking that matter for the occurrence of systemic risk. In this section we analyzed some examples of relevant indicators that could be considered for financial sector as a warning signal in the case of Tunisian banking system.

The macroeconomic effects of the revolution of January 2011 on the Tunisian economic performance as a whole will be studied in the first part of this section. In fact, early signs of economic repercussion appeared with an important drop in GDP growth (see figure 1-a). Indeed, the GDP Annual Growth Rate in Tunisia averaged 3.81 percent from 2005 until 2013, representing the lowest average comparing to Turkey, Morocco, Jordan and Egypt (with respectively 4,44 % ; 4,40% ; 5,28% ; 4,63%), reaching an all-time high of 6.2 percent in 2007 and a record low of -0.2 percent in 2011. Tunisia recorded a current account deficit of 8.20 percent of the country's GDP the end of 2012 due to the worsening of the trade deficit, difficulties in mobilizing foreign financing and the deterioration of tourist revenues. Finally, the low performance of the economy leads to an increase in the ratio of non-performing loans¹¹.

Another relevant indicator of macroeconomic vulnerability of a country is the level of employment. Tunisia's unemployment reached an average of 14,35 for the period of 2007 to 2012 (see figure 1-b), this rate is the highest comparing with averages recorded in Turkey, Morocco and Egypt in the same period. The high unemployment rates has played an important role in the emergence and spread of the 2010-2011 popular uprising in the country. Meanwhile unemployment rate declined by 1.4% from 2012 to 2013 (16.7% ; 15.3%) but the pre-revolution ratio of 13% (in 2010) has not been re-captured.

Concerning inflation rate, as mentioned in figure 1-c, Morocco and Tunisia have lower inflation records, however the inflation in Tunisia was positioned relatively high comparing to the pre-crisis period: 6.1% on average in 2013 against 5.5 % 3.6% and 4.4% in 2012, 2011 and 2010, respectively.

¹¹ Several empirical studies have found a negative association between NPL and real GDP growth (Salas and Saurina 2002; Fofack, 2005; Jimenez and Saurina, 2006; Khemraj and Pasha, 2009; Dash and Kabra, 2010).

Foreign direct investment (FDI) are increasing much faster in Morocco, Egypt, Jordan and Turkey, the persistent political uncertainty context affected FDI which slowed down to represent only 0.9 % of GDP in 2011 (see figure 1-d) the increased political instability and heightened social tensions could hamper domestic and foreign investments. Regarding FDI to gross fixed capital formation, Tunisia has been able to attract sufficient FDI to cover about 17,62% of its gross fixed capital formation during 2005 to 2012, a percentage which is, slightly higher than the average for Turkey (11,14 %), but remained deeply lower than the average of Jordan (44,1 %).

Similar in many other countries across North Africa, banks in Tunisia dominate the financial sector. According to IMF¹², the Tunisian financial system is small and fragmented. It remains mainly dominated by banks, with assets equivalent to 115 percent of GDP in 2011. The nonbank financial sector is relatively small with a market capitalization equal to only 19.6% in 2012 percent of GDP, lower than in regional peer countries such as Morocco (54,8 percent) and Jordan (87 percent), this indicator regressed of 4.6 percent from 2010 to 2012 (see figure 1-e) .

The Tunisian banking sector suffers from the importance of non-performing loans NPLs (around 13,3% in 2011) and loans' provisioning has been brought to an average of 66,3 percent in 2011 (86,3 percent in 2012) .The level of NPLs was higher at state owned banks¹³ (16,4%) than at private banks (10,2%) (see figure 1-f). Some researches have linked good governance and well-functioning banks to non performing loans level (Kaufmann et al., 2008). The high level of NPLs in Tunisia during the period pre crisis of January 2011 was the result of an institutional environment characterized by an inefficient judicial system, a corrupt bureaucracy and extractives political institutions. In the case of public owned banks, the supervision authority assume the role of both judge and party and often driven by political considerations rather than by objective risk assessment in their prudential control functions (Andrews, 2005), which impact negatively the level of risks which are accumulated in the sector. In fact, the state owned banks play an important role in the increase of NPLs level through the allocating of credits regardless of the risk-return profile (Salas and Saurina, 2002), which reveals the weaknesses of the banking supervision in risk management, leading to the deepening of the imbalances such as the excessive accumulation of risk in the financial system.

To analyze the potential determinants of systemic importance in banking sector, we collect bank balance sheet data of 11 Tunisian listed banks from 2006 to 2012. The balance sheet indicators we consider in our analysis are meant to describe banking institutions' situation. We ranked the listed banks in three categories: private banks held in majority by Tunisian shareholders (AB, BIAT, BTE and BT), private banks owned by foreign banks (ATB, Attijari Bank, UBCI and UIB) and state-owned banks (BNA, BH and STB). For each category we analyze the principal ratios which describe the **non interest income, capital, liquidity and profitability** indicators, using data from Bankscope.

The figure 2-a reflects the increase in the level of non-traditional activities in Tunisian banking sector over the past years, it shows an evolution of the level of NII of the sample composed by listed Tunisian banks since 2006 to 2012. This average followed an uptrend with impressive growth rate of 67,74 % from 2006 to 2012. The level of the NII starts to take higher values since 2008 with an average value of 82,07 mil TND, this average rises from 95.88 to 102.68 between 2011 and 2012. Regarding the share of non-interest income in total income, we notice

¹² Country Report n° 12/241 , August 2012

¹³ Empirically, Hu et al. (2004) using a panel of 40 banks in Taiwan over the period 1996-1999 find a positive correlation between capital share owned by the state and the level of NPLs. Barth et al. (2004), based on the results of the survey they established in 1999 with 107 countries, found that public ownership is positively related to non-performing loans, and a banking sector dominated by state ownership tends to be more corrupt

that Tunisian banking sector registered the highest average of non-interest income to interest income since 2009, in comparison to Morocco, Jordan, Egypt, Turkey and the GCC. We also notice that public banks had the highest level during the period 2006 to 2012.

To remain competitive and profitable, Tunisian banks tried to exploit new business lines such as fee-based activities and investment in public and private securities, to get rid of these NPLs. However, we must recognize that the expansion into noncore banking activities generates an increase in the rate of return on assets, but we must admit that banks may become less stable if they diversify into non-lending activities due to the higher volatility of non-interest income. Based on results of previous researches, the non interest income increase bank fragility and have a higher contribution to systemic risk. Indeed, the diversifying into more liquid nontraditional banking activities that generate non-interest income¹⁴, may end up increasing bank fragility and reduce overall performance. In an empirical study of European banks, Lepetit et al. (2008) analyses the relationship between bank risk and income structure. Their investigation shows that banks expanding into non-interest income activities present higher insolvency risk than banks which mainly supply loans¹⁵. Demirgüç-Kunt and Huizinga (2010) support this finding of increased bank fragility associated with a high proportion of non-core income and non-deposit funding. They show that banks with a high level of fee and trading income¹⁶ are more risky. The non-interest income is also associated with more volatile bank returns (Madura and Weigand (2002)¹⁷, some studies demonstrated that shifting away from traditional banking threatens bank system stability (Mercieca et al. (2007) and Baele (2005)). In fact, the analysis of the link between systemic risk and non interest income proved that there are a positive relation between non core banking activities and systemic risk. Altunbas et al. (2011), for example, show that banks with high non-interest income are more risky. These findings was confirmed with Moshirian.F, Sahga.S and Zhang.B (2011), who analyzed the effects of non-interest income on systemic risk measured by MES, find that non-interest income does have an effect¹⁸ on systemic risk. Brunnermeier, Dong, and Palia (2012)¹⁹ show similar results for the case of US banks.

The capital ratios have long been a valuable instrument for assessing safety and soundness of banks. Bank supervisors use capital ratios to scale the adequacy of an institution's level of capital. In fact, capital ratios indicate the robustness of financial institutions to shocks to their balance sheets. Bank capitalization is analyzed in this paper through equity to assets ratio. This ratio measures the equity cushion available to absorb losses on the loan book. We note that this ratio keeps a falling trend from 2009 until 2012 (see figure 2-b), this decrease may be interpreted as an increased risk exposure and possibility of capital adequacy problem. Overall, this capital ratio indicates a downward trend since 2009 and that public banks in Tunisia are less capitalized compared to private banks. Indeed, the emblematic of the financial sector failures in Tunisia is caused by the large debt of the tourism sector. Besides, the public banks contribute to the aggravation of the problem of this sector by channeling credit to less productive. Tunisian banking sector is burdened with a high ratio of non-performing loans (NPLs). The problem of

¹⁴ Which includes activities such as income from trading and securitization, investment banking and advisory fees, brokerage commissions, venture capital, and fiduciary income, and gains on non-hedging derivatives.

