Journal of Money and Economy
Vol. 14, No. 1, Winter 2019
pp. 1-25

Profit Rate Stickiness and Bank Specific Characteristics: Empirical Study of Panel Hidden Cointegration

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Received: 27 May 2019 Approved: 24 Jul 2019

Profit rate stickiness means the asymmetric behavior of the banking profit rate for positive and negative shocks. Scrutinizing this behavior would suggest a new perspective on policy tools and banking supervision. In this regard, this paper applies hidden panel cointegration, proposed by Hatemi-J (2018), to study profit rate and bank-specific characteristics nexus for all banks listed on Tehran Stock Exchange [TSE] during 2008-2017. This approach, in addition to analyzing the long-term relationship between variables, has another important capability for modeling asymmetry between variables. It has been shown that there is a long-run non-linear relationship between cumulative positive and negative components of variables. Then, asymmetric relationships are measured by using Panel DOLS. The results indicate that the leading causes of profit rate asymmetry are liquidity and credit risks, and there is a downward direction of profit rate stickiness. Finally, the SCP paradigm is well-supported in Iran's banking system. It seems the Central Bank of Iran [CBI] needs to be mindful of the anticompetitive effects of bank mergers firstly; and secondly, require banks to meet more stringent liquidity requirements and force them to stop roll over defaulted loans into new loans to increase the quality of banks' assets.

Keywords: Banking Profit Rate, Asymmetric Behavior, Market Concentration.
JEL Classification: D40, E40, L11

1 Introduction

A sound banking system is regarded as the backbone of any economy, and it is more important in countries with underdeveloped capital markets. In Iran's economy, banking is of extraordinary importance because the share of the banking sector in financing various economic sectors is approximately 83%

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(CBI, 2017). Despite disinflation in 2015, real profit rates[1] experienced the highest historical levels in the pre and post-revolutionary periods (Komeijani, Zamanzadeh, & Bahador, 2016). The banking profit rate is one of the key macroeconomic variables in each country's economy so that it is closely related to the real sector and the monetary and financial sectors of the economy.

Real profit rates affect both the demand and supply sides of the economy. On the demand side, firstly, a high-profit rate in the banking sector would postpone the current consumption of the private sector. It influences consumption-saving decisions so that positive changes in profit rates entice consumers to increase saving in the form of a bank deposit and benefit from its higher rates of return, higher levels of consumption, and, consequently greater prosperity in the future. Secondly, the profit rate as the cost of investment is one of the most important determinants of return on investment. High-profit rates do not merely justify many investment projects and reduce aggregate demand in the economy. Thus, they exacerbate the phenomenon of recession due to postponing consumption and investment demand.

On the supply side, the cost of capital, as an input, will be costly subject to high-profit rates. Thus, high-profit rates increase the variable cost of the firms and, consequently; reduce aggregate supply as well as impeding the formation of new production capacities.

Additionally, high-profit rates also have harmful effects on corporate balance sheets. In current economic stagnation, many of the firms are facing a drop in demand for their products, and high-profit rates make their debts expensive.

In a broader scope, high-profit rates affect the balance sheets of banks too (due to the default of borrowers increase), which leads to unbalanced cash flow and reduction in banks' profitability. Hence, in the current situation, banks' assets are rising as fictitious assets owing to increased non-performing loans (NPLs) and poor asset quality and debts are continually growing in the form of new deposits for offsetting liquidity deficiencies. Financial soundness indicators (FSIs) of Iranian banks reflect low banks' resilience to different shocks pertain to a lack of liquidity, inadequate capital, striking NPLs, massive participation in investment activities, and claims on government. It

[1] Islamic banking avoids interest-based transactions (Riba), and is based on profit and loss mechanism. In place of interest rate in conventional banking, a profit rate is defined in the contract (profit rate for deposits and loans).

means the unbalanced balance sheet of the banking system, and it is often followed by a banking crisis.

To prevent banks from falling victim to their high-risk strategies, we need to be more skeptical about high-profit rates. The aforementioned influences shed light on the determinant role of bank rates in economic performance and raise important questions about the underlying factors of profit rates — large theoretical literature examining the effects of market structure on profit rate. Price-concentration studies in banking typically find a significant and negative relationship between deposit rates and market concentration. Meanwhile, bank risk-taking behavior and deposit rates relationship are still questionable. One of the most significant disadvantages of previous studies is the omission of bank-specific variables which may systematically affect the demand for deposits. These studies have focused exclusively on supply-side variables when estimating the reduced form price-concentration relationship. Several variables may affect a bank's need for deposits and, thus its deposit rate. One important variable is the cross-sectional riskiness of the individual banks being analyzed. Repullo (2004), Boyd and De Nicoloí (2005), Brewer and Jackson (2006), Giovanni, Laeven & Marquez (2014), Holton and Rodriguez (2018) have focused on how bank risk-taking increases competition for deposits (i.e., higher deposit rates). After all, there is an important question as to whether profit rate adjustment is symmetric, or asymmetric? Aiming to answer these questions in Iran's banking system, first, bank-

Specific characteristics are included in profit rate-concentration analysis, and then we will specify an appropriate technique to find profit rates symmetry to differences across these characteristics. This study attempts to apply the recently introduced hidden cointegration method within a panel framework. Besides, the empirical research develops a microeconomic analysis of deposit rate stickiness and uses bank-level data, quoted every month by individual Iranian banks that represent over 75% of Iran's banking industry.

The paper is structured as follows. Section 2 presents the conceptual theories of profit rate stickiness. In section 3, the stylized facts of Iran's banking sector for 2008-2017 will be discussed. In section 4, we present the data and methodology used in this study; section 5 contains the empirical results; finally, in section 6 we discuss our findings.

2 Theoretical Foundations

In general, real price rigidity (stickiness) is the resistance of price(s) to change quickly (Kehoe, P., & Midrigan, V., 2016). In banking industry, we can refer profit rate rigidity concept to three possible definitions; a) bank rates

inelasticity with respect to shifts in demand (supply) for bank loans (deposits), b) small bank rates changes in response to money market rates variation, c) inflexible bank rates despite changing costs of funding. In this article, we base our analysis on the first definition.

