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A Formal Test of Competition in the Banking Sector of Pakistan: An Application of PR-H Statistic

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Abstract

This study explores competition in the banking sector of Pakistan in the context of transformation in its structure and business environment since the implementation of financial sector reforms in the country. Instead of relying on the changes in the market structure indicators (like concentration ratio), we employ widely used Panzar and Rosse H statistic as a formal test of competition. PR-H statistic is estimated by using a balanced panel data comprising 24 commercial banks operating in Pakistan from the year 1996 to 2015. The results suggest that the banking sector of Pakistan exhibits the characteristics of monopolistic and perfectly competitive market structures.

Keywords: Competition, Banking Market Structure, Panzar and Rosse H statistic
JEL Classification Codes: C12, D40, E50, G20

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Non-technical Summary

Banks are an important pillar of the economy owing to their key role in facilitating economic activity and smooth functioning of the payments system. Banking has gone well beyond its traditional function of channeling funds from surplus sector of the economy (households/savers) towards the deficit sector (firms/investors). In modern world, maturity transformation, risk management, monitoring, funds transfer, securitization, and facilitation of trading in financial assets, have emerged as main banking services. Provision of these services at competitive prices is one of the key objectives of financial sector policies both in Pakistan and other countries. This study explores competition in the banking sector of Pakistan in the context of significant transformation in its structure and business environment since the implementation of financial sector reforms in the country.

Instead of relying on traditional approach of looking at the changes in the market structure indicators, we employ widely used Panzar and Rose H statistic (abbreviated PR-H) as a formal test of competition. This statistic is defined as the sum of input price elasticities obtained from an estimated revenue/income equation. If the sum of input price elasticities is less than zero, between 'zero and unity', or equals unity, the underlying structure of the banking sector reflects the characteristics of monopoly, monopolistic or perfectly competitive environment, respectively.

In this study PR-H statistic is estimated by using a balanced panel data comprising 24 commercial banks operating in Pakistan from the year 1996 to 2015. Bank-wise data is compiled from banks' annual audited accounts, and notes attached to them. Total income and interest income functions are estimated by using ordinary least squares and generalized least squares techniques. Cost of funding, cost of labour and cost of capital are used as input prices, and the impact of bank specific characteristics is controlled by including variables like market share, non-performing loans, and share of non-remunerative deposits. Cost of funding and labor is found to be positively associated with income whereas cost of capital is negatively linked with income as expected. It is worth mentioning that we empirically tested the underlying condition (of equilibrium) necessary to ensure the validity of PR-H statistic for analytical discussion and policy prescription.

The empirical results along with formal test of PR-H statistic suggest that banking sector of Pakistan exhibits the characteristics of monopolistic and perfectly competitive market structures, and that the competition has increased after the global financial crisis of 2008. The monopoly structure is out rightly rejected across different specifications of the model for the case of banking market in Pakistan.

1.Introduction

In a bank-dominated financial sector, the role of an efficient and competitive banking system can hardly be over emphasized for a developing country like Pakistan. Banking sector in Pakistan has witnessed significant transformation in its structure and business activities following the financial sector reforms initiated in early 1990s, with an objective to transform repressed financial sector into a competitive, efficient, and sound one, owned and managed largely by the private sector. While the favorable impact of financial sector reforms on the banking structure of Pakistan is widely acknowledged, both the policy makers and researchers seriously question the level of competition and efficiency of the banking sector. Competition Commission of Pakistan has also been critical of competition in banking sector. Have the financial sector reforms, including the most pertinent one – the privatization of government owned banks and the entry of new banks – made the banking sector in Pakistan competitive, is the research question of this study.

Empirical literature on competition can broadly be bifurcated into two categories. The first strand of literature focuses on the market structure of the banking sector in line with the traditional theory of industrial organization: Structure-Conduct-Performance (SCP) paradigm, and Efficient Structure (ES) paradigm. Competing explanations of changes in market structure indicators in the context of both SCP and ES hypotheses suggest that indicators of market structure cannot be unambiguously used for exploring competition in banking sector. Some evidence in favor of ES hypothesis suggests that the market structure is not exogenously determined as envisaged by SCP proponents (Khan and Hanif, 2017).

Developments in information technology, introduction of sophisticated financial instruments for risk sharing and risk transfer, harmonization of financial markets, and wave of mergers and acquisition, have significantly changed dynamics of banking competition in Pakistan (as in the world). Moreover, analysis of banking businesses indicates that both the price and the quality of latest financial services are opaque, which limits the price competition in traditional sense. The effective price of financial products depends on the processing fees, annual charges, renewal fees, etc. These non-interest charges not only vary across banks, but are also difficult to compare. The increasing role of these developments is noticeable from the growing share of non-interest income in total income of the banking system.

It is also important to note that above developments have ambiguous impacts on competition in banking system. On one hand these developments create competition by promoting harmonization and standardization of financial products, while on the other hand these facilitate banks in exercising their market power due to ever increasing difficulty in comparing price and quality of financial services.