¹⁵ They also indicated that this funding is mostly accurate for small banks and essentially driven by commission and fee activities

¹⁶ DeYoung and Roland (2001) look at the impact of 3 fee-based activities for 472 large US commercial banks, and conclude to an increase in the volatility of bank revenue and the existence of a risk premium associated with these activities.

¹⁷ Stiroh (2004, 2006) used an US sample, to demonstrate that the non interest income has a larger effect on individual bank risk in the post 2000 period

¹⁸An effect which depends on degree of concentration of banks, see Moshirian.F, Sahga.S and Zhang.B (2011) "Non interest income and systemic Risk : the role of concentration"

¹⁹ The most recent research which confirmed that non-traditional banking activities in the form of noninterest income significantly increase a bank's contribution to systemic risk

bad loans originated in the government's policy of designating a part of bank loans to the so-called "priority sectors" of the economy (mostly tourism which accounts for over 25 percent of total NPLs)

The level of the average of net Loans to total asset ratio in Tunisia from 2006 to 2012 was the highest comparing with Morocco, Egypt and Jordan. Indeed, the higher this ratio, the less liquid the banking sector will be. The net Loans to total asset maintained his increase trend during 2009 to 2011 and registered the highest rise of 3,69 points between 2010 and 2011 (70,16 and 73,85 respectively), we notice that public banks registered the highest levels in 2010,2011 and 2012. Which reflected a real vulnerability of the Tunisian banking sector especially during the social revolution (see figure 2-c).

By looking at the average of return on assets (ROA)²⁰ and return on equity (ROE) during 2011 and 2012, we find that Tunisia and Egypt have a lowest average (see figure 2-d); Concerning the ROA, it presents the most important single ratio in comparing the efficiency and operational performance of banks as it looks at the returns generated from the assets financed by the bank. For private and foreign banks, although that this ratio began to increase from 2012; but it never reached the same level of the pre-crisis period. Regarding the public banks, we note that this ratio kept the decrease trend. This result is in line with previous research and probably reflects a mix of inefficiencies and policy mandates (Micco et al (2004), Levy-Yeiati, Micco and Panizza (2007)). As to ROE; which is defined as net profit over average equity, it knew the same evolution as for ROA, but also registered **a high drop for public banks** comparing to foreign and private bank which declined from 6.55 to -0.75 between 2010 to 2012.

In conclusion, figures above showed that **large state-owned banks are the worst performers** in Tunisia. Indeed, these banks are afflicted by the corporate governance problems. The financial development in Tunisia has been limited over the past decade and stills well below potential. The Tunisian banking sector is characterized by significant vulnerabilities, limited profitability, low credit intermediation, and inefficiency. The major source of failure is the weak intermediation of credit to the economy which presents a real brake to economic performance in Tunisia.

3.2 Supervision based on Market Data: Estimation of the Systemic Expected Shortfall (SES)

In this section, we presented a simple model of systemic risk and discussed the explanatory power of SES model which includes both marginal expected shortfall and leverage ratios of institutions calculated prior to the crisis period comparing to the risk measures like expected shortfall, annualized stock return volatility and stock market beta estimated during the same date.

We showed that each financial institution's contribution to the systemic risk can be measured as its systemic expected shortfall by providing a detailed empirical analysis of how our *ex-ante* measure of systemic risk would have performed during the Tunisian financial crisis of 2009-2011.

3.2.1 Data and sample

The crisis period is divided into two sub-periods. The first period covers data prior to the emergence of the financial stress in the system (From December 2009 to November 2010) and the second period consists of the realization of systemic risk (from December 2010 to November 2011). The aim is to compare the *ex-ante* performance of different risk measures like expected shortfall, annual volatility and market beta with MES, leverage ratio and

²⁰ROA is calculated as: Net Income / Total assets * 100.

ROE is calculated is: Net Income / Total equity * 100

determining whether SES is better in forecasting systemic losses in different financial crises environments.

We presented an empirical study of the Tunisian financial sector composed by 16 listed financial institutions (11 banks and 5 leasing companies) using Tunisian financial institutions stock market returns and balance sheet data through December 2009–November 2010. We studied how our measures of systemic risk estimated *ex ante* predict the *ex post* realized systemic risk as measured by analyzing the explanatory power of conventional risk measures like expected shortfall, volatility or stock beta comparing with leverage ratio and MES of financial institutions prior to the crises (December 2009 to November 2010). The list of the companies used in the computations is provided in Table 1.

3.2.2 Definition of variables

We choose this period of twelve month (from December 2010 to November 2011) because it witnessed extreme volatility in the Tunisian Stock Exchange due to politically uncertain environment and fears about the policy of the new Government. This period includes January 2011 during the political revolution – the period when Tunindex witnessed his largest fall (see Figures 3 and 4).

ES, MES, SES, Vol and Beta were measured for each individual company's stock using the pre-crisis period

ES: the Expected Shortfall of an individual stock at the 5th-percentile.

$$ES = -E[R_b/R_b \leq I_{5\%}]$$

R_b is the firm 's return

MES is the marginal expected shortfalls of a stock given that the market return is below its 5th-percentile

$$MES_{5\%} = \frac{1}{\text{number of days}} \sum_{t=\text{the worst 5\% market outcomes}} R_t^b$$

The marginal expected shortfall MES is estimated at a standard risk level of 5% using daily data of equity returns from BVMT. This means that we take the 5% worst days for the market returns (R) in any given year, and we then compute the average return on any given firm (R_b) for these days.

SES is the leverage-corrected MES

$$SES = \frac{60}{x} MES_{5\%} + \frac{z}{1-LVG} - 1$$

we set $z=6\%$ based on Tier-1 Basel capital requirements, and we set the crisis-level market drop to be a 60% drop in financial firms' equity, x represents the ES of the market return during the pre-crisis period.

Volatility (Vol) is calculated as square root of 250 times standard deviation of daily stock returns.

Beta (β) is the estimate of the coefficient in a regression of a firm's stock return on that of the market's.

$$\beta = \frac{cov(R_m, R_i)}{Var(R_m)}$$

R_i is the firm i's return, R_m is the market return

LVG: Leverage is measured as quasi-market value of assets divided by market value of equity, where quasi-market value of assets is book value of assets minus book value of debt + market value of equity.

We used in this paper individual risk measures as the expected shortfall (ES), stock market beta and annualized volatility of stock returns. ES is taken as the simple average of 5% left tail of stock's empirical return distribution in the pre-crisis period. Stock's beta is estimated as covariance between stock return and Tunindex return divided by variance of Tunindex return. Annualized volatility is calculated as square root of 250 times standard deviation of daily stock returns. Finally, the realized return is measured by the average of the equity returns values of the financial firms through the crisis periods.

3.2.3 Results

In MES calculations, firstly Tunindex pre-crisis period tail events are used to determine the worst 5% market outcomes. Then, simple averages of the listed stocks' returns for these determined 5% worst days are recorded as MES's of stocks like it is formulated in eq. (2). The leverage ratios of firms which are formulated in eq. (6) are computed using the last available balance sheet values before the start of the crisis period. Descriptive statistics for the calculated risk measures and realized systemic losses are given in Table 2.

Table 2 describes the summary statistics of all these risk measures. The Event Return illustrate how stressful this period were for banks (leasing companies), with mean return being -0.0008083 (-0.0006557). It is so useful to compare ES and MES, in fact the mean return of banks in its own left tail is -1,85 %, it is - 1,33% when the market is in its left tail. Regarding Leasing Companies the mean return in its own left tail is -2,26 %, and it is - 1,43% when the market is in its left tail. The market itself has an ES of -0,63% implying that the equally-weighted average return of banks when market is in its left tail is worse than the value-weighted average return. Mean volatility of banks stock return is 28,92% and beta is 0,2. For leasing companies, Mean volatility is 29,94% and beta is 0,3. All these measures however show substantial cross-sectional variability, which will be explained later.

The correlations between the variables are represented in Table 3. Looking at the first column for Banks, log total assets and leverage have the highest correlation with realized losses, where correlation of ratio of capitalization and realized returns is the lowest. As for leasing companies log total assets and ratio of capitalization have the highest correlation with realized losses, however correlation of ratio of ES and realized returns is the lowest. Moreover, STB which has the highest realized losses is in t the fourth place of % MES ranking and according to ES measure, is at the second place among 16 institutions (Table 4).