Given the direct effects of banking rates on all economic agencies, economists are increasingly studying possible explanations for banks' retail rates stickiness. Furthermore, Lowe and Rohling (2001) believed that many of the statements advanced to explain price stickiness in goods markets are also applicable to financial markets. These theories are discussed in the next section.

2.1 Industrial Organization Theories

Industrial organization (IO) theory is concerned with market structure and emphasizes the role of competitive barriers created by State or companies' strategies. This theory comprises of traditional and new IO approaches.

In the first approach, Bain (1956) formed the structure-conduct-performance (SCP) paradigm to interpret the correlation between market structure and market performance. His paradigm was heavily influenced by the analytical framework of structuralism school in which firms' decision making about coalitions is affected by market structure, and then the conduct of firms will shape the market performance that is reflected in price, efficiency, innovation, profitability, and output. From this point of view, the more concentrated the industry, the more undesirable the cost for consumers. Bain established the direction of causality runs from market structure to market performances.

There is another competing hypothesis to analyze market power effects, namely an efficient structure (ES) hypothesis. This paradigm is epitomized by the tradition of Chicago School. This hypothesis stipulates that a firm, which operates efficiently, will gain higher profits resulting from low operational costs. The same firm obtains greater market share. Consequently, differences at the level of efficiency create an unequal distribution of positions within the market, so efficiency determines market structure and performance (Grullon, Larkin, & Michaely, 2019). The new IO accentuates the necessity to endogenize market structure (Uzunidis, 2016) and considers extra profits as an economic return not a return to collusive activities (Demsetz, 1973; Peltzman, 1977; Smirlock, 1985; Chortareas, Garcia, & Girardone, 2009; Seelanatha, 2010).

In the 1950s and 1960s, significant mergers of banks in the US increased fears of high concentration and monopoly emergence in the banking industry

(Shaffer, 2004). Based on the SCP paradigm, high concentration results in high bank profitability, i.e., low deposit rates and high loan rates for consumers. While according to the ES model, large banks operate more efficiently; the deposit rates will be high and favorable for customers. In summary, the concentration and the deposit rates are positively related while according to the SCP paradigm, negatively related. Now the question arises: to what extent do banking interest rates respond to bank concentration?

Hannan and Berger (1991), Ausubel (1991), and Calem and Mester (1995) were the pioneers of research in the banking industry in the US. Several significant papers have tested the relationship between market concentration, banks characteristics and interest rates (Hoffman and Mizen, 2004; Gambacorta, 2008; De Graeve et al., 2004; González & Fumás, 2005; Begoev and Petrevski, 2012; Holton and Rodriguez, 2018) and emphasize loan and deposit rates stickiness in different European countries as well as the US (Sastre, 1997; Scholnick, 1999; Barreira et al., 1999; Hannan and Liang, 1993 Sellon, 2002; Berstein and Fuentes, 2003; Cottarelli and Kourelis, 1994; Guntner, 2010). They found interest rate stickiness hinges on market power, and the role of bank characteristics is remarkable.

2.2 Moral Hazard, Adverse Selection, and Credit Rationing Theory

This theory refers to loan interest rates. In financial markets, moral hazard and adverse selection are severe problems and occur when the information between two parties is not equally distributed (asymmetric information). Banks cannot realize the default risk of a project, but the borrower is supposed to have complete information about it. On the other hand, banks are reluctant to increase loan rates proportionately, even if the costs of the funding increase, because if they do so, all investors with the safest projects withdraw from the market, and only risky borrowers remain. In this way, the combination of credit applicants alters adversely (adverse selection).

Moreover, Blundell-Wignall and Gizycki (1992) point out that default on loans is affected by interest rates and economic conditions so that default risk can occur as a result of high loan rates. Taking these considerations together, banks have a preference to price their loan rates differently from the market-clearing rates in order not to experience default risk (Stiglitz and Weiss, 1981). The bank behavior is called credit rationing. It displays upward loan rates stickiness (Keizer, 2015).

2.3 Adjustment Costs and Customer Reaction Theory

"Menu costs are usually taken to include the costs of changing and circulating new price lists, printing, advertising, administrative costs and communicating the change to other branches" (Rotemberg and Saloner,1987). In the banking industry, costs of changing interest rates comprise other adjustment costs too (in the form of adverse selection costs or customer reaction in the deposit market). The latter theory points to banks' loss from disgruntled customers (Scholnick, 1999). A profit-maximizing bank internalizes these adjustment costs. If the cost of maintaining a disequilibrium interest rate exceeds adjustment costs, a rational bank decides to adjust its rate.

2.4 Switching Cost Theory

According to this theory, loan interest rates are sticky downward. To mitigate the risk of lending, banks need to perform a credit analysis on each loan request to assess a borrower's capacity to repay. In the same way, if the borrower prefers to switch from one bank to another, they attempt to locate banks offering favorable terms, better rates for loans, and filling out various applications. These are complicated and time-consuming, so both banks and customers incur different costs. These costs are named switching costs. In the banking sector, switching costs are passed onto customers as several fees. Thus, customers are reluctant to find better rates and prefer to stick to their existing banks (Cornel, 2008). In this regard, Klemperer (1987) argued that the elasticity of loan demand would decrease in case of switching costs. In our opinion, the same is true of the deposit market[1], which leads to upward sticky deposit rates.

2.5 Risk Sharing Theory

This theory is inspired by insurance contracts in which a risk-averse individual pays to avoid risk. In the banking sector, Fried and Howitt (1980) modeled this behavior using the idea of the labor market introduced by Azariadis (1976). In their model, the risk is inevitable, so both banks and borrowers share the risks by issuing implicit contracts so that a risk-averse borrower prefers to pay interest rates which are less-variant to the marginal cost of funds. In this way, the bank requires a higher average rate to compensate for

[1] Switching costs in deposit market exist too, for example there are penalties in form of transforming time investment deposit rate into a daily deposit rate in Iran in case of transferring deposit from one bank to another.

the additional risk. Therefore, interest rate stickiness depends on the client's risk perception about the bank's decision, and vice versa.

2.6 Reverse Adverse Selection Theory (Consumer Irrationality)

Ausubel (1991) suggested a new theory about reverse adverse selection, which relies on consumer irrationality. His theory is the opposite of what Stiglitz and Weiss called adverse selection theory (1981).

