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The Role of Stability and Ownership Structure in Determining the Efficiency of US Bank Holding Companies

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Abstract

During the last three decades,the focus of regulatorshas been to enhance the stability of the financial system.However, there is little research as to how the desire for higher financial stability for bank holding companies would affect their efficiency. Byusing a dataset of 553 US Bank Holding Companies (BHC)for the period 2004 to 2015 and a dynamic panel methodology,this study investigates whether the efficiency of BHC was affected by the requirement for higher stability and ownership structure during the sample period. The empirical findings suggest that BHC with higher stability (lower risk levels) are relatively more efficient. Regarding the ownership structure, we find evidence that BHC with a higher proportion of institutional ownership, especially those that exerting market discipline such as mutual funds and hedge funds,positively affects the efficiency of BHC. On the other hand,a higher level of government ownership adversely impacts the efficiency of BHC.Overall empirical findings support the regulatory view that higher stability levels and close monitoring by shareholders help in improving efficiency. The results remain robust with alternative measures of efficiency. These findings have implications for regulators and investors alike as there is a need to carefully evaluate regulatory policies such that they may not adversely affect efficiency while keeping the banking sector healthy and stable.

Key words: *Risk-taking, ownership structures, Bank Holding Companies, efficiency,interactive variables.*

1. Introduction

The past few decades have seen regulators and policymakers making every effort to curb risk-taking behavior of banks and BHCs. Regulations were introduced at both the national and global levels including a series of Basel standards for capital regulations, the Dodd-Frank Act, and Volcker's rule to enhance the resilience of

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the banking and financial sector. Compliance with any such regulation requires adjustment of risk-taking behavior in order to ultimately enhance the resilience of these institutions. However, the desire for higher stability may have the unintended consequence of lowering the efficiency of banks. Furthermore, banks'decisions to achievea target level of stability while maintaining a desired level of efficiency are not taken in isolation. Previous studies focusing on the relationship between bank efficiency and stability (risk-taking) have not considered the simultaneous nature of these decisions[4]. There is a need to view both decisions as coordinated and hence model them accordingly. The development of a model based on the premise that banks take these decisions simultaneously, in a coordinated fashion, represents this study's principal contribution to the literature.

The empirical literature based on banks and bank holding companies (BHCs) suggests that their efficiency is linked to its ownership structure.Laeven (1999) suggests that the ownership structure is not only complex but multi-dimensional. Banks with major shareholding from governments are generally considered less efficient than privately-held banks or foreign banks (Micco, Panizza &Yanez,2007,2009; Lin & Zhang, 2009; Cornett,Guo, Khaksari &Tehranian, 2010; Pessarossi &Weill, 2015). On the other hand, a higher proportion of institutional shareholdings may result in better efficiency albeit with lower stability. This can be due to the institutional investor's ability to off-load their stake in the secondary market, and carrying a relatively smaller proportion of individual/family shareholding in their overall portfolio (Fox & Lorsch, 2012).Furthermore, ownership concentration in terms of family or individuals may also exhibit a different risk appetite (Ashraf, Ramady & Albinalib, 2016).

The existing literature on ownership structure usually assumes institutional investors are a homogenous group. However, the objectives for institutional investors managing funds on behalf of their customers can be different from those institutional investors holding shares for their portfolio[5]. This study extends the literature on the ownership structure of the US BHCs by subdividing the institutional shareholding into two categories. The first category being financial institutions comprised of banks including investment banks, and insurance companies. Thes econd category is made up of as set manager-types ofinstitutional investors and is comprised of mutual funds, hedge/equity funds, real estate investment funds, structured funds and union fund companies, trust and endowment funds.

4 There are several studies investigating the relationship between efficiency and ownership structures including: Jensen and Meckling (1976), Morck et al. (1998), Laeven (1999), Williams and Nguyen (2005), Fries and Taci (2005), Micco et al. (2007), Lin and Zhang (2009), Berger, Hasan and Zhou (2009), and Cornett et al. (2010). There are other studies that are based purely on BHCs such as Demsetz and Strahn (1997), Kohers, Huang, and Kohers (2000), Klein and Saidenberg (1997), and Fung (2006).