The deficiencies with the structural measures of competition and aforementioned developments in the banking sector suggest that it is essential to use formal tests designed to analyze competition in the banking sector. Second strand of literature on the subject suggests to directly study banks' behavior in the context of standard theory of industrial organization [Bikker and Bos (2008), Leon (2014), and Bikker and Leuvensteijn (2015)]. In these setting, this paper employs one of the widely used measure, Panzar-Rose H-statistic (PR-H), to assess the degree of competition in the banking sector of Pakistan over the period of 1996 to 2015 using a panel data of 24 banks operating in Pakistan. This paper essentially updates an almost decade old study on the banking sector competition in Pakistan by Khan (2009). In addition to updating, this study focuses on resolving some definitional issues for the construction of variables, used in empirical estimation, to obtain more reliable results.

The paper is organized into seven sections. Section 1 follows a brief review of literature in the next section. Section 3 elaborates PR-H statistic as a measure of degree of competition, while the data and construction of the relevant variables are the subject of section 4. Descriptive analysis of the data is provided in section 5 followed by estimation and interpretation of empirical results in section 6. The final section concludes the paper.

2. Review of Literature

The concept of competition is as old as the trade history because the economic agents have been competing among themselves to secure benefits from the economic transactions. Specifically, suppliers of goods and services have been competing to sell their products. At micro level, competition forces the producers to manufacture/produce their output at minimum cost, and earn a normal profit. Perfect competition ensures the maximum level of efficiency, and therefore is widely used as a reference to analyze other market structures (like monopoly, monopolistic competition etc.). At the macro level, competition increases social welfare in the economy. Pareto optimality (or efficiency), which is central to economic theory implies that economic resources must be allocated in such a way that no one in the society can be made better-off without making someone worse-off. Unlike the industrial sector, the benefits of higher competition in banking sector are subject to debate due to inherently fragile structure of financial institutions,[1] and banks' role in smooth functioning of payments system [Cetorelli (2001) and Carletti and Hartmann(2002)].

Initial attempts to measure competition primarily focused on the indicators of market structure in the context of SCP paradigm. Most of the studies used US banking data to explore links between market structure and banks' retail rates (price) or profitability, and found evidence consistent with the implications of SCP paradigm [Berger and Hannan (1989), Hannan and Berger (1991), Hannan (1991), and Neumark and Sharpe (1992)]. The findings of these studies were disputed by Berger (1995) as the author could not find conclusive evidence in favor of either SCP or ES paradigm by using estimates of efficiency from the US banking. In case of European banking, Punt and Rooij (1999) empirically tested several hypotheses to explore relationships among concentration, efficiency, profitability and market power by using unbalanced panel data of European banking sector from the year 1992 to 1997. The results indicated the presence of profit-structure relationship in the context of ES paradigm. Cetorelli (2001) also provided a detailed analysis of Herfindahl-Hirschman index (HHI) and highlighted inherent weaknesses in HHI to analyze bank competition.

Problems with the concentration indicators and inconclusive empirical evidence in favor of SCP or ES paradigms shifted the focus of empirical research towards the formal testing of competition. Bikker and Haaf (2002) estimated PR- H statistic for 23 countries by using bank level data for the period 1988 to 1998. The formal tests favored the presence of monopolistic competition in all countries in the sample. The authors further explored competition by classifying all banks in their sample into small, medium and large banks. The results indicated relatively weaker competition among small banks as compared to big banks. Claessens and Laeven (2004) improved upon the work of Bikker and Haaf (2002) by extending the sample size to 50 countries and exploring key potential determinants of competition. The authors used bank level data from the year 1994 to 2001, to estimate PR-H statistic for each country from four different specifications. The results were in favor of monopolistic competition (as the estimated value of PR-H statistic ranged from 0.60 to 0.80).

[1] There is a mismatch between the assets and liabilities of the banks. On the assets side, the loans are of fixed maturity (medium to long term in nature), illiquid (cannot be traded), and non-transparent (loan contracts are borrower specific) assets. On the liabilities side, deposits are redeemable on demand, liquid and short term in nature. This difference, in the nature of loans and deposits, renders banking business inherently fragile.

Bikker et al (2006a) used the longer bank level data from the year 1980 to 2004 to estimate PR-H statistic for 101 countries. The world average of PR-H statistic turned out to be 0.5, while competition in individual countries varied from monopoly to perfect competition over the period of study. Specifically, the authors failed to reject the test of monopoly (value of PR-H statistic is equal to zero) in 29 of 101 countries. Similarly, the authors could not reject the null hypothesis of perfect competition (value of PR-H statistic is equal to 1) in 39 countries. The PR-H statistics for rest of the countries fell in the range of 0 to 1 indicating monopolistic competition. Furthermore, PR-H statistic did not differ systematically for developed and developing countries as these values clustered around the world average.

Bikker and Bos (2008) analyzed temporal changes in banking competition by using a well-specified PR model from Bikker et al. (2006b). The author estimated the PR-H statistics by using data of 25000 banks operating in 120 countries from the year 1986 to 2004. The results suggest that competition has gradually increased over time and the pace of change has varied across regions and some regions witnessed a reduction in competition as well.

In addition to above cross country analysis, a number of studies explored competition in different countries. To name a few, Nathan and Neave (1989) estimated a PR-H statistic for Canada; Vesala (1995) for Finland; Molyneux et al (1996) for Japan; Coccorese (1998) for Italy; Hempell (2002) for Germany; Lee and Lee (2005) for Korea; Prasad and Ghosh (2005) for Indian banking market; and Simatele (2015) for South African banking sector.