He believes that consumer irrationality is the main reason for the downward loan rate stickiness, not switching or search costs. He assumes there are two categories of customers: a) customers are not going to borrow on costly mediums (i.e., credit cards) but sometimes use them to repay their commitments. Since they do not have any plans for a new loan, they are irresponsive to interest rate changes by other banks. From the bank's viewpoint, customers in the first category are the best customers because of their loyalty as well as their timely repayment.

The second category of customers borrows entirely on credit cards for the reason that they cannot borrow on different alternatives because of their low credit scores. Customers in the second category are the bad customers owing to a high level of default risk and their exceptional sensitivity to tiny changes in loan rates from the bank's viewpoint. Such reasoning explains for consumer's irrationality and makes banks skeptical about interest rate changes. In other words, a lower price in the credit card rates has a significant appeal for the second class of customers who have payment difficulties. As a result, credit card rates are likely to be sticky in a downward direction versus adverse selection theory.

To sum up, search costs, switching costs, and adverse selection problems may cause deviations from perfect competition, which results in sticky behavior of interest rates (Calem and Mester, 1995). This article aims to focus on the reasons for the existence of deposit rate stickiness for banks' specific characteristics and market structure.

3 Stylized Facts of Iran's Banking Sector for 2008-2017

– Correlation analysis between profit rates for deposit and loan

One of Iran's banking system features is the determination of profit or expected rates of return on loans at the discretion of the Currency and Credit Council. This statutory determination of the profit rates has received a lot of criticism. Some argue since banks are not able to set prices in a free market, the prices are not in equilibrium levels, so profit rates do not experience fluctuations in response to monetary shocks, economic conditions, etc.

Finally, they conclude that no research on profit rate behavior can work properly.

It should be noted that, firstly, profit rate determination is not to be the responsibility of the Council, but specific economic conditions push the Council into doing it. Of course, the Council sets the maximum deposit rate and lending rate as a means of economic intervention, but it cannot hinder profit rates from being placed endogenously because the council only decides on specific deposits and loans like transactional contracts. Secondly, the money market shows that commercial banks do not obey regulations precisely because of weak supervision of CBI. This finding reflects the significant variation in bank profit rates. Thirdly, profit rate determination does not mean that the profit rate channel of monetary policy cannot work. Hence, it exists along with the terms and conditions of credit sale agreements, rental agreements, etc. Thus, understanding profit rate volatility is of great importance for policymakers and economists. The average banking profit rates (term investment deposit rates and lending profit rates) are presented in Figure (1). By examining profit rates for loans and deposits in 21 banks over a decade, we conclude that the loan profit rate follows the deposit profit rate closely, i.e., any rise in deposit rate increases the cost of funds, and the bank has to increase loan rate inevitably to cover the cost. It accords well with the conventional banking model, which is based on the provision of resources from the deposit market and then spent on the loan market at the cost of funds plus a profit margin (Salman and Nawaz, 2018). Therefore, the study of profit rate for deposits will clarify loan profit rate movements much. For this reason, in our paper, we focus on the deposit rate solely, and the profit rate refers to the profit rate for deposits afterward.

Saderat, Dey, Mehr-e-Eghtesad, and Sarmayeh have made a considerable investment in recent years. The important thing is that, as well as massive investment, some of these banks' capital bases have been negative, indicating the inability of banks to handle insolvency risks. It happened to Sarmayeh (in three consecutive years 2015-2017), Dey, Post-bank, and Saderat (in 2016 and 2017), Tejarat and Gardeshgari (in 2017).

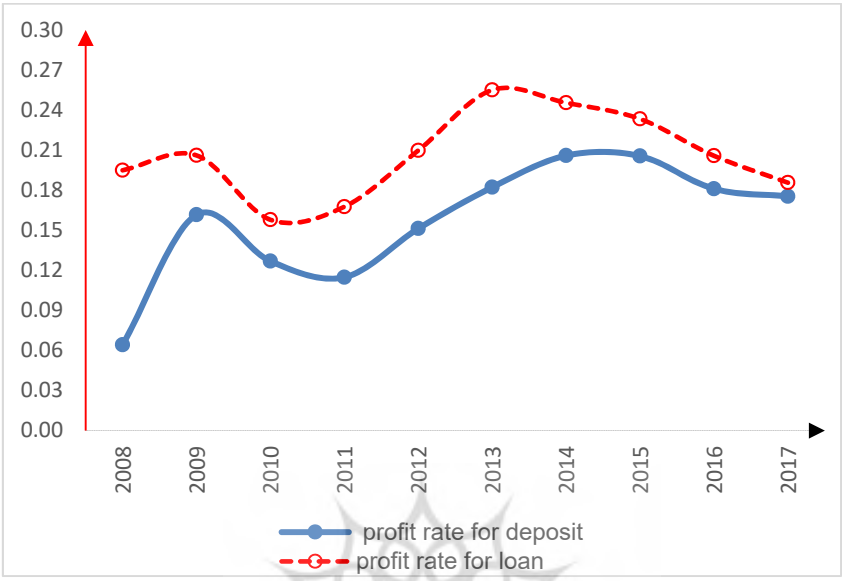

Figure 1. Average Profit Rates for Deposit and Loan in the Banking System, 2008-2017. Source: Audited banks' financial statements.

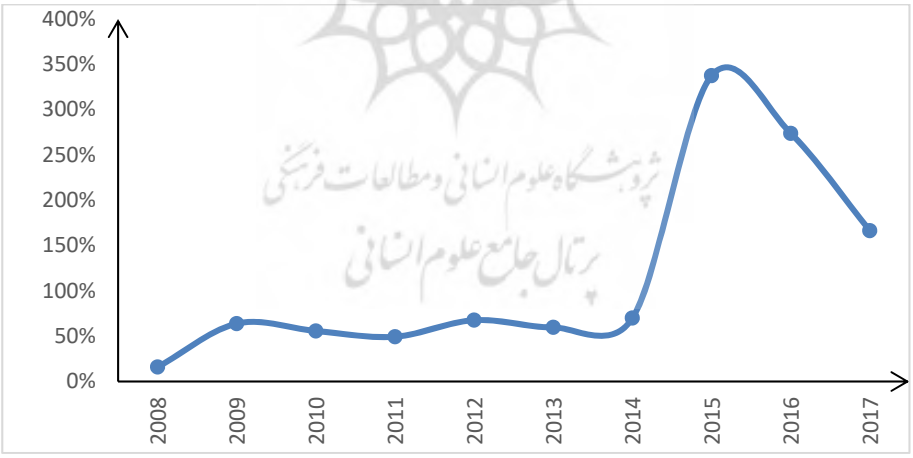

Figure 2. Average investment to the base capital ratio in 21 Iran's banks listed on TSE. *Source:* Audited banks' financial statements