The analysis of the realized returns during the crisis may vary significantly across types of institutions. We provided a statistics study of all the relevant risk measures by institution type. Table 5 showed OLS regression results for December 2010 –November 2011 crisis. For the panel A with concerns banks, the column (10) including both **MES** and **capitalization ratio** dominates the other models with the highest adjusted R2 value. Columns including **capitalization ratio** and **SES** as independent variables are also powerful in explaining the realized losses in both of the cases. Column (2) employs **MES** and **LVG** as separate regressors in explaining the realized returns. We note that these variables are both statistically significant. Column (7) showed that **Vol**, another measure of individual firm risk does very poorly in explaining realized returns. As for leasing companies (Panel B) only **ES** and **Vol** are statistically significant, Columns (4) and (5) , (8) show that risk measures **MES** and **LVG** and **Beta** do not contribute to explaining realized returns at all.

Figure 5 described our measures of systemic risk estimated ex ante over the period December 2009–November 2010 plotted against the realized return during the crisis December 2010 to November 2011.

Table 5 showed OLS regression results for December 2010 –November 2011 crisis. Column (10) including both **MES** and **capitalization ratio** dominates the other models with the highest adjusted R2 value. Columns including **capitalization ratio** and **SES** as independent variables are also powerful in explaining the realized losses in both of the cases. Column (2) employs **MES** and **LVG** as separate regressors in explaining the realized returns. We note that these variables are both statistically significant. Column (7) showed that **Vol**, another measure of individual firm risk does very poorly in explaining realized returns.

Therefore, we demonstrated empirically the degree of ability of SES to predict the realized systemic risk during the Tunisian financial crisis of January 2011 through the analyze of the ex-ante performance of different risk measures like expected shortfall, annual volatility, market beta, MES and leverage ratio, in forecasting systemic losses.

Empirical results have proved that SES is a powerful alternative in explaining potential riskiness of Tunisian banking sector during the financial crises of 2011 while the expected shortfall and volatility are both the only explanatory variables for the leasing companies' realized return during the crises period. Increasingly aware of the impact of risk in assets due to recent political instability, the Tunisian financial industry have to establish adequate measures in conformity with the new prudential regulation framework based on risk management which induce Tunisian policymakers to protect the savings invested in securities and to preserve market integrity and equality among investors and avoid economic and socio-political negative effects, in particular the under-capitalization of banking institutions in the aim to stabilize financial growth.

4. Conclusion and Policy Implications

The fragmentation of the Tunisian banking system and the small size of many Tunisian banks could explain the poor performance of the sector. In fact The Tunisian financial sector is dominated by public-controlled banks but also contains a significant number of private banks, both large and small, and a substantial foreign presence.

Through the analysis presented under section II, we underlined the disappointing performance of the Tunisian banking sector in terms of profitability, liquidity, capital adequacy and the interest to income ratio. Overall all these indicators, we noted that the financial sector suffers from the weak performance of public banks which reflects severe corporate governance failures. This paper reflected the necessity of develop a methodology for measuring systemic risk in Tunisian financial system, based on information of individual institutions and adjusted with global methodology. We used multivariate regression model with leverage ratio and MES of each financial institution as independent variables, fitted to institutions' stock value losses that are observed through crisis periods (from 2010-2011) . We found that SES model including both MES and leverage ratio is a powerful alternative in explaining potential riskiness of Tunisian banking sector during the financial crises of 2011. We also noted that the public banks (STB and BNA) figured in advanced ranking of realized returns, MES and ES.

This analyze of banking sector of Tunisia, demonstrates the fact that there are many challenges affecting the financial sector especially the important weak governance of state owned banks.

Indeed, the government protection for public banks considered as too-important-to-fail (TITF) banks, creates a variety of problems such the unequal playing field, excessive risk-taking, and large costs for the public sector. Since creditors of systemically important banks (SIBs) do not support the full cost of failure, they are willing to provide funding without paying sufficient attention to the banks' risk profiles, thereby encouraging leverage and risk-taking.

On the basis of previous results²¹, the following recommendations are proposed to respond to an important need to establish an adequate prudential framework by:

- Reforming and restructuring financial supervision along macro-prudential lines
- The necessity to restructure the balance sheets of state-owned banks need and to improve their governance to ensure that they operate on a commercial basis.
- The introducing and the enforcing stricter regulatory and reporting requirements to more strengthening of banking system.
- The assessment of systemic risk through the financial soundness indicators and banking sector data which suffer from deficiencies
- The conception of an exit strategy to resolve the large liquidity problem.

In conclusion, The main objectives of macro-prudential regulation is to monitor and control systemic risks and related risks across the financial system which require greater regulatory and supervisory intensity that necessitate increased intervention in the operations of cross-border banking and financial groups and a wider assessment of the risks they pose. The precedent recommendations need some requirements to ameliorate quality systemic risk management, such as adequate reorganization of financial institutions in case of collapse, a powerful and resistant market infrastructure and a proactive macro-prudential supervision and quality capital and satisfying liquidity standards.

²¹ See ‘the 2010 Development Policy Review “Towards Innovation-Driven Growth in Tunisia” (World Bank 2010a).

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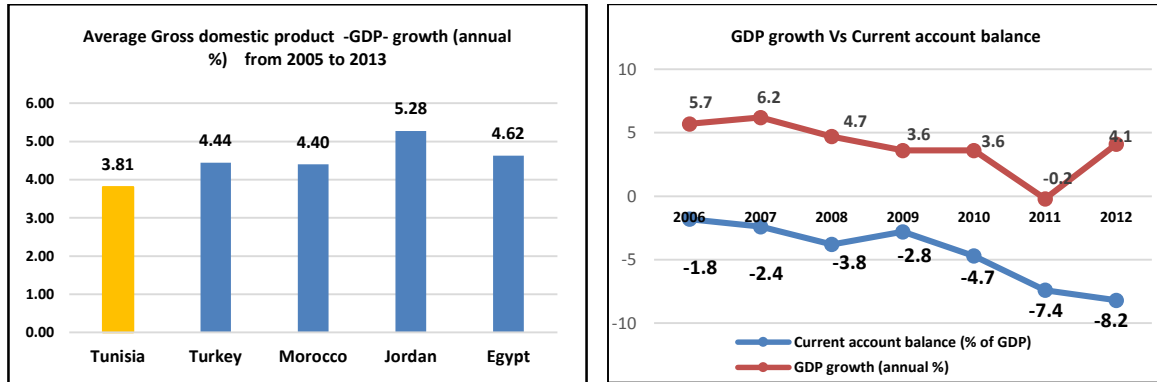
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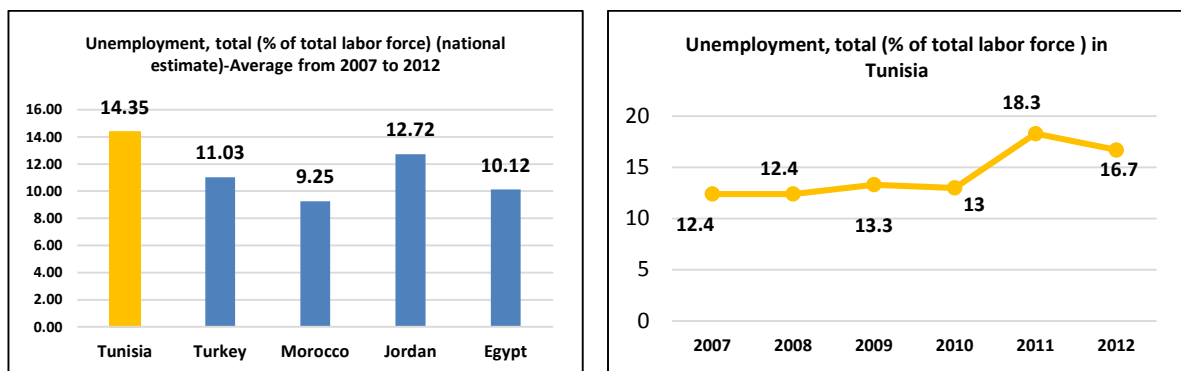
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Figure 1a: The Gross Domestic Product GDP Growth²²



