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Original Research Article

Bank Liquidity and Bank Performance: Looking for a Nonlinear Nexus

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Liquid assets are critical for banking operations. They guarantee avoiding liquidity risk and widens managerial decision options to invest in emerging profitable projects; however, holding extra liquidity entails opportunity costs. Accordingly, empirical literature does not provide a conclusive relationship between liquidity and profitability. The purpose of this research is to analyze the asymmetric effects of holding liquid assets by commercial banks on their profitability. Parallel to a detailed review of contradicting theories and empirical evidence, we have developed an econometric model to capture the nonlinear effects of liquidity on performance. The proposed model is tested for a sample of seven listed Iranian commercial banks during 2006-2018 by Arellano-Bond dynamic panel-data estimation. We found that the nonlinear relationship, if any, is not an inverse U as Bordeleau and Graham (2010) suggested. Results show a positive (holding more liquid assets increases the profitability of Iranian banks), and even an accelerating effect for liquidity, likely due to the low level of liquid assets maintained by Iranian banks.

Keywords: Liquidity, Profitability, Nonlinearity, Iranian Commercial Banks.
JEL Classification: C58, E58, G21

1 Introduction

Liquid assets are the water of life for banks (Choudhry, 2012). Basically, by holding liquid assets, banks intend to handle daily routine operations and to cover unexpected cash outflows. Although maintaining extra liquidity, hinders profitmaking, for such assets have the least profitability, if any. Therefore, managing liquidity has been one of the canonical responsibilities of bank directors that entails tremendous challenges.

Of the challenges is that a variety of liquid assets exist, ranging from "more liquid & less profitmaking" assets to "less liquid & a mediocre interest-

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making capacity" assets. Moreover, the volume of the liquid portfolio has a nonlinear effect on bank performance. Banks with low liquidity are more fragile and may encounter a bank run because of depositors' distrust (Miller, 2003; Allen &Carletti, 2008; Stix, 2013). Thus, fine-tuning liquidity requires a great deal of financial and banking knowledge. Due to the effect of industry level and country level exogenous variables on the quantity and quality of liquidity, it is essential to consider them as well. Montes and Peixoto (2014) state that at times of abundance before the financial subprime crisis, bank directors tended to be too optimistic and maintained low levels of liquid assets. Such a strategy was good for an individual bank but bad for the system, partly because Asset and Liability Management (ALM) in banks are not responsible for the macroeconomic effects of their actions.

The challenges have been addressed involving two different fields: Asset Liability Management (ALM) at the micro-level and macro-prudential regulatory body at the macro level. From a micro perspective, a bank is a profit-seeking firm. If ALM practices and macro-prudential regulations neglect this goal, they are doomed to failure. However, the literature on the relationship between liquidity management and bank profitability reports contradictory results (Bordeleau & Graham, 2010; Tan, 2016). Admittedly, liquidity management is a dynamic and sensitive practice. It requires permanent examinations and somehow unconventional approaches in modeling the relations. Researchers may consider alternative bank- or country-specific control variables or even dummy variables. Also, as Bordeleau and Graham (2010) innovatively suggested, there may be a nonlinear inversed-U relation between liquid assets and profit indices. Accepting the nonlinearity hypothesis, one would find witnesses in countries with a high level of liquidity ratios (Figure 1). However, the following studies have not yet confirmed the nonlinearity (see, for example, for Singapore, Thangavelu & Findlay, 2012; for Ghana Owusu-Antwi1, Mensah, Crabbe &Antwi, 2015).

The purpose of this paper is to analyze the nonlinearity hypothesis developed by Bordeleau and Graham (2010). Though Shahchera (2012) finds evidence of the concavity in the profitability-liquidity relationship in Iran, any other studies internally published in the country do not support the hypothesis. In addition to the theoretical importance, for policymakers in Iran, it is crucial to know whether encouraging Iranian banks to hold more liquid assets would affect their profitability. Thus, we investigate the hypothesis for a sample of Iranian listed commercial banks during 2008-2017. However, one can retest it for other samples in any country or a panel of international scope. Still, we

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strongly recommend revising it as the management of liquidity is hypersensitive to business models, regulations, and best practices of regional banks. We find that the relationship is positive, and even we find evidence of an accelerating effect for liquidity, likely due to the low level of liquid assets maintained by Iranian banks.

Iranian banking has experienced drastic changes since 2001. After that, privatized banks and new privately owned entrants have competed under national monetary and other commercial rules and regulations. In line with national strategies to liberate economic activities, enhancing international interactions, and especially in the aftermath of the financial crisis, the Central Bank of Iran (CBI) has attempted to direct the banking system to comply to a greater extent with international regulatory guidelines.

The literature on these evolutions is primarily in Persian, leading to a restricted internal discussion instead of a broader contribution to the banking system all over the world. So, this study also aims to contribute to the literature of banking, especially the liquidity risk management field, by providing insights into modeling bank performance when liquidity matters.

By using Iranian banks statistics, the paper would contribute the literature on Iranian banking liquidity management. Besides, the results have implications for transitional economies with extreme levels of liquid assets ratios in their banks.

After a brief review of the Iranian banking system and theories of the liquidity management in sections 2 and 3, data and the model will be presented in the fourth section. What comes in the next two sections is the result of the empirical analysis of a sample of Iranian banks. Finally, section 7 covers the conclusion, including policy implications and recommendations for further studies.

2 Iran Banking System

This section presents a brief description of the Iranian banking system, historically, structurally, and from the performance and regulation point of view. It would be useful in specifying the model and its country-specific variables. Moreover, the interpretation of results would be justified knowing these facts.

Modern banking in Iran has a 100-year history. Up to the late 1920s, the banking industry in Iran was dominated by foreign banks. However, these foreign banks had little contribution to introducing financial innovations. It was in the 1960s that the Iran central bank was established. In 1979, after the Iranian Islamic revolution, all banks were nationalized (ILIA, 2016).

[DOI: 10.29252/jme.16.4.417]

After twenty years of bank privatization since the late 1990s, the industry has undergone additional transparency and fewer mandatory loans in financial statements. Iranian private banks proved to be more efficient than their state-owned counterparts, as many other developing countries experienced the transition (Boubakri, Cosset, Fischer & Guedhami, 2005; Beigi & Shirmohammadi, 2011; Alipour, 2012). Sherafat and Sedaghatparast (2013) showed that even after privatization and entrance of new private banks into the market, many of the non-performing loans did not cease to grow. Currently, there are eight state-owned banks, 22 private banks, and five financial/credit institutions active in Iran (cbi.ir). Of private banks, only ten commercial banks were active, as listed with the Tehran Stock Exchange (TSE) (tsd.ir). All the banks are to follow the regulations set by the Money and Credit Council (MCC), which determine the interest rate of deposits and loans. According to Iran's national strategies to enhance international interactions and the significant role of the banking system in funding projects and facilitating payment central Bank of Iran (CBI) have attempted to direct the banks and pave the road. Designing Roadmap 1400 in 2012 was a big step forward, which was made up of different sub-plans such as the modernization of banking, developing interbank institutions, promoting compliance with international standards, and so forth.

