

# Reality of short-term causality of Islamic and conventional banking term deposit rates in Pakistan

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## Abstract

**Purpose** – The purpose of this study is to find the empirical causal relationship between Islamic bank term deposit rates (IBTDR) and conventional bank term deposit rates (CBTDR) in the short-term.

**Design/methodology/approach** – This study analyzes the short-term causal relationship between the term deposit rates (TDRs) for the time period of three years 2015 to 2018 on monthly data of IBTDR and CBTDR. Granger causality test, variance decomposition and impulse response function are applied to examine if there is any short-term causal relationship between the IBTDR and CBTDR.

**Findings** – This empirical study establishes that the IBTDR are dependent on the CBTDR in the short-term.

**Practical implications** – This research provides an insight for the customers of TDRs of the Islamic banking system. This study is not only a significant insight for the end-users but also for the regulators and researchers as it provides important empirical evidence. This could lead to further research on the reasons for causality.

**Originality/value** – There has not been any study of this nature in Pakistan to identify the causality of the two-TDRs. This research expands the dynamics of research in the context of the banking sector.

**Keywords** Islamic banking, Granger causality, Impulse response function, Conventional banking, Variance decomposition, Causal relationship

**Paper type** Research paper

## 1. Introduction

Islamic financial services and debt instruments have the component of being denied against the exchange of interest (RIBA) at a fixed or foreordained rate (Siddiqui, 2008); rather profit loss sharing (PLS) plans, buy and resale of merchandise and enterprises and arrangement of administrations for charges structure the premise of agreements. Comprehensively, PLS is an authoritative course of action between at least two executing parties that enables the gatherings to pool their assets to put resources into a task by sharing the benefit and misfortune. The PLS worldview, with regard to Islamic funds, basically alludes to the agreement of Mudarabah and Musharakah (Aggarwal and Yousef, 2000). Mudarabah is a



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detached association and Musharakah is a value interest contract giving benefit misfortune partaking in the joint business. Hence, the PLS worldview is one of a kind elements that separate Islamic banking from customary banking. Detachment from the use of funds leads, in turn, to another problem that arises from the fact that personal financing can be put to any kind of usage regardless of ethical or moral values (Kahf, 2006).

### *1.1 Banking system in Pakistan*

Banks are playing out numerous capacities to give a variety of products and services for various sections of the economy. Since its creation, the Pakistani financial sector has encountered extremely fierce conditions because of unsteady strategies and vulnerability. Private area banks were overwhelmed during the 1960s, yet they were nationalized in 1974. Nationalized banks indicated exceptionally lackluster showing because of sub-par items or benefits that came about into the privatization of the banking area in 1992. State Bank of Pakistan has started working for the initiation of Islamic financial practices in 2000 and Meezan Islamic bank was enlisted as the first purely Islamic bank in 2002. Islamic banks are new contestants in the Pakistani financial industry and require a similar report to evaluate the presentation of their operations and products/services. The services industry especially the banking area is developing over the globe during the time of 1990s. The 21st century accompanied the mixing of chances and dangers for the financial division because of the origin of Islamic financial practices in various nations such as Malaysia, Pakistan, Bangladesh, Bahrain and even in non-Muslim pieces of the globe. Islamic banks influence the fiscal framework by modifying the interest and supply powers for cash. It is discovered that the Islamic financial framework is better than the regular financial framework as it guarantees a progressively stable money-related segment (Khan, 1986). In another study, it was experimentally confirmed that the Islamic financial framework indicated incredible execution by supporting money related area in Tunisia (Darrat, 1988). There is observational proof to discover the impact of Islamic financial practices on money related steadiness of Iran. The investigation demonstrated blended outcomes, both for some proof in support to help and settle fiscal framework and to some degree against it (Yousefi *et al.*, 1997).