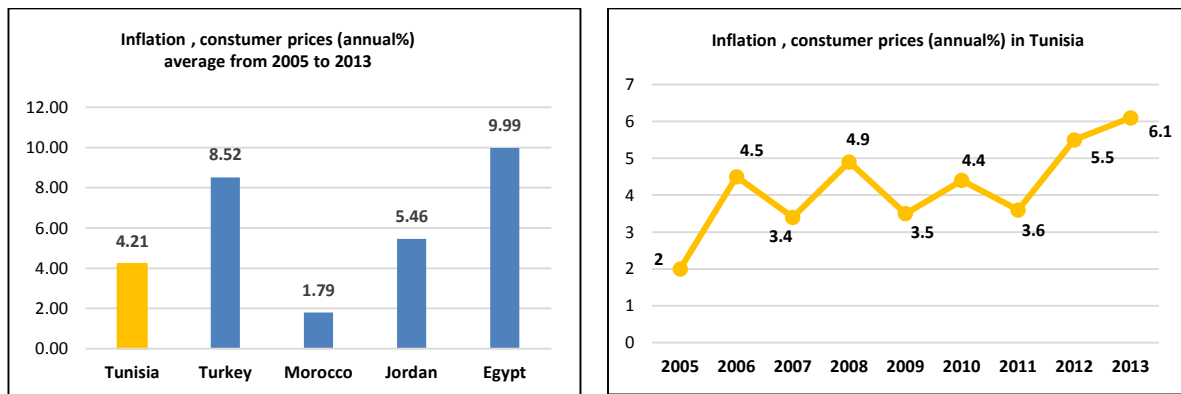
Source: Word Bank and own calculations

Figure 1b: The Unemployment Rate Evolution



Source : Word Bank and own calculations

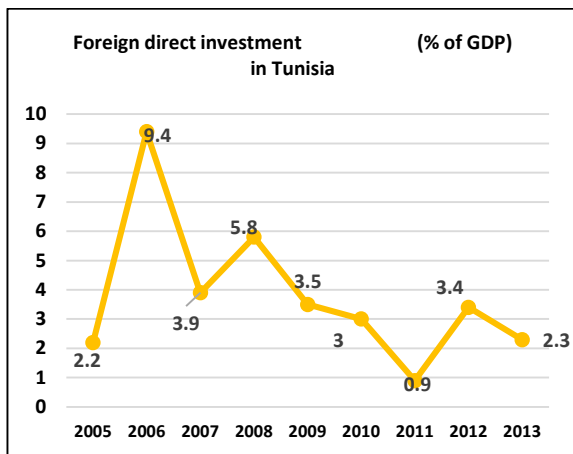
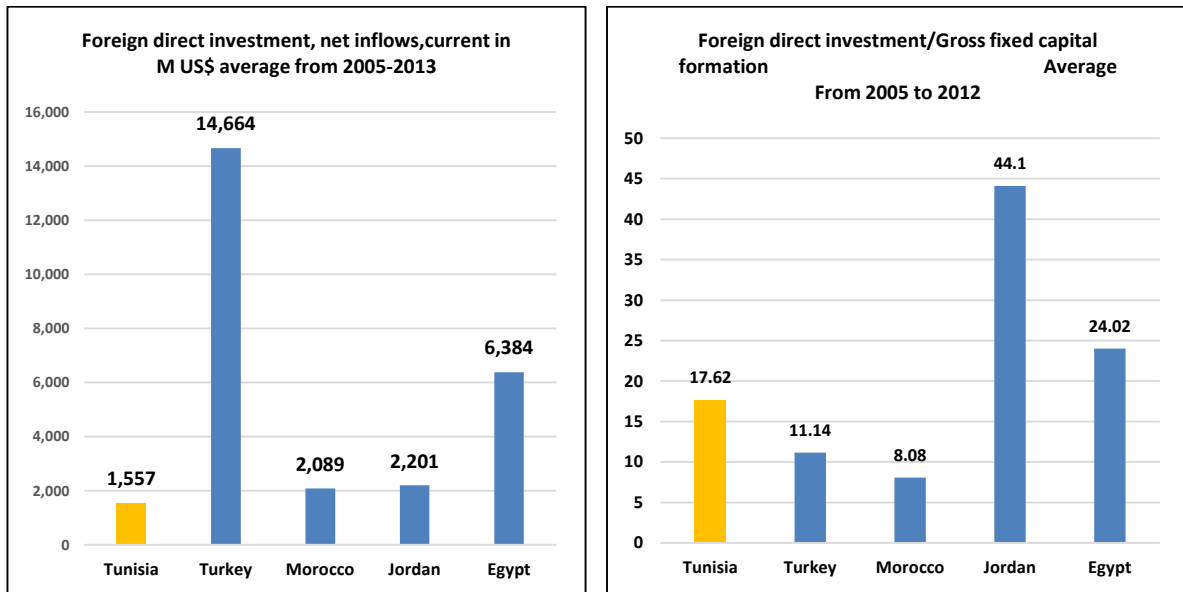
Figure 1c: The Inflation Rate Evolution



Source : Word Bank and own calculations

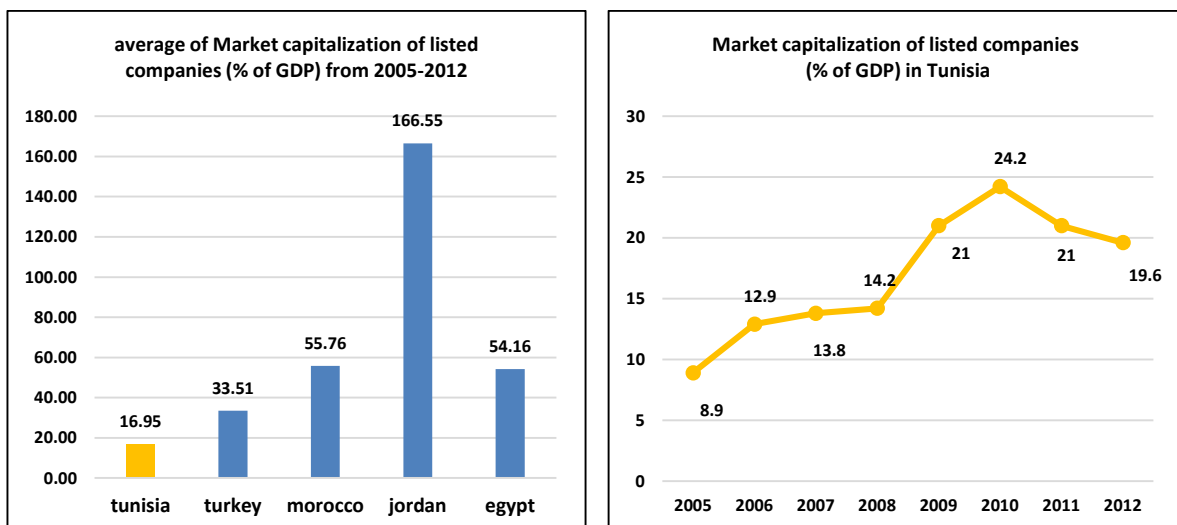
²² Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2005 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources"

Figure 1d: The Foreign Direct Investment Evolution



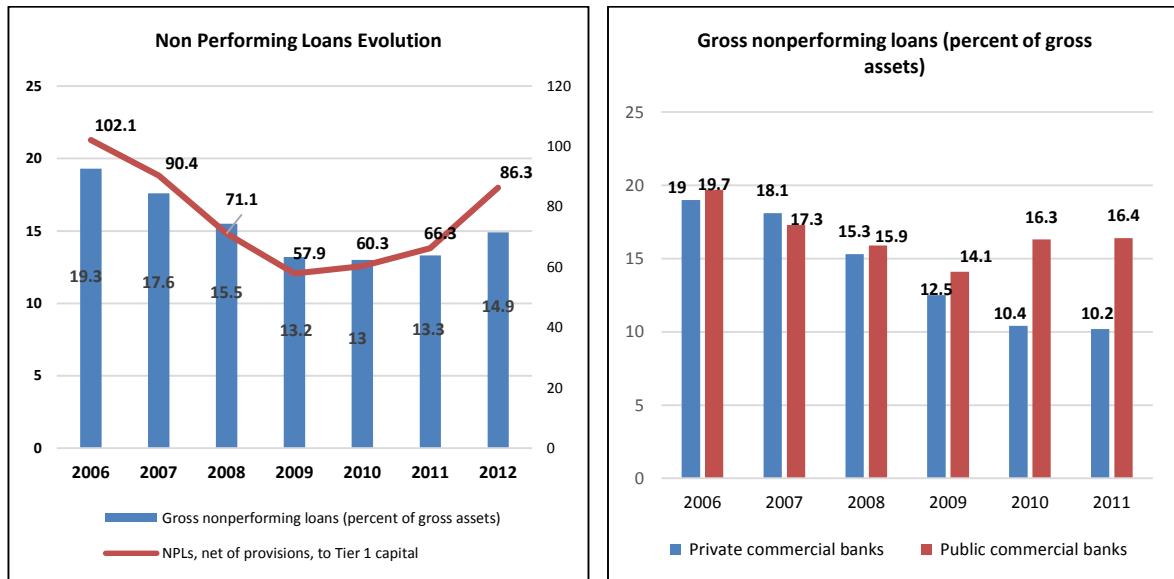
Source : Word Bank and own calculations

Figure 1e: The Market Capitalization of Listed Companies Evolution



Source : Word Bank and own calculations

Figure 1f: The Non-Performing Loans Evolution



Source: Central Bank of Tunisia, IMF Country Report No. 13/161 , June 2013 and IMF Country Report No. 14/123 , may 2014. IMF country report²³