In the aftermath of the financial crisis, CBI issued guidelines to direct the banking system to comply with international regulations. "Requirements of liquidity management for banks and other financial institutions" guideline, which is based on Basel III, is one of the latest regulations that has been implemented since February 2017. Discussions on the importance, consequences, and implementation of the new guidelines continue.

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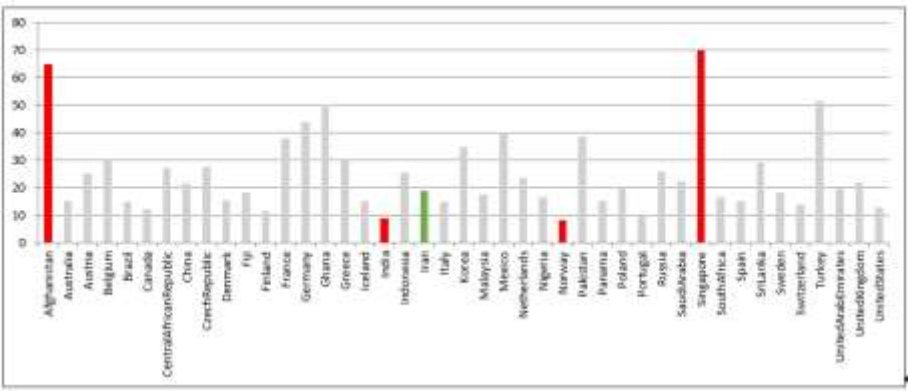

Figure 1. Liquidity Ratio of Banks across Nations. Source: IMF

Figure 1 provides a summary of liquidity holding by banks of countries. The variety of countries include least developing to most developed countries, according to the IMF website. The maximum liquid holding banks are in Montserrat (75.08%), Singapore (69.66%), Afghanistan (64.89%), Ghana (50.27%), and France (50.27%). On the opposite extreme, Panama, with only a 2.78% liquidity ratio, embraces the least liquid holder firms. The mean of the liquid assets ratio for the sample is 29.58 percent.

3 Liquidity and Bank Performance

3.1 Bank Liquidity Management

Coping with liquidity shortages seems approximately straightforward in other industries than banking. Banks have evolved to the extent to fill the liquidity requirements of firms. Naturally, businesses generally maintain liquid assets to four motives: (1) the transaction motive (Keynes, 1934; Baumol, 1952; Miller and Orr 1966), (2) the precautionary motive (Keynes, 1934; Opler, Pinkowitz, Stulz, and Williamson, 1999), (3) the tax motive (Foley, Hartzell, Titman & Twite 2007) and finally (4) the agency motive (Jensen, 1986).

According to Keynes (1934), firms save transaction costs to acquire funds and avoid liquidating assets to make payments. Firms may use the liquid assets to finance their activities and for investments in the shortage of other sources of funding or if such sources are excessively costly. The former is the transaction motive; they optimize the liquid balances subject to income streams of earning assets and a steady flow of expenditures (Baumol, 1952). The latter is the precautionary motive; some managers have a greater tendency

[DOI: 10.29252/jme.16.4.417]

to hold cash funds to reduce liquidity risk and to increase their discretion. Moreover, shortfalls in cash flow might delay firms' quick reaction to profitable opportunities (Opler et al. 1999). These motives are sensitive to financial market efficiency. As firms with liquid stocks, hold less cash (Hu, Li & Zeng, 2019).

Foley et al. (2007) add that holding significant amounts of cash by US corporations was traditionally elaborated by transaction costs and precautionary motives. The alternative to the approaches above is that "US multinational firms hold cash in their foreign subsidiaries because of the tax costs associated with repatriating foreign income." It is called a tax incentive, which shows that firms with higher repatriation tax burdens, had higher levels of cash. Such "firms hold this cash abroad, and hold this cash in affiliates that trigger high tax costs when repatriating earnings (Foley et al., 2007)."

The last discussed motive, as Jensen (1986) explains, stems from conflicts between interests and incentives of managers and shareholders overpayment of cash to shareholders. Firms with substantial free cash flows might undergo such disputes. Jensen (1986) developed a theory to explain the benefits of debt in reducing agency costs of free cash flows.

In times of financial frictions, firms may violate maintaining the usual optimal level of liquid assets. Then, managing liquidity, to increase their ability to finance future projects, would lead to higher levels of liquidity. Since maintaining liquid assets impose opportunity cost, there is a trade-off reaching an optimal amount of liquidity (Aspachs et al. 2005; Chiaramonte, 2018). Therefore, in practice, one may observe a rising balance of liquidity holdings as cash flows increase. Firms try to make a buffer of liquidity for future projects' funding (Aspachs, et al. 2005).

Liquidity deficits in banks are, to some extent, a different story and might be, to the most extent, extraordinarily severe and contagious, which might lead to bank runs and the collapse of the financial system. In this regard, regulations matter. Historically, liquidity crises are widespread in banking systems, especially during economic cycles (Choudhry, 2012; p. 592). Throughout the recent financial crisis of 2007-2008, many banks that did not maintain adequate liquidity got damaged and began to acquire liquid assets. Central banks obliged unprecedented levels of liquidity support to sustain the financial system, although it was late for several banks (BCBS, 2010).

Choudhry, the author of the seminal book "Principles of Banking," states: "Liquidity is the "water of life" of banking." He emphasizes that "the art of banking is essentially the art of liquidity management" (Choudhry, 2012, p. 589). Banks are simply like mathematical functions transforming deposits

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with short maturities to loans with longer maturities; the function is well known to maturity transformation. One way to do this task is by maintaining a sound level of liquidity buffer. Dealing with the sound/optimum level of liquidity, a banker faces significant restrictions like regulations, business-model liquidity requirements, and explicit and opportunity costs (Aspachs, Nier & Tiesse, 2005; Bordeleau & Graham, 2010; Bonner et al., 2013). All the restrictions are time-varying. Thus, finding a sound level of liquid assets is a dynamic problem and differs for banks.

Liquidity management in banking is conducted under Assets and Liability Management (ALM). Banks use accounting techniques to assess the required liquidity to meet financial obligations (Owolabi & Obida, 2012). According to the shiftability theory of Mitchell (1923), banks keep liquid assets throughout the shifting of assets. All other things being equal, when a bank needs liquidity, it can sell a reasonable amount of its illiquid assets in favor of adding more liquidity to its portfolio. Accordingly, banks can operate efficiently: with fewer reserves or investing in long-term assets (Emmanuel, 1997). But all the things are not equal, especially during a crisis. Liability Management Theory lets individual banks to benefit the capital market either. Emmanuel (1997) insists on the fundamental contribution of this theory in considering both sides of a bank's balance sheet as sources of liquidity. The other trending theory of liquidity dates back to the 1940s when Herbert v. Prochnow developed Anticipated Income Theory. This theory also considers the loan portfolio as a source of liquidity. It relies substantially on the series of installments. Therefore, even in a liquidity crisis, the bank can sell the loans to obtain needed cash in secondary markets (Alshatti, 2014, P63).