As far as literature on banking sector of Pakistan is concerned, Arby (2003) was the first attempt to formally analyze SCP paradigm in case of Pakistan. The author estimated a profit function by using pooled data of 36 banks operating in Pakistan from the year 1990 to 1999. It is interesting to note that the author did not include any indicator of concentration as an explanatory variable in the profit function. Discussion on the structure of banking sector on the basis of inequality indicators like Lorenz curve, Gini coefficient, HHI, and concentration ratios was not linked to the performance of the banking sector. Moreover, these measures of inequality were not evaluated against any accepted bench mark. Yet the author concluded that "even after financial reforms and liberal licensing policy, the industry is still far from the competitive structure". It is apparent that the author was unable to provide a meaningful analysis of SCP in case of Pakistan.

In line with SCP paradigm, State Bank of Pakistan (SBP) has also been analyzing the changes in the market structure of the banking sector in its financial sector assessment reports (for example SBP, 2003). All these studies provide ample evidence of notable changes in the market structure, which are favorable to promote competition. Specifically, concentration in the banking sector (measured by HHI, coefficient of variation, number of banks, M-concentration ratio, Lorenz curve, Gini coefficient etc.) has significantly declined since 1996.

The analysis was further strengthened in SBP (2008) by applying a well-established PR methodology to analyze competition. Using panel data of 26 banks from the year 1997 to 2007, PR-H statistic was estimated to formally measure the degree of market contestability. The results indicated that banking sector of Pakistan reflected the attributes of monopolistic competition over the estimation period. These results reconfirmed the earlier findings of Claessens and Laeven (2004) and Bikker et al (2007) for Pakistan, as a part of their cross-country analysis for understanding determinants of competition, and misspecification of the PR models, respectively.

Taking care of misspecification of PR model as highlighted by Bikker et al. (2007), Khan (2009) focused on measuring competition in Pakistan by using correct specification in line with of Panzar and Rosse (1987). As a first step, Khan (2009) provided a detailed analysis of changes in banking structure of the country over time by using panel data of 26 banks from the year 1996 to 2007. The results were in line with the findings of SBP (2008) as the market structure was found to support the competitive behavior in the context of SCP paradigm. In the second step, the author estimated PR-H statistic to directly test the degree of competition. The results indicated that banking sector in Pakistan depicted the characteristics of monopolistic competition during 1996 to 2007. However, the value of PR-H statistic was higher compared to the value found in Claessens and Laeven (2004) and Bikker et al (2007), reflecting an increase in overall competitive environment. Khan (2009) is, however, almost a decade old study. Mirza et el. (2016) also attempted to assess the level of competition in the banking industry of Pakistan (for the period of 2004-2012) using PR-H statistic (along with some other such measures), but without formally testing the underlying assumptions (like that of long run equilibrium) necessary for using the PR-H statistic.

A lot has changed on the banking front of Pakistan as discussed in Khan and Hanif (2017) during the last decade. It is therefore imperative to have another look at the overall competitive environment of banks in Pakistan. This study fills this gap by providing a formal analysis of competition in the banking sector of Pakistan by preparing and considering the recent most data set.

3. Methodology

In simple terms, the PR-H statistic measures the pass-through of changes in input prices (cost) to firms' (banks) revenues. Panzar and Rosse (1987) developed a framework to test whether the underlying market structure reflects the behavior of monopoly, monopolistic, or perfectly competitive market structure.[2] The authors utilized standard assumption of market equilibrium to derive the revenue equation of a profit maximizing firm (bank, in this study), which helps measure the pass through of changes in input prices to the revenue. A brief discussion of this framework is given below.

Standard theory of equilibrium postulates that a firm (or bank) would maximize its profit when the marginal revenue (MR) of the firm is equal to its marginal cost (MC). At equilibrium, MC depends on the profit maximizing level of output, prices of inputs and some exogenous factors, while the MR depends on the equilibrium level of output and exogenous factors. Panzar and Rosse (1987) pointed out that change in marginal revenues in response to change in marginal cost, to attain new equilibrium level of output, will reflect firm's (bank's) market power (behavior) and the underlying market structure.

The basic idea of PR-H statistic is straight forward. An increase in input prices will increase the marginal cost regardless of the market structure. How much of this increased cost of production could be passed on to customers, will depend on underlying competitive environment. For example, in case of monopoly, the monopolist will increase its product price to achieve new profit maximizing output. The authors proved that at new equilibrium level, output and revenues will decline, and price of output will increase. It implies that an increase in input prices will reduce total revenues of the firm in case of monopoly. Similarly, in a perfectly competitive environment, an increase in marginal cost would lead to an equal increase in marginal revenue, and there will be no change in equilibrium output level. As a result, total revenues will increase. Formally, link between firm (bank) revenues and its input prices is specified as follows:

[2] See also Rosse and Panzar (1977).

$RE = f(IP, Y, X)$

Where RE is the revenues, IP stands for input prices, Y for output, and X represents exogenous factors. The PR-H statistic is defined as follows:

$$PRH = \sum_{i=1}^{k} \frac{\partial RE}{\partial IP_i} * \frac{IP_i}{RE}$$

In simple words, PR-H statistic is the sum of input price elasticities of a revenue equation, which indicates how much revenues will change in response to a one percent change in price of factor inputs. The value of PR-H statistic will help determine the underlying market structure.

