6-2016

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Available online at www.sciencedirect.com

Borsa İstanbul Review

Borsa İstanbul Review 16-2 (2016) 72–81

http://www.elsevier.com/journals/borsa-istanbul-review/2214-8450

Full length article

Risk management and capital adequacy in Turkish participation and conventional banks: A comparative stress testing analysis☆

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Received 26 August 2015; revised 1 April 2016; accepted 2 April 2016
Available online 12 April 2016

Abstract

In this study, we investigate changes in banks' capital adequacy ratio (CAR) under different stress scenarios and examine the results by comparing conventional banks to participation banks in Turkey. Our results report that the capital adequacy ratio of the banks declines substantially given the stress scenarios. We find that participation banks in Turkey suffer more in declined capital adequacy ratio compared to conventional banks. Our findings reveal that participation banks in Turkey are more sensitive to sudden changes in exchange rates and increased non-performing loans. However, this sensitivity is in regards to capital adequacy, not profit. Overall, our study shows the effect of stress in the banking sector by contributing to the existing literature.

JEL classification: G21; G28; P43; Z12

Keywords: Islamic banks; Basel I; Credit risk; Market risk; Operational risk; Stress testing; Scenario analysis; Basel I; Capital adequacy; Turkey

1. Introduction

Pillar 1 risks are a major component of the banking sector crucial to measuring the capital adequacy ratio and determining a bank's performance under stress. In this study, we specifically focus on Turkish conventional and participation banks in terms of Pillar 1 risks to understand the expected movements of the capital adequacy ratio after analyzing different types of risks such as credit risk, market risk, and operational risk. Pillar 1 risks are important due to the fact that they set out the rules by which regulatory capital can be determined. For this reason, Pillar 1 risks can be used as an indicator to understand certain risks banks will take.

This study shows that participation banks are more sensitive to shocks followed by economic turmoil such as a) a drop in house prices (real estate market), b) an increase in bad loans (non-performing loans) as a result of customers' bankruptcy in terms of capital adequacy ratio and its components (capital, credit risk, market and operational risk), and c) an increase in currency rates, as Turkey applies the floating exchange system and is open to all kinds of large fund movements due to political stability, interest rates, and investment opportunities. As a result, we are motivated to investigate whether or not the participation banks in Turkey (Islamic banks) are more sensitive to those risks than conventional banks.

The reason participation banks are more sensitive can be explained by credit risk exposures, as observed throughout the study. We conclude that participation banks are more exposed to credit risk scenarios such as currency and NPL increases

☆ The authors thank the participants at the Conference on "Stress Testing the Islamic Banking System: Methodologies and Applications," in Khartoum, Sudan, January 25–26, 2015. We also thank the Editor for helpful suggestions and comments.

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Peer review under responsibility of Borsa İstanbul Anonim Şirketi.

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http://dx.doi.org/10.1016/j.bir.2016.04.001

and collateral value decreases. However, this sensitivity involves only the capital adequacy, not the profitability or liquidity, as the main focus of this study is the capital adequacy standards of banks. Overall, our study shows the effect of stress in the banking sector by contributing to the existing literature.

Pillar 1 is derived from Basel II, which are recommendations and suggestions on banking laws and regulations issued by the Basel Committee on Banking Supervisions. Therefore in this study we will analyze the Pillar 1 risks in Turkish conventional and participation banks, considering Basel II rules, to evaluate the capital adequacy ratio in both interest-rate sensitive and interest-rate free banking systems under stress.

Basel II was implemented in June 2006, when the committee uploaded the new framework for capital measurement and capital standards. As a result, financial institutions changed the way they calculate and measure capital. For this reason, we will evaluate different approaches such as the Basic Indicator Approach and Standardized Approach to understand the Pillar 1 risks, benefitting from moving from one approach to the other while controlling for capital.

Since the banking system has become more sophisticated recently, with rapid changes resulting from technology and deregulation, it has been a dilemma to find the right balance between supervision, regulation, and market discipline. Since Turkey is an emerging market, banks and other financial institutions in the country react differently compared to the emerged markets of innovations and transformations.

Hence, in this paper we will study Basel II along with Pillar 1 risks to evaluate the major changes that are taking place in financial markets and to understand the allocation of the capital ratio of given participation banks once exposed to stress, with particular reference to the need for increased sensitivity to all types of risks. Since Basel II was planned to strengthen capital adequacy, we will implement stress tests in a framework designed to understand how the Pillar 1 risks can affect the banking system and determine the performance of participation banks in Turkey compared to conventional banks.

Participation banks have been in Turkey since the early 1980s (Investment Support and Promotion Agency of Turkey, 2015). According to the Banking Regulation and Supervision Agency of Turkey (BDDK), assets of participation banks in Turkey reached 45 billion USD, which is 5.5% of the whole banking sector's assets, while deposits of participation banks are around 28 billion USD, or 6.3% of all deposits including conventional banks (Mustafa Dereci, 2014).

Similar to assets and deposits, loans issued by participation banks reached about 29 billion USD by 2014, which is 6% of all loans, and saving deposits of participation banks is 19 billion USD, which is 7.8% of all saving deposits (BDDK, 2014). Participation banks in Turkey have also been growing their SME loans, gold deposits, number of ATMs, and number of branches over the last 30 years (Turkish Central Bank, 2013). For the purpose of this study, we will compare participation banks in Turkey with conventional banks and try to understand the stress test results under Pillar 1 risk and examine their performance.