²³ IMF Country Report No. 12/241, December 2014 , August 2012 IMF Country Report No. 14/362

Figure 2a: The Evolution of the Non –Interest Income

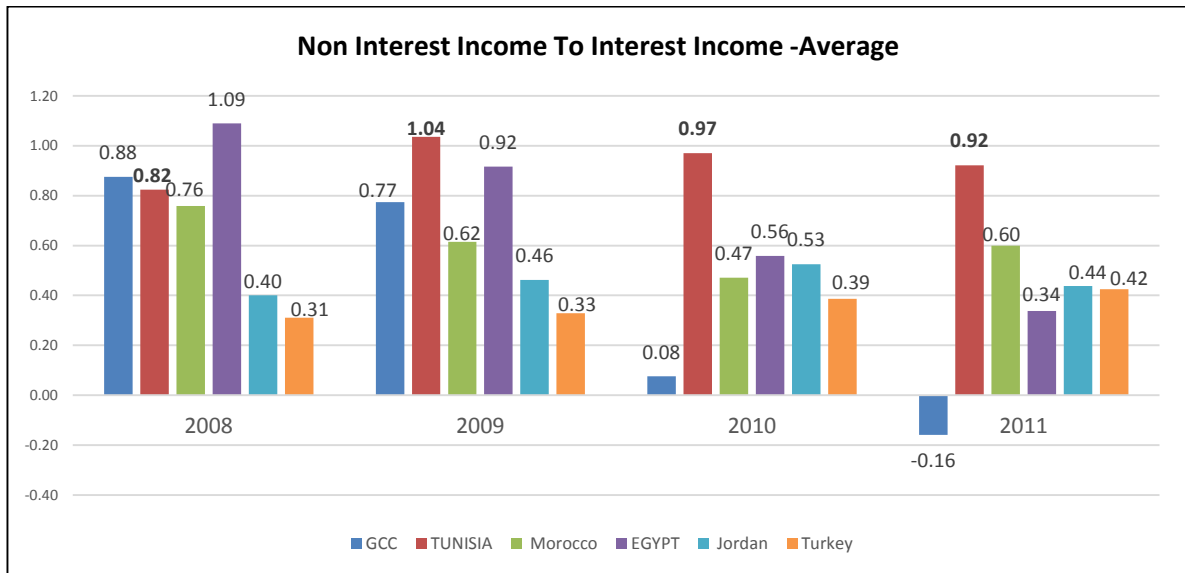
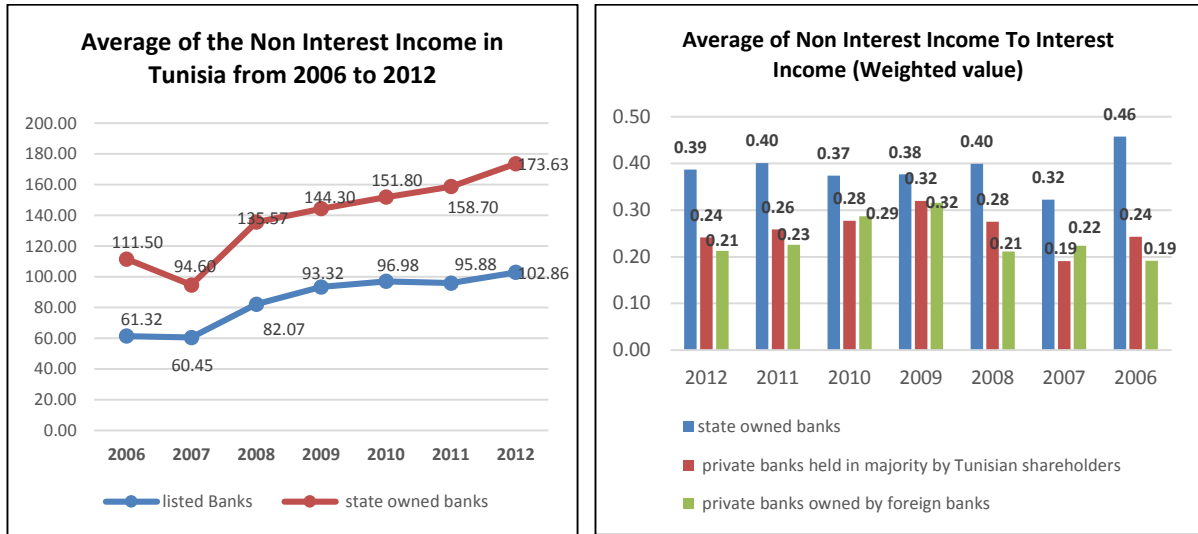


Figure 2b: The Evolution of Capital Indicator

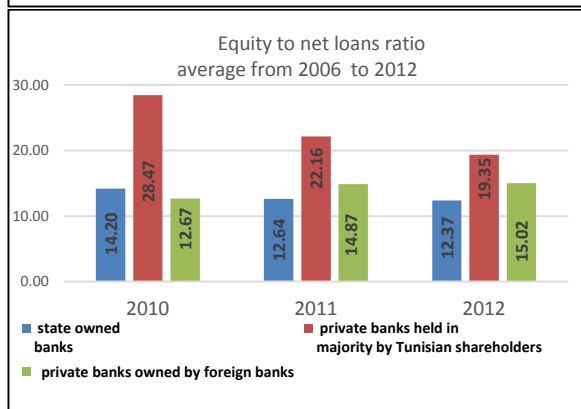
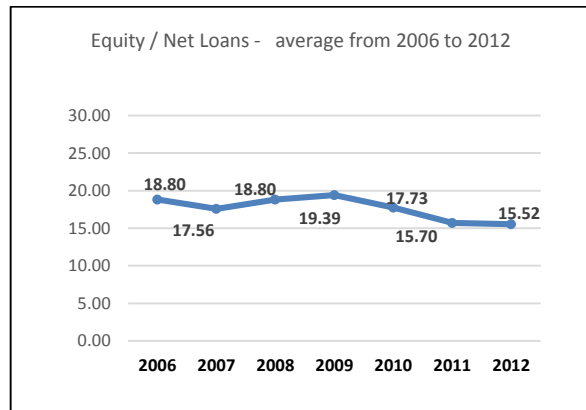
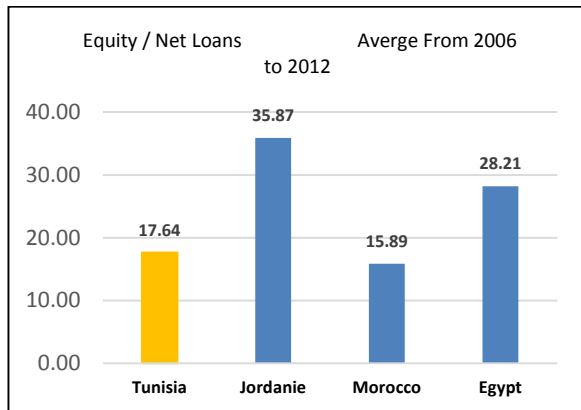