Testing perfect competition

In a perfectly competitive environment, a one percent change in cost requires a one percent change in revenue to maintain equilibrium in the market. It means the value of PR-H statistic will be equal to one in case of perfect competition. Statistically, the following hypothesis is tested.

H_0: PRH $= 1$ there is a perfect competition in the banking sector

H_1: PRH $\neq 1$ there is no perfect competition

Testing monopolistic competition

In this case, one percent change in cost requires less than one percent change in revenue to achieve new equilibrium as firms (banks) face a fairly inelastic demand function. Statistically, following hypothesis is tested.

H_0: $0 < PRH < 1$ there is a monopolistic competition in the banking sector

H_1: PRH ≤ 0 or PRH ≥ 1 there is no monopolistic competition

Testing monopoly

As mentioned earlier, overall revenue will reduce in response to an increase in input prices. It implies sum of input price elasticities should be less than zero. Statistically, following hypothesis is tested.

H_0: PRH ≤ 0

H_1: PRH > 0

It is important to note that validity of above testable hypotheses is based on a number of key assumptions. First, it is assumed that firms' (banks') objective is to maximize their profit. Second, it is assumed that both cost and revenue functions follow normal behavior. Finally, firms (banks) are operating at their long run equilibrium level. In practice, first two assumptions generally hold true and do not undermine the analysis. However, third assumption could be restrictive. We will explicitly test this assumption in this study to check the validity of our results. In addition, Bikker et al. (2007) proved that misspecification of revenue equation will also yield biased results. Cognizant of these issues, we followed Bikker et al. (2007) to specify the revenue equation for estimation of PR-H statistic.

$$\mathrm{Ln}(\mathrm{II}_{i,t}) = \beta_0 + \beta_1 \ln(\mathrm{ACF}_{i,t}) + \beta_2 \ln(\mathrm{ACL}_{i,t}) + \beta_3 \ln(\mathrm{ACK}_{i,t}) + \sum_{j=1}^{m} \mathrm{BSF}_{i,t} + \varepsilon_{i,t} \qquad (1)$$

Where $II_{i,t}$ denotes interest income of bank i in time period t, ACF stands for average cost of funding, ACL for average cost of labor, ACK for average cost of capital, and BSF denotes bank specific factors. Finally, $\varepsilon_{i,t}$ denotes the error term.

As evident from banks' balance sheet, non-interest income is also a significant portion of banks' total income. Specifically, non-interest income accounted for 17.5 percent of total income of banks (in Pakistan) as of end December 2015. In literature, this issue is resolved by two ways. First, we may directly replace interest income in above specification with total income. However, this could bias the estimation of PR-H statistic as a fraction of non-interest income comprises of revaluation gains/losses from banks' investments. Secondly, as suggested by Bikker et al. (2007), we may include the ratio of non-interest income to interest income as an explanatory variable in the revenue equation. In fact, simple algebra will show that $\text{Ln}(\text{TI}) = \text{Ln}(\text{II} + \text{OI}) \approx \text{Ln}(\text{II}) + {}^{\text{OI}}/_{\text{II}}$. It implies that use of OI/II as an explanatory variable completes the model. In this study, we will estimate the model by using both these specifications to check consistency across different regressions.

4. Data and Construction of Variables

The above model is estimated by using a balanced panel data comprising 24 commercial banks operating in Pakistan from the year 1996 to 2015. Bank-wise data is compiled from their annual audited accounts and notes attached to them. Although data collection on balance sheets and income statements are straightforward, there is no easy way out to find the prices of inputs in case of banking sector. In practice, banks not only intermediate funds from savers to the investors, but also perform the functions of resource allocation, risk management, funds transfers, and as agents of their clients. Moreover, the complexity of financial products is increasing with the developments taking place in information and communication technologies, and it is becoming difficult to calculate the actual price of a product and the cost of providing that product. Last, but definitely not the least, data on product-wise revenues and the cost of providing that product, is not publically available. Due to above mentioned data limitations, input prices are 'estimated' by using data from banks' balance sheets and income statements. In this study, the 'estimated' input prices are worked out as follows.

Cost of funding

Funding cost of a bank generally includes the profit/interest/markup paid by bank on its deposits and borrowing. Information on interest expenses of a bank during a given year is readily available from the income statement. Following literature on bank competition, average cost of funding is proxied by the ratio of interest paid during the year to average interest bearing liabilities - as an average of bank deposit and borrowing at the beginning and at the end of the year [Claessens and Laeven (2004), Bikker et al. (2007), Gajurel and Pradhan (2012), Khan (2009), Lee and Lee (2005)].

Cost of labor

Unlike average cost of funding, various indicators are used to proxy the cost of labor. For example, Bikker et al. (2007) proxied the unit cost of labor by administrative expenses to total assets and Gajurel and Pradhan (2012) used a ratio of personal expense to total assets. Following Khan (2009), we used bank's expense on salaries, allowance and other personal benefits as a ratio of the number of bank employees. This is a relatively good proxy for average cost of labor as it is the most direct measure.