The presence of Islamic and conventional banks made challenge among banks to live up to clients' desires for long-haul benefits. There are two financial frameworks that exist in Pakistan Islamic banking and conventional banking. The Islamic bank (IB) and conventional bank (CB) are separated based on targets, RIBA and risk-sharing practices. IB produces pay as benefits that is variable while CB procures from the premium that is fixed; the risk is shared among loan specialist, borrower and bank in IB while CB moves the entire risk to other people; IB is exchange arranged unit while CB fills in as an unadulterated budgetary delegate to bargain based on premium. State Bank of Pakistan (SBP) assumes a functioning job to build up a sound Islamic financial framework in Pakistan as per standards of Sharia'h as referenced in its statement of purpose that read "to advance and create Islamic banking industry in accordance with the best worldwide works on, guaranteeing Sharia'h compliance and straightforwardness." SBP issued a point by point criteria in December 2001 for the foundation of pure IB in the private part. Al Meezan investment bank got the permit from SBP in January 2002 and began its activities with the name of Meezan Islamic bank as the main IB from March 20, 2002.

### *1.2 Mudarabah*

Mudarabah is the main mode used by Islamic banks for gathering deposits from people in general. Siddiqi (2000) has examined completely the all-encompassing extent of Mudarabah.

The connection among investors and Islamic banks is that of lenders and businesses (the banks). It is for the investment account holders (IAHs) who wish to get a return on their reserve funds and speculations and maintaining a distance from RIBA (Ayub, 2013; Ullah, 2013). All deposits are assigned to different pools that are used by banks for business. The immediate costs are charged to the pool while administrative costs are borne by the bank (mudarib). The net benefits are disseminated, first between the bank and the pools as indicated by the stipulated proportions, and after that among the contributors' dependent on the weight-ages framework. In the event of misfortunes, assuming any, the equivalent is appropriated among the financial investors. In case all financing is from the depositors, the bank suffers time and effort loss only. In case, the bank also invests in a pool, the loss is shared as per the ratio of finance provided by it. In the case of term deposit rates (TDRs), the IAHs are the collective investors and the IB plays the role of the fund manager.

### *1.3 Term deposit rates*

TDRs are viewed as the focal point of finance-related activities (Kaleem and Isa, 2003). TDR is a method for mobilization of assets from the overall population under the Mudarabah method of account. Aside from its pertinence to TDR, Mudarabah is a significant contract in Islamic banking because of the way that hypothetically it is the method of the fund on which the Islamic banking and finance should be built.

### *1.4 Problem statement*

Islamic finance is the backbone of the Islamic economic system. It is much needed to identify if Islamic banking has imprints of any other system i.e. conventional. A number of studies have been conducted internationally (Kaleem and Isa, 2003; Lee *et al.*, 2017) analyzing the existence of the causal relationships between the TDRs of both banking systems. However, no such work is done yet to identify that either is there any causal relationship between the TDRs of both banking systems in the short-term specifically in Pakistan.

### *1.5 Objective of the study*

This study focuses on the short-term causal relationship between the Islamic banking term deposit rates (IBTDR) and the conventional banking term deposit rates (CBTDR). The objective can be narrowed down as to evaluate if there is any causal relationship between the IBTDR and CBTDR.

The study is divided into five sections, Section 1 being the introduction. Section 2 is about the previous literature, Section 3 discusses the data and methodologies adopted. Section 4 is having the results of empirical tests performed. Section 5 concludes the article.

## **2. Literature review and hypotheses development**

This study has followed a thematic literature review approach. In a thematic literature review, this study had organized and discussed existing literature based on themes extracted and summarized from the contribution of various researchers that were important to understanding the topic.

Hypothetically, Islamic banks are not permitted to offer a fixed and foreordained loan cost on deposits or to charge interest on financial transactions. IB tasks are implanted in the premium free financial structure. Accordingly, hypothetically it is normal that Islamic banks would not be impacted by loan fees (Ergeç and Arslan, 2013). The questioning on whether Islamic banks are emulating conventional products is not restricted to a reasonable level. Notwithstanding, it is extended to experimental proof. If the Islamic financial items are

theoretically unique in relation to premium based financing, we ought not to locate a lot of relationship in premium or interest rates or financing and loaning rates. Studies of [Ahmad \(1994\)](#), [Khan \(2010\)](#) express that there are significant divergences between Islamic banks' standards and their practices, and they are functionally identical to conventional banking. The supporters of Islamic banking recommend that the comparability of certain Islamic financial products with conventional banking products is only at the process stage. Advocates of Islamic banking suggest that the similarity of certain Islamic banking products with conventional products is solely a transition phase. They believe that Islamic banking products and services will gradually achieve full compliance with Islamic principles in the near future. In the meantime, researchers are turning to empirical evidence for possible answers to the independence of Islamic banking.