5 For a detailed discussion on the classification of different types of institutional ownership categories please refer to Çelik and Isaksson (2014).

By using a sample consisting of 553 US BHCs for the period 2004 to 2015 in a simultaneous equation model following the generalized method of moments instrument variable (GMM IV) approach, we find empirical evidenceto suggest that those BHCs which are more stable are highly efficient. We find that the market discipline imposed by having a higher proportion of institutional investors in the ownership structure of US BHC, especially those with an asset management focus positively affects efficiency whereasa higher proportion of government ownership adversely affects performance.

A most interesting finding of this paper is the unanimous result emerging from the interactive term "ownership categories with stability"whereby higher ownership in any category of ownership coupled with higher stability of BHC yields lower efficiency. The decrease in efficiency is more pronounced in both institutional ownership categories.

The empirical findings have important policy implications for both investors and regulators. There is a need for regulators to carefully design regulations that not only protect the stability of the financial system but also protects the incentives for shareholders in the form of the ability to generate investment returns as suggested by Çelik and Isaksson (2014).

The paper is organized in the following manner; section two providesa literature review while section three develops the empirical methodology utilized in this paper. Section four describes variables used in this study and section five provides details of data sources and descriptive statistics, empirical findings and robustness checks. Section six presents the conclusions.

2. Literature Review

Banking is an important channel aiding economic development (Levine, 2005). Altunbas, Gambacorta, and Marques-Ibanez (2010) argue that risk-taking by financial institutions can potentially impact growth, investment, and credit as well as have implications on macro-economic stability in the long run. However, financial intermediaries may function in a manner that could defeat these objectives (Barth, Lin, Lin & Song, 2009) and may lead to events such as the sub-prime mortgage crisis in 2008. Capital regulations are designed to keep a check on risk-taking behavior of financial institutions including BHCs through mandatory capital requirements.

Since raising additional capital may not be the preferred method to meet regulatory capital requirements, the consequence of stringent regulations may result in higher risk-taking (Laeven & Levine, 2009). To comply with higher capital requirements, financial institutions tend to opt for riskier portfolios togenerategreater profits(Koehn & Santomero, 1980; Buser, Chen & Kane, 1981; Lin, Hwang, Wang & Xie, 2013; Van

Xie, 2007). Financial institutions while complying with capital regulations simultaneously adjust their risk appetite (Shrieves &Dahl, 1992; Jokipii &Milne, 2011; Stolz, Heid & Porath, 2003; Ashraf, 2008) suggesting that the level of capital requirement can also affect the relationship between stability and efficiency. In other words, an increase in stability may follow a decline in efficiency levels (Fiordelisi, Marques-Ibanez & Molyneux, 2010). Altunbas, Evans and Molyneux (2001) studied the impact of risk-taking on efficiency and found that the level of financial capital has the largest influence on scale efficiency estimates. Meanwhile Kwan and Eisenbeis (1997) report that BHCs that are performing poorly with low efficiency levels take on higher levels of risk. Risk-taking behavior of financial institutions potentially affects the fragility of the financial system and has an impact on the economy of a country (Keeley, 1990). While Barth, Caprio and Levine (2008) found no evidence of improved stability even with extensive regulatory reforms and Basel guidelines. Furthermore, ownership structure has been found to play an important role in determining risk-taking behavior of financial as well as non-financial institutions (Jensen & Meckling, 1976; John, Litov, &Yeung, 2008; Laeven & Levine, 2009). Anderson and Fraser (2000) provide evidence that risk-taking is positively associated with managerial shareholding. By using a sample of international banks from 22 countries, over the 2004-2008 period Anginer, Demigruc-Kunt, Huizinga and Ma (2014) found higher risk-taking is associated with shareholder-friendly corporate governance.

