

PRIMARY RESEARCH

Impacts of Inflation and Interest Rate Uncertainty on Performance and Solvency of Conventional and Islamic Banks in Pakistan

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Keywords

Performance

Solvency

z-score

Inflation

Interest Rates

Uncertainty

Received: 21 August 2017

Accepted: 20 November 2017

Abstract. This paper examines the effects of inflation and real interest rate uncertainty on the performance and solvency of banks in Pakistan. It also examines whether the effect of both types of uncertainty differs for conventional and Islamic banks. Annual data covering the period 2008-2015 for a sample of 25 banks are used to carry out the empirical analysis. Generalized Least Square (GLS) estimator is applied to overcome the problem of heteroscedasticity. The results indicate that several bank-specific variables are important in determining the performance and solvency of banks operating in Pakistan. The results also show that these variables have considerable differential impacts on the financial performance and solvency of both conventional and Islamic banks. With regard to the effects of macroeconomic variables, the results show that the rate of inflation, the interest rate, and their volatility also have quite different effects on the performance and solvency of conventional and Islamic banks. We find that although neither inflation nor interest rate uncertainty significantly affect the solvency of conventional banks, the solvency of Islamic banks is significantly affected by both types of uncertainty. Specifically, we find that inflation uncertainty has a negative, whereas, the uncertainty associated with the real interest rate has a significant positive impact on the solvency of Islamic banks. However, both types of uncertainty have a statistically insignificant effect on the financial performance of both conventional and Islamic banks in Pakistan. Providing significance evidence on the bank-specific empirical determinants, our analysis helps bank managers to improve their banks' financial performance and solvency. Further, our findings are helpful for understanding how the financial performance and financial soundness of conventional and Islamic banks are determined during periods of heightened inflation and real interest rate uncertainty.

KAUJIE Classification: J0, L3, L25

JEL Classification: G20, G21

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INTRODUCTION

Banks act as financial intermediaries between depositors and borrowers/fund users as they acquire money from depositors in the form of deposits and lend it to the end users also including the corporate sector and the public sector. Banks are important pillars of a financial system. Therefore, they are highly regulated to protect the investors, provide financial facilities to their customers at suitable terms, and enhance their performance. Demirgüç-Kunt and Detragiache (1998) stated that the profitability of the banking sector is an essential forecaster of economic crises. Further, the profitability of the banking sector helps to identify present conditions of banking sector and understand the key aspects that are important in decision-making.

Since banks significantly contribute to financial system, it is of great interest to know how they perform and how variations in economic conditions affect their financial performance and creditworthiness. Although inflation is considered as an important factor to affect bank's performance, there is ambiguity in the literature regarding its impact. Perry (1992) argued that the impact of inflation is highly dependent on the fact whether the rate of inflation is predictable or less predictable or completely unpredictable. In case of predictable inflation, banks modify their return rates on lending or investment to cover up the costs caused by higher inflation. However, if the rate of inflation is unpredicted, then it is difficult for the banks to adjust the rate of return with the increasing rate of inflation. Inflation also affects the real rate of return negatively due to interest rate rigidity caused by regulatory measures. Due to low returns, there may be a depletion of funds from the financial sector and, thereby, lowering the availability of investment resources. Hence, the financial sector makes fewer loans, which lead towards inefficient allocation of resources and weak intermediary activity (Kulyk, 2002). According to Huybens and Smith (1998, 1999), high inflation rate decreases the real return rate on equity and investment. Consequently, it affects banks' performance negatively.

Besides inflation, the effect of interest rates on the profitability of the banking sector is also important. Compared to other financial organizations, banks are expected to be more affected by unexpected variations in interest rates. Samuelson (1945) suggested that high interest rates generally result in lower bank profitability. Determining the relationship between bank profitability and the interest rate, Demirgüç-Kunt and Huizinga (1999) argued that bank profitability and Net Interest Margin (NIM) are highly linked with the real interest rate. Similarly, English (2002) is also of the opinion that variations in the interest rate have a significant impact on banks' net interest income. Thus, one can say that the financial performance and solvency of banks are highly sensitive to variations in interest rates. Increased unexpected variations in the interest rate may negatively affect the financial stability of banks. According to Feldstein (1998), high interest rates make it difficult for individual customers and corporate firms to pay off the amount of loan borrowed, which may cause bank insolvency.

Banks act as financial mediators and offer a variety of financial services. An efficient financial mediator affects economic growth positively. On the other side, banks' insolvency can be one of the fundamental reasons of systematic crisis. Therefore, economies that have

profitable banking systems are highly capable of absorbing negative shocks and playing an imperative role in the financial soundness of the economic system (Athanasoglou, Brissimis, & Delis, 2008). Thus, evaluation of banks based on risk and solvency would be of great interest to bank managers, investors, depositors, customers, and policymakers. Banks that have more liquid assets and more equity capital are generally considered financially sound (Khan, Akhtar, Ullah, Iqbal, & Riasat, 2013). The interim high real interest rate has generally a detrimental impact on the banks' balance sheets, particularly when banks are not able to increase the lending rate in proportion to deposit rates (Demirgüç-Kunt & Detragiache, 1998). Higher inflation rate may also have a negative impact on the financial soundness of banks. Due to a high rate of inflation, it is difficult for the banks to predict precisely real returns on the deposits and loans, which may result in poor quality lending and borrowing decisions, increasing bank insolvency risk (Ivipcisc, Kunovac, & Ljubaj, 2008).

One of the key costs of high inflation is uncertainty about the future rate of inflation. Inflation uncertainty also deteriorates the loan policy of banks as it results in withdrawals of money by depositors from the banks. Thus, it leads to a scarcity of resources in banks and affects their lending because banks do not want to provide finances apart from high interest rates. Owing to a shortage of resources, banks may also not be able to fulfill their financial obligations and are very likely to become insolvent. Bank profitability is also highly exposed to interest rate risk as changes in the interest rate increase the cost of funding and reduce assets returns and equity of banks. To remain vigilant on the effect of interest rates on banks' profitability, the managers of banks consider costs and revenues as a primary concern. Moreover, volatility in the interest rate makes it difficult for an investor to make investment decisions. Therefore, unpredictable variations in the interest rate affect the overall performance of the banking sector by affecting lending and investment opportunities.