In Turkey, conventional and participation banks can collect deposits and utilize them through extension of credits, both corporate and retail. Both types of banking are regulated by the Banking Regulation and Supervision Agency (BRSA) under a single Banking Law and associated regulations. The BRSA regulates and supervises all aspects of banking. The Central Bank is also involved with regards only to foreign currency operations and reserve requirements.

Participation banks are functionally similar to deposit banks, but their collecting and lending methods of funds are different. There is no separate regulation regarding participation banking. The law, however, distinguishes between deposit and participation banking. Regulations governing fund collection and fund utilization are different between these two types of banks. There are also minor differences in accounting methods. The law, taking into consideration the nature of the profit and loss participation accounts, also allows for a slightly different calculation method for the capital adequacy ratio for participation banks. The account structure of participation banks is as follows:

Current accounts (*demand accounts*) are described as drawn partially or completely at any call, earnings unpaid with liability covering principal. *Profit/loss participation accounts* are defined as profit/loss accrued at maturity shared pro rata, with no profit ratio fixed in advance and no guarantee of any revenue or repayment of principal amount after tenor.

The main products of participation banks can be summarized as follows: *Corporate finance support* includes financing the purchase of goods and services required by the customer. Costs of the goods and services are paid to the seller, the customer becomes indebted to the bank, and payment documents must be kept by the branch.

Individual finance support includes financing the purchase of the vehicles, houses, and consumer goods required by consumers. The costs of the goods to be purchased are paid to the seller and the customer becomes indebted to the bank.

Leasing movable/immovable goods are purchased by participation banks and the purchased goods are hired to the customer and transferred to the Lessee after the payments.

Profit and loss partnership investment refers to financing both the labor and the amount invested where profit/loss shares are mutual. After completion of the investment or projects, profit or loss is shared by partners.

As a result of the unique working principles of participation banks, i.e. all credit facilities (loans) must be used for real solid projects, funds are paid directly to the vendor (supplier of commodity) after the purchase of equipment against invoices. This prevents credits from being used in risky and speculative areas that run contrary to their intended purpose.

The policy of lending loans in installments and recovering the loans by monthly installments has been generally effective in regulating the cash flow and liquidity needs of participation banks and strengthening the loans' security. Lending against invoices places an obstacle to irrational behavior by preventing enterprises from using credits to incur unnecessary debts.

On the other hand, the crediting method in participation banks' pattern called “leasing” provides enterprises credited

compatible with their cash flow and financing is made compatible with crediting techniques. In other words, this method allows investments to be financed by long-term financing. Because participation banks have based their processes on invoices and formal documents as per their principles, they have been helping the government in its struggle against the informal economy.

2. Literature review

The previous literature has examined the Pillar I risks and Basel II regulations in various dimensions. Chami, Sharma, and Khan (2003) suggested that Basel II is necessary for the surveillance and supervision of banks where regulations are created to answer fast-changing financial environments. Gurtler, Hibbeln, Vohringer (2007) studied the measurement of concentration risk in credit portfolios which is necessary for regulatory capital and showed the importance of assured Basel II rules. Our study contributes to the literature by examining Pillar I risks and focusing on identifying, evaluating, assessing, and reporting the main risks and measurement methods and applying scenario analysis and stress tests to the banking sector of Turkey.

Ojo (2010) concentrated on both Basel I and Basel II rules and found that under Basel I the capital of the banks increased during economic downturns and decreased during economic booms and the increased risk sensitivity of Basel II increased the sensitivity of capital charges. He found that Basel II had an effect on lending. Additionally, he mentioned that Basel II can help financial institutions, such as banks, manage high levels of credit through their funds from loans to bonds. Building on that, we shed light on how Pillar I risks are important and may affect the banking sector in Turkey during stress scenarios of economic downturns.

Hakenes and Schnabel (2006) studied bank size and risk-taking under Basel II. Under Pillar 1 of the New Basel Capital Accord, they found that small banks (and small borrowers) may actually profit from the introduction of an internal ratings based approach if the approach is performed uniformly across the banks. However, the study also showed that banks which cannot distinguish between the standardized approach and the internal ratings based approach can suffer and be pushed towards higher risk-taking competition which may lead to higher aggregate risk in the economy. This is consistent with Kashyap and Stein (2004) who pointed out the potentially adverse macroeconomic effects of Basel II with the endogeneity of financial risks. Similar to previous findings, Rime (2003) and Repullo and Suarez (2004) analyzed Pilar 1 risks and found that banks under different risks should choose approaches carefully because they can result in higher competition, leaving them with either high risk or low risk consumer loan types.

Roy (2005) observed that Basel II is an important concept; banks have better information and can therefore effectively control Pillar I risks, such as credit risks, operational risks, and market risks. Each of these risks has different approaches to measure it. Thus, the basic indicator approach, internal measurement approach, and value at risk approach have been used to test Pillar I risks where banks can adjust themselves once they are exposed to given risk levels. Based on this, we also test Pillar I risks and confirm that participation banks and conventional banks in Turkey adjust themselves once they are exposed to risk scenarios. However, the result and response from adjustment is different for each bank type.

Gilbert (2006) confirmed that Basel II regulations have a different adoption process in different nations. He found that the U.S., Europe, and Hong Kong have a regulatory divergence from the objectives of Basel II for implementation, since different countries apply different capital ratios for risk sensitivity requirements. Additionally, Pelizzon and Schaefer (2005) found that banks should comply with Pillar I requirements to reduce the likelihood of exposing capitalization costs. Equally important, Santos (2000) mentioned that Pillar I risks encourage banks to develop sufficient capital requirements and adjust their risk profiles for measuring, determining, and analyzing the risks. Subsequently, Naceur and Kandil (2008) examined the MENA region based on the Basel accord. Their study provided support for a significant increase in credit growth after applying capital regulation implementations. Although a higher capital adequacy ratio was measured, the study concluded that banks increased their credit and assets growth. Moreover, Jacques and Nigro (1997) studied the Basel approach on risk in the selected banks' portfolio. After using a sample of U.S. banks, the authors concluded that capital regulations have a significant effect on the proportion of risky assets in banks' balance sheets where the higher capital requirements may result in an increase of portfolio risk.