The empirical evidence on the degree of the linkage between Islamic rate of return and conventional loan fees are conflicting. Numerous investigations, for example, [Anuar et al. \(2014\)](#), [Cevik and Sharap \(2011\)](#), [Chong and Liu \(2009\)](#), [Ito \(2013\)](#), [Kaleem and Isa \(2006\)](#) and [Khan \(2010\)](#) find that there are solid co-development and causality connections between the two rates, which drove them to contend that, there is no huge contrast between Islamic banks and ordinary banks in the dual banking system of Malaysia. Fewer examinations, be that as it may, discover no proof of a connection among Islamic and conventional rates. These studies are done by [Hassan and Lewis \(2007\)](#), [Latiff and Halid \(2012\)](#). [Kaleem and Isa \(2006\)](#) inspect the IBTDR and CBTDR linkages which spread the period from January 1984 to December 2002. Their Granger causality result demonstrates that conventional impact Islamic rates in all classes of the development TDRs. This suggests there is a huge challenge among Islamic and conventional rates and Islamic banks consider financing costs before modifying its deposits returns. In a later report, [Chong and Liu \(2009\)](#) analyze the connection among Islamic and conventional deposit rates in Malaysia over the period 1995 to 2004. Their outcomes are commonly predictable with [Kaleem and Isa \(2006\)](#). [Chong and Liu \(2009\)](#) locate that conventional rates Granger caused Islamic rates, yet not the other way around. Also, the cointegration test demonstrates the nearness of a long-run connection between the two rates. This has prompted the end, by and by Islamic banks is not vastly different from conventional banks. They state that Islamic banks are overly dependent on fixed-rate financing that are permissible under Islamic law and competition compels them to follow the conventional rates. The authors rationalize the dependence of Islamic rates on conventional rates as follows. The actual implementation of Islamic banking products is controlled indirectly by conventional banks. Owing to the significantly small market share, competition dictates that Islamic banking must follow the leader, which is conventional banking. Islamic banking practices often cannot deviate substantially from conventional banking.

In a recent study, [Anuar et al. \(2014\)](#) return to the issue by breaking down the conventional loan costs and venture deposit rates of Islamic banks in Malaysia for the period from 1994 to 2012. By and large, the findings proved a long-haul connection between loan fees and Islamic rates. The Granger causality test demonstrates that conventional deposit rates Granger cause Islamic deposit rates. This outcome proposes that Islamic deposit rates are essentially connected with loan costs in the short and long-run research on the connection among Islamic and conventional rates are additionally done in other dual financial economies. [Cevik and Sharap \(2011\)](#) looked at the conduct of CB deposit rates and IB rate of return in Malaysia and Turkey over the time of 1997 to 2010. Their investigation demonstrates that CB deposit rates and Islamic rate of return (PLS venture account) is cointegrated in the two markets. The pairwise and multivariate causality tests demonstrate that changes in PLS returns are influenced by conventional deposit rates. In another

examination, [Ergeç and Arslan \(2013\)](#) use a cointegration way to deal with investigate the impact of financing costs on IB rates in Turkey over the period 2005 to 2010. The specialists find that adjustments in the overnight financing costs influence the deposits and advances of conventional banks, as well as of Islamic banks. This finding indicates that Islamic banks are encountering a risk of interest rate changes in the same manner as conventional. In the most recent study, [Lee et al. \(2017\)](#) using four pairs of data of average and base lending rates of Islamic and conventional banking found out, that the conventional rates are cointegrated and conventional base lending rates Granger cause Islamic base lending rates.

### *2.1 Hypotheses*

Based on the literature review the following hypothesis are developed:

*H1.* IBTDR have a short-term impact on CBTDR.

*H2.* CBTDR have a short-term impact on IBTDR.

## **3. Methodology and data set**

### *3.1 Data set and variable formulation*

This study analyzes the relation between IBTDR and CBTDR for the fixed deposits of five-year, profit payment at monthly. Data set uses mean of TDRs of three out of five purely Islamic banks, namely, Bank Islami Pakistan, Dubai Islamic Bank and Al Baraka Bank Pakistan as the IBTDR. This is due to the unavailability of data of combined IBTDR for any period. Deposit rates are taken as the CBTDR. The source of IBTDRs is from the profit announcement schedule, whereas for CBTDRs were extracted using the trading economics data portal. The study period is of three years from January 2015 to December 2018.