In recent approaches to liquidity management, banks adjust their liquidity according to their current lending opportunities. They may increase liquidity when lending opportunities are reduced and decrease liquidity when lending opportunities improve, which in turn suggests that banks cannot entirely rely on external funding. Therefore they have to manage their internal funds to invest (lend) over time optimally. (Aspachs, et al. 2005).Remarkably, the optimization of banks' liquid portfolio is not a simple task since it is a multi-factor and multi-objective problem. Macroeconomic environment, regulatory regime (primarily via capital and liquidity constraints), and agency issues (different interests of banks' creditors (depositors) and shareholders) all are to be considered.

In practice, banks tend to maintain a sound quantity and quality of liquid assets. Though, throughout the recent liquidity crisis, it was disclosed that the majority of banks do not follow a sound liquidity management discipline

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(BCBS, 2010). For UK banks, the principle of maintaining a liquidity buffer became a regulatory requirement in Policy Statement 09/16, published in October 2009 (UK FSA, 2009). As a result, the Basel Committee on Banking Supervision (BCBC) set out standards defining minimum levels of liquidity for internationally active banks, such as the Liquidity Coverage Ratio (LCR). The standard requires that the value of the ratio be no lower than 100% (i.e., the stock of liquid assets should at least equal the estimated net cash outflows) (BCBC, 2010). The other measure, Net Stable Funding Ratio (NSFR), provides a longer time horizon on the resilience of the banks. The new standard "relates the bank's available stable funding to its required stable funding" (FSI, 2018). However, it accounts for even the potential liquidity risk of off-balance sheet (OBS) exposures and various types of maturity mismatches involved in short-term secured funding of long-dated assets (ibid).

The buffer has two aspects: combination and magnitude. The recent financial crisis unveiled that a bank's liquidity portfolio needed to be genuinely liquid, enabling it to respond to market conditions. All sources of liquidity risk have to be covered within the bank's risk management regime, including off-balance sheet commitments such as derivative trade collateral requirements, and undrawn commitments such as liquidity funding lines (Choudhry, 2012, pp. 622-23). The critical point here maintains that not a unique portfolio setup does exist. Every bank must set its liquidity risk management subject to its specific needs and business model (Bordeleau and Graham, 2010). Maintaining a buffer like tax deductions affects the balance sheet. All other things being equal, this intervention would cause restructuring of institutions' balance sheets, leading to a reduction in their profitability. Therefore, it is expected that if banks have a sound liquidity buffer and a proper balance sheet structure, they may be profitable. On the other hand, if banks maintain less liquid assets or have excess liquidity, they may experience a reduction in profitability.

Finally, two other topics discussed here generally elaborate on analyzing practical procedures. The first one considers banks' relation with the central bank as a Lender of Last Resort (LOLR). It is discussed that the presence of LOLR affects the level of the optimal buffer of liquid assets. In other words, whenever the central bank shows less strictness in accepting banks' claims, banks subsequently tend to maintain lower levels of safe assets in their portfolios (Aspachs et al. 2005). The second topic is about disclosing strategies. Disclosing liquidity policy allows market participants to price an institutional strategy more accurately.

[DOI: 10.29252/jme.16.4.417]

Meanwhile, these strategies undermine socially excessive risk-taking by financial institutions (Jordan et al. 2000; Nier and Baumann 2006). It is expected that a bank, which is subject to low disclosure requirements to manage liquidity risk, would likely maintain a limited size of liquidity buffer. A quantitative liquidity requirement signals investors whether a bank's liquidity holdings are sufficient or not (Bonner et al. 2013).

3.2 Empirical Literature Review

Knowing that liquidity management is conceived as an art rather than a mere scientific technique, reviewing the literature requires extra elegance. Besides, the measurement issues add more complexity to this practice. This approach starts with an overview of the seminal classical papers of the last decades. The evident feature of the studies is inconclusiveness in recognizing a positive relationship between liquidity and profitability. Moreover, liquid assets are generally included as a control variable in these studies, with a minimal discussion around the estimated parameter.

Bourke (1989) defines liquid assets like cash and bank deposits plus investment securities and use it as a control variable in a series of equations where dependent variables are all proxies of profitability. His extensive sample included 90 banks in Europe, North America, and Australia. Bourke finds a positive effect between liquid asset ratio and profitability indices. Molyneux and Thornton (1992) replicated Bourke's methodology in an extensive sample of European Banks, and while confirming the overall results of that paper, they also find a negative relation. Goddard et al. (2004) find mixed evidence of a negative relationship between the two variables.

Bordeleau and Graham (2010) tried to synchronize the contradicting results by hypothesizing a nonlinear relation between liquidity and profit in the banking sector. They introduced a polynomial regression equation where an inverse U shaped curve exemplifies the positive and negative effect of liquidity ratio on the profitability of US and Canadian banks. They emphasized that their study does not seek to find the optimum point of holding liquidity, though one can calculate the turning point of the concave estimated curve.

DeYoung and Jang (2016) analyze US commercial banks' liquidity management experiences before the implementation of Basel III. They gathered twenty years of data for more than 6000 banks before 2000 and for more than 5000 banks between 2000 to 2012. The results show that banks react to regime change, and their behavior does not match the pre-regulation

[DOI: 10.29252/jme.16.4.417]

era. Moreover, their results differentiate the reaction of small and large banks to the introduction of new liquidity rules.

Tran, Lin, and Nguyen (2017) analyze interrelationships among liquidity creation, regulatory capital, and bank profitability of US banks. They find a positive relationship between regulatory capital and liquidity creation after controlling for bank profitability. Nevertheless, this relationship is sensitive to the size, analysis period, strictness of banks' regulations. For instance, the results show that small banks during non-crisis periods are excessively affected. Above all, they find that banks with more liquidity creation and higher illiquidity risk experience less profit.

Delechat et al. (2012) found a positive relationship between profitability and banks' liquid asset holdings. They discussed macro-economic effects, especially the cyclical behavior of liquidity demand. They argued that liquidity buffers should be negatively relate

d to real GDP growth, credit cycle, and policy interest rates. Aspachs et al. (2005) also found that liquidity buffers are negatively associated with GDP growth and the policy rate. Similarly, Agénor et al. (2004) suggested that excess reserves are negatively related to the GDP gap. Turning to institutional determinants, Delechat et al. (2012) showed that financial development and the quality of institutions substantially affect banks' holdings of liquidity. A further argument for the importance of financial development for liquidity buffers can be found in Almeida et al. (2004), which showed that financially constrained firms have a higher propensity to save cash. It is in line with the above discussion of regulatory mandates from a socially beneficial viewpoint.

Studies that examine determinants of liquidity provide insights on modeling a liquidity-profitability relationship, such as avoiding collinearity. Bonner et al. (2013) believed that market participants, especially retail clients, has difficulty in observing banks' liquidity risk. And when liquidity regulation lacks, banks' liquidity buffers are determined by a combination of bank-specific (business model, profitability, deposit holdings, size) and country-specific (disclosure requirements, the concentration of the banking sector) factors. Almost all the determinants in their study turned out to be insignificant with a liquidity requirement in place, which led to the conclusion that regulation substitutes nearly all of the incentives to hold liquid assets. Aspachs et al. (2005) also did not find a significant effect of size on banks' holdings of liquid assets, while Kashyap et al. (2002) and Delechat et al. (2012) found a significant effect of bank size on liquid asset holdings.