However, Montgomery (2005) discussed the concept of capital adequacy ratio, assumed under the Basel Accord in Japanese banks. The study indicated that banks modified their portfolios into less risky assets rather than heavily weighted risky assets. The study concluded that the regulatory capital ratio has no effect on both international and domestic asset portfolios. Likewise, Agenor and Silva (2009) built a connection between the risk weights of regulations and the risk premium of banks under Basel II. The authors found that the necessary amount of capital that banks must hold is determined in two ways, namely the institutional nature of borrowers and the riskiness of each particular borrower. Therefore, capital adequacy requirements affect bank lending rates, which in turn determine investment and output. In the same manner, our study contributes to the literature by investigating the effect of Pillar I risks on the capital adequacy ratio and showing that participation banks and conventional banks in Turkey respond differently to stress scenarios. The change in the capital adequacy ratio for both types of banks differs in terms of the risk they are exposed to.

Taher (2012) analyzed risk and capital adequacy ratio based on Islamic finance in UAE. His study suggested that although the Basel approach may not be designed for Islamic institutions, the Islamic Finance Board announced that risk management and capital adequacy would be implemented in accordance with Islamic Shari'a. Hassan and Mazumder

(2001) illustrated the key points of Islamic finance and found that interest-free banking in OIC countries is more effective in terms of stable and smooth velocity of money, controllability of monetary aggregates (MNI and MI), and stronger linkage between monetary policy instruments and ultimate policy goals of the economy. Given this, our study introduces a new approach where we compare participation (Islamic) and conventional banks in Turkey and test the capital adequacy ratio changes under Pillar I risks by investigating whether participation (Islamic) banks' response to shock is different than that of conventional banks since participation banks have a different operational approach.

Equally significant, Mariani and Hassan (2012) analyzed the efficiency of a sample of Islamic and conventional banks in Malaysia for the period of 2000–2008 and demonstrated that full-fledged Islamic banks have higher input requirements. In addition, their results indicated that conventional banks that have Islamic bank subsidiaries have relatively higher efficiency. In contrast, their study also found that both foreign full-fledged Islamic banks and conventional banks with Islamic bank subsidiaries exhibited a negative productivity change, which they attributed to a negative rate of technical change and scale change effects. This is a similar finding to our study where we show that participation (Islamic) banks in Turkey are more sensitive to shocks because their asset structure, operations, and risk exposure are different from conventional banks.

Subsequently, Hassan, Hussain, Kayed (2011) analyzed Basel I regulations on Islamic banking with 67 unique banks from 2002 to 2008 and found that regulations actually forced undercapitalized Islamic banks to increase their capital. Although the authors showed that Islamic banks adjusted themselves to the higher capital requirement, increased risk had no effect on the banks' asset portfolio.

Following this further, Hassan and Dicle (2005) considered the impact of Basel II regulations on Islamic banking. Their findings showed that although the concept of Basel II does not include Islamic banks, the new model of credit risk rating can actually be implemented in Islamic banking. Since it provides financial stability and risk control, the authors suggested that Basel II should be implemented by Islamic finance, as the regulations could help Islamic banks compete globally. Hassan and Chowdhury (2010) studied the relationship between Basel II regulations and Islamic finance. They mentioned that since Islamic banks must operate under regulatory regimes, Islamic banking is more difficult and complex compared to conventional banks as it includes a set of ethical and religious standards. The authors favored Basel II regulations and commented that the regulations would help increase growth opportunities for Islamic banks. Further, Smolo and Hassan (2010) recommended that Basel II should be applied by the Islamic banking sector where the regulations could develop an appropriate capital adequacy ratio that would increase the credibility and soundness of the Islamic financial system worldwide. For this purpose, Hassan and Dicle (2007) suggested that Basel II regulations could provide better corporate governance for Islamic banking and address major problems in the sector. Motivated by that, we also investigate the capital adequacy ratio changes in both participation (Islamic) and conventional banks in Turkey to understand the effects of regulations and how they respond to shocks under given circumstances.

3. Methodology

To test stress on Pillar I risks and identify the expected changes in the capital adequacy ratio, we start by understanding each risk and its basic assumptions. Pillar I risks are identified as credit risk, market risk, and operational risk. Therefore, we run three different scenarios on three types of Pillar I risks and try to analyze the consequences of each scenario.

Credit risk is the possibility of loss that the bank may become exposed to due to the failure of a credit customer to fulfill the obligations of the enacted contract and the failure to execute these obligations, partially or fully, in the required time frame. Credit Risk Weighted Assets indicates the amount of assets banks should reserve to prevent damage if exposed to credit risk.

3.1. Increase in non-performing loans

This scenario is the first component of credit risk where the risk amounts of banks are associated with “non-performing loans.” NPL can increase dramatically as a result of market fluctuations. To demonstrate our stress scenario, we include the recalculated total credit risk amount to the capital adequacy ratio calculation and measure the shock effect of an increase in NPL accounts on capital. While the gross NPL amount of the related month-end figure is increased 80%, the “Special Provision” amount set aside for those loans is assumed to be the same. The reason for leaving provision amounts unchanged due to the scenario is that the capital adequacy ratio is calculated by using net NPL amounts according to Basel II principles. The provision amount is left unchanged in order to create a larger impact on capital in the NPL amount increase scenario, and the effect of an increase in NPL accounts on the capital adequacy ratio is measured.