Table 1
NPLs and claims on government ratio (%) in 21 Iran's banks listed on TSE, 2008-2017

Bank	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Sina	...	25.3	19.3	19.9	22.2	16.4	13.4	13.9	10.8	30.3
Parsian	...	36.8	33.1	30.5	29.3	36.1	42.3	42.9	35.9	35.6
Pasargad	...	11.8	8.30	6.60	6.70	6.80	6.40	6.50	5.50	5.1
Ayandeh	...	...	3.20	7.80	9.90	8.00	4.50	3.00	5.00	4.0
Ansar	...	...	9.30	5.10	4.10	2.80	3.60	5.60	6.90	14.1
Ghavamin[1]	...	0.00	0.00	0.00	0.70	1.70	1.70	2.10	...	...
Shahr[2]	...	20.40	9.60	8.10	5.20	4.50	7.20	6.10	8.20	...
Hekmat	...	...	0.00	0.00	0.30	2.80	6.10	3.50	4.30	12.4
Iran-Zamin	...	...	0.00	0.00	0.70	7.30	10	15.2	32.4	24.8
Sarmayeh	...	33.10	31.40	37.40	26.00	34.80	50.00	36.60	82.00	116.2
Mellat	...	15.90	9.70	11.80	10.00	8.10	7.30	5.90	6.20	6.0
Saderat	...	73.70	21.60	12.70	11.30	9.00	8.60	5.50	19.90	20.6
Dey	...	...	0.00	6.90	2.90	3.90	13.00	9.60	23.40	50.3
Post-bank	...	...	11.40	31.20	31.80	23.10	20.90	19.30	17.30	20.6
Eghtesad-Novin	...	23.20	32.40	25.70	19.80	18.80	17.00	18.90	22.90	26.2
Gardeshgari	...	...	...	1.50	14.10	15.20	4.50	6.50	25.50	26.1
Khavarmianeh	...	...	...	...	0.00	0.00	2.50	4.80	5.80	5.1
MehrEghtesad	...	...	...	...	...	...	2.70	3.40	0.70	2.2
Saman	22.00	24.40	25.60	44.10	41.90	37.80	30.20	24.40	20.00	21.7
Tejarat	...	40.60	16.60	19.40	16.20	19.30	19.10	16.00	18.10	18.1
Karafarin	...	23.70	19.30	19.90	22.20	16.40	13.40	13.90	10.80	30.3

note. Concerning the NPLs' data, it should be noted that banks can roll over defaulted loans into a new loan. Employing complicated accounting tricks, the amount of NPLs is less than the original amount, and this enhances toxic assets, which make up a significant proportion of banks' assets in reality. It is some fictitious asset and will allow banks to realize a profit for these non-profitable loans and pay dividends to shareholders. Bank's investment: Another characteristic is significant investments in subsidiaries, fixed assets, stock, etc. Banks are inclined to establish their own companies to reduce moral hazards. Although it sometimes refers to fraudulent transactions and investment in fake companies to hide the problems. According to CBI's new directive on investment (2017), bank participation in investment activities is subject to a limit of 20 percent of the bank's base capital. Otherwise, a predetermined penalty is employed. Since 2013, all banks have breached CBI prudential exposure limits; as even some of them have invested 11 to 40 times their base capital. *Source:* Audited banks' financial statements

Price war on profit rates: Due to toxic assets and substantial investment in fixed assets, banks attract new deposits by offering high-profit rates to address deficiencies in their liquidity. Meanwhile, the presence of unregulated credit institutions (Moasesat-e-E'tebari[3]) makes the competition more complicated. These institutions trigger a price war on profit rates and promise higher returns to depositors.

Introduction of Islamic treasury bills in the financial market: Accumulation of government and state-owned companies' debts is another

problem in the economy of Iran. In recent years, oil sanctions besides the shrinking economy make the government incapable of repaying its debts. As a result, the government has decided to issue T-bills since 2015, so T-bills compete with deposits, and the noticeable yield on T-bills puts upward pressure on profit rates.

Capital adequacy ratio (CAR): Another severe problem refers to alarming statistics about CAR. A large segment of the banking sector operated with insufficient capital as the average ratio has reached an unprecedented level in 2017 (lower than 1%), which is far below the minimum capital requirement for all banks (8%). Indeed, Sarmayeh, Dey, Saderat, Post-Bank, Tejarat, and Gardeshgari have shown the lowest ratio as well as the negative value of net capital in 2017.

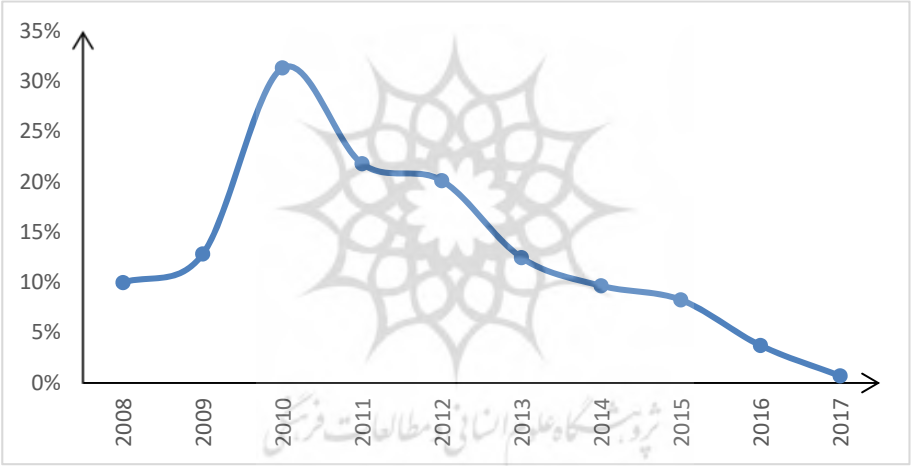

Figure 3. Average Capital Adequacy Ratio in 21 Iran's Banks Listed on TSE. *Source*: Audited banks' financial statements