Cost of capital

Compared to average cost of funding and labor, calculation of average cost of capital is extremely difficult as both the amount of capital utilized and the price of capital are not directly observable from banks' balance sheets and profit & loss accounts. It is generally proxied by a ratio of other expenses to operating fixed assets [Claessens and Laeven (2004), Bikker et al. (2007), and Gajurel and Pradhan(2012)]. Key issue is the unknown nature of other expenses. For example, it could be the fee paid by a bank for using services of another bank, or it could be provision for bad loans, or some other extra ordinary expenditures. Taking the benefit of detailed data, we used a ratio of administrative expenses (net of expense on employees) to average operating fixed assets of bank.

Table 1: Data Description

Name	Unit	Definition
Dependent variables		
II	Million Rupees	Interest income
TI	Million Rupees	Total income
Explanatory variables		
Input variables		
ACL	Million Rupees	Average cost of labor: salaries, allowances and other benefits per employee
ACF	Percent	Average cost of funding: interest expense to average interest bearing liabilities (deposits and borrowings)
ACK	Ratio	Average cost of capital: ratio of other administrative costs (admin cost net of salaries, allowances etc. to employees) to average operating fixed asset.
Bank specific factors		
EQTAR	Ratio	Equity to total asset ratio
EATAR	Ratio	Share of earning assets in total asset
OITII	Percent	Other income to interest income ratio
SNRD	Percent	Share of non-remunerative deposits in total deposits
NIM	Percent	Net interest margin: a ratio of net interest income to average earning assets.
NPL	Percent	Non-performing loans to gross loans ratio
ROA	Percent	Return on average assets - before tax (BT)
MS	Percent	Market share – share of bank assets in total assets of the banking system

In addition to input prices, we also used a number of bank specific variables to account for the differences in composition of banks' assets and liabilities. Table 1 (above) describes the way the variables used in this study are defined/constructed.

5. Descriptive Analysis

Before estimating the model, it is instructive to look at the descriptive statistics of the data. Table 2 indicates huge variation in interest income across banks, which ranges from Rs 2.1 million to Rs 142,478.3 million. This primarily reflects the bank-size and the presence of few really small banks in our data set. It also reflects the need to control for bank-specific factors. Descriptive statistics also indicate that average cost of funding varies from less than one percent to 14.6 percent. It implies that funding structure of banks is substantially different across banks as some of the banks have relatively greater access to low cost funding as compared to others. At one end, we have government owned banks, which have access to government deposits being as an agent of the government, while on the other end we have small private banks, which sometimes have to pay premium to mobilize funds.

Average cost of capital also ranges from almost zero to 15.1 percent, with an average of 1.3 percent. Substantially higher values pertain to foreign banks, especially those operating with few branches. In fact, fixed operating assets of these banks are small, as these are mostly located in rental building. As a result, they generally face higher average cost of capital.

Table 2: Descriptive Statistics

	Maximum	Minimum	Mean	Std. Dev.
TI	175,553.0	2.2	17,835.5	27,374.1
II	142,478.3	2.1	14,913.9	23,019.3
ACF	14.6	0.6	6.2	2.7
ACL	6.7	0.1	0.6	0.6
ACK	15.1	0.0	1.3	1.6
OITTII	328.1	1.4	26.2	27.1
EQTTAR	0.6	-0.2	0.1	0.1
EATTAR	0.9	0.3	0.8	0.1
MS	23.8	0.0	3.8	4.9
NIM	20.1	-4.4	3.7	2.1
ROA-BT	9.4	-19.1	1.3	2.6
SNRD	84.0	0.3	25.6	12.8
NPL	95.5	0.1	13.0	13.8

Average cost of labor also reflects a good deal of variation. Although all banks have access to the same labor market, average expense per employee for public sector banks and big banks substantially differ from those of small foreign banks. In fact, a number of small foreign banks are focused on the corporate sector, which requires well trained staff to cater to the ever-changing financial needs of the corporate sector. As mentioned earlier, this variation in input prices will be managed by introducing bank-specific factors to account for differences in their business strategies, size, capitalization, funding structures etc. Moreover, fixed effects will also be included in the panel data based regression estimation to account for the time invarying factors.

Another aspect that we must consider in the estimation is strong correlations among the explanatory variables, if any. This aspect is analyzed by calculating correlation coefficients among the variables. Table A1 (of Annexure) indicates that maximum pair-wise correlation coefficient among the explanatory variables is negative 0.52. In response to existence of such correlations, we used GLS estimation in this study. It is an appropriate way to take care of the great deal of variation among the banks in the country.

6. Estimation and Results

Testing for equilibrium condition

One of the key assumptions of PR-H statistic is that the market is in its long term equilibrium. This assumption is all the more important in case of Pakistan because we used data of 24 banks operating in Pakistan over the sample period (1996-2015). In other words, this study excluded a number of relatively new banks which entered the banking sector of the country. Theoretically, there should be no entry/exit of banks in/from the system if the banking system is in its long term equilibrium. However, this is unlikely to be the case in practice for any market. In literature, the equilibrium condition is evaluated by exploring links between profitability of a bank and its input prices. In case of long term equilibrium there should be no link between return on assets and input prices.