Regarding the literature on the relationship between BHCs efficiency and ownership structure, Akhigbe, McNulty and Stevenson (2016) studied the effect of ownership on efficiency of publicly and privately held BHCs in the US and concluded that the difference in profit efficiencies was small to the extent that agency issues become irrelevant. Dong, Meng, Firth and Hou (2014) however, while focusing on efficiency and ownership structures of Chinese banks, conclude that higher ownership concentration in the form of government, state-owned enterprises, and private investors leading to more control and power improves efficiency. By using an international sample consisting of 289 banks from 15 European countries Micco et al. (2007) using a data set of banks from 197 countries from 1996 to 2002 report that banks with state ownership have lower efficiency levels as compared to privately owned banks. While Cornett et al. (2010), using a sample of South Asian banks from 1989 to 2000, found that state-owned banks had lower profitability as compared to private banks.

In terms of the stability and efficiency relationship Iannotta, Nocera, and Sironi (2007), by studying 181 banks from 15 European countries over the period 1999–2004, report that public sector banks are, on average, less profitable and riskier than other banks. Similarly Williams and Nguyen (2005), who studied the impact of ownership on performance for a sample of commercial banks in south Asia from 1996 to 2003,

report that financial deregulation and private ownership improved bank performance as compared to state owned banks. Sullivan and Spong (2007) investigated the owner-manager agency problems on a sample of US banks, their findings suggest that bank efficiency improves when managers have an ownership stake in the bank.

The above literature review suggests that ownership structure plays a significant role in determining the performance of banks however, the focus of these studies has been on foreign vs domestic, private vs state owned, manager vs owner and focus mainly on banks. There is limited literature available on how institutional ownership would affect BHCs efficiency except for Elyasiani and Jia (2008) who compared the performance and institutional ownership stability among BHC from the banking industry and less regulated utility and industrial firms to determine whether regulation displaces owner monitoring. They suggest that BHC performance is positively associated with institutional ownership stability, while better performance is more prominent during the era of financial deregulation and for those BHC with a lower likelihood of regulatory intervention. However, where the measurement of Institutional ownership stability is the main variable of interest in Elysiani and Jia (2008) we are using financial stability based on z-score measure as described by Lepitet and Strobel (2013). Our research also differs in its scope and definition of efficiency, Jia and Elysiani (2008) use profitability as their efficiency measure while we use operating efficiency as our efficiency measure. In addition, the relationship between efficiency and institutional ownership for BHCs has not been investigated especially after the 2007-2008 crisis when more regulations have emerged. It is therefore pertinent to review the relationship not only to fill the gap in the current efficiency literature but also to understand their implications towards the fragility of banking systems.

Since each group of shareholders have different investment objectives thatmay affect the efficiency of BHC we categorize ownership into three groups: family ownership, government ownership, and institutional ownership. In the case of institutional shareholding we sub-dividethe shareholders into two categories: financial institutional investor comprised of banks including investment banks, and insurance companies, and asset management institutional investors comprised of mutual funds, hedge/equity funds, real estate investment funds, structured funds, trust and endowment funds. Furthermore, both institutional investors may have different motivations for holding stocks of a specific bank and the ability to relinquish their position.

3. Empirical Methodology

Altunbas,Carbo, Gardener and Molyneux, (2007) argue that efficiency and meeting capital requirements are relevant determinants of risk-taking and moral hazard incentives for financial institutions. While Fiordelisi et al. (2010) argue that an increase

in risk may follow a decline in efficiency levels. Coles, Daniel and Naveen (2006, 2008) assume that financial risk, ownership and performance are jointly determined, while Kwan and Eisenbeis (1997) reported higher risk-taking by BHCs with lower efficiency. Given the possible endogeneity problem between efficiency and stability, we formulate a simultaneous equations model in which both variables are treated as endogenous variables:

$$STB_{it} = \alpha_0 + \alpha_1 EFF_{it} + \alpha_2 REG_{it} + \vartheta OWN_{ijt} + \varphi X_{it} + E_{it} \quad (1)$$

$$S\check{T}B_{it} + \beta_3 REG_{it} + \vartheta OWN_{ijt} + EFF_{it} = \beta + \beta_1 EFF_{it-1} + \beta_2 \wp Y_{it} + + \lambda_t + \quad \widetilde{\varepsilon}_{it} \quad (2)$$