According to the Financial Stability Review published by the State Bank of Pakistan (2016), the financial system of the country has shown remarkable growth. The overall growth of the banking sector has been 16.8% in 2015 as compared to the average growth of 13.2% during 2013-2015. Despite of the dominant position of conventional banks, the role of Islamic banks towards overall growth of the country cannot be ignored. Islamic banks have proved their identity and increased their share over time in overall banking sector in Pakistan. The latest figures exhibit the growth of Islamic banking around 12% in overall banking industry in Pakistan. Since the banking sector in Pakistan captures a major share of the financial system and is considered as an imperative aspect of the country's overall economic development, there is a need that the performance and solvency of Islamic banks vis-à-vis conventional banks should be investigated by considering the impact of macroeconomic indicators.

To our knowledge, there is no in-depth study available in the literature that examines the performance and solvency of the banking sector by considering the impact of uncertainty of macroeconomic factors, particularly real interest rate and inflation uncertainty. In principle, solvency ratios, namely the Debt to Assets (DTA) ratio, the Debt to Equity (DTE) ratio, and the Equity Multiplier (EM) are considered important indicators to assess the capacity of a bank to fulfill its contractual obligations. Furthermore, for analyzing the solvency

and financial stability of the banking sector, these ratios have been extensively used in the empirical literature. However, as per our knowledge, the impact of these ratios on banks' z-score, a measure of solvency, has not been determined in Pakistan so far. Therefore, keeping these vacuums in the existing literature, in this study, we investigate the impact of both inflation and interest rate uncertainty along with these solvency ratios on Islamic and conventional banks' z-score. Finally, since a major portion of banks' income is comprised of its non-interest income, we considered the Burden Ratio (BURD) as a potential determinant of banks' performance¹. Previous studies on Pakistan have ignored this important ratio and have only used overheads (non-interest expense) as a determinant of banks' profitability.

The rest of the paper is structured as follows: Section 2 presents a brief summary of the existing empirical evidences on banks' performance and solvency. Section 3 discusses the empirical methodology, data, and estimation methods. Section 4 presents the empirical results and their interpretation. Section 5 concludes the paper by presenting the key findings and some policy implementations.

LITERATURE REVIEW

Empirical Evidence on Banks' Performance

Reviewing the existing empirical literature, we found a handful of studies that have examined the impact of bank-specific variables on banks' performance. We also found some studies that have examined the impact of macroeconomic variables, such as, Gross Domestic Product (GDP), the interest rate, and the level of prices, on the performance of banks. However, their findings regarding different variables are mixed at best. For example, Demirgüç-Kunt and Huizinga (1999), using data for 80 developed and developing countries over the period of 1988-1995, found that banks with sound capital tend to have high interest margins and earnings. They also found the significant impact of inflation on high-realized income and interest margins. Finally, both interest margins and profitability are positively related to real interest rates in developing countries. Jiang, Tang, Law, and Sze (2003) examined the bank-specific and macroeconomic indicators of bank profitability in Hong Kong during the period of 1992-2002. They found that non-interest expense, the rate of inflation, the real interest rate, and GDP are significantly related to the profitability of banks.

Sayilgan and Yildirim (2009), using a sample of Turkish banks, found that low inflation rate induces high bank profitability. They also found that banks with high Capital Adequacy Ratio (CAR) tend to have high revenue, whereas, banks with rising off-balance sheet assets tend to have low profits. Similarly, Anbar and Alper (2011) found that bank profitability is significantly and positively affected only by bank size in case of both Return on Assets (ROA) and Return on Equity (ROE), which supported the economies of scale theory. They also showed that only the real interest rate affects banks' performance positively and significantly. Abdullah, Parvez, and Ayreen (2014) analyzed the profitability of 26 banks listed on Dhaka Stock Exchange in Bangladesh over the period from 2008-2011. They found sig-

¹The BURD measures the extent to which a bank covers up its non-interest expense by its non-interest income. For more on the importance of the BURD, see 2015 Intelligent Bank Management Series: The Importance of the BURD, <https://www.cmpg.com/bank-consulting-whitepapers/bank-burden-ratio.pdf>

nificant and positive impacts of bank size, cost efficiency, capitalization, and higher concentration on ROA and NIM. Regarding the effects of macroeconomic conditions, they found that only the rate of inflation affects banks' NIM and ROA significantly. Another study by Noman, Chowdhury, Chowdhury, Kabir, and Pervin (2015) reported that the profitability of banks appeared to be significantly affected by the Credit Risk (CR), cost efficiency, bank size, and the CAR. The authors further found that both the real interest rate and GDP appeared to have a significant effect on bank profitability. The review of these studies indicates that along with the bank-specific variables, macroeconomic conditions are also important in determining the financial performance of banks.

Choong, Thim, and Kyzy (2012) analyzed internal and external factors affecting the performance of Malaysian Islamic commercial banks during the period 2006-2009. They found that CR influences the performance of banks significantly. Similarly, in another study, Rahaman and Akhtar (2016) examined the profitability of 8 Islamic banks operating in Bangladesh for the period 2009-2013. Their empirical results indicate that Islamic banks' performance tends to decrease with bank size and deposits of these banks. They further provided evidence that the equity of the bank has a significant impact on the profitability of banks, whereas, both credit and operating expense do not have any significant influence on the profitability of Islamic banks in Bangladesh.

In the context of Pakistan, Kanwal and Nadeem (2013) have examined the empirical determinants of the financial performance of banks. They considered both bank-specific and macroeconomic determinants of banks' performance. They found that the rate of inflation had a significant effect on ROA, ROE, and EM of banks while the effect of real interest rate on these performance indicators was positive and statistically significant. Yet, they showed that GDP had no significant impact on ROA, ROE, and EM. Similarly, Khan and Sattar (2014) analyzed the performance of commercial banks in Pakistan with respect to changes in interest rates during the period 2008-2012. They found that interest rate changes had a significant impact on commercial banks' profitability. Finally, Zaman, Arslan, Sohail, and Malik (2014) analyzed the effect of market interest rate on the performance of public and private banking sectors in Pakistan. They reported that private sector banks' profitability was more affected by interest rates as compared to public sector banks' profitability.