3.2. Increase in exchange rates

The scenario of an increase in exchange rates is the second part of credit risk and is applied to risk weighted assets. To determine the amount of foreign currency in the credit risk weighted assets, we first check the part of the balance sheets that lists the ratio of foreign currency divided by assets. As a result, we find that between 30% and 40% of credit risk weighted assets are in foreign currency rather than domestic currency (FX indexed loans are considered to be in foreign currency as balance sheet items). Since the purpose of this study is to distinguish the results of participation banks and conventional banks under stress, we calculate two ratios for the two types of banks. To apply our scenario, we increase the USD currency rate from 2.20 to 2.50 for the assumption that

the balances of all the FX loans in the banks' portfolios are affected by a possible increase in exchange rate.

3.3. Changes in collaterals

The last component of credit risk is changes in collaterals. For the collateral scenario, we determine the mortgage loans and consider the expected decreases in the true value of the properties in a given financial crisis. According to the Basel II rules in Turkey, credits with real estates defined as collaterals contain 50% risk weights. An unexpected decrease of 20% in the true value of properties increases the risk weight bucket by 75%. We calculate the changes in collaterals for both participation banks and conventional banks. Based on the assumption that all appraisal values of the real estate mortgage collaterals of loan portfolios will be devalued by 20% as a result of a crisis scenario, the impact on the capital adequacy ratio is measured.

After applying three scenarios for the three components of credit risk, we continue evaluating the second part of the Pillar I risks, which is defined as market risk.

Market Risk is the probable loss that the bank may be exposed to as a result of its positions/portfolios on/off the balance sheet as a result of changes in interest rates, exchange rates, and securities prices. Market Risk Weighted Assets indicates the amount of assets banks reserve to prevent damage if exposed to market risk.

3.4. Market risk

Stress testing of market risk in the banking sector is conducted by the method of estimating maximum losses by applying a reverse shock to the net general FX position on the basis of the FX rate increase scenario and adding the sum of the losses to the market risk weighted asset amount. Thus, it measures how FX rate shocks, in parallel with the FX increase scenario, will affect the banks' CAR.

The last component of the Pillar I risk is operational risk.

Operational risk is the possibility of loss created by inadequate or unsuccessful internal processes, persons, or systems, or external factors including legal risk. Operational Risk Weighted Assets indicates the amount of assets banks reserve to prevent damage if exposed to operational risk.

3.5. Operational risk

Banks in Turkey are currently applying the 'Basic Indicator Approach' as per the Basel II guidelines regarding operational risk measurement. In this approach, an operational risk weighted asset is calculated as a function of gross income and the formulation is stated below:

$$K_{BIA} = \left[\sum (GI_{1\ldots n} \text{ x } \beta)\right]/n$$

K_{BIA}: The capital amount to be kept in accordance with Basic Indicator Approach;

GI: Annual ***gross income**** of the last three years (if positive);

β: Rate of **15%** which is determined by the Basel Committee as per the ratio of sectoral required capital level to the sectoral indicator level; and.

n: The number of years in which the gross income is positive in the last three years.

* *Gross income = Net Operating Income + Net Non-Operating Income*.

In order to apply stress to operational risk, the effect of possible damage to physical assets is measured. In the stressed case, operational risk loss is assumed to be 1% of the regulatory capital and this amount is added to the current operational risk weighted asset in order to create a negative impact on the capital adequacy ratio.

On the other hand, since operational risk is a function of gross income in the "Basic Indicator Approach," when the stress testing shock scenario is applied to operational risk in the same way, the amount of risk declines, which creates a positive impact on the capital adequacy ratio.

Therefore, the common approach followed in stress testing will not generate meaningful results in terms of operational risk. Hence, as an alternative approach of exposing operational risk to stress, the amount of damage to be incurred in physical assets is added to the legal capital reserved for operational risk in order to measure the impact of such damage on the capital adequacy ratio.

To summarize, we apply our scenario below to test the Pillar I risk under stress;

a) Credit Risk:

FX Rate Increase: 1 USD = 2.50 TRY (currency was 2.20 as of October 14)

NPL Ratio Increase: 80%

Collateral Deterioration: 20% (Real Estate appraisal value devaluation)

b) Market Risk:

FX Rate Increase: 1 USD = 2.50 TRY (applied to Structural FX open position)

c) Operational Risk:

Operational risk loss: 1% of the capital.

4. Data

The data is collected from BDDK, the Banking Regulation and Supervision Agency of Turkey. BDDK is a public open database that contains all banks types of Turkey including conventional, participation, and investment. We use monthly data from January 2006 to October 2014 to calculate NPL (non-performing loans). Our sample contains 106 monthly observations.

Moreover, we use daily exchange rates from January 2014 until the end of October 2014. The foreign exchange rate is the ratio of the Turkish Lira to the U.S. dollar. Since we use daily data, we end up having 238 observations. We use Turkish Central Bank data in addition to BDDK banking information for consistency.