Specifically, we followed Bikker et al. (2007) and Khan (2009) to test the presence of equilibrium condition in the banking sector of Pakistan and estimated the following regression.

$$\mathrm{Ln}(\mathrm{ROA}_{i,t}) = \beta_0 + \beta_1 \ln(\mathrm{ACF}_{i,t}) + \beta_2 \ln(\mathrm{ACL}_{i,t}) + \beta_3 \ln(\mathrm{ACK}_{i,t}) + \sum_{j=1}^{m} \mathrm{BSF}_{i,t} + \varepsilon_{i,t} \qquad (2)$$

While specification of above equation is exactly the same as equation 1 in the methodology section, interest income has been replaced with return on bank assets and bank specific factors are considered in a manner to ensure selection of a parsimonious model. The equilibrium condition implies that sum of inputs coefficients should be equal to zero. Mathematically, it can be written as follows:

$$\text{Sum of inputs realted coefficients} = \beta_1 + \beta_2 + \beta_3 = 0$$

The above regression is estimated by using the same panel data techniques and pooled results are obtained by using OLS (detailed results in Table A4 of Annexure).[3] The regression has good explanatory powers as more than 50 percent variation in average return on assets is explained by the explanatory variables over the estimation period. The sum of inputs coefficients for both specifications reported in Table 3 indicates that we fail to reject the null hypothesis in both specifications at one percent level of significance.

Table 3: Test of Equilibrium

Dependent variable	Sum of inputs coefficients	F-statistic
Return on assets		
Fixed Effect	0.0244	0.059
Pooled	-0.2947	6.225

Critical values for F-test (1, 353) at 5 % level of significance is 3.868; and 6.707 at 1 percent.

It implies that sum of input elasticities have no statistically significant impact on return on assets. Thus critical condition of long run equilibrium is met and now we can proceed to estimate PR-H statistic.

Results from estimated PR-H statistic

Regression specified in the methodology section is estimated by using GLS techniques to exploit heterogeneity of the panel data.[4] Initial results reported in Table A2 (of Annexure) were obtained by using OLS method. The model explains 92 percent variation in banks' interest income: a reflection of strong explanatory power of the model. Moreover, parameter estimates are in line with our expectations. For example, increase in average cost of funding and labor should be positively associated with interest income, and a rise in cost of capital will negatively impact the interest income. In practice, all banks face the same cost of marginal funding, which is primarily determined by very short term interest rate set by the central bank. An increase or decrease in marginal cost will be partially passed on to the customers, which implies a positive association between cost of funding and interest income of the bank. Similarly, increase in average cost of labor will also be passed on to the customers as upward revision in salary structure or pay packages in one bank are generally followed by the peers, to keep their trained staff motivated and to avoid excessive turnover.

[3] In this log linear specification of the model, the negative or zero values cannot be used in estimation. Given return on assets would be negative for loss making banks, all those observation will automatically be excluded.
[4] For the sake of completion /comparison, results from OLS estimation are also given in the results' tables.

Compared to average cost of funding and labor, increase in average cost of capital is largely a bank-specific phenomenon, which is difficult to pass on to the consumers. Not surprisingly, the magnitude of elasticity is quite low, though statistically significant, over the estimation period.

The most valuable result is sum of input elasticities (PR-H statistic), which is 1.0034 over the estimation period (Table 4). It implies that after controlling for bank-specific factors, a 100 basis points (bps) increase in input prices will lead to almost the same (100.34 bps) increase in interest income. A statistical test of whether banking sector of Pakistan reflects the presence of perfect competition or not (i.e. H_0: PRH=1 and H_1: PRH≠1) indicated that we failed to reject the null of perfect competition. In the next step, we tested whether banking sector of Pakistan exhibits the presence of monopoly structure or not (i.e. H_0: PRH=0 and H_1: PRH≠0). The results indicated the rejection of null hypothesis in favor of alternate hypothesis. The positive value of PR-H statistic close to one along with the rejection of monopoly structure reflects the presence of perfect competition among the banks in Pakistan.

The robustness of this finding is checked by using different specifications of basic equation and panel estimation options. Sensitivity of PR-H statistic in pooled estimation is gauged by replacing the interest income with total income as a dependent variables and excluding non-interest income from the explanatory variables. There is almost no change in PR-H statistic obtained from re-estimated regression. This confirms that the model encompasses banks' businesses, i.e. all banking activities are taking into account.

Table 4: PR–H Statistic of Banks in Pakistan

Dependent variable	PR-H statistic	F-statistic (H_0: PRH=0)	F-statistic (H_0: PRH=1)
Interest income			
Fixed Effect	1.4426	587.98*	55.345*
Pooled	1.0034	222.27*	0.003
Total income			
Fixed Effect	1.3864	782.62*	60.783*
Pooled	0.9886	223.79*	0.03

Critical Values for F-test (1, 408) at 5 % level of significance is 3.864; and 6.697 at 1 percent.

*: statistically significant at 1 percent

Both models for interest income and total income are also estimated by invoking the options of fixed effect for cross-sections and using cross-sectional weights for generalized least square (GLS). The option of White-cross section was used to obtain robust coefficient estimates. While detailed results of these estimations are reported in Table A3 (of Annexure), values of PR-H statistic as tests of market structure are reported in Table 4. The formal test of market structure indicates that the results clearly reject the possibility of monopoly structure over the estimation period. The results also indicate the rejection of perfect competition among the banks. These findings along with positive value of PR H statistic suggest the presence of monopolistic competition among the banks.