Liquidity deficit: The ability of banks to attract deposits by raising profit rates causes the banks' liabilities to increase. Paying higher profit rates exacerbate cash flow problems. The higher cost of funds increase the profit rate for loans too and create fictitious assets as a result of NPLs growth. Further, significant investments hinder banks from meeting sudden needs for

[1] Ghavamin Bank did not issue a financial statement for the fiscal years, 2016 and 2017.
[2] Shahr Bank did not issue a financial statement for the fiscal year, 2017.
[3] The last year of the unregulated credit institutions' activity dates back to 2017.

cash. Figure (4) illustrates the correlation between profit rates and banks' liquidity. As high-liquid assets decrease, liquidity risk increases prominently, and banks begin to offer higher profit rates accordingly. High-profit rates aggravated the problems and made the debt settlement more complicated, and again the same story continues. While these cases are highly informative, a close inspection brings out powerful insight into the imbalance of balance sheets. Hence, banks are caught in a vicious circle.

This paper focuses on profit rate asymmetries coming from the selected financial soundness indicators (NPLs and claims on the government, investment, credit, and liquidity positions) of banks listed on TSE as well as market concentration. Next, we develop an econometric relationship and show that there is significant asymmetry in the behavior of the profit rate variable.

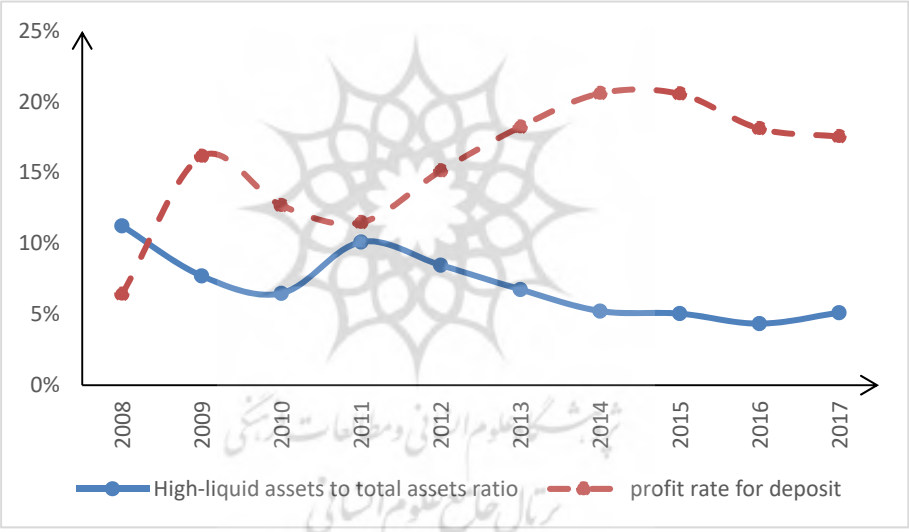

Figure 4. Average Profit Rates and High-Liquid Assets Ratio in the Banking System, 2008-2017. *Source:* Audited banks' financial statements

4 Data and Methodology

To investigate the effects of bank-specific characteristics and market concentration on profit rates, we extract data from audited financial statements provided by TSE during 2008-2017. The standard approach in banking rate stickiness literature is an error correction framework, but we treat the stickiness differently. If there is nonlinear cointegration between variables, it gives rise to some degree of price stickiness. Granger and Yoon (2002)

introduced the concept of hidden cointegration. Hidden cointegration is an example of nonlinear cointegration that ordinary linear cointegration fails to identify (Koutroulis, Panagopoulos, and Tsouma, 2016). One of the advantages of this approach over the standard cointegration is the investigation of all possible combinations of cointegration between data components. The data components are cumulative positive and negative changes in variables.

In particular, as long as research concerns a price variable, it reveals the asymmetric response of price to various positive and negative shocks. For the first time, Hatemi (2018) extended the concept of hidden cointegration to panel data analysis to study the impact of contractionary as well as the expansionary fiscal policy on the economic performance in a panel consisting of Denmark, Norway, and Sweden. This approach differentiates between upward and downward trending variables. In this paper, we illustrate the applicability of this new methodology in profit rate stickiness.

Consider the following two variables that are integrated of the first degree, with the resultant solution for each that is found by the recursive approach:

$$Y_{i,t}= Y_{i,t-1}+ e_{i1,t}= Y_{i,0}+ \sum_{j=1}^{t} e_{i1,j} \quad (1)$$

$$X_{i,t}= X_{i,t-1}+ e_{i2,t}= X_{i,0}+ \sum_{j=1}^{t} e_{i2,j} \quad (2)$$

For i=1, 2, …, m. Where m signifies the cross-sectional dimension, and e is a disturbance term that is assumed to be a white noise process. The positive and negative shocks for each panel variable are defined as

$$e_{i1,t}^{+}= \max \{e_{i1,t}, 0\} \quad (3)$$

$$e_{i1,t}^{-}= \min \{e_{i1,t}, 0\} \quad (4)$$

$$e_{i2,t}^{+}= \max \{e_{i2,t}, 0\} \quad (5)$$

$$e_{i2,t}^{-}= \max \{e_{i2,t}, 0\} \quad (6)$$

Using these results, the following expressions can be obtained:

$$Y_{i,t}^{+}= Y_{i,0}^{+}+e_{i1,t}^{+}= Y_{i,0}+ \sum_{j=1}^{t} e_{i1,t}^{+} \quad (7)$$

$$X_{i,t}^{+}= X_{i,0}^{+} + e_{i2,t}^{+} = X_{i,0}+ \sum_{j=1}^{t} e_{i2,t}^{+} \quad (8)$$

$$Y_{i,t}^{-}= Y_{i,0}^{-}+e_{i1,t}^{-}= Y_{i,0}+ \sum_{j=1}^{t} e_{i1,t}^{-} \quad (9)$$

$$X_{i,t}^{-}= X_{i,0}^{-} + e_{i2,t}^{-} = X_{i,0}+ \sum_{j=1}^{t} e_{i2,t}^{-} \quad (10)$$