Figure 2c: The evolution of liquidity Indicator

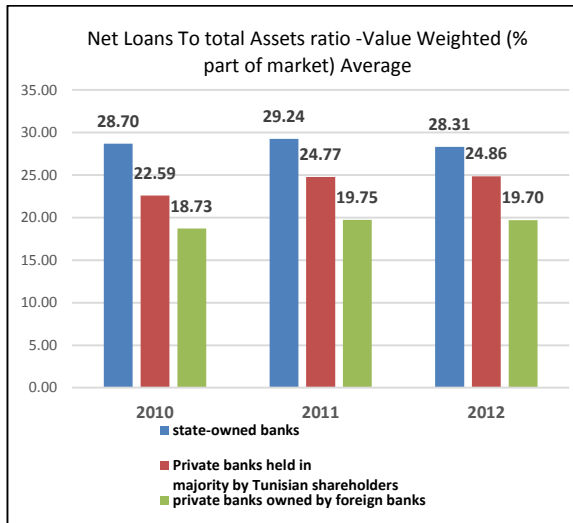
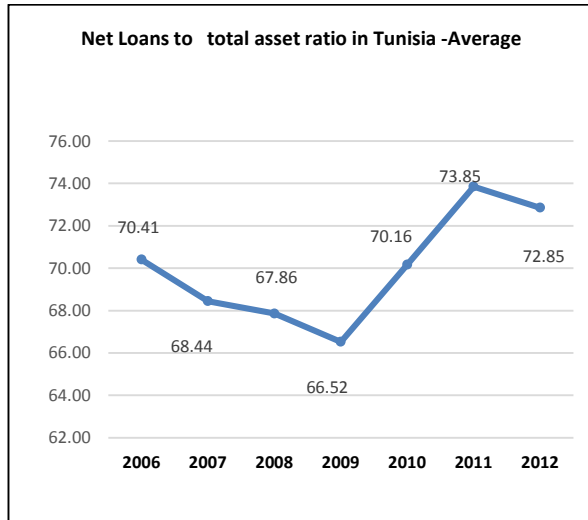
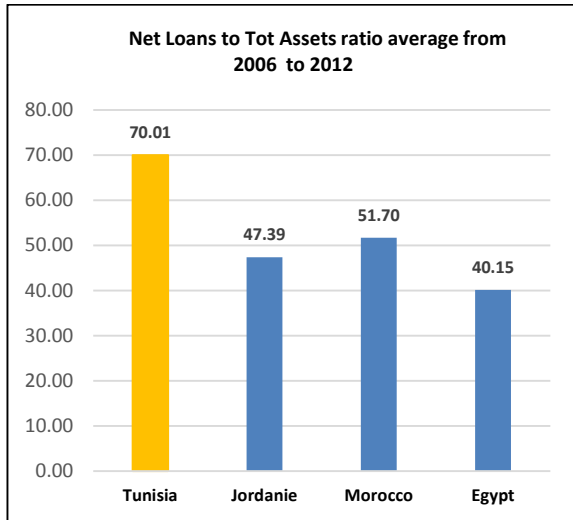


Figure 2d: The Evolution of Profitability Ratios

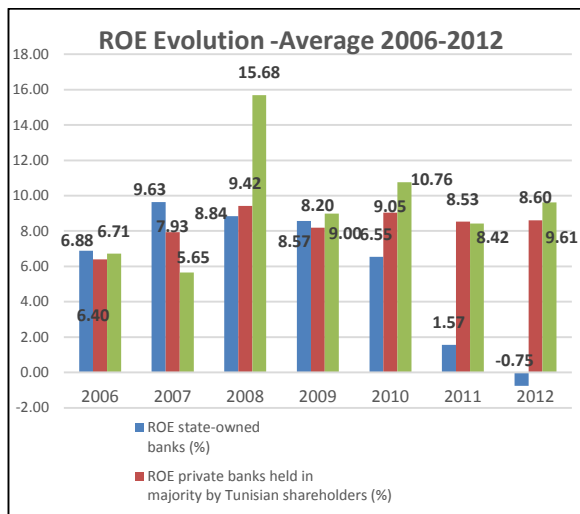
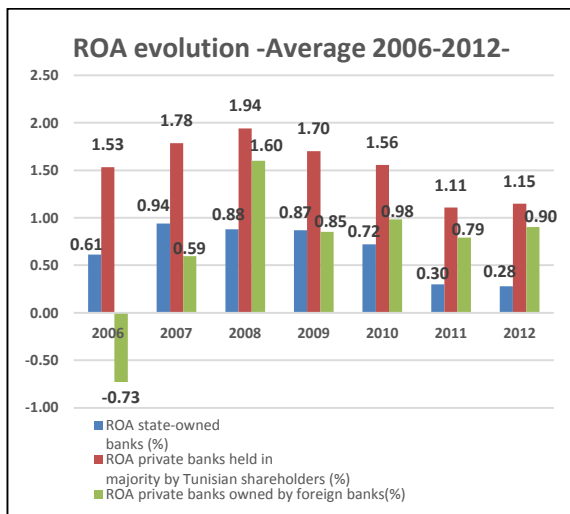
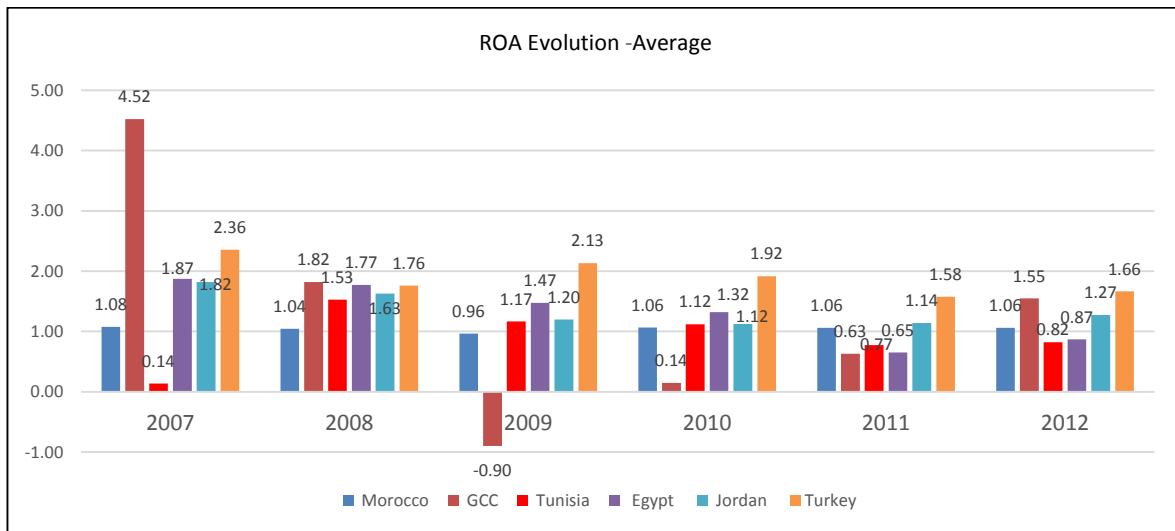
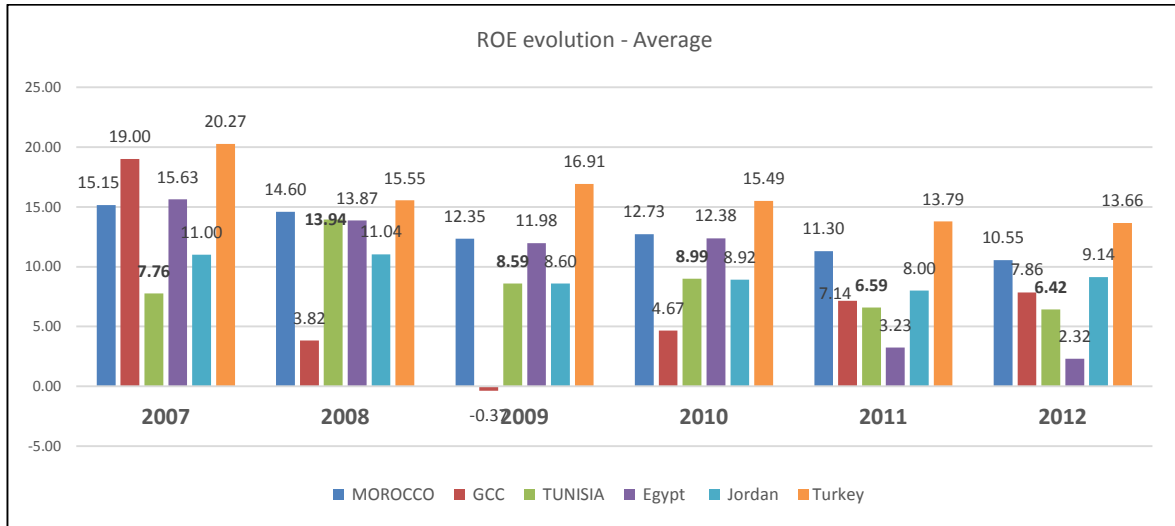
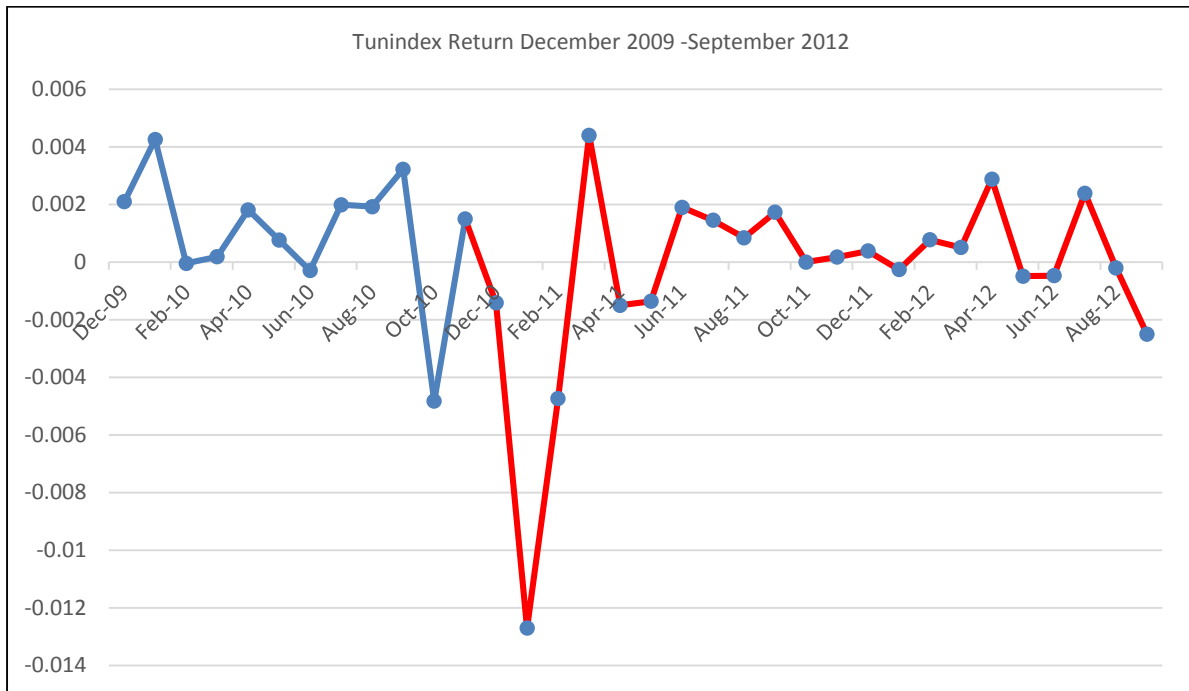
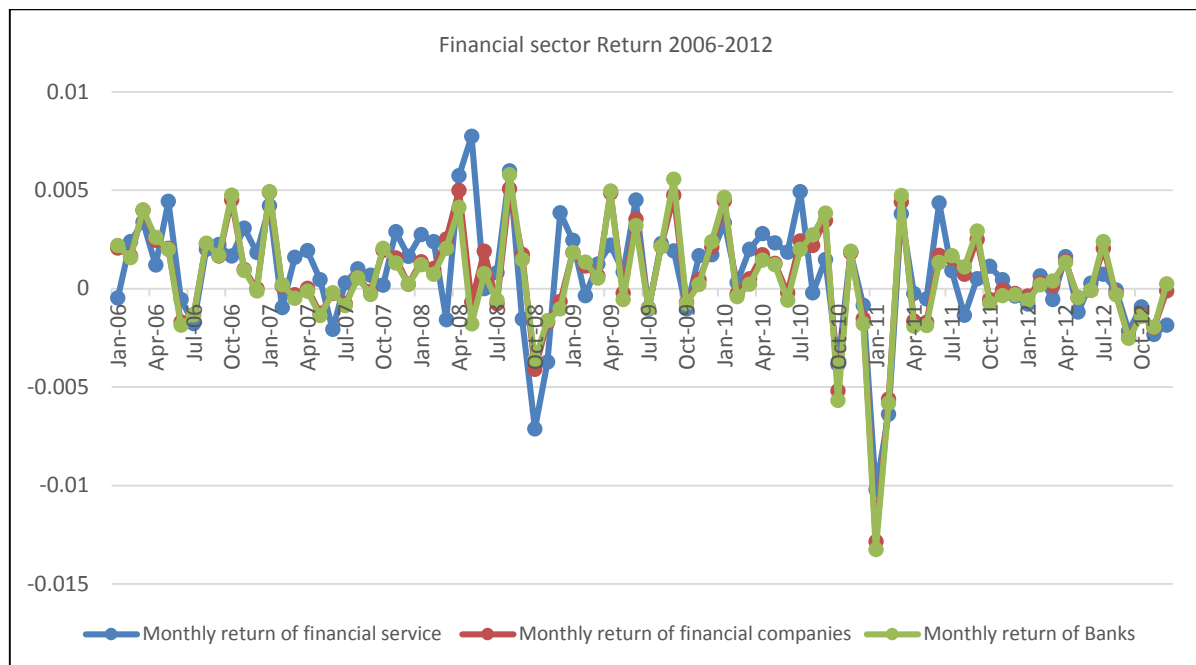