An interesting question at this stage is how to interpret the value of PR-H statistic greater than one. Theoretically, it may reflect lack of competition among banks as it suggests that 100 bps increase in input cost would lead to around 140 bps increase in bank revenues (after controlling for bank-specific factors). Essentially it implies that banks were able to pass on the input cost to the customers higher than the required level, which will ultimately contribute to higher profits. This situation is largely akin to the monopolistic competition in the banking sector of Pakistan. In these settings, a comparison with PR-H statistic for Pakistan in literature would be instructive.

Khan (2009) estimated PR-H statistic for Pakistan by using bank-level panel data from the year 1997 to 2007. More recently Mirza et al. (2016) has also estimated the PR-H statistic for banking sector in Pakistan using data from the year 2004 to 2012. While these studies were entirely focused on Pakistan, there are a couple of other studies which included information on banking sector in Pakistan as part of their cross-country analysis. As shown in Table 5, the value of PR-H statistic varies from one study to another, depending on the sample period, specification of the regression, estimation techniques, and the variables used for controlling bank-specific factors. However, despite variation in the value of PR-H statistic across studies and specification, the qualitative results remained unchanged, i.e. banking sector of Pakistan exhibits the market structure of monopolistic competition, which is slightly different from the findings of this study. In this study, the results suggest that banking sector of Pakistan exhibits the characteristics of monopolistic and perfectly competitive market structures.

Table 5: Comparison PR-H statistics of Pakistani Banks

Studies	PR-H statistic	SE (PR-H)	Conclusion
Claessens and Laeven (2004)	0.48		Monopolistic competition
Bikker et al. (2007)			
Specification 1*	0.47	0.261	Reject Monopoly & PC
Specification 2	0.724	0.068	Reject Monopoly & PC
Specification 3	0.734	0.064	Reject Monopoly & PC
Specification 4*	0.457	0.261	Reject Monopoly & PC
Specification 5	0.71	0.074	Reject Monopoly & PC
Specification 6	0.719	0.07	Reject Monopoly & PC
Khan (2009)			
Interest income	0.407		Monopolistic competition
Total income	0.418		Monopolistic competition
Mirza et al. (2016)			
Interest income	0.988		Monopolistic competition
This study			
Interest income	1.0034	0.0673	Perfect competition
Total income	0.9886	0.0661	Perfect competition

*: denotes preferred estimates of H-statistic

Findings this study are expected to differ from the earlier research due to difference in data spans: Khan (2009) is based on panel data of 26 banks ranging from the year 1996 to 2007 only, and Mirza et al. (2016) is based upon 2004 to 2012 data set. The global financial crisis of 2008 has exerted profound impact on the financial industry around the globe. Although banking sector in Pakistan was not directly affected by the global financial crisis due to its limited exposure towards international financial sector, indirect impact was visible from the banking sector.[5] In effect, some of international banks (which were severely impacted by the global crisis) operating in Pakistan revisited their business strategy as part of their crisis management measures. Specifically, some of the foreign banks pulled out their businesses from the banking sector of Pakistan as part of their consolidation strategy (elsewhere). These developments, together with balance of payments situation in Pakistan at that time impacted banking sector of Pakistan. This study takes into account the impact of all the above

[5] Pakistan Stock Exchange (formerly Karachi Stock Exchange) saw a steep fall in 2008, and the index was capped for more than two months. SBP was forced to inject huge liquidity into the banking system to calm down the nervy investors and the depositors.

developments by using the latest data up to the year 2015, the results were expected to differ from the earlier studies.

7. Conclusion

Given the weaknesses of traditional concentration measures as robust indicators of competition in the banking sector, this paper directly analyzes the behavior of banks to understand the level of competition in the banking sector of Pakistan. One of the widely utilized Panzar and Rosse (1987) model is estimated by using panel data of 24 banks from the year 1996 to 2015, to analyze changes in banks' income in response to changes in input prices.

The results indicate that the behavior of banks in Pakistan is in line with the monopolistically and perfectly competitive market environment. These findings broadly remained intact when the model specification was changed to check the robustness of results by replacing interest income with total income as a dependent variable. Similarly, change in estimation methodology from OLS to GSL along with the relevant panel estimation options to deal with inherent problem of heteroskedasticity, lead to hardly any material change in the our findings.

The crucial assumption of long run equilibrium was explicitly tested by estimating a return on assets function. The results indicated that we fail to reject the null hypothesis of equilibrium at 1 percent level of significance. This explicit test of equilibrium condition lent credence to the findings based on the revenue equation that banks' behavior reflected the market characteristics of monopolistic to perfectly competitive environment. Combining the findings of this study with those of Khan (2009), we can infer that competition has increased after the global financial crisis of 2008. For rigorous exploration of how competitive environment of the banking sector in Pakistan has evolved over time, one needs to employ other approaches like Boone Indicator (Boone, 2008) to measure competition.