Assume that our dependent variable is y, and then the two potential panel cointegration equations for the components can be defined as

$$Y_{i,t}^{+} = \alpha_i^{+} + \beta_i^{+} X_{i,t}^{+} + e_{i,t}^{+} \quad (11)$$
$$Y_{i,t}^{-} = \alpha_i^{-} + \beta_i^{-} X_{i,t}^{-} + e_{i,t}^{-} \quad (12)$$

The positive cumulative shocks are cointegrated in the panel if $e_{i,t}^{+}$ is stationary. Likewise, the negative cumulative shocks are cointegrated in the panel if $e_{i,t}^{-}$ is stationary. If cointegration is found, the parameters in Eqs. (11) and (12) can be estimated by the least-squares method or any other more efficient approach (Hatemi, 2018; Alexakis, Dasilas, and Grose, 2013).

5 Estimation Results

The suggested test for hidden panel cointegration is applied to investigating the asymmetric effects of bank characteristics on profit rates in 21 banks listed on TSE. Bank-level data is used during the period 2008/04 to 2017/03(1775 observations), and the source of data is the Independent Auditor's Reports on Financial Statements. To capture real effects, the variables are expressed at constant prices. The cumulative sums of positive and negative components were constructed based on the procedure presented in the previous section. The models are as follows:

$$lRDr_{i,t}^{+} = \alpha_i^{+} + \beta_i^{+} HHI_t^{+} + \gamma_i^{+} (HHI_t^{+})^2 + \delta_i^{+} CR_{i,t}^{+} + \theta_i^{+} LR_{i,t}^{+} + \zeta_i^{+} INV_{i,t}^{+} + e_{i,t}^{+} \quad (13)$$
$$lRDr_{i,t}^{-} = \alpha_i^{-} + \beta_i^{-} HHI_t^{-} + \gamma_i^{-} (HHI_t^{-})^2 + \delta_i^{-} CR_{i,t}^{-} + \theta_i^{-} LR_{i,t}^{-} + \zeta_i^{-} INV_{i,t}^{-} + e_{i,t}^{-} \quad (14)$$

The variables have the definitions reported in table 2.

Prior to testing for panel cointegration, panel unit root tests were implemented by using Levin, Lin & Chu (LLC), Augmented Dickey-Fuller Fisher, and Phillips-Perron Fisher unit root tests. The results are reported in Table 3.

Table 2
Variable Definitions (Bank-Time Level)

Variable	Definition	abb.	definition
Profit rate for deposit	$DR_{i,t}$=Profit rate for bank i in period t = $\frac{(\text{Profit rate expenses on term investment deposits})_{i,t}}{\frac{1}{2}(\text{time investment deposits}_{i,t-1}+\text{time investment deposits}_{i,t})}$ *RDr= real deposit profit rate	$lRDr^{+}_{i,t}$	the cumulative sum of positive components of the logarithmic transformation of RDr_{it}
		$lRDr^{-}_{i,t}$	the cumulative sum of negative components of the logarithmic transformation of RDr_{it}
Market power of bank	HHI_t=Herfindahl-Hirschman Index= $\sum_{i=1}^{21} MS_i^2.100$ $*\ MS_i$= Asset market share for bank i in period t	HHI^{+}_{t}	The Cumulative sum of positive components of HHI_t
		HHI^{-}_{t}	The cumulative sum of negative components of HHI_t
Bank credit risk	$CR_{i,t=}$ NPL ratio for bank i in period t = $\frac{(\text{Nonperforming loans+claims on government})_{it}}{(\text{total loans})_{it}}$ *Loans= Total Installment sales, Ju'alah, Mozarebeh, Mosharekat Madani (civil partnership contracts), Debt purchase, Murabaha, Gharz-al-Hasaneh(interest-free) loan, Debtors for paid LCs, Debtors for paid guarantee.	$CR^{+}_{i,t}$	The cumulative sum of positive components of CR_{it}
		$CR^{-}_{i,t}$	The cumulative sum of negative components of CR_{it}
Bank liquidity position	$LR_{i,t}$= high liquid asset ratio for bank i in period t[1] = $\frac{(\text{assets that can be coverted into cash within 24 hours})_{it}}{(\text{total assets})_{it}}$	$LR^{+}_{i,t}$	The cumulative sum of positive components of LR_{it}
		$LR^{-}_{i,t}$	The cumulative sum of negative components of LR_{it}
bank participation in investment activities	INV ratio for bank i in period t = $\frac{\text{Total Investment}_{it}}{\frac{1}{2}(\text{base capital}_{i,t-1}+\text{base capital}_{it})}$ * Total Investment= Investment in subsidiaries+ Investment in associates+ Other long term investments+ Investment in listed and unlisted share	$INV^{+}_{i,t}$	The cumulative sum of positive components of INV_{it}
		$INV^{-}_{i,t}$	The cumulative sum of negative components of INV_{it}

note. High-liquid assets are as follows: sum of cash, current account with CBI (Rial and foreign currency), current account with foreign Central Banks, current account with international banks, current account with local banks, demand deposits with local banks and non-bank credit institutions, demand deposits with foreign banks, check clearing with Chakavak[2] system, claims on other banks due to bulk payment system (Paya[3]) and Shetab[4] transactions, investment in treasury bills, CBI securities and government bonds.

[1] According to some research high liquid assets ratio is an indicator of liquidity risk. If banks hold enough high liquid assets, they are not exposed to liquidity risk.
[2] The infrastructure of systematic and electronic processing of checks and other banking documents.
[3] Automated clearing system for individual and multiple payment orders, together with SATNA and SAHAB.
[4] Interbank Information Transfer Network.