Finally, of recent Iranian studies, Mehranpour et al. (2016) determined bank-specific and macro-industry specific factors of profitability in Iranian

[DOI: 10.29252/jme.16.4.417]

banks. In the former category, they maintain asset structure, revenue diversification, capital, and size; for the latter category, economic growth, inflation interest rate, competition as significant variables. This work could not find any significant relation between asset quality and efficiency with the rate of return as a performance index. Shamsaei et al. (2016) find a negative relationship between liquidity and profitability.

4 Data and the Model

4.1 Data

Our sample consists of seven commercial banks listed in Tehran Stock Exchange (TSE) that were active during the period from 2006 to 2018. These banks have the most transparent records of financial statements, and they struggle to comply with national monetary and financial regulations and, to some extent, also follow international standards. Of 12 listed banks in TSE, five banks are newcomers and disclose limited financial records. Therefore, we concentrated on the remaining seven banks. Nonetheless, our sample accounts for at least 30% of assets of all banks (including government-owned particular banks) and more than 50% of private banks' assets. Although several privatized banks have been included, the sample is, to some extent, homogeneous. Moreover, the period encompasses significant events experienced by the banking system that deserves more scrutiny.

Banking data were primarily obtained from Iran Banking Institute (IBI), which is available since 2004 (both in hard copy and online formats). We triangulated these data with TSE's released reports to check for the missing or doubtful data. For macroeconomic data, the time series database of the central bank of Iran (tsd.ir) was used. Thereby, an unbalanced panel with at least 89 observations for every variable was prepared to run the models.

4.2 The Model

Following Bordeleau and Graham (2010) and based on the theoretical and empirical literature, we test whether liquidity (LA) has a nonlinear effect on bank profitability. The conclusion of a broad review of liquidity management literature was that maintaining liquid assets may have two contradicting effects. Lower levels of liquidity provoke liquidity risk and may even lead to the brand risk of a bank, while high levels of liquidity have opportunity costs and would spoil profitability. Therefore, hypothesizing a concave form for the relation is reasonable, though the average of Iranian banks maintains lower balances of liquid assets. To make the model, we have followed Delechat et

[DOI: 10.29252/jme.16.4.417]

al. (2012) and Tran et al. (2017) as well as the work of Bordeleau and Graham (2010) for their innovative quadratic form of liquidity.

Moreover, we introduced additional bank-specific and country-specific control variables. Equation (1) is the proposed econometric model:

$$\pi_{it}=\alpha_0+\sum\gamma_j\pi_{it-j}+\alpha_1\mathrm{ULA}_{it}+\alpha_1\mathrm{ULA}_{it}^2 + \sum\beta_j Bank\ Specifics_{it}^{j}+\sum\theta_j Country\ Specifics_{i}^{j}+\mathrm{u}_{it} \quad (1)$$

Despite Bordeleau and Graham (2010), lagged explanatory variables were not appropriate here for two reasons. First, our data are annual, while theirs were quarterly. Second, the banks in Iran identify income at the end of each year. Even for a loan, which is going to mature next year, they identify proportionate interest at the end of the current year. Therefore, one year is long enough for transmitting the effects of fluctuations in liquidity and other variables into bank profitability.

To measure the bank performance (independent variable), we followed the literature and used ROA (returns on assets) as the prevailing measure of income performance from the organizational point of view.[1] Figure 2 shows how ROA has scattered across time and banks. Three banks reported unprecedented losses mainly after implementing localized IFRS by central banks (to the extent they did not calculate equity and loan loss provisions accurately). Moreover, there seems to be a cyclical time trend in ROA data. We will come back to this when dealing with the stationary issue in data.

[DOI: 10.29252/jme.16.4.417]

[1] The reason that we did not apply ROE (Return on Equity) for the main analysis relies on the equity measurement problems in Iran. As experts gave us their advice, even after the central bank intends to implement IFRS9, the majority of the financial reports on the equity side are not very reliable. The evidence was that after the implementation of a localized form of IFRS, some of the banks reported huge losses.

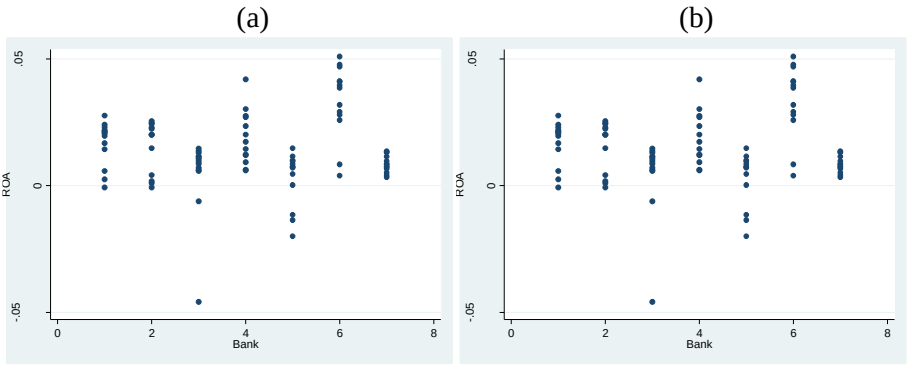

Figure 2. ROA Scattered Plot the Sample Period and Bank. Source: IBI.Ir

Ultra Liquid Assets (ULA) ratio is not reported readily and is calculated as the summation of liquid assets consisting of cash, bonds, and bank deposits with other banks, as a percentage of total assets.[1]To mitigate size effect, total assets play a role in the denominator of explanatory and other bank-specific control variables (though we use LnA as an independent variable in one of the models). Figure 3 provides a scatter plot of the ULA cross time and banks. There are limited observations where the liquidity ratio is above 20 percent. Thus, expecting a quadratic form is hardly possible as liquid assets atios are not high enough in Iran's banking system.

The other notable subject about the ULA trend is that despite Iranian banks' least relation with the international banking system and global capital markets, they have taken into account the trends, best practices, and experiences. It has been intensified in the aftermath of the recent financial crisis of 2008. Following international orientations in the banking industry, the central bank of Iran translated Basel III requirements in early 2016 and tried to prepare bankers for future developments. Besides, it emphasized implementing a localized form of IFRS9 since 2016. Interest rate adjustments accompany these two structural changes. Because of these evolutions as well as the stricter monitoring, banks with excess liquidity that used to play lender

[1] Most Iranian studies take deposits with central banks as an item in liquid assets. This is misleading, for the deposits are regulatory, not free reserves. Exploring banks' balance sheets, we could not find any explanation of how much free reserves bank hold with central banks. Since these free reserves are for clearing operations between banks, it is not as liquid as other items. Anyway, we tested for the effect of the liquid assets including all reserves in the robustness section, as an alternative to ULA.

[DOI: 10.29252/jme.16.4.417]

role in the interbank money market turned out to be borrowers. Only one of the banks in our sample became a lender in the last two years of the period.