where STB_{it} is the indicator of stability, EFF_{it} represents efficiency of US BHC *i* at timetfor ownership type *j*. SeeSection 4 for a definition of these variables. The discretionary EFF_{it}in (2) depends on the true value of the desired stability (STB_{it}) which is not observable. However, the observed level of efficiency (EFF_{it}) in equation (2) of a BHC can be determined by an endogenously determined adjustment STB_{it} in.Vector X and Y are observable bank and country/State-specific control variables to explain variations in stability and efficiency with possible common variables. λ_t is the (unobserved) individual and time-specific effects that reflect the panel nature of the data. $\tilde{E}_{it}$ and it $\widetilde{\varepsilon}_{it}$ are the error (idiosyncratic) terms that vary over time and between BHC.

Due to the presence of endogeneity concerns and simultaneous feedback we employ the instrument variable generalized method of moments (GMM IV) model as adopted by Arellano and Bover (1995), Blundell and Bond (1998). We use the two-step estimation procedure with the finite-sample correction of standard errors which produce coefficients less biased and lower standard errors as proposed by Windmeijer (2005). All regressions include the lag of the dependent variables, and for the instrument variables we used the lag of the dependent variable as well as ownership structure variables. We also use bank size, diversification, and liquidity as our instrument variables as they are suspected of not being strictly exogenous.

The following section describes the main covariates used in this study.

4. Definition of variables

4.1. Efficiency

The studies involving comparisons of financial intermediaries performance use different measures ranging from standard accounting ratios (Gedajlovic & Shapiro, 1998; Thomsen & Pedersen, 2000; Levine & Barth 2001; Berger, Demirguc-Kunt, Levine & Haubrich, 2004; Lin & Zhang, 2009) to non-parametric techniques such

as the stochastic frontier approach and DEA techniques (Kohers, Huang, & Kohers, 2000; Klein & Saidenberg, 1997; Fung, 2006; Altunbas et al. 2001; Lensink, Meesters & Naaborg, 2008; Lin, Doan, & Doog, 2016). Berger and Humphrey, (1992) suggest that inefficiency in the US banking sector is primarily operational and results from overuse of labor and capital inputs. Since regulatory enforcement may also lead to a higher burden on net operating revenue we define efficiency as the proportion of net operating revenues consumed by overhead expenses:

$$EFF_{it} = \frac{OE_{it} - NON_{it}}{NII_{it} + OI_{it}} \tag{5}$$

where OE_{it} is non-interest expense, NON_{it} is amortization of intangible assets, NII_{it} is net interest income and OI_{it} is non-interest income. Bank efficiency is a representative measure of the proportion of net operating revenues that are consumed by overhead expenses, hence a lower value, and would be indicative of greater efficiency.

4.2. Stability

Empirical literature cites Z-score as a widely used measure of bank risk/stability. See for example Laeven and Levine (2009), Demirgüç-Kunt and Huizinga (2010), Ashraf et al. (2016), Ashraf, Rizwan and L'Huillier (2017). As the research on the calculation of Z-score has evolved so have different methodologies on its calculation. This research follows the Lepetit and Strobel (2013) model and calculates Z-score as measure of stability as follows:

$$STB_{it} = \frac{\overline{r_{it}} + \mu_{it}}{\overline{\sigma}_{it}} \tag{6}$$

where subscript *i* indicates BHC and *t* indicates time. is the mean of the returns on assets, $\overline{\sigma}_{it}$ is the volatility of the returns on assets while is defined as the ratio between total equity capital and total assets. A lower STB_{it} of a BHC would point towards a higher probability of its failure. Previous literature reports that Z-score is highly skewed, so for all our estimations we used the logarithmic transformation of Z-score, and this is in line with Laeven and Levine (2009), Schaeck and Cihák (2012), and Ashraf et al. (2016). We expect a negative association of STB_{it} with EFF_{it} suggesting that BHCs enjoying higher stability are efficient BHCs.