5. Empirical results

Table 1 shows the summary statistics for the Turkish banking sector. Panel A shows the main differences between conventional and participation banks in terms of banking characteristics. Since the conventional banks in Turkey have a longer history, their numbers outperform the participation banks for all criteria. However, the number of participation banks in Turkey has been growing and its portion of the banking sector is expected to increase. Panel B exhibits the non-performing loans with their current ratio as of October 2014. A non-performing loan is a loan that is in default or close to being in default. In Turkey, loans become non-performing after being in default for 90 days according to the Banking Law. In October 2009, the NPL ratio of the Turkish banking sector reached 5.42% as a result of economic crisis. "NPL Fluctuation" indicates the increase in NPL from the Current Ratio to Maximum Ratio by 80% (5.42/3.00). Panel C demonstrates the volatility of Daily Exchange Rates in USD with standard deviation and the maximum value of USD.

Table 1a contains the summary values for collaterals and risk weighted assets in conventional banks as of October 2014. The numbers are in millions. Credit risk is the possibility of loss that the bank may become exposed to due to the failure of a credit customer to fulfill the obligations of the enacted contract, partially or fully, in the required time frame. "Credit Risk Weighted Assets" indicates the amount of assets banks reserve to prevent damage if exposed to credit risk. The main difference between credit risk and credit risk weighted asset is the collateral amount, or in other words, security coverage and risk degree of the customers. "Stressed Credit Risk Weighted Assets" indicates the credit risk weighted assets after applying the stress test. The total shows the total amount of credit risk weighted assets after stress scenario. The numbers are in millions. Risk weighted assets are multiplied by 80% as a result of a decrease in the true value of property. Mortgage loans with real estate collateral are defined by a 50% risk

Table 1
Summary statistics.

October 2014	Conventional	Participation
Panel A		
Number of banks	44	4
Number of domestic branches	11.115	1.046
Number of abroad branches	84	4
Number of ATMs	40.953	2.025
Number of staff (Domestic)	197.627	16.675
Number of staff (Abroad)	786	70
Regulatory capital amount	251.289	11.247
Credit risk weighted asset amount	1.371.391	67,009
Market risk weighted asset amount	38,204	1628
Operational risk weighted asset amount	116,654	7009
Panel B		
2006–2014 monthly time series	Non performing loans ratio	
Current ratio	3.00%	
Maximum ratio (2009 October)	5.42%	
NPL fluctuation (%)	80%	
Panel C		
2014 daily time series	USD currency	
Standard deviation	5.95%	
Maximum value (28 January 2014)	2.34	
Calculated shock (St. Dev * Max.Value)	2.5	

Table 1 shows the summary statistics of the banking characteristics in Turkey. Panel A exhibits the main differences between Conventional and Participation banks in terms of banking characteristics. Data is collected from the Turkish Central Bank as of October 2014. Panel B shows the Non Performing Loans in the banking sector. NPL Fluctuation indicates the increase in NPL from Current Ratio to Maximum Ratio by 80%. Panel C demonstrates the volatility in Daily Exchange Rates in USD with Std. Deviation and the maximum value of USD reached.

Table 1a
Change in collaterals and current credit risk weighted assets by October 2014.

Panel A. Conventional banking sector	Credit risk	Credit risk weighted assets	Stressed credit risk weighted assets
Assets with 0% of risk weight	481,367.94	–	
Assets with 10% of risk weight	–	–	
Assets with 20% of risk weight	75,428.10	15,085.62	
Assets with 50% of risk weight	164,781.02	82,390.51	
Assets with 50% of risk weight (With mortgage as a collateral)	156,826.70	78,413.35	
Assets with 75% of risk weight	321,946.25	241,459.69	
Assets with 100% of risk weight	724,757.52	724,757.52	
Assets with 150% of risk weight	29,377.97	44,066.96	
Assets with 200% of risk weight	88,101,44	176,202.87	
Assets with 250% of risk weight	3605.90	9014.75	
Assets with 1250% of risk weight	–	–	
Total		1,371,391.27	
Panel B. real estate appraisal value deterioration			
Assets with 0% of risk weight	481,367.94	–	
Assets with 10% of risk weight	–	–	
Assets with 20% of risk weight	75,428.10	15,085.62	15,085.62
Assets with 50% of risk weight	164,781.02	82,390.51	65,912.41
Assets with 50% of risk weight (With mortgage as a collateral)	156,826.70	78,413.35	78,413.35
Assets with 75% of risk weight	321,946.25	241,459.69	266,176.84
Assets with 100% of risk weight	724,757.52	724,757.52	724,757.52
Assets with 150% of risk weight	29,377.97	44,066.96	44,066.96
Assets with 200% of risk weight	88,101,44	176,202.87	176,202.87
Assets with 250% of risk weight	3605.90	9014.75	9014.75
Assets with 1250% of risk weight	–	–	–
Total			1,379,630.33

Table 1a is the summary values for Collaterals and Risk weighted assets in Conventional banks as of October 2014. The numbers are in millions. Credit risk is the possibility of loss that the bank may become exposed to due to the failure of a credit customer to fulfill the obligations of the enacted contract, partially or fully, in the required time frame. Credit Risk Weighted Assets indicates the amount of assets banks reserve to prevent damage if exposed to Credit Risk. Stressed Credit Risk Weighted Assets indicates Credit Risk Weighted Assets after applying the stress test. Total shows the total amount of credit risk weighted assets after the stress scenario. Numbers are in millions.

weight. According to the Basel II rules, for example, a 20% decrease in the value of real estate would leave 20% of mortgages non-collateralized. Thus, this uncovered portion of the credit risk weighted assets will be added to the 75% risk weight bucket due to Basel II principles.