### *3.2 Methodology*

This study analyzes the relation between IBTDR and CBTDR through several means, examining the data set with Augmented Dickey-Fuller (ADF) unit test, correlation analysis to confirm the viability of data set for the application of Granger causality test further relationship is explained with variance decomposition and impulse response function (IRF).

### *3.3 Pre-testing*

The ADF test is a unit root test for stationarity. Unit roots can cause unpredictable results in time series analysis. Correlation is a statistical measure that indicates the extent to which two or more variables fluctuate together. A positive correlation indicates the extent to which those variables increase or decrease in parallel; a negative correlation indicates the extent to which one variable increases as the other decreases. The covariance matrix explains the correlation and probability.

### *3.4 Granger causality*

Granger causality is a statistical concept of causality that is based on prediction. According to Granger causality, if a signal  $X_1$  "Granger causes" (or "G-causes") a signal  $X_2$ , then past values of  $X_1$  should contain information that helps predict  $X_2$  above and beyond the information contained in past values of  $X_2$  alone. Its mathematical formulation is based on linear regression modeling of stochastic processes. More complex extensions to nonlinear cases exist, however, these extensions are often more difficult to apply in practice. To analyze the short-term causal relationship between the IBTDR and CBTDR, the Granger

causality test is conducted on the data sets to either accept or reject the following two null hypotheses.

- (1) IBTDR do not Granger cause CBTDR.
- (2) CBTDR do not Granger cause IBTDR.

#### 4. Empirical study

##### 4.1 Descriptive statistics

Descriptive statistics of the two variables of the study, IBTDR and CBTDR are stated in [Table 1](#). On average the value of IBTDR and CBTDR are 5.818% and 5.13%, respectively. The spread (standard deviation) is 0.616% for IBTDR and 0.766% for CBTDR. The minimum and maximum values of IBTDR and CBTDR indicate that the IBTDR has a higher value by almost 1%.

##### 4.2 Augmented Dickey-Fuller unit root test

ADF test is conducted to test the null hypothesis: Time series data has a unit root. ADF test is used here to trend and intercept at the lag length is calculated automatically on Schwartz information criterion to test the viability of the newly developed data set of IBTDR. The ADF unit results in [Table 2](#) shows the probability value of 0.0003 which is <5% so we can reject the null hypothesis and adopt the alternate hypothesis that the data set does not have the unit root and it is stationary. The data set is viable and can be used to test the further analysis.

##### 4.3 Correlation analysis

The correlation analysis is applied on the data set of IBTDR and CBTDR is mentioned in [Table 3](#) shows a positive correlation between CBTDR and IBTDR. The coefficient of correlation is high at 0.78 with a probability value less than 5%, i.e. 0.00 shows that results are highly significant. This implies that both the rates move in the same direction. The values show that the correlation is strong and is highly likeliness to happen at the given

	Count	Mean	Median	Std. dev.	Minimum	Maximum
<i>IBTDR</i>	48	5.818	5.585	0.616	5.390	8.250
<i>CBTDR</i>	48	5.123	4.820	0.766	4.410	7.160

**Table 1.**  
Descriptive statistics of variables of interest

**Note:** All values except “count, minimum and maximum” are in percentage

	<i>t</i> -statistic	Prob.*
ADF test statistic	-5.391633	0.0003
Test critical values:		
	1% level	-4.170583
	5% level	-3.510740
	10% level	-3.185512

**Table 2.**  
The augmented ducky fuller test to account for the stationarity in the IBTDR time series

**Notes:** \*[MacKinnon \(1996\)](#) one-sided *p*-values; the null hypothesis of this study is that the IBTDR has a unit root

data set (Lee *et al.*, 2017). However, no issue of autocorrelation is evident as the autocorrelation criteria given by Dohoo *et al.* (1997) is at 0.9.

4.4 Granger causality test

The correlation analysis clarifies that there is some relationship between the two. The application of the Granger causality test is to see the direction of this relationship.