4.2. Ownership structure

The ownership structure debate has generated a lot of interest and attention ranging from changes in ownership type to ownership concentration.Ownership structures may include different categories of investors with diverse investment objectives and risk management strategies. Hu and Izumida (2008) argue that different categories of shareholdings, whether concentrated or diffused, would either benefit the institutions

or could cost them depending upon the specific corporate governance environment.

Institutional investors are considered to be sophisticated investors due to their outreach, superior analytical skills, and access to resources not only to interpret market information but also to carry out a required strategy and have the ability to influence risk-taking decisions through their voting power (Barry, Lepetit & Tarazi, 2011). However, it is important to consider that the different categories of institutional investors may not have similar motivations for holding shares in a Bank Holding company, including monitoring and evaluation of the management. One of the important limitations of the existing literature is that it assumes institutional investors are a single homogenous group. However, institutional investors can easily be categorized into the two major categories mentioned above.

To capture the impact of types of ownership (denoted by OWN_{ijt}) on efficiency of BHC in the US, we use the proportion of each ownership category as described below:

i. FI_{it} – comprising of banks including investment banks, and insurance companies

ii. $INST_{it}$ – comprising of mutual fund, hedge/equity funds, real estate investment funds, structured funds andunion fund companies, trust and endowment funds

iii. $FAMILY_{it}$ – individuals and family

iv. GOV_{it} – government shareholding

By focusing on the percentage of ownership it is expected that OWN_{ijt}will capture the impact of individual categories of shareholders on efficiency.

Lin et al. (2016) argue that a true representation of the performance of a financial institution cannot be made using ownership measures in isolation and suggest the use of an interactive variable approach where cost efficiency is determined by the interactive variable of ownership structure and risk. Pessarossi and Weill (2015), while investigating the relationship between capital requirements and efficiency for Chinese banks, used interactive ownership with the capital ratio to explain its effect on efficiency. In line with Lin et al. (2016) we investigate whether efficiency is impeded or enhanced using the interactive term for ownership categories with stability. After incorporating the interactive terms, the simultaneous equation model can be written as:

$$STB_{it} = \alpha_0 + \alpha_1 EFF_{it} + \alpha_2 REG_{it} + \vartheta OWN_{ijt} + \omega OWN_{ijt} \times STB_{it} + \varphi X_{it} + E_{it} \quad (3)$$

$$EFF_{it} = \beta + \beta_1 EFF_{it-1} + \beta_2 \tilde{STB}_{it} + \beta_3 REG_{it} + \vartheta OWN_{ijt} + \omega OWN_{ijt} \times STB_{it} + \wp Y_{it} + \lambda_t + \tilde{\varepsilon}_{it} \quad (4)$$

4.4. Control variables

It is well established in the banking literature that stringent regulations improve theefficiency of financial intermediaries (Barth, Caprio & Levine, 2004, 2008; Barth,Lin, Ma, Saede & Song, 2013; Beck & Hesse, 2006; Chortareas, Giardone &Ventouri, 2012). To control for the impact of regulatory capital requirements on efficiency, we use the total risk-based capital ratio ($TRBCR_{it}$) as our regulatory measure.

Among other BHC specific control variables we used $SIZE_{it}$ as the proxy of size of the BHC and is calculated by taking the natural logarithm of total assets of BHC (Berger, Hancock &Humphrey, 1987; Berger & Mester, 1997; Al-Amarneh, 2014; D'Souza & Lai, 2003). We use DIV_{it} as the ratio of net non-interest income scaled by net interest income as a measure for income diversification (Ashraf & Goddard, 2012; Landskroner, Ruthenberg & Zaken, 2005; Baele, Jonghe & Vennet, 2007; Amidu & Wolfe, 2013; Acharya, Hasan & Saunders,2002; Hirtle& Stiroh, 2007). BHCs are prone to asset liability mismatch due to extending loans of long maturity with deposits of shorter-term maturity. To control for the effect of an asset-liability mismatch, following Iannotta et al. (2007), we use ($LIQUID_{it}$) as the ratio of net loans and leases to deposits.