Table 3
The Results of Panel Unit Root Tests

variables	F-PP	F-ADF	LLC
$lRDr^{+}$	5.04	10.12	2.04
$\Delta lRDr^{+}$	628.91^{***}	271.89^{***}	-13.80^{***}
$lRDr^{-}$	4.82	10.31	1.73
$\Delta lRDr^{-}$	223.04^{***}	186.21^{***}	-10.86^{***}
HHI^{+}	3.53	6.47	1.11
ΔHHI^{+}	412.82^{***}	199.15^{***}	-6.83^{***}
HHI^{-}	1.45	3.24	1.24
ΔHHI^{-}	478.49^{***}	260.47^{***}	-7.66^{***}
CR^{+}	5.92	14.43	2.17
ΔCR^{+}	331.07^{***}	160.25^{***}	-6.03^{***}
CR^{-}	4.20	12.13	2.50
ΔCR^{-}	500.81^{***}	242.67^{***}	-10.21^{***}
LR^{+}	4.96	7.96	0.84
ΔLR^{+}	402.32^{***}	189.09^{***}	-6.75^{***}
LR^{-}	6.97	11.68	1.46
ΔLR^{-}	474.85^{***}	238.61^{***}	-12.26^{***}
INV^{+}	7.03	11.01	3.87
ΔINV^{+}	530.95^{***}	248.93^{***}	-10.61^{***}
INV^{-}	6.62	9.65	3.02
ΔINV^{-}	496.88^{***}	233.3^{***}	-8.03^{***}

Notes: Δ denotes the first differences. *** indicates rejection of the null hypothesis of a unit root at 1% level of significance. *Source*: Research Findings.

According to Table 3, our variables are nonstationary in level, but their first differences are stationary, so all variables are I (1). Now we test for the presence of a long-run relationship using the Pedroni (1999; 2001) panel cointegration tests. The panel cointegration test results are presented in Table 4 with the lag length chosen based on the Schwarz information criterion. The results indicate that there is a panel cointegration between the underlying components.

Table 4
Panel Cointegration Tests

Statistics	
Positive components	
$panel\ v-statistic$	1.41
$panel\ rho-statistic$	7.15^{***}
$panel\ PP-statistic$	-5.63^{***}
$panel\ ADF-statistic$	-3.33^{**}
$Group\ rho-statistic$	6.70^{***}
$Group\ rho-statistic$	-7.66^{***}
$Group\ rho-statistic$	-3.52^{***}
Negative components	
$panel\ v-statistic$	1.44
$panel\ rho-statistic$	10.16^{***}
$panel\ PP-statistic$	-1.84^{***}
$panel\ ADF-statistic$	-2.36^{**}
$Group\ rho-statistic$	-9.58^{***}
$Group\ rho-statistic$	-2.29^{***}
$Group\ rho-statistic$	-2.72^{***}

*** significant at 1%, ** significant at 5%. *Source*: Research Findings.

Next, in line with the main objectives of the paper, we estimated the cointegrating relationship between positive and negative components using panel dynamic ordinary least squares (DOLS) estimators (Stock & Watson 1993, 2001).

Table 4 shows cointegration vectors between positive and negative components of real profit rate and bank-specific characteristics. The DOLS estimation shows the evidence of long-run cointegration. It indicates that the change in credit risk, liquidity position, and investment ratio significantly pass on through the profit rate in the long-run.

Turning on to the long-run coefficients for the cointegrated system of lRDr^{+}, CR^{+} and LR^{+} have a significant effect on lRDr^{+} by 0.51 and -0.67, respectively. Intuitively, an increase in CR by 10 percent would possibly drive up lRDr by a roughly 5.1 percent while a 10 percent increase in LR could averagely expect a decrease in lRDr by 6.7 percent. Furthermore, lRDr^{+} highly relates to INV^{+}, i.e., a 10 percent increase in bank investment would cause a 2.9 percent increase in lRDr.

In the case of lRDr^{-}, the profit rate logarithm could be expected to decrease by 1.3 percent and 1.4 percent if credit risk and investment ratio respectively reduce by 10 percent. Similarly, if the bank's liquidity drops by 10 percent, then lRDr would increase by 8.7 percent.

Table 5
Long-Run DOLS Estimates

$\mathbf{lRDr^{+}}$		$\mathbf{lRDr^{-}}$	
Independent Variable	Coefficients	Independent Variable	Coefficients
Intercept	0.18**	Intercept	-0.22*
	(2.76)		(-4.29)
CR^{+}	0.51^{***}	CR^{-}	0.13^{***}
	(11.22)		(2.82)
LR^{+}	-0.67^{***}	LR^{-}	-0.87^{***}
	(-21.96)		(-25.57)
INV^{+}	0.29^{***}	INV^{-}	0.14^{***}
	(20.59)		(2.97)
HHI^{+}	-0.33**	HHI^{-}	-0.05**
	(-9.86)		(-16.34)
$(HHI^{+})^2$	0.16^{***}	$(HHI^{-})^2$	0.31^{***}
	(9.63)		(14.15)
$\bar{R}^2$	0.80	$\bar{R}^2$	0.71

T-statistic in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. *Source*: Research Findings.

This finding remarks some insightful information about asymmetry in profit rate behavior firstly. This asymmetric response to bank characteristics shocks could be caused by the fact that profit rates are rigid downwards and very flexible upwards. For instance, an increase in LR by 10 percent would cause a 6.7 percent decrease in lRDr, whereas a 10 percent decrease in LR could increase lRDr by 8.7 percent. The reason is that a liquidity deficit puts banks in danger of liquidity risk and insolvency, so they prefer to absorb new deposits and offer higher profit rates to deal with these risks. Secondly, there is a mild association of bank participation in investment activities and profit rate, so it is clear that liquidity and credit position significantly capture the profit rate deviation from its average level.

About banks' market power, it is worth mentioning that there is a quadratic nonlinear relationship between real profit rate and market concentration. Therefore, a graphical representation shows the relationship between these two variables (ceteris paribus).

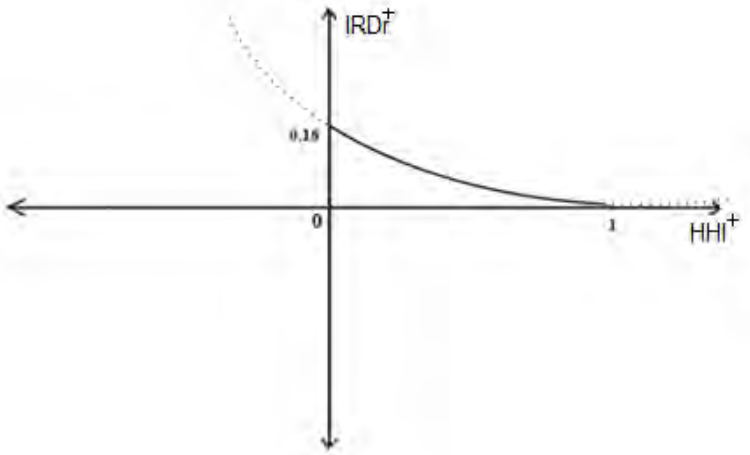

Figure 5. Nonlinear Relationship between Positive Components of HHI and Real Profit Rate. According to the domain of cumulative positive components, the dotted curve is not in the range. *Source*: Research Findings.