Rashid, Khaleequzzaman, and Jabeen (2015) analyzed the performance of conventional vis-à-vis Islamic banks operating in Pakistan during the period 2006-2012 by constructing the Financial Performance Index (FPI) based on CAMELS' ratios. They found that conventional banks were on top of the list, whereas, Islamic counterparts stood mostly after 12th rank in terms of financial performance. They also found that the Islamic banks had better performance in 2012 as compared to 2006 in terms of the progress ratio. In another study, Rashid and Jabeen (2016) examined the bank-specific, financial, and macroeconomic determinants of the performance of Islamic vis-à-vis conventional banks working in Pakistan during the period 2006-2012. Using the FPI constructed by considering CAMELS' ratios and applying the GLS estimator, they found that operating efficiency, reserves, and overheads had significant effects on the performance of conventional banks, whereas, the financial performance of Islamic banks was significantly affected by operating efficiency,

deposits, and market concentration. They also found that both GDP and the lending interest rate had a statistically significant and negative impact on the financial performance of both types of banks.

The existing empirical studies have significantly established the impact of macroeconomic variables such as the interest rate, the rate of inflation, and GDP on the financial performance of the banking industry. However, these studies have totally ignored the effects the unpredictable variations in interest rates and inflation rates while examining banks' financial performance. Yet, the uncertainties associated with the macroeconomic indicators, such as, inflation and interest rates are expected to play an important role in determining the performance of banks in not only theoretical but also empirical aspects.

Empirical Evidence on Banks' Solvency

There are also some studies that have examined the impact of different bank-specific and macroeconomic variables on the solvency position of Islamic and conventional banks. For example, Mokhtar, Abdullah, and Al-Habshi (2006) empirically investigated the solvency of 2 full-fledged Islamic banks, 20 Islamic windows, and 20 conventional banks in the context of Malaysia over the period 1997-2003. The results demonstrated that Islamic banking showed significant growth in terms of average efficiency than conventional banks but the overall efficiency of Islamic banks was still less than that of conventional banks. The study by Cihák and Hesse (2008) was the pioneering one in terms of determining financial strength of Islamic banks in a cross-country empirical analysis by using z -score for calculating bank insolvency risk over the period 1993-2004. They found that 1) small Islamic banks have higher z -scores than small conventional banks, and 2) large Islamic banks have lower z -scores than both small Islamic banks and large conventional banks, indicating less financial stability of large-sized Islamic banks.

Altaee, Talo, and Adam (2013) empirically investigated banks' financial stability in the Gulf Cooperation Council (GCC) countries during the period 2003-2010 covering pre- and post-fiscal crisis periods. They found no indication of a change in the financial soundness of conventional and Islamic banks in pre-crisis (2003-2007) and post-crisis (2008-2010) periods. Rahim and Zakaria (2013) attempted to examine the soundness of Islamic and conventional banks in Malaysia during 2005-2010 by applying GLS method. They found that the cost to income ratio, Herfindahl Index, market share, inflation, and real GDP are significantly related to the financial stability of Islamic banks. On the other hand, the financial stability of conventional banks is significantly affected by the loan to asset ratio, the cost to income ratio, bank size, income diversity, market share, Herfindahl index, and real GDP.

In the context of Pakistan, Shahid and Abbas (2012), using panel data covering the period 2006-2009, found that 1) small Islamic banks have shown more financial strength than small conventional banks and large Islamic banks, and 2) large Islamic banks have shown less financial strength than large conventional banks. Moin (2013), evaluating the financial performance of banks in Pakistan during the period 2003-2007, found that Meezan Bank tended to be less profitable, more solvent, and less resourceful in comparison to the conventional banks.

Ashraf, Rizwan, and L'Huillier (2016) examined the impact of the net stable funding ratio on the financial stability of 136 Islamic banks operating in 30 jurisdictions. They included several bank, country, and market specific variables into the specification while examining the effects of the net stable funding ratio. Their empirical analysis covered the period 2000-2013. To take into account the unique aspects of the Islamic banking industry, they modified the net stable funding ratio. They found that the modified net stable funding ratio had a significant and positive impact on Islamic banks' financial stability during the examined period. However, they also showed that the impact of the net stable funding ratio on the financial stability of large Islamic banks was less than the impact on the financial stability of small-sized Islamic banks.

Ashraf, Ramady, and Albinali (2016) investigated the impact of ownership structure and diversification of income on the financial stability of banks operating in the GCC region. They found that banks' insolvency risk has increased with the concentration of any type of ownership. They also found that bank size was positively and significantly related to the financial fragility of the banks included in the sample. Islamic banks were relatively more financially unstable during the examined period. They reported that substantial fee-based activities significantly had enhanced the financial stability of banks. Finally, they showed that banks, that mainly engaged in traditional intermediation activities, were more financially fragile.

Rizwan, Moinuddin, L'Huillier, and Ashraf (2017) examined the impact of financial regulations on the financial stability of conventional and Islamic banks in 15 countries over the period 2000-2015. They found that the financial regulations have different impacts on the default risk of Islamic and conventional banks. They also found that although the regulations that significantly increase default risk have higher effect on conventional banks, the regulations that reduce default risk have more impact on Islamic banks.

Recently, Rashid, Yousaf, and Khaleequzzaman (2017) examined the contribution of Islamic banks toward the financial stability of Pakistan. To do this, they studied the relative financial strength of Islamic banks vis-à-vis contribution over the period 2006-2012. They used z-score as the measure of stability of banks and applied the random effects estimator to quantify the impact of bank-specific variables and macroeconomic indicators on the financial stability. They found that income diversity, the profitability ratio, the loan to asset ratio, asset size, and the market concentration ratios of banks had significant effects on the stability of banks. Comparing Islamic and conventional banks, they found notable differential effects of the empirical determinants of financial stability of both types of banks. Specifically, they found that Islamic banks have performed better as compared to conventional banks and contributed more effectively to the stability of the financial sector.