Chortareas et al. (2012) use the Herfindahl-Hirschman's index to take into account market conditions, but Casu and Girardone (2006) caution that Herfindahl-Hirschman's index is a concentration measure and a poor proxy for market competition. Casu and Girardone (2006) use the panzer H-statistic instead to measure competition. Research by Phan, (2016) shows that market competition decreases efficiency, however they use the Lerner's index to calculate market competition and their sample is based on Asian banks. This paper uses Herfindahl- Hirschman's index as a proxy for market competition and this is in line with Chortareas et al. (2012). We expect a positive relationship with efficiency.

Previous research showed that broader economic indicators such as the GDP as the proxy for business cycles potentially affects the efficiency of financial institutions (Berger, Bonime, Covitz & Hancock, 2000; Daly & Ali,2010; Albertazzi &Gambacorta, 2009; Laeven & Levine, 2009; Demirgüç-Kunt & Huizinga, 2010; Bushman &Williams, 2012; D'Souza & Lai, 2003). Ashraf, Altunbas and Goddard (2007) suggest that for the US, a State-level GDP indicator is more appropriate. In this study we use $GSPG_{it}$, the natural log of the per capita Gross State Product growth for each State, as a proxy for business cycle fluctuations. We also use unemployment growth rate $UNEMP_{it}$ as a measure of the effect of unemployment on efficiency. We expect higher unemployment rates will correlate with lower efficiency. Following Athanasoglou, Brissimis and Delis (2008), to control for the effect of interest rate movement,

we use the effective federal fund reserve rate $EFFRR_{it}$.

Table 1 shows a full list of variables used in this study along with their definition.

5. Empirical Estimations

5.1. Data sources and descriptive statistics:

The data for this study is acquired from multiple sources. The sample includes a total of 553 BHC in the US for the period 2004 to 2015. The financial statement data for the US BHC is downloaded from the Federal Reserve Bank of Chicago. The ownership structure data is sourced from Capital IQ for the same period. While the Unemployment data is downloaded from the Bureau of Labor Statistics, US Department of Labor, The Gross State-wise Product data was obtained from The Bureau of Economic Analysis, US Department of Commerce for the period 2004 to 2015. We first matched and merged Ownership data with the financial data. We dropped data points where either financial data or ownership data were either missing or were obviously incorrect. We then merged this data to the Unemployment and Gross State-wise product data. To mitigate the impact of outliers, the entire dataset is winsorized at the 1st and 99th percentile. After these adjustments we were left with unbalanced panel data for 553 US BHC.

Table 1 reports the descriptive statistics of each variable in the sample after correcting for possible outliers; the data is pooled across BHC and across years. The descriptive statistics highlight that BHC in the sample, on average, represent 68 percent cost efficiency, a capitalization ratio of 14.90, and have an average stability score of 3.80 suggesting that BHC are not only efficient but also highly capitalized and stable during the sample period. The ownership structure in the sample indicates a tilt towards institutional ownership with the majority toward the asset manager-type of institutional investor with an average ownership stake of 19.23 percent.

Table 2 reports the correlation matrix.The associations between the covariates are generally in line with expectations. Efficiency and stability measures are highly, albeit inversely, correlated suggesting that higher stability leads to higherefficiency. Among other notables are the correlation between efficiency and the risk-based capital ratio, and various ownership categories. Since the correlation matrix identified a one-to-one relationship, there is a need for more comprehensive empirical analysis. The following section presents the empirical results for the model developed in the above section.

5.2. Estimation results

Table 3 reports the regression results by using the dynamic panel data estimation

IV GMM model. Two sets of estimation results are reported in Table 3. The first set reports the results without interactive terms while the second set reports the results with interactive terms. Panel A reports the estimation results based on the GMM model, while Panel B reports the diagnostic tests indicating that the model is appropriate for this study. The Hansen J-statistics for identifying restrictions tests the null hypothesis of valid instruments; the insignificant J-statistics indicates validity of instruments in the system GMM estimations.This estimated coefficient of F-test is statistically significant at the 5% level, justifying the use of the instrument variable model.