Table 1b contains the summary values for collaterals and risk weighted assets in participation banks as of October 2014. The numbers are in millions. Credit risk is the possibility of loss that the bank may become exposed to due to the failure of a credit customer to fulfill the obligations of the enacted contract, partially or fully, in the required time frame. "Credit Risk Weighted Assets" indicates the amount of assets banks reserve to prevent damage if exposed to credit risk. The main difference between credit risk and credit risk weighted asset is the collateral amount, or in other words, security coverage and risk degree of the customers. "Stressed Credit Risk Weighted Assets" indicates the credit risk weighted asset after applying the stress test. The total shows the total amount of credit risk weighted assets after stress scenario. The numbers are in millions. Risk weighted assets are multiplied by 80% as a result of a decrease in the true value of property. Mortgage loans with real estate collateral are defined by a 50% risk weight. According to the Basel II rules, for example, a 20% decrease in the value of real estate would leave 20% of mortgages non-collateralized. Thus, this uncovered portion of the credit risk weighted assets will be added to the 75% risk weight bucket due to Basel II principles.

Table 1b
Change in collaterals and current credit risk weighted assets as of October 2014.

Panel A. Participation banks	Credit risk	Credit risk weighted assets	Stressed credit risk weighted assets
Assets with 0% of risk weight	18,807.74		
Assets with 10% of risk weight	–		
Assets with 20% of risk weight	5258.44	1051.69	
Assets with 50% of risk weight	23,907.08	11,953.54	
Assets with 50% of risk weight (With mortgage as a collateral)	5248.85	2624.43	
Assets with 75% of risk weight	15,281.30	11,460.98	
Assets with 100% of risk weight	38,859.34	38,859.34	
Assets with 150% of risk weight	291.24	436.86	
Assets with 200% of risk weight	297.32	594.63	
Assets with 250% of risk weight	11.12	27.80	
Assets with 1250% of risk weight	–		
Total		67,009.27	
Panel B. Real estate appraisal value deterioration			
Assets with 0% of risk weight	18,807.74		
Assets with 10% of risk weight	–		
Assets with 20% of risk weight	5258.44	1051.69	1051.69
Assets with 50% of risk weight	23,907.08	11,953.54	9562.83
Assets with 50% of risk weight (With mortgage as a collateral)	5248.85	2624.43	2624.43
Assets with 75% of risk weight	15,281.30	11,460.98	15,047.04
Assets with 100% of risk weight	38,859.34	38,859.34	38,859.34
Assets with 150% of risk weight	291.24	436.86	436.86
Assets with 200% of risk weight	297.32	594.63	594.63
Assets with 250% of risk weight	11.12	27.80	27.80
Assets with 1250% of risk weight	–		
Total			68,204.61

Table 1a is the summary values for Collaterals and Risk weighted assets in Conventional banks as of October 2014. The numbers are in millions. Credit risk is the possibility of loss that the bank may become exposed to due to the failure of a credit customer to fulfill the obligations of the enacted contract, partially or fully, in the required time frame. Credit Risk Weighted Assets indicates the amount of assets banks reserve to prevent damage if exposed to Credit Risk. Stressed Credit Risk Weighted Assets indicates Credit Risk Weighted Assets after applying the stress test. Total shows the total amount of credit risk weighted assets after the stress scenario. Numbers are in millions.

Table 2 shows the Increase in Non-Performing Loans, defined as Net Non-Performing Loans in the Balance Sheets of Banks collected from BDDK. NPL indicates the loans that are in default or close to being in default after being delayed for 90 days or more. NPL is multiplied by 80% to simulate an NPL increase scenario in case of an economic crisis. NPL is calculated including both Turkish Currency and Foreign Currency (FX) NPL amounts. The "After Stress" column exhibits the amount of increase in NPL under the stress scenario. 80% of 32,561.38 is equal to 26.049,11 and the rest of the figures are calculated with this principle. Currency shift is reflected into the Foreign Currency NPL amounts as well as the 80% increase. The total number, given in millions, is the amount left after the 80% increase.

The column labeled "Before Stress" exhibits the amount of NPL in both conventional and participation banks in the given national currency and foreign currency. NPL indicates the loans that are in default or close to being in default after being delayed for 90 days or more. The column labeled "After Stress" exhibits the amount of increase in NPL under the stress scenario due to the stress caused by an increase of 80% given a shock. The Total section indicates the amount of NPL by combining both currencies after applying the converting rate.

Table 3 shows the second component of credit risk in Pillar I as defined by an increase in exchange rates. To calculate the foreign currency, we analyze the increase in USD in 2014 against the Turkish Lira. We start by studying the volatility of daily USD and find that the highest value of 1 USD between January 2014 and October 2014 was 2.34 TL (1 USD = 2.34 TL). In the case of our stress scenario, we add the standard deviation and assume that 1 USD will be equal to 2.50 TL in this scenario (1 USD = 2.50 TL). The results are shown in Table 3.

Table 3 exhibits the stress test of an increase in the USD from 2.20 TL to 2.50 TL. Furthermore, we calculate our results based on including foreign currency indexed loans (calculated FX). The loans are derived from the part of balance sheets that lists the ratio of foreign currency items to total assets. Including foreign exchange indexed loans shows that 36% of the risk weights are in foreign exchange for conventional banks while 30% are in foreign exchange for participation banks. In this table, we assumed that the ratio of foreign currency items to total assets reflects the proportion of foreign currency credit risk weighted assets to total credit risk weighted assets. So, "Calculated FX" shows the credit risk weighted assets in foreign currency calculated by the Foreign Currency/Total Assets ratio (1,406,238.25 × 36%). "Calculated TL" indicates credit risk weighted assets in Turkish Lira.