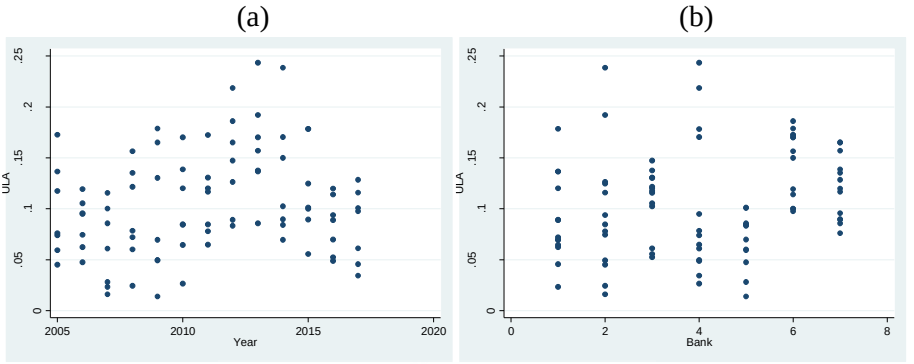

Figure 3. Liquidity Ratio Scattered Cross The Sample Period And Bank. Source: IBI.ir

Control variables are categorized into two groups: bank specifics and country specifics. While in the first group, the focus is on general banking features based on the empirical literature, the growth of real gross domestic product and inflation were used as country-specific variables.

Regarding the revenue side, one of the major determinants of bank performance is capital structure. Capital requirement is not only a source of funding; it is the most perceived requirement in credit risk management according to Basel committee guidelines (Bace. 2016). Raising capital might encourage risk-taking while providing a buffer for credit risks. In effect, it is expected that banks with more equity to asset ratio, earn higher incomes, likely through entering new markets and investing in emerging profitable projects. In this study, EA represents equity to assets ratio.

By deregulation of the banking industry in recent years, the share of traditional deposit-loan functioning has decreased (Sedaghtaparast, 2018). On the other hand, banks have benefited from their economies of scope and diversified their services, raising their interest-based revenues. Our diversification index of bank revenues DIVERS captures the effect of approaching non-interest revenues. To calculate the variable, we have followed the concentration formula as in Eq. 1.

[DOI: 10.29252/jme.16.4.417]

$$DIVERS = 1 - \left[\left(\frac{Interest\ Revenues}{Revenues}\right)^2 + \left(\frac{Noninterest\ Revenues}{Revenues}\right)^2\right]$$

As an alternative to DIVERS, the introduction of OBSA, off-balance-sheet activities as a share of assets, was examined. These activities include various types of guarantees (mainly Letters of Credits, LCs), commitments, and derivatives.

InvestR is the ratio of bank investments on revenues. In a repressed financial system, this determinant variable would give meaningless signals. While housing prices were escalating, banks tended to invest in real estate. Nevertheless, these were not liquid assets, and banks could not identify income unless they sold them. On the other hand, loanable funds in practice decreased, and with high non-performing loans in balance sheets, authorities forced banks to sell their rigid real estate and reduce their shares in the stock market. These challenges have prevailed for the last 15 years. Citers Paribus, these investments would raise bank income.

Other bank control variables include LoanA, the ratio of loans to assets, LD, loans to deposit ratios, and LnA, the logarithm of assets as a proxy for the size of the banks. It is expected that LoanA and LD positively associate with profit. LnA may have a positive effect on profitability because of economies of scale. At the same time, there may be a diseconomy of scale for some banks as their assets grow out of their management capacity.

Besides, to capture Iranian banking system circumstances, the loan qualities and the relationship between banks and the central bank of Iran were candidates. Historically, to offset their liquidity shortages, Iranian banks have used claiming the central bank. Therefore, we expect that NPL, non-performing loans, and DCB, debt to the central bank and other banks, would have adverse effects on bank performance. While borrowing from the lender of last resort is an expensive way of funding, for Iranian banks that have low liquidity or for insolvent banks, it used to be a permanent rescue plan. On the other hand, the rising ratio of loan to assets while raising more default loans exacerbates assets' quality and would hurt performance. Subhanij (2010) shows that as the central bank provides additional credit, in the absence of proper credit risk management, the overdrafts find their ways toward bad loans.

Turning to the cost and expenditures side of the profit equation, it is well-identified that in the banking industry, interest expenses have the most considerable share in total costs. On the other hand, by taking into account the diversification trend in modern banking, new services entail investing in new skills and equipment unrelated to deposit-taking, e.g., e-banking. Therefore,

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we introduced two cost indices: NFCR, nonfinancial costs to revenues, and IntCR, Interest expenses to revenues. Nonfinancial costs are calculated as total cost minus financial costs (interests paid to deposits), consists of operational costs, charges, and provisions for credit losses. Despite setting interest rates by the central bank of Iran, banks typically take two different approaches. A few banks follow the regulations, while the majority of them compete on absorbing the liquidity by offering a bit higher interest rates to depositors. Especially since late 2015 that interest rates pulled down, the informal biding and unfair competition rose. As a result, in the interbank market, banks that were used to be lenders confronted liquidity shortages and became borrowers. Knowing these facts, one should be cautious in using and interpreting interest related statistics.

According to structure-performance theories, in concentrated markets, there are rent opportunities (Gilbert, 1984; Hannan, 1991; Samad, 2008) although, there is evidence of fierce competition that has led to bank failures (Fungáčová &Weill, 2013). The last bank-specific control variable capturing the bank market structure effects is the Herfindal Hirshman Index (HHI). The index shows the concentration of the bank industry. It is calculated as the sum of the squared share of each bank (asset) in the market (s_i):

$$HHI_t = \sum_i^N S_i$$

To control for macroeconomic circumstances, economic growth in real GDP and inflation are the most relevant factors. These variables reflect the national level of real and nominal states. It is expected that economic growth (GDP growth) positively affects bank profitability. As the economy expands, there would be more demand for credit. While far less default would happen as enterprises can earn extra money and clear their debts. Moreover, the ratio of riskier customers is expected to fall in a stable monetary condition. Thus, inflation would have a positive impact on banks' incomes.

Since 2006, exogenous fluctuations such as national currency devaluation and the implementation of new regulations affected banks functioning in Iran. For all these, proper dummy variables are introduced and tested for their significance. Preliminary estimations showed only the relevance of the dummy variable for the last three years of the period, i.e., 2016 and 2018. During these years, the banking system experienced two different impulses: (1) new regulations forced banks to calculate their equity more accurately as localized IFRS guidelines, and (2) interest rate fluctuations changed banks' decisions on holding balances of liquid assets.

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Table 1 presents descriptive statistics for the variables used in the regression, along with their definitions. Of note, the average liquid assets ratio in our sample is nearly 10 percent, which is close to the lower experienced values by other countries (see the discussion under Figure 1). If one considers reserve hold with central banks as liquid assets, then the ratio will almost double to 18.5 percent. The minimum of 1.4 percent is extraordinary. Such a bank with expectedly is a newly privatized one and could raise its liquidity balances to the average of the sample in the short run.

EA is tier 1 capital divided by total assets. The mean for this traditional leverage ratio in the sample is 6.7 percent. The negative minimum belongs to one of the banks after the central bank insisting on reporting standards. As a result of calculating provisions for bad loans, the bank had to identify and report a remarkable loss. It seems rather that our sample banks have diverse revenue sources. The average of 0.37 and a maximum of 0.5 exemplifies concentrated revenues. Conversely, the negative minimum suggests a highly concentrated revenue structure, mainly because some banks, at particular time intervals, tended to have an interest-intensive revenue structure. In contrast, while examining Off-Balance Sheet Activities to Total Assets (OBSA) maximum values, they turned out to be huge numbers.