Figure 3: Evolution of Monthly Tunindex Returns



Source : BVMT and own calculation

Figure 4: Evolution of Financial Sector Return



Source : BVMT and own calculation

Figure 5: Realized Return Vs Fitted Values

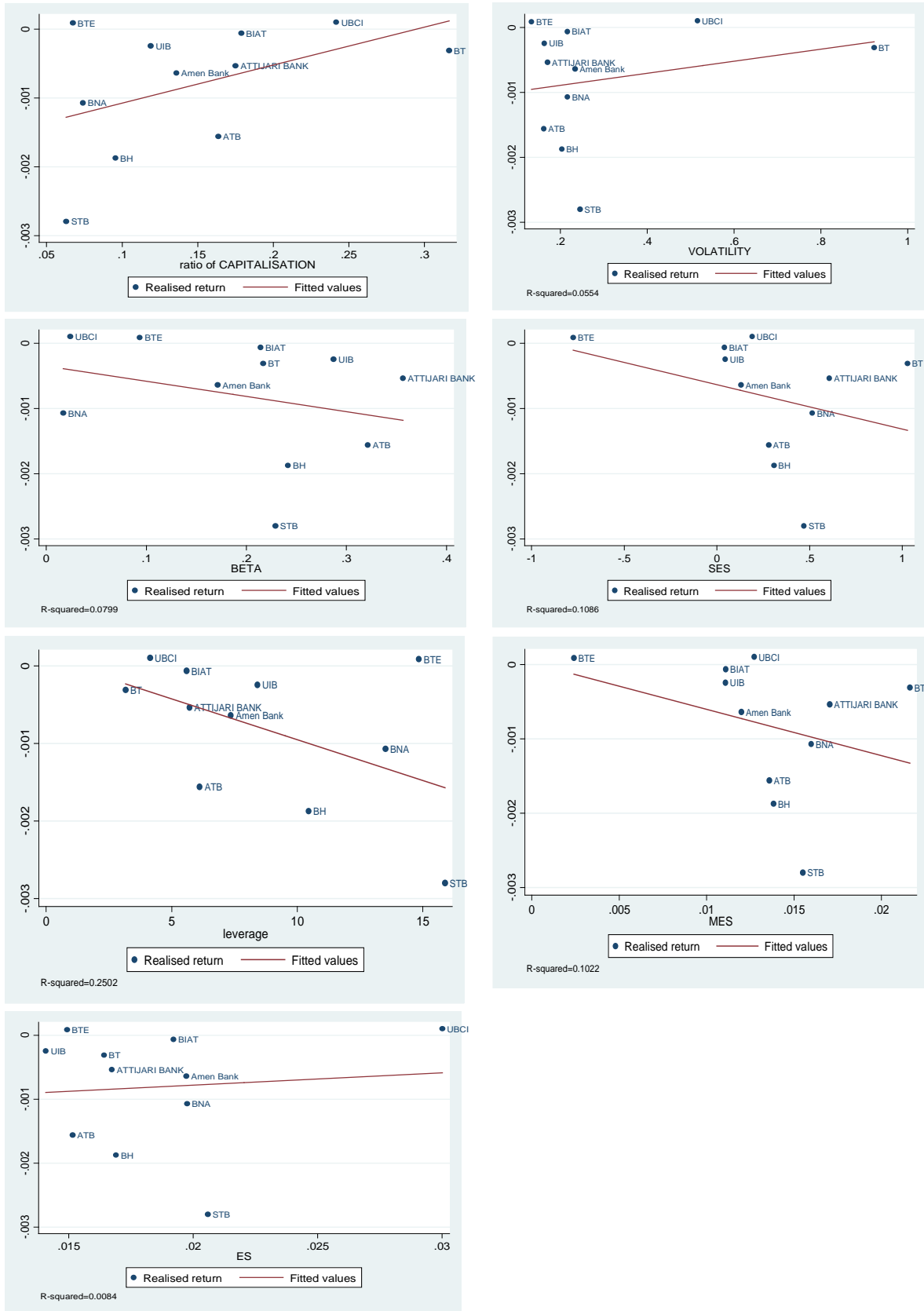


Table 1: List of the Financial Institutions

<u>Banks</u>	<u>Leasing Companies</u>
Arab Tunisian Bank	Arab Tunisian Lease
Attijari Bank Of Tunisia	Attijari Leasing
Arab International Bank Of Tunisia	Company Internationale De Leasing
Bank Of Housing	El Wifack Leasing
National Agriculture Bank	Tunisie Leasing
Amen Bank	
Bank Of Tunisia	
Bank Of Tunisia And Emirates	
International Banking Union	
Banking Union For Trade And Industry	
Tunisian Company Of Bank	