There is a requirement of optimal lag length for the Granger causality test to run. This is done using the vector autoregression (VAR) lag length criterion, to finding the suggested Akaike information criterion (AIC) at a lag level for the given data set. In VAR lag order selection criteria as mentioned in Table A1 (Appendix), the appropriate lag length is 5. The VAR model is stable as no unit-roots are outside the circle and free of serial correlation at five lags (Damane, 2018) and show no heteroscedasticity mentioned in Table A2 to A4, respectively (Appendix).

Table 4 states the results of the pairwise Granger causality test between two variables of interest i.e. IBTDR and CBTDR. The criteria for the acceptance of the null hypothesis is that the probability value should be greater than 5%. The criteria for the acceptance of the null hypothesis is that the probability value should be greater than 5%. The results show that the probability value for the first null hypothesis is >5% so we cannot reject the given hypothesis and it is established that the IBTDR does not Granger cause the CBTDR. For the second null hypothesis, the result is significant at 2.18% so we reject this null hypothesis and accept the alternate hypothesis that the CBTDR do Granger cause the IBTDR.

4.5 Variance decomposition

To further examine the relationship of IBTDR and CBTDR this study uses variance decomposition. Variance decomposition analysis provides details on the degree to which shocks in the past and shocks from other independent variables impact changes in one of the variables. In other words, the decomposition of variance shows the size of a movement within one rate which can be interpreted with the other rate as the percentage of the market's forecasting error variance. Table 5 shows the results of variance decomposition analysis for a

		Covariance analysis: ordinary	
		CBTDR	IBTDR
<b>Table 3.</b> Covariance matrix of the two variables (IBTDR and CBTDR) of this study	Correlation		
	Probability		
	CBTDR	1.000000	
	IBTDR	0.786577	1.000000
		0.0000	-

<b>Table 4.</b> Pairwise Granger causality tests to evaluate the causal relationship between the IBTDR and CBTDR	Null hypothesis:		
	Obs	F-statistic	Prob.
	43	1.51118	0.2140
		3.09083	0.0218*

**Notes:** "\*"Significant at 5% level of significance; lag length is 5

ten-month forecast period for the IBTDR and CBTDR. The findings suggest that the CBTDR is mainly affected by their own short-term shocks. The effect of CBTDR on IBTDR in the short-run is visible. In the third month effect of CBTDR on IBTDR increases by almost 10% in just one shock from the previous and in the fifth month the shock influence of CBTDR on IBTDR has increased to 34.11% (Lee *et al.*, 2017). This makes it clear that the IBTDR is influenced by the CBTDR. This influence gets even more strong in the long-run as well.

#### 4.6 Impulse response function

For studying the interactions between variables in a vector autoregressive model, IRFs are useful. They reflect the reactions of the variables to the shock that impacts the system. The IRF traces the VAR's dependent variable's responsiveness to shocks of its own and each of its other variables. Provided that the VAR model is stable (Brooks, 2014). The IRF is in-line with the variance decomposition as shown in Figure 1. One standard deviation shock to CBTDR increases IBTDR. This positive response increase with the decrease in alternate periods. The response of CBTDR to one standard deviation shock of IBTDR till period two is neutral but eventually turns negative.