Table 2
Increase in non-performing loans.

		Before stress			After Stress (Incremental)		
		Local currency	Foreign currency	Total	Local currency	Foreign currency	Total
Conventional	Non Performing Loans	32,561.38	614.69	33,176.07	26.049,11	558,81	26,607.92
Participation	Non Performing Loans	3425.81	6.16	3431.97	2740.65	5.60	2746.25

Table 2 shows the Increase in Non-Performing Loans defined as Net Non-Performing Loans in the Balance Sheets of Banks collected from BDDK. NPL indicates the loans that are in default or close to being in default after being delayed for 90 days or more. NPL is multiplied by 80% to simulate an NPL increase scenario in case of economic crisis. NPL is calculated by including both Turkish Currency and Foreign Currency (FX) NPL amounts. The "After Stress" column exhibits the amount of the increases in NPL under the stress scenario. The total is the amount left after the 80% increase and is given in millions.

Table 3
Increase in exchange rates.

	Ratio of foreign currency items to total assets			
	Conventional	Participation		
Excluding foreign currency indexed loans	35%	27%		
Including foreign currency indexed loans	36%	30%		
FX increase in conventional banks				
	Credit risk weighted assets	Calculated FX	Calculated TL	After FX (USD = 2.50)
	1,406,238.25	506,527.02	899,711.23	1,475,310.11
FX increase in participation banks				
	Credit risk weighted assets	Calculated FX	Calculated TL	After FX (USD = 2.50)
	70,950.86	21,377.50	49,573.37	73,865.98

Table 3 shows the scenario of Increase in Exchange Rates from 2.20 USD to 2.50 USD to analyze the effect in Conventional Banks and Participation Banks. Credit Risk Weighted Assets are calculated by adding the total amount of Risk Weighted Assets and the amount left after the 80% increase in NPL and 20% collateral deterioration. Foreign Currency Indexed Loans are loans in Turkish lira whose interest rates are indexed to a foreign currency. Calculated FX shows the Credit risk weighted assets in foreign currency calculated by the Foreign Currency/Total Assets ratio. Calculated TL indicates Credit risk weighted assets in Turkish Lira. "After FX" exhibits the sum of foreign currency credit risk weighted assets multiplied by the stressed USD currency difference and TL credit risk weighted assets. Numbers are in millions.

"After FX" exhibits the sum of foreign currency credit risk weighted assets multiplied by the stressed USD currency difference and TL credit risk weighted assets.

In Table 3, Calculated TL has two components. First, we determine the credit risk weighted assets where we use the total amount of risk weighted assets after the 20% collateral deterioration (Table 1). Then, we add the total non-performing loans (Table 2). The difference is the Calculated TL (national currency). Simply, Calculated TL refers to total credit risk weighted assets in Turkish Lira.

The increase in foreign currency (USD) is from 2.20 TL to 2.50 TL, which is approximately a 13% increase. Multiplying this ratio by the Calculated FX gives us the increase in foreign currency. Finally, we add the Calculated TL to the Calculated FX to find the total effect of an increase in exchange rates as a credit risk component of Pillar I risks.

Until this point, we applied our scenarios of changes in collaterals, increases in NPLs, and changes in exchange rates to a subset of credit risk under Pillar I. In the next section, we control for market risk as a component of Pillar I risks.

Similar to an increase in exchange rates, we calculate market risk based on the given rise in exchange rates from 2.20 to 2.50 and analyze the open position of reverse shock to net general FX position. First, we determine the net open position of both conventional and participation banks in terms of foreign exchange. Then, due to our scenario, we factor in the exchange rate increase of 13% as a shock and report it in the last column as "Additional Market Risk Weighted Assets".

Table 4 exhibits the stress scenario for market risk. We determine the net position of FX and calculate market risk based on an increase in foreign exchange rates. "Net Open Position of FX" is the difference between total open long (receivable) and open short (payable) positions in a given asset in terms of foreign currency. Market risk is the probable loss that the bank may be exposed to as a result of its positions/portfolios on/off the balance sheet due to changes in interest

Table 4
Market risk effect.

Conventional	Net Open Position of FX	2933.16	
Participation	Net Open Position of FX	149.40	
USD currency	Stressed FX	Difference	Additional market risk weighted assets
2.20	2.50	13%	399.98 (conventional) 20.37 (participation)

Table 4 shows the Market Risk effect under stress based on Pillar I risks. We determine the Net Position of FX and calculate Market Risk based on increasing foreign exchange rates. Net Open Position of FX is the difference between total open long (receivable) and open short (payable) positions in a given asset in terms of foreign currency. Market Risk is the probable loss that the bank may be exposed to as a result of its positions/portfolios on/off the balance sheet due to changes in interest rates, exchange rates, and securities prices. Market Risk Weighted Assets indicates the amount of assets banks reserve to prevent damage if exposed to Market Risk. Additional Market Risk Weighted Assets denotes the amount of loss that will be added to the original market risk weighted assets as part of the scenario assumptions. Additional Market Risk Weighted Assets are in millions.

Table 5
Operational risk.