Turning to the cost side of the profit, the NFC deserve consideration. While the average seems reasonable, the extremes are extraordinary. The minimum, 0.053, belongs to the bank that had newly started operation as a private, efficient entity. In contrast, the maximum, 0.787, is for a transitioning bank that was going to be privatized while having too many branches and employees, thus maintained high operating costs. Interest expenses as a percentage of revenue for Iranian banks are among the highest in the world (see IMF Sectoral Financial Statements available at https://data.imf.org/regular.aspx?key=61404591); partly because, having roots in soaring interest rates which per se is affected by excessive, persistent inflation. Interestingly, there are periods that some banks have lent more than they could absorb deposits. The loan to deposit ratio has a maximum value of 1.07, which is not an exceptional situation in our sample.

Of traditional balance sheet ratios, loan to deposit, LD, is restricted by regulations through fractional reserves. Yet, at times of crisis, usually, by bailout plans or borrowing through overdrafts, central banks play their lender of last resort role. Therefore, sporadically, LD has exceeded even value 1. DCBA represents the ratio of bank borrowings from central banks, as a percentage of assets. The maximum values are observable in the last years of the sample period for privatized banks. Surprisingly, the large NPLs pertain

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to private banks, likely because privatized banks were forced to control their non-performing loans as well as having a vast amount of assets as the denominator of NPL. Finally, HHI values suggest that the Iran banking system, while it was utterly publicly-owned banks, has a more competitive structure in recent years.

Correlation ratios for variables as well as probability values (p-values are based on t statistic) are summarized in Table 2. The table provides clues for variable selection as well as hints to avoid collinearity.

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Table 1
Variables description

Variables	Abbr.	Description	Mean	St.D.	Min	Max
Dependent	ROA	Returns on Assets (%)	0.014	0.015	-0.046	0.051
Liquidity Ratio	ULA	Liquid Assets as a share of Total Assets. (%)	0.105	0.050	0.014	0.243
	LA	Liquid Assets (including reserves) as a share of Total Assets. (%)	0.185	0.051	0.047	0.322
Bank Specifics	EA	Equity to Asset Ratio (%)	0.067	0.031	-0.013	0.166
	DIVERS	Income Diversity Index	0.347	0.244	-0.514	0.500
	OBSA	Off-Balance Sheet Activities to Total Assets (%)	0.968	1.820	0.032	11.879
	NFCR	Non-interest Costs to Revenues	0.242	0.172	0.053	0.787
	IntCR	Interest Expenses to Revenues (%)	0.901	0.206	0.411	1.370
	HHI	HerfindalHireshman Index	0.110	0.008	0.099	0.124
	InvestR	Investments as percentage of Revenues (%)	0.251	0.262	0.061	1.729
	LnA	Logarithm of Total Assets (%)	5.387	0.564	4.099	6.346
	DCBA	Bank debt to Central bank and Other Banks (%)	0.083	0.069	0.000	0.364
	LD	Loan to Deposit ratio (%)	0.809	0.141	0.497	1.300
	LoanA	Loan to Deposit Ratio (%)	0.617	0.113	0.232	0.816
	NPL	Non Performing Loans as a share of Total Loans (%)	0.159	0.086	0.001	0.397
Country Specifics	GDPGrowth	Growth of Real Gross Domestic Product (%)	0.021	0.038	-0.074	0.082
	INF	Inflation (%)	0.171	0.082	0.090	0.347
Dummy	Dum1617	Dummy Variable for 2016 & 2017 take value 1, and 0 otherwise	0.154	0.363	0	1

Notes: This table represents the summary statistics of the variables used in the regressions. All bank-specific are obtained from the Iran Banking Institute Database (Reports on Financial performance of Iran's Banking System). All variables are calculated as percentages except for DIVERS, LnA, HHI, and Dum1617. Bank specific variables, as well as dependent variable and liquidity ratios, have variations cross-time and cross-banks.
Source: Research Findings

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Table 2
Correlation Matrix

	ROA	LA	ULA	LA2	ULA2	LnA	EA	LnmA	LD	lnCR	NFCR	DIVERS	OBSA	DCBA	lnmarR	HHI	GDPgrowth	INF
ROA	1.00																	
LA	0.89	1.00																
	0.00																	
ULA	0.81	0.92	1.00															
	0.00	0.00																
LA2	0.89	0.98	0.89	1.00														
	0.00	0.00	0.00															
ULA2	0.84	0.90	0.96	0.88	1.00													
	0.00	0.00	0.00	0.00														
LnA	-0.04	-0.13	-0.04	-0.13	-0.08	1.00												
	0.00	0.01	0.48	0.01	0.46													
EA	0.77	0.82	0.81	0.82	0.81	-0.48	1.00											
	0.00	0.00	0.00	0.00	0.00	0.00												
LnmA	0.22	0.16	-0.05	0.09	-0.04	-0.42	0.32	1.00										
	0.04	0.17	0.78	0.40	0.87	0.00	0.04											
LD	0.08	0.02	0.08	-0.01	-0.09	-0.06	0.05	0.40	1.00									
	0.44	0.84	0.47	0.96	0.78	0.60	0.74	0.00										
lnCR	-0.12	-0.07	0.17	0.12	0.22	0.09	0.01	-0.04	-0.44	1.00								
	0.28	0.51	0.11	0.27	0.08	0.37	0.93	0.90	0.00									
NFCR	-0.43	-0.40	-0.23	-0.38	-0.28	0.43	-0.33	-0.48	0.16	-0.27	1.00							
	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.13	0.01								
DIVERS	0.49	0.12	-0.07	0.10	-0.04	-0.60	0.35	0.57	0.48	-0.62	-0.09	1.00						
	0.00	0.28	0.64	0.36	0.71	0.00	0.00	0.00	0.00	0.00	0.58							
OBSA	0.47	0.38	0.39	0.36	0.38	-0.42	0.40	0.04	0.14	0.00	-0.20	0.16	1.00					
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.23	0.97	0.05	0.33						
DCBA	-0.01	0.13	0.22	0.09	0.17	0.41	-0.33	-0.17	0.14	-0.04	0.33	-0.10	-0.07	1.00				
	0.00	0.26	0.08	0.39	0.13	0.00	0.05	0.13	0.18	0.71	0.03	0.62	0.68					
lnmarR	-0.16	0.08	0.08	0.13	0.01	0.22	-0.04	-0.11	-0.02	-0.07	0.24	-0.10	-0.08	0.11	1.00			
	0.14	0.48	0.48	0.32	0.91	0.04	0.72	0.41	0.87	0.49	0.06	0.41	0.47	0.28				
HHI	0.33	-0.13	-0.15	-0.09	-0.11	-0.32	0.31	0.09	0.23	-0.21	0.23	0.27	0.04	-0.42	-0.64	1.00		
	0.00	0.27	0.25	0.38	0.33	0.06	0.06	0.40	0.10	0.20	0.02	0.09	0.74	0.00	0.00			
GDPgrowth	-0.09	-0.20	-0.14	-0.20	-0.12	-0.18	-0.20	0.17	0.13	-0.28	0.13	0.13	-0.10	-0.16	-0.02	0.08	1.00	
	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.00	0.01	0.22	0.08	0.02	0.86	0.43		
INF	0.01	0.08	0.09	0.02	0.07	0.04	0.01	-0.10	-0.12	0.34	-0.02	-0.07	0.02	0.10	-0.04	-0.02	-0.30	1.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.84	0.03	0.64	0.06	0.74	0.87	0.00	

Note: This table presents Pearson correlations for paired continuous variables. Values in highlighted rows are probability values for t statistics.
Source: Research Findings

All the variables were tested for stationary. We used Kao (1999) test for our panel with limited data, and the results indicated that the residual cointegration test for the models is confirmed by 5% (the t-statistic for ADF was -3.62). Moreover, we followed a precautionary approach by introducing a lagged dependent variable on the right side of the equation. This approach not only maintains a theoretical justification (current performance depends on the past performance by learning process and management attempt to keep the earlier records of success), helped us to avoid spurious regression. The resulting autoregressive model is estimated using the Arellano-Bond dynamic panel-data GMM method. All the reported coefficients are robust standard errors developed by Arellano (1987).