Although the above-mentioned studies have provided significant evidence on the effects of several bank-specific and macroeconomic variables on the financial soundness of Islamic and conventional banks, these studies remained silent about the effects of unexpected fluctuations in macroeconomic indicators, such as, the interest rate and the rate of inflation, on the solvency of banks. In principle, it is very likely that besides the level effects of macroeconomic conditions, unpredictable and sudden changes in macroeconomic conditions have

a significant role in the financial soundness of the banks.

EMPIRICAL METHODOLOGY

Empirical Models

Banks' Performance Model

To examine the impact of macroeconomic indicators and their uncertainty, we estimate the following model:

$$ROA_{it} = \beta_1 + \beta_2 CAR_{it} + \beta_3 BURD_{it} + \beta_4 AQ_{it} + \beta_5 VD_{it} + \beta_6 CR_{it} + \beta_7 BS_{it} + \beta_8 INF_t + \beta_9 RI_t + \beta_{10} UN_t^{INF} + \beta_{11} UN_t^{RI} + \mu_{it} \quad (1)$$

Where ROA_{it} denotes ROA²; CAR_{it} is the CAR; $BURD_{it}$ is the BURD; AQ_{it} is the Asset Quality (AQ); VD_{it} is the Volume of Deposits (VD); CR_{it} is the CR; BS_{it} is the bank size; INF_t is the rate of inflation; RI_t is the real interest rate; UN_t^{INF} is the inflation uncertainty and UN_t^{RI} is the real interest rate uncertainty at year t , and μ_t is the error term. The bank-specific variables are taken from the models estimated by Abdullah et al. (2014), and Anbar and Alper (2011). However, the inflation rate and the real interest rate are taken from the model estimated by Demirgüç-Kunt and Detragiache (1998); Kanwal and Nadeem (2013). Finally, we included the uncertainty variables to examine the effects of unexpected changes in the rate of inflation and interest rates on banks' performance.

Bank Solvency Model

In bank solvency model, z -score is used as a measure of solvency of the banking sector³. The z -score, as an indicator of banks' solvency, is widely used in the previous literature, like, among several others, Ariss (2010), Berger, DeYoung, Flannery, Lee, and Öztekin (2008), Cihák and Hesse (2008), Cihak, Maechler, Schaeck, and Stolz (2009), Hesse and Cihak (2007), and Rashid et al. (2017). A bank with a greater value of z -score falls in the lower upper bound of insolvency risk. Therefore, higher value of z -score means that banks have higher chances of solvency and vice versa. Following the literature, we define z -score as follows:

$$z\text{-score}_{it} = \left(\frac{EQ_{it}}{TA_{it}} + \theta_{ROA} \right) / \sigma_{ROA} \quad (2)$$

Where $\frac{EQ_{it}}{TA_{it}}$ is the equity capital as the percentage of total assets of the bank, θ_{ROA} is the mean of returns on assets for each firm over the sample period, and σ_{ROA} is the standard deviation of returns on assets for each firm over the sample period, which is used as a proxy

²We use ROA as a proxy for banks' performance. Other performance measures, such as, earnings per share, Tobin's Q, etc., are also widely used in the literature. However, we do not consider these measures because of non-availability of data on stock prices as only few full-fledged Islamic banks are listed on the stock exchange.

³We prefer z -score to other measures of solvency, such as, default probability and distance to default, due to three reasons. First, z -score is widely used in the empirical literature. Second, it is easy to compute and understand. Finally, its calculation does not require data on stock prices, which is not available for most of the Islamic banks in Pakistan.

for return volatility. Following the literature, we model bank solvency as follows:

$$z-score_{it} = \beta_1 + \beta_2 EFF_{it} + \beta_3 LAR_{it} + \beta_4 CR_{it} + \beta_5 BS_{it} + \beta_6 DTA_{it} + \beta_7 DTE_{it} + \beta_8 EM_{it} + \beta_9 INF_t + \beta_{10} RI_t + \beta_{11} UN_t^{INF} + \beta_{12} UN_t^{RI} + \varepsilon_{it} \quad (3)$$

Where EFF_{it} is the efficiency ratio, LAR_{it} is the loan to asset ratio, CR_{it} is the CR, BS_{it} is the bank size, DTA_{it} is the DTA ratio, DTE_{it} is the DTE ratio, EM_{it} is the EM, and ε_{it} is the residual. The rest of the variables are as defined in equation (2). In this model, the efficiency ratio, the loan to asset ratio, CR, and bank size are taken from the models estimated by Cihák and Hesse (2008); Shahid and Abbas (2012). However, the ratios of DTA, DTE, and EM are taken from the study of Moin (2013). INF_t stands for inflation and RI_t is the real interest rate, which are taken from the models estimated by Bourkhis and Nabi (2013), and Ivipcisc et al. (2008), respectively. Finally, we include uncertainty variables to examine the effects of uncertainties regarding the rate of inflation and the rate of interest on bank solvency. The description and characteristics of bank-specific and macroeconomic variables are presented in Table 1.