	October 2014 Equity	Operational-RWA	Shock	Stressed loss	Operational risk weighted assets after shock
Conventional	251,289.00	116,653.91	0.01	2512.89	119,166.80
Participation	11,246.79	7009.19	0.01	112.47	7121.66

Table 5 shows the Operational Risk in Sector, Conventional, and Participation Banks based on a given shock to their capital and calculates the loss after the stress. Equity refers to the total capital amount of the bank and consists of paid capital, retained earnings and cash and statutory reserves. Operational Risk is the possibility of loss created by inadequate or unsuccessful internal processes, persons or systems, or external factors including legal risk. Operational Risk Weighted Assets indicates the amount of assets banks reserve to prevent damage if exposed to Operational Risk. Shock is 1% of the total capital as per the stress scenario assumptions. Numbers are in millions.

rates, exchange rates, and securities prices. Therefore, the additional market risk weighted assets is the 13% increase in exchange rate as a shock that we report in the last column under "Additional Market Risk Weighted Assets" for both conventional and participation banks.

Therefore, in Table 4, we assume that the market risks of the banks are sensitive to their open FX positions since one of the major components of market risk under Basel II regulations is "currency risk". So here we calculate the impact of a currency shift to net open FX positions and assume that same impact will hit the market risk weighted assets in parallel. Generally, the BDDK does not publicly announce the market risk components of banks so we can never know the real impact of a stress to the market risk weighted assets of the sector.

Table 5 shows the operational risk under Pillar I. To apply stress to operational risk, the effect of probable damage to physical assets is calculated. Under the stress scenario, operational risk loss is assumed to be 1% of the regulatory capital; therefore that amount is added to the current operational risk weighted asset to generate a negative impact on the capital adequacy ratio.

The first column in Table 5 shows the equity of given banks in October 2014. Equity refers to the total capital amount of the bank and consists of paid-capital, retained earnings and cash, and statutory reserves. Operational risk is the possibility of loss created by inadequate or unsuccessful internal processes, persons or systems, or external factors including legal risk. Operational risk weighted assets are calculated using the amount of operational risk exposure collected from the capital adequacy data of the BDDK. After applying a 1% shock, we calculate the stressed loss and add that amount to the operational risk weighted assets to see the total shock in the banking sector.

Based on the findings in Table 5, we assumed that a big disaster like an earthquake, tsunami, or flood will hit banks' head offices or major branches and cause damages which can be calculated as a portion of the banks' capital amounts. Despite the fact that all banks in Turkey currently measure operational risk using the basic indicator approach, which is based on income, we hereby simulate a real operational loss scenario and add this loss to the actual operational risk weighted asset amount.

In the last part of our study, we calculate the expected decrease in the capital adequacy ratio. To determine the capital adequacy ratio, we combine our losses under the Pillar I risks derived from the stress shocks in the tables explained above. Since the purpose of this study is to analyze expected decreases in the capital adequacy ratio, we report our findings in Table 6.

Table 6 reports the expected decreases under all Pillar I risks combined. "Regulatory Capital" refers to the amount of equity to be considered in the capital adequacy ratio calculation as defined by the local regulator, which can be directly obtained from BDDK web site. The credit, market, and operational risk weighted assets (RWA) amounts stated in the table are the main outputs of this study. Each risk weighted asset calculation methodology is explained in the related section of the paper. "CAR" (Capital Adequacy Ratio) signifies "Regulatory Capital" divided by the summation of "Credit RWA", "Market RWA", and "Operational RWA". "Impact" is the change in CAR between current and stressed scenarios and is calculated in percentages. Numbers are in millions. In this table it can be easily seen that the capital adequacy ratio of the participation banks is more sensitive

Table 6
Expected decrease in capital adequacy ratio.

Impact analysis[a]	Conventional	Participation
Credit RWA	7.6%	10.2%
Market RWA	1.0%	1.3%
Operational RWA	2.2%	1.6%
October 2014	**Conventional**	**Participation**
Panel A		
Current		
Regulatory capital	251,289.00	11,246.79
Credit RWA	1,371,391.28	67,009.26
Market RWA	38,203.77	1628.36
Operational RWA	116,653.91	7009.19
CAR	16.46%	14.87%
Panel B.		
Stressed		
Regulatory capital	251,289.00	11,246.79
Credit RWA	1,475,310.11	73,865.98
Market RWA	38,603.75	1648.73
Operational RWA	119,166.80	7121.66
CAR	15.39%	13.61%
Impact	−6.95%	−9.24%

Table 6 reports the expected decreases under all Pillar I risks combined. Regulatory Capital refers to the amount of equity to be considered in the capital adequacy ratio calculation defined by the local regulator. CAR (Capital Adequacy Ratio) indicates Regulatory Capital divided by the summation of Credit RWA, Market RWA and Operational RWA. Impact is the change of CAR between the current and stressed scenarios and is calculated in percentages. Numbers are in millions.

[a] Individual impact on risk weighted assets after applying each shock.

(−9.24% impact) to stress than the capital adequacy ratio of conventional banks (−6.95% impact).

6. Conclusion

In this study, we investigate the effect of stress tests on the Turkish banking sector by determining the Pillar I risks for participation banks and comparing them to the sector as a whole. Since the main purpose of this study is to calculate the expected decreases in the capital adequacy ratio after exposure to Pillar I risks under the stress scenarios, we examine each of the Pillar I risks as well as their components; credit risks, market risks, and operational risks. Furthermore, we conduct our stress tests for the given risks and report our results. To finalize, we combine the amount left after exposing risk as a loss and then calculate the decrease in the capital adequacy ratio. Since the decrease in CAR in participation banks is higher, we can summarize that participation banks in Turkey are more sensitive to stress compared to conventional banks. However, this sensitivity is in regards to capital adequacy, not profit. The reason participation banks are more sensitive can be explained by the credit risk exposures observed throughout the study. We conclude that participation banks are more exposed to credit risk scenarios such as currency and NPL increases and collateral value decreases. Overall, our study shows the effect of stress in the banking sector by contributing to the existing literature.

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