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Annexure

Table A1: Correlation Coefficients & t-Statistics

Variables	TI	II	ACF	ACL	ACK	OITTII	EQTAR	EATAR	MS	NIM	ROABT	SNRD	NPL
TI	1.000												
II	0.998	1.000											
	341.760												
ACF	-0.230	-0.217	1.000										
	-5.156	-4.869											
ACL	0.088	0.083	-0.127	1.000									
	1.941	1.819	-2.803										
ACK	-0.231	-0.235	0.000	0.329	1.000								
	-5.200	-5.294	0.008	7.616									
OITTII	-0.146	-0.162	-0.295	0.356	0.345	1.000							
	-3.231	-3.589	-6.762	8.319	8.049								
EQTTAR	-0.150	-0.151	-0.018	0.393	0.235	0.278	1.000						
	-3.315	-3.348	-0.392	9.348	5.276	6.318							
EATTAR	0.223	0.225	-0.277	-0.204	-0.347	-0.305	-0.517	1.000					
	4.994	5.054	-6.305	-4.547	-8.098	-6.996	-13.201						
MS	0.640	0.632	-0.275	-0.101	-0.246	-0.098	-0.297	0.120	1.000				
	18.188	17.848	-6.246	-2.218	-5.545	-2.142	-6.807	2.636					
NIM	0.273	0.278	-0.243	0.183	0.088	-0.121	0.078	-0.016	0.184	1.000			
	6.211	6.321	-5.474	4.071	1.933	-2.669	1.702	-0.360	4.093				
ROABT	0.160	0.157	-0.261	0.149	0.064	0.175	0.110	0.085	0.056	0.468	1.000		
	3.553	3.484	-5.917	3.289	1.404	3.887	2.430	1.856	1.229	11.565			
SNRD	0.136	0.133	0.049	-0.040	-0.018	0.079	-0.114	-0.011	0.133	0.112	0.170	1.000	
	2.998	2.934	1.073	-0.879	-0.389	1.728	-2.509	-0.251	2.941	2.468	3.769		
NPL	-0.018	-0.020	0.063	-0.109	-0.098	-0.153	-0.089	-0.012	0.084	-0.192	-0.422	0.141	1.000
	-0.392	-0.447	1.377	-2.403	-2.142	-3.385	-1.957	-0.254	1.851	-4.271	-10.177	3.121	

Table A2: Pooled Estimation of the Model

	Log (Interest income)		**Log (Total income)**	
Variable	**Coefficient**	**t-statistics**	**Coefficient**	**t-statistics**
Intercept	7.1128	37.2586	7.0606	35.0496
Log (ACF)	0.5084	9.445	0.4737	10.2698
Log(ACL)	0.857	20.1496	0.862	20.8236
Log(ACK)	-0.3621	-9.3885	-0.3471	-9.3449
Bank specific variables				
OITII	-0.0047	-4.0462		
Log(ETTAR)	-0.1799	-3.0271	-0.1291	-2.1908
Log(EATTAR)	1.3762	7.6256	1.4004	8.053
Log(NIM)	0.5299	12.3366	0.4903	11.7613
Log(MS)	0.8618	33.3446	0.8645	33.6181
Log(SNRD)			0.1262	3.3679
Adj. R-Square	0.9212		0.9192	
No. of Obs.	440		440	
Years (1997-2015)	19		19	
Cross-sections	24		24	
PR-H statistic	1.0034		0.9886	

Table A3 : Fixed Effect Estimation of the Model

Variable	Log (Interest income)		Log (Total income)	
	Coefficient	t-statistics	Coefficient	t-statistics
Intercept	7.9748	27.9476	7.8633	27.4513
Log (ACF)	0.4946	11.9592	0.429	11.117
Log(ACL)	1.1301	21.1995	1.1216	22.6167
Log(ACK)	-0.1821	-4.5729	-0.1642	-4.4318
Bank Specific Variables				
OITII	-0.0037	-2.391		
Log(ETTAR)	0.1234	1.8654	0.1349	2.254
Log(EATTAR)	0.5048	2.5089	0.6765	3.4696
Log(NIM)	0.3609	3.9334	0.2923	4.1924
Log(MS)	1.0236	24.9126	1.0403	28.259
Log(SNRD)			0.1582	2.5814
Adj. R-Square	0.9665		0.9679	
No. of Obs.	440		440	
Years (1997-2013)	19		19	
Cross-sections	24		24	
PR-H statistic	1.4426		1.3864	

GLS estimation options: fixed effect; cross section weights; and white cross sections for coefficient variance.

Table A4: Log of Return on Assets as Dependent Variables

Variable	Pooled Estimation		Fixed Effect	
	Coefficient	t-statistics	Coefficient	t-statistics
Intercept	0.8736	2.4035	2.0898	9.0762
Log(ACF)	-0.1779	-2.2245	-0.108	-1.8997
Log(ACL)	-0.1578	-2.2314	-0.0751	-1.3534
Log(ACK)	0.0411	0.6781	0.2075	3.522
Control variables				
Log(ETTAR)	0.3171	3.3092	0.6567	8.6024
Log(NIM)	0.8609	8.8421	0.7849	9.2801
Log(EATTAR)	1.0557	3.3273	1.2996	2.7508
Log(SNRD)	-0.0199	-0.2801	-0.1169	-3.3273
Log(NPL)	-0.196	-4.7462	-0.1884	-6.2401
Adj. R-Square	0.2462		0.524	
No. of Obs.	385		385	
Sum of inputs	-0.2947	-2.4951	0.0244	0.2435

GLS estimation options: fixed effect; cross section weights; and white cross sections for coefficient variance.