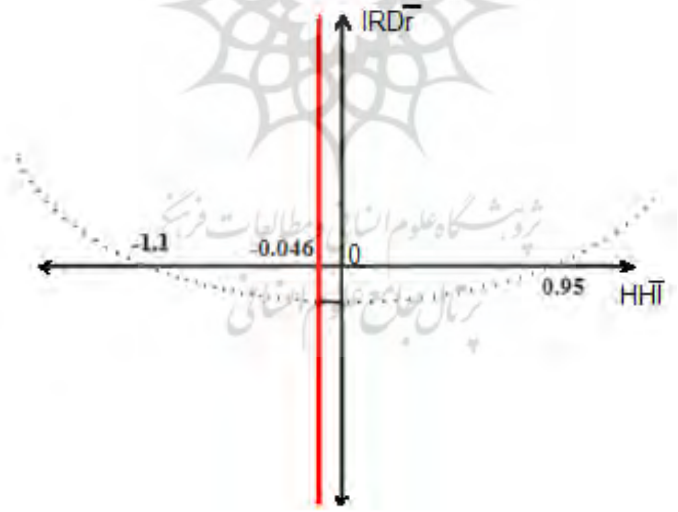

Figure 6. Nonlinear Relationship between Negative Components of HHI and Real Profit Rate. In the long run, cumulative negative components of HHI range from -0.046 to zero (which is the distance between the parallel lines; x=-0.046 and x=0). According to the domain of cumulative negative components, the dotted curves are not in the range. *Source*: Research Findings.

Firstly, there is a negative correlation between market concentration and profit rates. Secondly, depending on the functional form of the function, its slope in two cases will determine which of the two situations (concentration increase or decrease) the adjustment is faster. Profit rates in less competitive markets (fig. 5) show stronger long-run responses to the corresponding market concentration compared to more competitive markets (fig. 6).

6 Conclusions

The aim of the research was threefold. The first aim was to study the existence of the SCP hypothesis for 21 selected banks during the 2008–2017 period. The second aim was to understand the relationship between profit rate and bank characteristics, and the third aim focuses on important questions, namely profit rate asymmetry. We used the panel hidden cointegration technique introduced by Hatemi-J (2018). Initially, we established the cumulative positive and negative shocks for variables; then we investigated the cointegration between aggregate positive and negative components. Empirical results show that it is asymmetric and hence, nonlinear cointegrating relationships between variables. Then, the analysis employed Panel DOLS estimators to detect long-run asymmetric interactions. Applying this model, we arrive at the following findings:

1) Risk variables cause significant fluctuations in the profit rate. This finding is consistent with the market discipline hypothesis. It indicates that bank risk is positively related to profit rates (price-based mechanism of market discipline) so that depositors punish banks for excessive risk-taking by asking higher rates. Another implication of this hypothesis is that profit rates predict bank failure; thus, depositors demand more profit rates to guarantee their deposits. This result ties well with previous studies by Flannery and Nikolova, 2004; Berger and Bouwman, 2009 and Bowman and Berger, 2013; Ben-David, Palvia, and Spatt, 2015.
   On the other hand, our results cast a new light on bank management point of view, it implies that NPLs growth ties up banks' resources and causes a poor quality of assets portfolio and building-up frozen assets, so banks prefer to borrow funds in the deposit market because, without deposits,

there would be no new loans. CBI must be involved in more regulatory oversight and force the banks to increase the quality of assets. Additionally, it should change the false accounting methods to stop the transformation of non-performing loans into new loans as well.
Similarly, if banks do not hold enough high liquid assets, they are exposed to liquidity risk and have to offer higher profit rates for fear of liquidity drying up (liquidity shortage). In Iran's economy, it seems CBI should require banks to meet more stringent liquidity requirements and regulate the level of banks' liquidity.

2) Although significant effects of credit and liquidity risks on profit rates exist, our findings show that profit rates are more sensitive to liquidity changes. It merely mentions the contagion effect, which contributed to liquidity deficiencies. In other words, if one bank faces a liquidity deficiency, depositors start a run to withdraw their funds. These behaviors can lead to spillover effects, causing contagion. In case of losing confidence in the banking system, there are disastrous consequences for the whole economy, so banks react promptly. Hence, reducing the exposure to the liquidity risk also induces a reduction in the banks' expenses for paying profit rates. A similar conclusion reached by Resti, 2011; Baldan, 2012 and Huseynov, 2018, etc.
3) It is essential to highlight the fact that banks finance their investments in bonds or own projects by issuing liabilities whose maturity is shorter than that of that investment, this imbalance between maturities of assets and liabilities implies profit rate increases. This result goes beyond previous findings wherein bank investment and profit rate has been investigated (Resti and Sironi, 2007; Stádník and Miecinskiene, 2015) by taking into account the asymmetric behavior of profit rates. Results show that positive investment shocks are found to have a stronger effect on the profit rate than adverse investment shocks.
4) The present study specifies the SCP paradigm that is supported by the negative concentration-profit rate relationship. Such a negative relationship sheds light on dangers lie ahead for bank merger and raises a question of whether merger policy in the Iranian banking industry would protect against the anticompetitive effects of mergers or not. A further finding is that there is a quadratic nonlinear relationship between these two variables. Because of profit asymmetry, positive concentration shocks are found to have a stronger effect on the profit rate than adverse concentration shocks. This relationship implies that highly concentrated banking markets are "bad" for depositors.

5) From the results, it is clear that the profit rate shows downward stickiness in response to a decrease in bank concentration, liquidity risk, credit risk, and bank participation in investment activities (downward stickiness of profit rates).

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