TABLE 1
Description of variables

Variable	Description
ROA	ROA is the ratio of net earnings after tax over assets. ROA reflects the ability of banks' management to utilize the banks' actual assets to generate income. $ROA_{it} = (Net\ Income_{it} / Total\ Assets_{it} \times 100)$
Bank-specific Variables	z-score
	z-score is used to determine banks' solvency level. Banks' solvency is the competence of a bank to fulfill its long-term financial commitments. Higher the value of z-score, higher the probability of banks' solvency. $z - score_{it} = (\frac{EQ_{it}}{TA_{it}} + \theta_{ROA}) / \sigma_{ROA}$
CAR	CAR is an important measure of banks' profitability and capital strength. Higher CARs reflect low leverage and, therefore, lower risk and higher revenue. $CAR_{it} = [(Tier\ 1\ Capital_{it} + Tier\ 2\ Capital_{it}) / Total\ Assets_{it}] \times 100$
BURD	A banks' burden is the difference, which is calculated by non-interest expense minus non-interest income. A bank can improve its burden by increasing fees and controlling operating overheads, which can lead to higher banks' earnings. $BURD_{it} = [(Non-interest\ Expense_{it} - Non-interest\ Income_{it}) / Total\ Assets_{it}] \times 100$

TABLE 1 continue

Variable	Description
AQ	The ratio of non-performing loans to total gross loans is one of the vital measures of AQ. Lower value of this ratio shows higher AQ. It is defined as follows: $AQ_{it} = (Non-performing\ loans_{it}/Gross\ loans_{it}) \times 100$
Bank-specific Variables	VD
	Deposits are the core sources of capital for a bank as they can be invested to generate revenue. Deposit to asset ratio calculates the amount of deposits received by a bank in proportion to its size. $VD_{it} = (Deposits_{it}/Total\ Assets_{it}) \times 100$
	CR
	CR is described as the risk, which the bank faced when the given amount of credit/loan is not recovered from the borrower. Bank creates provisions against these loans. CR affects the performance of bank negatively. $CR_{it} = (Loan\ Loss\ Provisions_{it}/Gross\ Loans_{it} \times 100)$
	BS
	Mostly, in finance literature, total assets of a bank are considered as a substitute for bank size. Bank size is also a measure of banks' lending decision. $BS_{it} = ln(Total\ Assets_{it})$
	EFF
	Efficiency ratio is also known as cost to income ratio. This ratio specifies the operative effectiveness of the bank, demonstrating the cost of banks' operations as compared to its revenue. Higher ratio reveals banks' ability to run their operations at a high, cost thus, lowering the profitability and lowering the financial soundness of the bank. $EFF_{it} = (Non-interest\ Expense_{it}/Total\ Income_{it} \times 100)$
Bank-specific Variables	LAR
	Loan to assets ratio can also be described as banks' source of income. This ratio indicates that how much assets of the bank are financed through loans. Higher the ratio, lower will be the liquidity, thus, higher will be the riskiness of the bank. $LAR_{it} = (Net\ Loans_{it}/Total\ Assets_{it}) \times 100$
	DTA
	DTA ratio shows the ability of a bank to acquire additional funding for prospective attractive investment opportunities. Higher DTA ratio means that bank is indulging in risky business. Thus, higher DTA ratio lowers the solvency of a bank. $DTA_{it} = (Deposits_{it}/Total\ Assets_{it}) \times 100$
	DTE
	DTE ratio defines the capability of bank's capital/assets to take up financial losses. A bank with lower DTE is considered sound in contrast to the bank with higher DTE. $DTE_{it} = (Deposits_{it}/Shareholder's\ Equity_{it}) \times 100$

TABLE 1 continue

	Variable	Description
	EM	EM specifies the volume of banks' assets in proportion of stockholders' equity. This ratio depicts the proportion of banks' assets that are financed or possessed by the stockholders. Higher the ratio, higher will be the risk for the bank. $EM_{it} = (Total\ Assets_{it} / Shareholder's\ Equity_{it}) \times 100$
Macroeconomic Indicators	INF	Inflation is described as the continual rise in the level of prices of goods and services available. Inflation rate is calculated by taking annual percent change in Consumer Price Index (CPI). CPI is used as the proxy for calculating inflation rate.
	RI	Real interest rate is the call money rate adjusted with inflation. Call money rate is the interest rate on a type of short-term loan, which the banks give to brokers. The brokers, in turn, lend the money to investors to fund margin accounts. Call money rate is the policy determined rate and it strongly affects the bank's deposits, advances, etc.
Uncertainty	Inflation Rate Uncertainty UN_t^{INF}	Inflation rate uncertainty is defined as the unexpected variation in the rate of inflation over time. It is proxied by the yearly standard deviation of monthly rate of inflation over the sample period.
	Real Interest Rate Uncertainty UN_t^{IR}	Real rate uncertainty is defined as the unexpected variation in the level of interest rate over time. It is proxied by the yearly standard deviation of monthly interest rate over the sample period.

Data

The annual data covering the period 2008-2015 are used. This study consists of a sample of 25 banks of which 20 are conventional banks and 5 are Islamic banks. Data of bank-specific variables are collected from the consolidated annual financial statements of selected banks through their official websites. However, data for interest given on deposits are taken from World Bank Indicators (WDI). Monthly data of CPI and call money rate are collected from International Monetary Fund's (IMF) International Financial Statistics (IFS) database.

Estimation Technique

For starting our empirical analysis, z-score is calculated for each Islamic and conventional bank included in the sample. Uncertainty of macroeconomic indicators, namely, the rate of inflation and the interest rate, is measured by calculating the yearly Standard Deviation (SD) of the underlying variables using monthly data.

For testing heteroscedasticity in the data, we applied Breusch Pagan/Cook Weisberg and White test. Both tests follow the Chi-square distribution and test the null hypothesis of homoscedasticity. To control heteroscedasticity, we used GLS estimator for estimation purpose, as GLS is more efficient as compared to OLS in the presence of heteroscedasticity/autocorrelation in the data (see, for more detail on this, Baltagi (2008)). We also apply linear parametric restriction test for testing the joint significance of macroeconomic uncertainties for determining banks’ performance and solvency.

Empirical Results

The results of Breusch Pagan/Cook Weisberg test and White test are presented in Table 2 and Table 3, respectively.

TABLE 2
Results of Breusch Pagan/Cook Weisberg test

ROA	chi ² (1) = 449.51 Prob > chi ² = 0.0000
z-score	chi ² (1) = 195.42 Prob > chi ² = 0.0000

It can be observed from the Table that the *p*-values of the performance (ROA) model and *z*-score model are 0.000, suggesting the rejection of the null hypothesis at less than 1% level of significance. The rejection of the null hypothesis confirms the presence of heteroscedasticity in the models.