Among the most notable results shown in Table 3 is the negative and statistically significant relationship between efficiency andstability measure suggesting that BHC aiming for higher stability tend to be more efficient. This relationship may be explained by the fact thatin order to maintain higher stability levelsBHCmay engage in lower risk-taking that may result in higher efficiency levels.This result is in line with Fiordelisi and Molynuex (2011) who found that any reduction in efficiency was followed by increased risk-taking through lax standards and less intense monitoring of their credit portfolios

Among the institutional ownership categories, the coefficient of $INST_{it}$ is negative and significant. This suggests that market discipline imposed by having a higher proportion of institutional investors, mainly consisting of asset management companies, enhances the efficiency of US BHC during the sample period. Interestingly the other category of institutional ownership, $FI_{it,}$ is not significant suggesting the divergent role of the two categories of institutional investors.

In case of other categories of ownership, GOV_{it} is positive and significant. This suggests that higher government ownership adversely affects the efficiency of US BHC. This result is in line with past literature that among the different ownership categories government-owned banks are the least efficient (Bonin, Mizsei, Szekely& Wachtel, 1998; and Micco et al. 2007). The coefficient of $FAMILY_{it}$ is statistically insignificant albeit positive.

The second set of results in Table 3 introduces the interactive term of stability measure with that of proportionate ownership by categories to see whether higher stability coupled with higher ownership in specific categories of ownership help in improving the efficiency of BHC. A unanimous result emerging from the interactive terms is that higher ownership in any category of ownership coupled with higher stability of BHC adversely affects efficiency. This decrease in efficiency is more pronounced in both institutional ownership variables. The major difference in terms of the coefficients for individual categories of ownership is the change in significance level for FI_{it} and GOV_{it} and both the sign and significance level of $FAMILY_{it}$. A possible

explanation for the significance of the $FAMILY_{it}$ covariate in the second set of results is that BHC with significant family ownership may tend to focus on stability and not efficiency as reported by Anderson and Reeb (2003).

Regarding bank specific control variables, the coefficient of $SIZE_{it}$ is negative and significant in both sets of empirical results suggesting that BHC bigger in size enjoy-better efficiency due to economies of scale. These results are consistent with Barth et al. (2013) who found that large size tends to correspond with higher efficiency level. The coefficients of $TRBCR_{it}$ is positive albeit insignificant suggesting that regulatory capital is not a relevant factor in determining the efficiency of BHC during the sample period. In line with Ionnata et al. (2007), we find the coefficients of $LIQUID_{it}$ as negative and significant suggesting that higher liquidity levels reduces liquidity risk and improves efficiency.

The coefficient $DIV_{it,}$ as an indicator for income diversification, is not significant in the first set of results however, is negative and slightly significant in the second set of empirical results. This result is in contrast with the findings of Turkman and Yigit (2012) who suggest that higher diversification may lead to cost inefficiencies while our results point towards benefits of diversification where non-traditional sources of income contribute to higher efficiency levels. However,Lee, Meng-Feng and Yang (2014) cautioned that under different financial systems the relationship between diversification and performance is not simple one.

Among the macroeconomic control covariates, the coefficients of $GSPG_{it}$, $EFFRR_{it}$ and $HERF_{it}$ are negative and significant in both sets of results suggesting that the efficiency of BHC improves during economic growth periods, lenient monetary economic environments, and in concentrated markets. However, we do not find any evidence that State-wise employment growth has any effect on efficiency.

5.3. Robustness tests

Although cost efficiency is a comprehensive accounting measure this may not be reflective of the opinion of shareholders. Since the aim of this study is to understand the impact of ownership structure we use return-on-equity (ROE_{it}) as an alternative measure for efficiency. Hassan (2006) argues that as efficiency measures are correlated to ROA and ROE these can be used as an alternative measure for efficiency; however their sample was based on Islamic banks from 1995 to 2001.Following Bordo (1995) who use ROE for comparing efficiency of US and Canadian banks, we estimate the empirical results with ROE_{it}andreport them as below.