#### 4.7 Discussion on findings

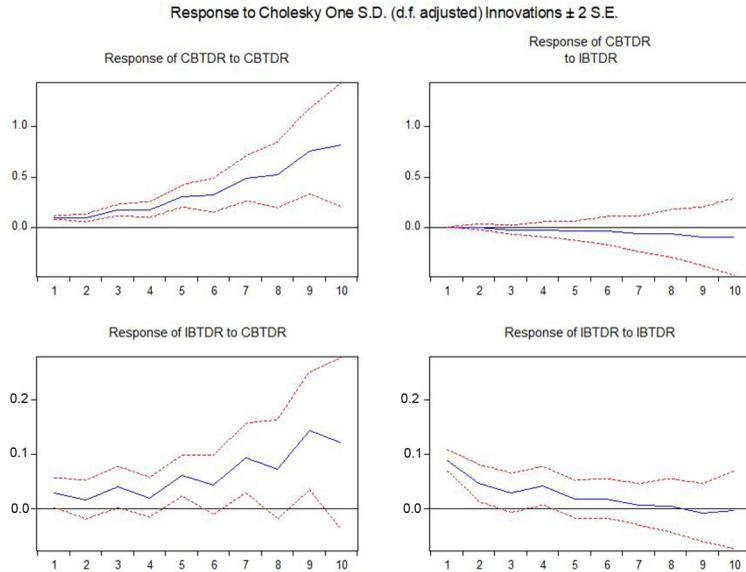
The findings tend to suggest, in general, the dependency of Islamic rates on conventional rates. This sort of outcome has led to the conclusion of some authors that Islamic banking could be interest-based instead of interest-free. Conventional financing has taught us that debt financing is preferable to equity financing in the presence of information asymmetry. This assumption is due to the preference of the market for leveraged firms when debt costs are fixed. If the cost of debt is not fixed and instead, debt is subject to a similar risk as equity, how can things change? Does the pecking order of capital acquisition have a strong business preference? The results of this study can only be an indicator that the above questions but do not have a straightforward response. As Islamic banks also function in an asymmetrical information setting, the preference of Islamic bankers for non-PLS funding is an eminently rational response to the problems of information asymmetry inherent in all financial transactions.

In traditional economics, Khan (2010), Stiglitz and Weiss (1981) and Williamson (1987) stressed that there is an existing consensus that debt financing is the best method of financing to guarantee payment in the presence of information asymmetry in the market. As Islamic banks also operate in a market with the same characteristics, in their financing

Variance decomposition of CBTDR:				Variance decomposition of IBTDR:			
Period	S.E.	CBTDR	IBTDR	Period	S.E.	CBTDR	IBTDR
1	0.09	100	0	1	0.09	9.44	90.56
2	0.13	99.94	0.06	2	0.10	9.63	90.37
3	0.22	98.40	1.60	3	0.12	19.46	80.54
4	0.28	98.32	1.68	4	0.12	19.24	80.76
5	0.42	98.38	1.62	5	0.14	34.12	65.88
6	0.53	98.47	1.53	6	0.15	39.33	60.67
7	0.72	98.33	1.67	7	0.17	56.53	43.47
8	0.89	98.42	1.58	8	0.19	62.85	37.15
9	1.17	98.41	1.59	9	0.24	76.35	23.65
10	1.43	98.52	1.48	10	0.27	81.26	18.74

Note: Cholesky ordering: CBTDR IBTDR

**Table 5.**  
Variance decomposition of variables CBTDR and IBTDR



**Figure 1.**  
Impulsion response  
function with  
variables CBTDR  
and IBTDR

activities they also resort to fixed-rate financing (non-PLS). In addition, much like conventional banks, Islamic banks are financial intermediaries. They may not have any experience in equity-financed project monitoring, so they are vulnerable to all market risks. To reduce their risk completely collateralized debt assets (or non-PLS financing) will therefore be the financing mode preferred by Islamic banks. [El-Gamal \(2006\)](#) argues that Islamic banks mask the use of interest in their mark-up selling (murabaha) or lease (ijarah) financing on the asset side and use Islamic securitization on the liability side in deciding financing rates. [Chong and Liu \(2009\)](#) and [Khan \(2010\)](#) support the arguments of El-Gamal and find that the most prevalent forms of Islamic funding are mark-up sales and leasing.

## 5. Conclusion

Commonly previous studies appear to suggest that in a dual-banking system. IB rates tend to follow CB rates or fluctuations in conventional rates largely influence IB rates. Another common finding is that Islamic deposit rates are higher than conventional rates. This study provides evidence on the relationship and causality between Islamic and conventional deposit rates for Pakistani banks in the short-run.

This study provides additional evidence on the relationship and causality between Islamic and conventional rates. We use standard time-series techniques that include, Granger causality, variance decomposition and the IRF, to analyzes the relation between the rates. Results of the Granger causality show that CBTDR significantly cause the IBTDR. The relationship of IBTDR and CBTDR becomes clearer as the variance decomposition shows that IBTDR are influenced by the CBTDR in the short-run. Variance decomposition is supported by the impulsive response function. The implication of this result is that Islamic rates follow conventional banking rates. These results are consistent with the work of [Saraç and Zeren \(2015\)](#) as they found causality in the TDRs in Turkey. This study establishes that the findings of [Cevik and Sharap \(2011\)](#) are true and CBTDR impact the IBTDR in the short-term.