White test is also applied to check the existence of heteroscedasticity in the models. The results are given in Table 3.

TABLE 3
Results of White Test

ROA	chi ² (58) = 124.88 Prob > chi ² = 0.0000
z-score	chi ² (69) = 57.82 Prob > chi ² = 0.8292

It can be examined from the Table that the *p*-value of bank performance (ROA) model is 0.000. Therefore, the null hypothesis of homoscedasticity is rejected and we accept the alternate hypothesis of heteroscedasticity. However, in case of *z*-score model, we do not find any significant evidence of the presence of heteroscedasticity based on White test.

Results of Banks' Performance Model

Table 4 presents the results for banks' performance, which is measured by ROA. The results for full sample suggest that the coefficient of CAR is significant and positive, suggesting that CAR is positively related to the financial performance of banks in Pakistan. This finding implies that banks with higher CAR are more profitable. The positive relationship between CAR and ROA is consistent with the results of Noman et al. (2015). The estimated coefficient of the BURD is statistically significant and negative, which implies that increases in banks' non-interest expense decrease banks' financial performance. The coefficient of AQ, which is proxied by the ratio of non-performance loans to total loans, also appears statistically significant with a negative sign, suggesting that banks with more non-performing loans relative to their total loans are less profitable. These results are consistent with the results of Ongore and Kusa (2013). The coefficient of VD implies that banks having more deposits are likely to be more profitable. Previously, Tariq, Usman, Mir, Aman, and Ali (2014) have also reported the positive impact of the deposit ratio on banks' performance.

The results reveal that CR is negatively and significantly related to the financial performance of banks, suggesting that to improve banks' performance, efficient CR management is required. The negative effect of CR on banks' performance is consistent with the finding of Ali, Akhtar, and Ahmed (2011). The coefficient of bank size is positively and statistically significant, suggesting that large banks harvest the benefits of economies of scale and, thus, they are more profitable than their small counterparts. Abdullah et al. (2014) have also documented the positive link between banks' size and performance. These results suggest that banks can increase their financial performance by increasing their size and reducing CR.

Turning to the effects of macroeconomic indicators, we find that the estimated coefficient of the rate of inflation is positively and statistically significant. This finding implies that during periods of high inflation, banks perform better. The positive relationship between the inflation rate and banks' performance suggests that in periods of high inflation, banks control interest rate changes which may lead to profit generation and, thus, in turn, affects banks' profitability positively. The positive impact of inflation on the performance of banks has also been reported by some previous studies like Noman et al. (2015) and Wasiuzzaman and Tarmizi (2010). On the other hand, Kanwal and Nadeem (2013) found the negative effect of the rate of inflation on banks' performance. The estimated coefficient of the real interest rate suggests that interest rates are significantly and positively related to the financial performance of banks in Pakistan. This finding implies that banks can earn more profits on average during periods of higher real interest rate. This result is in line with the findings of Kanwal and Nadeem (2013).

Observing the effects of uncertainty on the performance of banks, we find that neither inflation uncertainty nor interest rate uncertainty played any significant role in determining the performance of banks in Pakistan during the examined period. This finding is quite unexpected. However, it implies that the performance of the banking sector in Pakistan is not significantly affected by unpredictable variations in the rate of inflation as well as in the real interest rate. Rather, the financial performance of banks operating in Pakistan is driven mainly by bank-specific factors. One possible explanation of such finding is that the banks

operating in Pakistan may manage risks in effective ways and, thus, they are less likely to be affected by any uncertainty associated with macroeconomic conditions. Another possible reason is that the banking sector in Pakistan is working not in fully competitive environment and they may charge higher spread and, thus, they have capability to effectively absorb any unpredictable change in the rate of inflation and the real interest rate.

TABLE 4
Regression results for banks' performance model

Variables	Full Sample	Conventional Banks	Islamic Banks
CAR	0.065*** (0.01)	0.093*** (0.01)	0.012 (0.02)
BURD	-0.557*** (0.07)	-0.613*** (0.09)	-0.442** (0.17)
AQ	-0.059*** (0.02)	-0.027 (0.02)	-0.065*** (0.02)
VD	0.023*** (0.01)	0.029*** (0.01)	0.003 (0.02)
CR	-0.027* (0.03)	-0.089*** (0.03)	-0.011 (0.01)
Bank Size	0.471*** (0.07)	0.531*** (0.07)	0.361 (0.26)
Inflation Rate	0.240*** (0.07)	0.249*** (0.07)	0.177 (0.13)
Real Interest Rate	0.182*** (0.06)	0.183*** (0.06)	0.182* (0.10)
Inflation Uncertainty	0.077 (0.22)	0.122 (0.25)	-0.188 (0.41)
Real Interest Rate Uncertainty	0.162 (0.12)	0.147 (0.13)	0.174 (0.22)
Constant	-10.636*** (1.48)	-13.590*** (1.72)	-7.107 (5.40)
Wald Chi ²	297.827	264.452	79.736
Prob. > Chi ²	0.0000	0.0000	0.0000
Linear Parametric Restrictions			
(1) Coefficient of Inflation Uncertainty = 0			
(2) Coefficient of Interest Rate Uncertain = 0			
Chi ² (2)	7.12	5.97	0.65
Prob > Chi ²	0.0284	0.0505	0.7220

Note: The values given in parentheses are standard errors. *Indicates significant at the 10% level, **Indicates significant at the 5% level, and ***Indicates significant at the 1% level.

After getting the statistically insignificant effect of both types of uncertainty, we apply the linear restriction test to examine whether uncertainty should be included in the model. The value of Wald Chi² is 7.12 with a probability of 0.0284, which is significant at the 5% level of significance. This implies that both inflation uncertainty and real interest rate uncertainty

contribute towards the prediction power and fitness of the model and, thus, these uncertainty variables should be the part of the model.