The dynamic system Generalized Method of Moments (GMM) panel methodology, developed by Blundell and Bond (1998), is an efficient and consistent methodology (Brei et al., 2013). However, Kim and Sohn (2017) echo the rationales Gambacorta and Mistrulli (2004) provided on the

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unreliability of the GMM results when the serial correlation of order two exists, or invalid instruments are used. Moreover, Roodman (2006) suggests that fixed effects estimators are superior alternatives to GMM only when time interval tends to be longer. As a result, additional instruments are required to make the dynamic panel consistent. These shortcomings are not present in our sample data, and therefore, we can apply the GMM as a superior methodology.

The unique feature of our sample is that, because of restricted regional activity and also limiting regulations, banks' business models are rather homogeneous. The only significant difference is that three of the seven banks in our sample are privatized large banks. Their organizational arrangement, diversification of services, profit management, and customer relationship management has been improved in recent years. We even tested by proper dummies whether the size of these banks is playing a significant role, but the hypothesis was rejected. However, from a liquidity management point of view, limited accessibility to different liquid asset instruments in Iran ensured us that our sample is not too diverse. Thus, the remark of Banerjee and Mio (2017) who mention that banks would make changes in their liquid assets portfolio because of introducing new regulations is not relevant here.

5 Results

Table 3 presents the results of the Arellano-Bond dynamic panel-data estimations for the dependent variable, ROA. The difference between theses specification lays in the introduction of quadratic ULA and other control variables. Before estimating the final models, the VIF test was applied to ensure non-collinearity between independent variables. All models are credible with significant Wald chi2 statistics. The first model is the base model. The specification captures the nonlinearity by including the quadratic form of ULA as the independent variable. While the quadratic ULA has a significant coefficient at 5%, it takes a positive value, i.e., a convex U- shape delineates the relationship between liquidity and profitability.

To put it in another way, as the banks have increased their liquid assets shares in total assets, they have experienced an increasingly high return to asset ratios. While examples of the positive association are extensive in the literature, for the sample with low levels of ULA, it is certainly reasonable. Eliminating ULA2 (a quadratic form of ULA), in all other regressions, the significant coefficient of ULA is positive. In Model 4, ULA2 is the only explanatory of liquidity with a positive impact at 10%.

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Table 3
RegressionResults: Arellano-Bond dynamic panel-data estimation

Variables	(1)	(2)	(3)	(4)	(5)	(6)
ULA	-0.090	0.030**	0.033**		0.028*	0.034***
	(0.056)	(0.014)	(0.014)		(0.014)	(0.013)
ULA2	0.454**			0.152*		
	(0.223)			(0.079)		
EA	0.355***	0.336***	0.351***	0.366***	0.368***	0.307***
	(0.059)	(0.038)	(0.045)	(0.046)	(0.045)	(0.060)
DIVERS	0.013***	0.012***	0.012***	0.013***	0.013***	0.011***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
NFCR	-0.024***	-0.021	-0.020	-0.020	-0.025*	-0.018
	(0.008)	(0.015)	(0.015)	(0.015)	(0.014)	(0.015)
HHI	0.605***	0.633***	0.708***	0.696***	0.719**	0.415***
	(0.138)	(0.139)	(0.169)	(0.169)	(0.174)	(0.145)
DCBA	0.017					
	(0.015)					
LoanA					-0.016***	
					(0.004)	
LnA						-0.010*
						(0.005)
LD	-0.009	-0.006	-0.007	-0.007**		
	(0.007)	(0.004)	(0.004)	(0.004)		
NPL	0.007					
	(0.015)					
InvestR	0.000					
	(0.003)					
GDPgrowth	0.052***	0.057***	0.062***	0.062***	0.065***	0.035***
	(0.019)	(0.015)	(0.018)	(0.019)	(0.017)	(0.012)
INF	0.015	0.018***	0.019***	0.018***	0.019***	0.011***
	(0.010)	(0.001)	(0.002)	(0.004)	(0.002)	(0.002)
DUM1617	-0.005**	-0.003				
	(0.003)	(0.003)				
Wald chi2(15)	342.240	61.800	559.100	467.280	1024.970	741.230
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Kao (t-statistic)	-3.92	-3.62	-3.56	-3.66	-4.02	-4.00

Notes: Constant terms and lagged dependent variables are included but not reported. *, **, *** denote significant at 10%, 5% and 1% level respectively. Values in parentheses are p-values for z-statistics.
Source: Research Findings

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The equity ratio and diversity index positively affect ROA at 1%. Significant positive EA coefficients suggest the risk-taking tendency of sample banks. In terms of diversity, the impact of approaching diversification is significant at 1%. Of note is the robustness of the coefficients for these variables.

Considering efficiency, NCFR is negatively related to ROA. While the coefficient is significant at 1% level in Model 1 and suggests a negative relationship in any specification, it is not significant in other models. Thus, explaining the coefficient of NCFR requires more attention.

Debt to central banks and other banks (overdrafts) has two contrasting effects. On the one hand, overdrafts incur interest; thus, banks might avoid overusing it to prevent more losses. On the other hand, banks may use this credit line to cover their inefficiencies regarding their growing NPLs. To the extent that banks identify income from their non-performing loans, as well as fail to calculate provisions as precisely as the regulations dictate, the relationship between NPL and ROA would be insignificant or even positive in the short run. However, loan-related variables, LD and LoanA, are suggesting significant negative relations at 5% in the last two model specifications.

The introduction of LnA as a proxy for the size of banks resulted in a significant effect (Model 6). To control for the collinearity, LD was eliminated from the model. The negative sign of this variable suggests that larger banks have less return on assets.

The last bank-specific variable measuring concentration in the industry shows that the structure of the market matters. The results suggest that more concentration has led to higher incomes, thus confirming the structure-profitability hypothesis. Meanwhile, as we examined in the descriptive statistics section, the Iran banking industry gets away from concentration.

Country-specific variables were almost significant with expected signs. Thus, the results confirm the procyclical effect of GDP growth on banks' performance. Dummy variable capturing the last two years' interest rate policy shocks and implementation of new financial reporting standards, takes negative sign, though its significance is more than 1%.