Table 2: Descriptive Statistics for the Calculated Risk Measures and Realized Return

Banks				
Variable	Mean	Std. Dev.	Min	Max
Realized return	-.0008083	.000927	-.0027979	.0001029
mes	.0133483	.0047556	.0024057	.0216218
ses	.2578483	.4482489	-.7756472	1.02761
es	.0185007	.0044014	.0140845	.0300045
leverage	8.654541	4.408358	3.161904	15.88534
Logtotal assets	15.0886	.7102122	13.24639	15.72558
beta	.1974846	.1124482	.0169342	.3564597
volatility	.2892933	.2337161	.1336933	.9227325
Ratio of capitalization	.1481847	.0787264	.0629511	.31626
Leasing Companies				
Variable	Mean	Std. Dev.	Min	Max
Realized return	-.0006557	.0006685	-.0017255	.0000125
mes	.0142943	.0071471	.0025253	.0199936
ses	.3331566	.6820076	-.7882609	.8760148
es	.0225979	.0089289	.0158115	.036605
leverage	3.43794	.5862956	2.826743	4.386191
Logtotal assets	12.59265	.4543547	11.94995	13.11952
beta	.0994126	.093656	-.0111238	.2016672
volatility	.2994473	.1251073	.2001957	.4798726
Ratio of capitalization	.2971314	.0463744	.2279883	.3537641

Table 3: Correlation Matrix between Main Variables

Banks										
	Realized return	mes	ses	es	leverage	logtot~s	beta	volati~y	ratioo~n	
realisedreturn	1.0000									
mes	-0.3197	1.0000								
ses	-0.3296	0.9999	1.0000							
es	0.0916	0.1010	0.0981	1.0000						
leverage	-0.5002	-0.3979	-0.3877	-0.1721	1.0000					
Log total assets	-0.5601	0.6369	0.6430	0.1259	-0.1017	1.0000				
beta	-0.2826	0.2673	0.2687	-0.6075	-0.2741	0.2734	1.0000			
volatility	0.2353	0.5875	0.5785	0.2794	-0.5140	-0.0380	-0.1852	1.0000		
Ratio of capitalisation	0.4685	0.5154	0.5038	0.2500	-0.8953	-0.0163	0.0927	0.8203	1.0000	
Leasing Companies										
	realisedreturn	mes	ses	es	leverage	logtot~s	beta	volati~y	ratioo~n	
realisedreturn	1.0000									
mes	-0.1716	1.0000								
ses	-0.1692	1.0000	1.0000							
es	0.1347	0.6031	0.6024	1.0000						
leverage	0.2524	0.4271	0.4335	0.0310	1.0000					
logtotalassets	-0.2569	0.5255	0.5235	-0.2641	0.1330	1.0000				
beta	-0.1073	0.0483	0.0488	-0.7429	0.2799	0.8029	1.0000			
volatility	0.0083	0.6395	0.6387	0.9912	0.0334	-0.2389	-0.7324	1.0000		
Ratio of capitalization	-0.2240	-0.4587	-0.4650	-0.1443	-0.9894	-0.0384	-0.1474	-0.1522	1.0000	

Table 4: Classification of Banks Relative to MES, ES, SES and Realized Return²⁴

rank	Financial institution	Realised return	rank	Financial institution	MES	rank	Financial institution	ES	rank	Financial institution	SES
1	STB	-0.0027979	1	BT	0.0216217	1	UBCI	0.0300046	1	BT	1.0276102
				ATTIJARI						ATTIJARI	
2	BH	-0.0018730	2	BANK	0.0170390	2	STB	0.0205882	2	BANK	0.6069950
3	ATB	-0.0015590	3	BNA	0.0159850	3	BNA	0.0197513	3	BNA	0.5147411
4	BNA	-0.0010714	4	STB	0.0154999	4	Amen Bank	0.0197260	4	STB	0.4693929
5	Amen Bank	-0.0006362	5	BH	0.0138212	5	BIAT	0.0192105	5	BH	0.3074994
	ATTIJARI										
6	BANK	-0.0005346	6	ATB	0.0135798	6	BH	0.0169024	6	ATB	0.2791614
							ATTIJARI				
7	BT	-0.0003081	7	UBCI	0.0127214	7	BANK	0.0167364	7	UBCI	0.1901687
8	UIB	-0.0002434	8	BTE	0.0024057	8	BT	0.0164225	8	Amen Bank	0.1298748
9	BIAT	-0.0000598	9	BIAT	0.0110904	9	ATB	0.0151515	9	UIB	0.0453451
10	BTE	0.0000886	10	UIB	0.0110818	10	BTE	0.0149301	10	BIAT	0.0411902
11	UBCI	0.0001029	11	UBCI	0.0127214	11	UIB	0.0140845	11	BTE	-0.7756472

²⁴ Realized returns is the stock return of bank i during the systemic crisis event

Table 5: OLS Regression Analysis Dependent Variable is Realized Losses in Crisis Period (December 2010 –November 2011)

Panel A Banks Crisis December 2009 to November 2011 * for p<.05, ** for p<.01, and *** for p<.001										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
INTERCEPT	.0008651 (1.54)	.0021518 (2.24)	-.1115959 (-3.44)	0.0000235 (0.03)	.0001019 (0.17)	-.001888 (-4.51)	-.0010783 (-2.30)	-.0003483 (-0.59)	-.0011788 (-0.86)	-.0003248 (-0.56)
MES		-.1201348* (-2.44)	10.45546 * (3.42)	-0.0623172 (-1.01)						-.148951* (-3.12)
LEVERAGE	-.0001554* (-2.95)	-.0001567* (-2.95)			-.0001052 (-1.73)					
SES	-.0012741* (-2.46)		-.1115963* (-3.44)			-.0015676* (-3.12)				
ES									.0059145 (0.08)	
BETA								-.0023295 (-0.88)		
VOL							.0009333 (0.73)		.0009021 (0.64)	
CAPITALISATION RATIO						.0100133* (3.50)				.0101539* (3.52)
Adj-R2	46,58%	46,23%	54,75%	00,24%	16,68%	56,03%	-4,96%	-02,24%	-17,99%	56,04%

Panel B Leasing companies Crisis December 2009 to November 2011 * for p<.05, ** for p<.01, and *** for p<.001										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
INTERCEPT	-.0021162 (-0.77)	-.0017605 (-0.68)	.0456934 (0.50)	-.0004263 (-0.51)	-.0016452 (-0.74)	.0011125 (0.34)	-.000669 (-0.68)	-.0005796 (-1.09)	-.0014373 (-3.77)	.0014508 (0.39)
MES		-.0319671 (-0.48)	-4.285267 (-0.50)	-.0160499 (-0.30)						-.0324962 (-0.47)
LEVERAGE	.0004574 (0.56)	.0004543 (0.56)			.0002878 (0.45)					
SES	-.0003363 (-0.48)		.0447407 (0.50)			-.0003419 (-0.47)				
ES									.5435311* (4.75)	
BETA								-.0007662 (-0.19)		
VOL							.0000443 (0.01)		-.038408* (-4.70)	
CAPITALISATION RATIO						-.0055677 (-0.52)				-.0055263 (-0.52)
Adj-R2	-68,14%	-68,16%	-72,41%	-29,41%	-24,84%	-70,89%	-33,32%	-31,80%	83,71%	-70,90%