We also estimate the effect of uncertainty on conventional and Islamic banks' performance by splitting the full sample. For conventional banks, the findings suggest that almost all bank-specific and macroeconomic indicators are statistically significant except AQ. One can see from the Table that the effects of bank-specific variables on the performance of conventional banks are similar to those for the case of full sample. Similarly, the effect of inflation and real interest rates is positive and statistically significant. However, the coefficients of inflation uncertainty and real interest rate uncertainty appear to be positive but statistically insignificant. The result of the linear restriction indicates that although both types of uncertainty do not have any statistically significant impact on the performance of conventional banks, their inclusion in the model significantly increases the explanatory power of the model.

The results of Islamic banks' performance model are significantly different from the results for the full sample and conventional banks. Specifically, we find that only the BURD, AQ, and the real interest rate have significant impacts on Islamic banks' financial profitability. There are two possible reasons for getting such results. First, Islamic banks are relatively new in the business and yet the bank-specific factors are not playing any significant role in determining their financial performance. Second, the statistically insignificant estimates of the bank-specific variables are the results of the small sample biasness. Due to having the relatively small sample, the econometric framework and estimation method that we apply here are not able to capture the effects of bank-specific variables on the financial performance of Islamic banks. Application of econometric methods, which are more suitable for relatively small sample, like Bayesian estimation method, may yield more significant results. The estimates of inflation uncertainty and real interest rate uncertainty also appear to be statistically insignificant with positive and negative signs, respectively. This means that unexpected variations in inflation and real interest rate have no significant impact on the financial performance of Islamic banks. The parametric restriction tests reveal that inflation and interest rate uncertainties are not significantly contributing to the prediction power of the model.

Results of Bank Solvency Model

To estimate bank solvency model, we first calculate z -score in each year for each bank and then regress it on bank-specific and macroeconomic variables and their uncertainty. Table 5 presents the empirical results. We find that the efficiency ratio, the loans to assets ratio, and bank size are positively and significantly related to z -score during the examined period. On the other hand, CR, the DTE ratio, and the EM are significantly and negatively related to z -score. The estimated coefficient of the efficiency suggests that a percent increase in the efficiency ratio will result in 0.018 unit increase in z -score of banks on average. This finding implies that more efficient banks are also creditworthy. Further, this finding suggests that banks can increase their solvency by increasing their efficiency. The results also suggest that bank size has a positive and significant impact on the solvency of banks, suggesting that

large banks are more financially sound. This finding implies that large banks are better in managing their risks as they have more human and capital resources and obtain economies of scale as well as economies of scope benefits. Finally, the positive impact of bank size on z -score suggests that banks can increase their financial soundness by expanding their businesses. The results also indicate that banks that have higher loan to asset ratio also have higher z -score. This finding suggests that banks that offer more loans relative to their assets face less insolvency problem.

However, the estimated coefficient of CR indicates that a one-unit increase in the credit ratio will decrease the z -score by 0.28 units on average. This finding implies that banks that face higher CR have higher chance of default. This result suggests that banks should manage their CR effectively to enhance their financial solvency. Our results also suggest that banks those have more debt as a percentage of total assets are more likely to face the problem of insolvency. This finding suggests that banks should rely less on debt financing in order to decrease the likelihood of bankruptcy. These findings are generally similar to those reported by Hesse and Cihak (2007), Ivipisc et al. (2008), Mokhtar et al. (2006); Shahid and Abbas (2012). The estimate of the DTE ratio is positive but statistically insignificant. This ratio does not determine the solvency of banks in Pakistan.

Turning to the effects of macroeconomic indicators, we find that both the rate of inflation and the real interest rate are positively and significantly related to z -score. A possible explanation for such effect is that relatively higher inflation and real interest rate indicate booms in economic activities and during good economic conditions, businesses increase demand for bank loans. Thus, because of higher demand for banks' loans, banks are in better position to issue only good and secure loans, which, in turn, positively affect their solvency. During better economic conditions, banks also charge higher premiums/markup, which also reduces the chance of bankruptcy and increases the financial soundness of banks in Pakistan. The impact of inflation uncertainty on the solvency of banks is not statistically significant. Although the estimated coefficient is negative, it is statistically insignificant at the 5% level of significance. This implies that variations in the rate of inflation do not have any significantly negative influence on the solvency of banks in Pakistan. In contrast, the estimated coefficient of the real interest rate uncertainty is positive and statistically significant, indicating that unpredictable variations in the real interest rate have positive impacts on banks' z -score. A possible explanation for this finding is that in periods when the real interest rate is unstable, banks may charge higher interest rate and be cautious in lending risky loans and, thus, they reduce their chance of insolvency. The linear restriction test results provide evidence that both inflation and real interest rate uncertainties significantly enhance the prediction power of the model, suggesting that these two variables should be the part of the model.

To investigate the effects of uncertainty on the solvency of conventional and Islamic banks, we separately estimated the solvency model for both types of banks. The estimated coefficients provide evidence that the effects of bank-specific variables on the solvency of conventional banks in Pakistan are quite similar, in terms of sign and statistical significance, to those in the case of full sample. However, the effect of the EM now turns statistically in-

significant, which was statistically significant at the 10% level of significance in case of full sample. Similarly, we find that both the rate of inflation and the real interest rate have significant and positive impacts on the solvency of conventional banks. These results are also similar to those for the full sample. In contrast, both types of uncertainty appear to have statistically insignificant impact on the solvency of conventional banks. The results of linear restrictions provide evidence of the significant contribution of both types of uncertainty towards the modeling of the solvency of conventional banks.