6 Robustness Tests

In this section, we examine the robustness of our baseline results. Here, alternative proxies for bank-specific banks as well as violating sample period length are analyzed. Table 4, you can find the results of the regressions using the same method, except for the last column. Model 6 of the table is the

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estimation result with random effects GLS method. Results confirm the positive relationship between ULA and ROA at a 10% confidence level. However, country-specific variables emerged to be insignificant.

Model 1 and Model 2 of Table 4 are representing regression results, as we have applied a broadened definition of the liquid assets. The broad definition includes bank deposits with the central bank, i.e., required reserves plus excess (free) reserves. Excess reserves are accessible freely and thus are liquid, though banks need them to make sure the clearinghouse of the central bank never punish them. Required reserves are not available unless customers' deposits with the bank diminish. Therefore, knowing all these, we regressed quadratic and linear form and found the results almost as the same. While the linear model failed to support a significant relation, the quadratic form confirmed the U shaped relationship, meaning that by the increase of LA, return on assets rises with accelerating speed. The introduction of LA instead of ULA does not disturb the signs or statistical significance of other variables in the models comparing variables with significant coefficients in Table 3.

In Model 3 of Table 4, we replaced IntCR with NFCR and ran the regression. The results suggest no significant relation between IntCR and the dependent variable. As noted earlier in section 4.2, the IntCR ratio captures the efficiency of a bank regarding interest flow management. Interest expenses account for a considerable proportion of bank costs, but generally, in income statements, these expenses are deducted from interest revenues resulting in net interest revenue of a bank. In analyzing such an essential factor, the degree of financial system freedom is crucial. Accordingly, IntCR in the Iran banking system reflects mostly policy interventions, as Figure 4.a shows that the trend of the IntCR has been rising in the last decade. Besides, IntCR fails to accompany ROA variations (Figure 4.b). Its time trend is without order (Figure 4.a)

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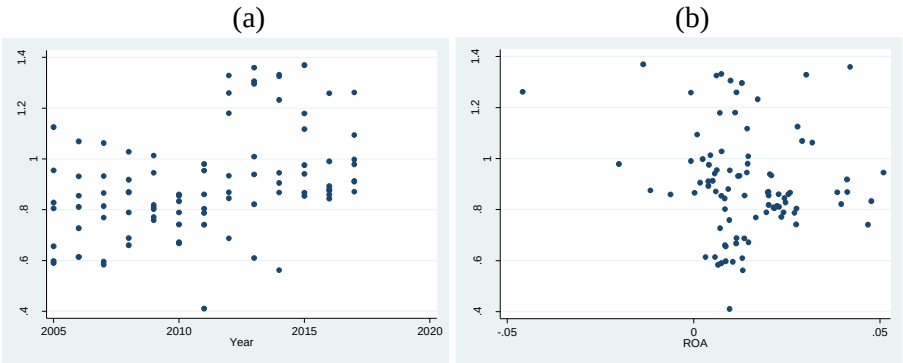

Figure 4. Scatter Plot of IntCR Trend (a) and IntCR-ROA (b). Source: IBI.ir

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Table 4
Regression results: Arellano-Bond dynamic panel-data estimation

Variables	(1)	(2)	(3)	(4)
LA	0.017	-0.085*		
	(0.020)	(0.047)		
LA2		0.261*		
		(0.145)		
ULA			0.033*	0.015*
			(0.018)	(0.009)
EA	0.308***	0.332***	0.343***	0.134*
	(0.049)	(0.061)	(0.062)	(0.071)
DIVERS	0.011***	0.011***	0.012***	0.010**
	(0.003)	(0.003)	(0.004)	(0.003)
IntCR			0.003	
			(0.009)	
NFCR	-0.024	-0.027*		-0.011
	(0.016)	(0.014)		(0.011)
HHI	0.608***	0.594***	0.523***	0.112
	(0.143)	(0.151)	(0.148)	(0.103)
LnA				-0.007***
				(0.002)
LD	-0.007*	-0.007**	-0.004	
	(0.004)	(0.004)	(0.004)	
GDPgrowth	0.053***	0.053***	0.047***	0.020*
	(0.014)	(0.015)	(0.014)	(0.016)
INF	0.020***	0.018***	0.012**	0.004*
	(0.003)	(0.004)	(0.005)	(0.007)
DUM1617	-0.003	-0.003	-0.002	
	(0.003)	(0.003)	(0.003)	
Wald chi2(15)	24.190	281.000	4553.540	358.820
	(0.001)	(0.000)	(0.000)	(0.000)

Notes: Constant terms and lagged dependent variables are included but not reported. *, **, *** denote significant at 10%, 5% and 1% level respectively. Values in parentheses are p-values for z-statistics.
Source: Research Findings

The last intervention is shortening the period by eliminating the previous two years of the sample period (Model 5, Table 4). This intervention did not change our main results. ULA is still significant, suggesting that even before 2016, ROA was affected positively by liquidity. Yet, country-specific variables are significant at 10%, likely because of period shortening.

7 Conclusion

This study deals with a disputable topic in liquidity management in the banking industry. While more liquid assets guarantee to avoid liquidity risk

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and widen managerial decision options to invest in new profitable projects, holding further liquidity entails opportunity costs. Therefore, empirical literature does not conclude in a robust relationship between liquidity and profitability. This paper provides a twofold contribution to the literature. It reviews the theoretical and practical literature in more detail to capture the explanations and shreds of contradictory evidence. As preliminary results, the conclusion was that at least three factors had played significant roles. First, an in-depth understanding of the relationship confirms both the positive and negative effects of liquidity on profitability theoretically. Second, model specification, as well as variable selection, is crucial. Third, sample characteristics impose different restrictions that would readily result in predetermined outcomes. The other contribution deals with the focus of the research on the rarely studied economy where the banking system has experienced privatization during the last decades.

The results with applying the quadratic model specification showed that only liquid asset ratio positively affects returns on assets. No sign of inverse-U relationship was recognized. We inferred that such an observation might have roots in low levels of liquidity held by Iranian banks. We found that equity to assets ratio and income diversification, both have a significant positive impact on profitability. Efficiency ratio measured by non-interest costs to revenues had a significant adverse effect on ROA of banks. We found pieces of evidence in favor of the structure-performance hypothesis, as the coefficient of concentration index, HHI, was strongly positive. However, the HHI trend was decreasing in the sample period. Moreover, the results confirmed the ROA pro-cyclicality as well as inflation's positive effect on performance for our sample.

As policy implications, our results confirm the positive effect of raising liquidity among Iranian banks. Moreover, authorities should reconsider the calculation and reporting of liquid assets. It may be resolved after the Basel III implementation, where extensive detailed liquidity ratios are introduced. Since implementing new standards requires information technology infrastructures, mainly up to date core banking systems, in the short run, central banks can focus on transitional ratios which reflect more realistic states of liquidity held by banks. Then the central bank can encourage banks to manage their liquidity balances and move towards profitability.

Future researches may conduct more detailed reviews of theoretical and empirical aspects of liquid asset holding in the literature. As a recommendation, one might categorize seemingly contradicting results by liquidity levels, bank business plans, time intervals, and country regulations

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to provide more insights into the recognition of the underlying interactions in liquidity risk management.

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