The disparity between Islamic and traditional rates are another significant finding. Our findings show that the rates of Islamic banking are consistently higher than conventional rates. This could be an attraction and distinction technique from Islamic banks as they are smaller in size, such that their overhead is relatively high; therefore, an additional premium is paid. The size constraint has resulted in the lack of economies of scale in Islamic banks' operations. It is therefore a big challenge for policymakers and bank practitioners to find ways of developing Islamic banking products and becoming independent of conventional prices.

This study contributes to the literature as it provides evidence of causality between the IBTDR and CBTDR. This implies that this study has opened gateways to research in the theoretical framework of Islamic banking as the dependency on the fixed rate is against the essence of Islamic financing. The real-life implication is that the depositors' Islamic banking system must be more cautious, as the primary objective of such investors is to obtain returns but those which are free from interest. However, as the results show the causality, this negates their primary objective. This study was limited as it was only in the context of Pakistan, it could be extended with cross-country comparisons. Another extension can be the evaluation of the lending rates and deposit rates against each other.

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Lag	VAR lag order selection criteria						
	LogL	LR	FPE	AIC	SC	HQ	
0	-13.68123	NA	0.007509	0.784061	0.868505	0.814594	
1	66.41170	148.1719	0.000167	-3.020585	-2.767253	-2.928988	
2	69.84805	6.013602	0.000172	-2.992402	-2.570183	-2.839741	
3	86.82970	28.01973	9.05e-05	-3.641485	-3.050377*	-3.427759*	
4	87.18016	0.543213	0.000110	-3.459008	-2.699012	-3.184218	
5	96.58246	13.63333*	8.47e-05*	-3.729123*	-2.800239	-3.393268	
6	100.0101	4.627365	8.90e-05	-3.700507	-2.602735	-3.303587	
7	100.6895	0.849149	0.000108	-3.534473	-2.267813	-3.076489	
8	106.1650	6.296847	0.000104	-3.608249	-2.172701	-3.089200	

**Notes:** \*Indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion

**Table A1.**  
Vector auto regression lag order selection criteria for obtaining the appropriate lag length to apply the Granger causality

**Table A2.**  
Vector auto  
regression model's  
stability test using  
AR root test

Roots of characteristic polynomial	
Endogenous variables: <i>CBTDR IBTDR</i>	
Root	Modulus
0.968221 – 0.121983i	0.975875
0.968221 + 0.121983i	0.975875
0.050483 – 0.930215i	0.931584
0.050483 + 0.930215i	0.931584
0.851023	0.851023
–0.749129	0.749129
–0.322090 – 0.473614i	0.572758
–0.322090 + 0.473614i	0.572758
0.140722 – 0.151723i	0.206936
0.140722 + 0.151723i	0.206936

**Notes:** No root lies outside the unit circle. VAR satisfies the stability condition

**Table A3.**  
VAR residual serial  
correlation LM tests  
for detection of serial  
correlation in vector  
auto regression  
model

Lag	LRE* stat	df	Prob.
1	9.580656	4	0.0481
2	7.361732	4	0.118
3	4.197149	4	0.38
4	0.507233	4	0.9728
5	0.877987	4	0.9277
6	2.273497	4	0.6856

**Notes:** The null hypothesis of the test is, no serial correlation at lag h. At 5 lag length, there is no issue of serial correlation as the prob. value is 0.9277

**Table A4.**  
White  
heteroscedasticity  
test for testing  
heteroscedasticity in  
the vector auto  
regression model

<i>Joint test</i>						
$\chi^2$	df	Prob.				
63.37928	60	0.3581				
<i>Individual components</i>						
Dependent	$R^2$	F(20,17)	Prob.	$\chi^2$ (20)	Prob.	
res1*res1	0.64223	1.525825	0.1914	24.40472	0.2252	
res2*res2	0.561192	1.087066	0.435	21.3253	0.3782	
res2*res1	0.699247	1.97624	0.0805	26.57139	0.1478	

**Note:** The null hypothesis of this test is that there is no heteroscedasticity and the hypothesis is accepted as the prob. value of  $\chi^2$  is 0.3581

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