TABLE 5
Regression results for Bank Solvency Model

Variables	Full Sample	Conventional Banks	Islamic Banks
Efficiency Ratio	0.018** (0.01)	0.014* (0.01)	0.039* (0.02)
Loan to Asset Ratio	0.101*** (0.04)	0.078* (0.04)	0.228*** (0.08)
CR	-0.280*** (0.10)	-0.744*** (0.14)	-0.058 (0.09)
Bank Size	4.247*** (0.41)	4.562*** (0.55)	2.970 (2.32)
DTA Ratio	-0.225*** (0.06)	-0.142* (0.09)	-0.025 (0.10)
DTE	0.258 (0.19)	0.091 (0.17)	3.180** (1.32)
EM	-0.242* (0.14)	-0.093 (0.12)	-4.512*** (1.21)
Inflation Rate	2.644*** (0.59)	2.565*** (0.73)	-1.253*** (0.95)
Real Interest Rate	1.906*** (0.48)	1.600*** (0.58)	-0.441*** (0.76)
Inflation Uncertainty	-0.433 (2.02)	2.029 (2.46)	-7.381*** (2.28)
Real Interest Rate Uncertainty	3.240*** (1.06)	1.521 (1.28)	4.458*** (1.28)
Constant	-74.621*** (10.71)	-78.828*** (13.95)	-5.814 (13.95)
Wald Chi ²	163.962	158.781	112.930
Prob. > Chi ²	0.0000	0.0000	0.0000
Linear Parametric Restrictions			
(1) Coefficient of Inflation Uncertainty = 0			
(2) Coefficient of Interest Rate Uncertain = 0			
Chi ² (2)	19.730	8.190	7.250
Prob > Chi ²	0.0001	0.0166	0.0036

Note: The values given in the parentheses are standard errors. * indicates significant at the 10% level, ** indicates significant at the 5% level, and *** indicates significant at the 1% level.

Looking at the results of Islamic banks, we find that the efficiency ratio, the loan to asset ratio, and the DTE ratio have positive and significant effects, while, the effect of EM on the

solvency of Islamic banks is negative and statistically significant. The results also suggest that CR, bank size, and the debt to total asset ratio do not have any statistically significant effect on Islamic banks' solvency. An interesting finding is that quite opposite to the case of full sample and the conventional banks, the effect of both the rate of inflation and the real interest rate on the solvency of Islamic banks is negative and statistically significant. These results suggest that during periods of higher inflation and higher real interest rate, Islamic banks face more financial distress. These findings make sense as Islamic banks are relatively new in the market and, thus, they may not be able to properly manage the risk associated with higher inflation and real interest rate. The estimated coefficient of inflation uncertainty is also negative and appears statistically significant. This implies that Islamic banks face more insolvency problems when prices are uncertain in the economy. Taken together, the findings suggest that not only the rate of inflation but also the uncertainty associated with inflation has an adverse effect on the solvency of Islamic banks.

These results suggest that the managers of Islamic banks should be cautious about their financing decisions in periods of volatile commodity prices. In contrast to the effects of inflation uncertainty, the impact of interest rate uncertainty on Islamic banks' solvency is positive and significant, although the effect of interest rate uncertainty on conventional banks' solvency is statistically insignificant. One possible justification for the positive effect of interest rate uncertainty on Islamic banks' solvency is that during period of more volatile interest rate, business firms may opt to obtain capital to finance their investments and other capital needs from Islamic banks based on profit and loss sharing rather than fixed or floating interest rates. Higher demand for financing enables Islamic banks to finance only those investments that are relatively secure and more profitable. Thus, they reduce their chance of insolvency and financial distress. The linear restriction test also justifies the inclusion of both types of uncertainty in the model.

CONCLUSION

In this paper, we have examined the effects of inflation and real interest rate uncertainty on banks' performance and solvency. We have also examined whether the effect of both types of uncertainty differs for conventional and Islamic banks. We used several bank-specific control variables while examining the effects of uncertainty on the performance and solvency of banks. We used annual data covering the period 2008-2015 for a sample of 25 banks operating in Pakistan. GLS estimator is applied to overcome the problem of heteroscedasticity.

We find that several bank-specific variables are important in determining the performance of banks in Pakistan. For instance, our results suggest that the CAR, VD, and bank size have significant and positive impacts on the performance of banks when we run the model for full sample. We also show that the BURD, the AQ (non-performance loans to total loans ratio), and CR affect the performance of banks negatively. The rate of inflation and the real interest rate both have positive and significant effects on banks' performance. However, we did not find any evidence of the significant impact of inflation and interest rate uncertainty on banks' performance during the examined period. The results for the conventional banks are

generally consistent with the results for the full sample. For Islamic banks, we find different effects of bank-specific variables on banks' performance. For example, bank size, VD, and CAR do not have any significant impact on the performance of Islamic banks. Similarly, we show that both the rate of inflation and real interest rate also do not significantly affect Islamic banks' performance.

The results regarding the solvency of banks indicate that the efficiency ratio, the loan to asset ratio, and bank size have positive, whereas, CR, the DTA ratio, and the EM have negative and significant impacts on the solvency of banks in Pakistan. We also found that the rate of inflation and real interest rate are positively and significantly related to banks' solvency. Our analysis also suggests that although inflation uncertainty does not have any significant impact on banks' solvency, variations in the real interest rate have a positive and significant impact on banks' solvency. Interestingly, we find that although the solvency of conventional banks is not significantly affected by either type of uncertainty, the solvency of Islamic banks is significantly related to both types of uncertainty. Specifically, we find that inflation uncertainty has a negative, whereas, the uncertainty associated with the real interest rate has a significant and positive impact on the solvency of Islamic banks.

Our results suggest that conventional banks are more efficient in terms of earning more income by efficiently managing the costs. Conventional banks are highly liquid and this increases their financial stability. Conventional banks are well-diversified and there is an economy of scale, which increases their solvency. Most of the assets of conventional banks are financed through debt, which decreases their solvency. Conventional banks can predict inflation more precisely and adjust the interest rates accordingly. Also, higher real interest rate leads towards higher bank profitability, which has a positive influence on the solvency of conventional banks. The results of Islamic banks' solvency model suggest that Islamic banks are less efficient and less liquid than conventional banks. Islamic banks have larger equity base than deposit base, which increases their solvency. Also, the EM has a negative impact on Islamic banks' financial stability. High inflation and real interest rates affect the solvency of Islamic banks negatively. In addition, unexpected variation in the rate of inflation affects the solvency of Islamic banks negatively, whereas, unexpected variations in the real interest rate affect the financial stability of Islamic banks positively.

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