The empirical results based on alternative efficiency measures are reported in Table 4. There is no major difference in empirical results related to major variables

of interest namelystability, ownership structure, and their interactive terms. The revised estimations validate our previous findings as reported in Table 3 that ownership structure does affect the efficiency of BHC. The market discipline imposed by institutional investors, especially those with an asset management orientation, adversely affect efficiency. The impact is more pronounced among those BHCaiming for higher stability as indicated by the results from the interactive terms. However, there are some differences in terms of the bank-specific control variables both in signs and significance. Among the most notable are the coefficients for the regulatory requirement ($TRBCR_{it}$) that changed from positive and insignificant to negative and significant suggesting that higher capital requirements affects the income efficiency of BHC shareholders.

6. Conclusions

The turmoil in the banking industry arising from the subprime mortgage crisis of 2008 put a question mark on the stability of financial institutions. Attempts are made to curb excessive risk-taking through regulatory measures at national and international levels however, the revised regulations might have unintended consequences for bank efficiency. The main focus of this paper is to investigate whether the nexus of regulatory capital requirements, desire for stability, and ownership structure has an impact on the efficiency of BHC. By using a sample of 553 US BHC for the period 2004-2015, we find empirical evidence that the desire for higher stability positively impacts the efficiency of US BHC during the sample period. However, there is no evidence that BHCs, while meeting capital requirements, compromised on their efficiency.

One of the important contributions of this paper is the breaking down of institutional ownership into two broad categories. The most interesting finding of this paper is that the market discipline imposed by having a higher proportion of institutional investors in the ownership structure of US BHC, especially those with an asset management orientation,improves efficiency. Furthermore, the impact is more pronounced among those BHC aiming for higher stability levels as indicated by the results from the interactive terms. The empirical findings have important policy implications for both investors and regulators. There is a need for regulators to carefully design regulations that not only protect the stability of the financial system but also provide enough incentives for shareholders in the form of the ability to generate adequate returns on their investments. The relationship between efficiency and institutional shareholding warrants more research using the dynamic panel methodology for ownership in other countries especially emerging economies.

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Table 1: Descriptive Statistics

Variable	Definition of variables	Obs	Mean	Std. Dev.	Min	Max
EFFit	Efficiency - Non-interest expenses less the amortization of intangible assets as a percentage of net interest and non-interest income	4348	0.682538	0.139691	0.404212	1.328387
STBit	z_score	4272	3.796903	1.348714	-0.59993	9.001843
TRBCRit	Total risk-based capital scaled by total risk-weightedassets	4186	14.8982	4.029366	8.79	35.16
FAMILYit	Ownership by Individuals and Families	5353	0.503132	1.67732	0	10.78606
INSTit	Ownership by Mutual funds, hedge/equity funds, Corporations, real estate, Structured funds and Union fund companies, Trust and Endowment companies.	4835	19.23167	25.45226	0	92.48551
FIit	Ownership by banks, investment banks, insurance companies	5353	1.425078	2.745964	0	12.24452
GOVit	Ownership by Government	4835	0.497709	0.892782	0	3.43847
SIZEit	Size of firm-log of total Assets	4348	14.20915	1.658234	11.77993	21.66825
DIVit	Diversification 1- net non-interest income scaled by net interest income	4348	0.178759	0.103129	-0.00619	0.541928
LIQUIDit	Liquidity - loans to deposit ratio	4348	0.849757	0.205826	0.24404	6.79127
GSPGit	GSP growth rate	4835	0.009272	0.020345	-0.06188	0.058269
UNEMPGit	Unemployment growth rate	4835	-0.03949	0.162322	-0.24846	0.524729
HERFit	Herfindahl- Hirschman's index	5353	0.390791	0.28723	0	1
EFFRRit	Effective Federal Fund reserve rate	4835	1.120031	1.67026	0.04	5.17

Table 2: Correlation Matrix

	EFFit	**STBit**	**TRB-CRit**	**FAMit**	**INSTit**	**FIit**	**GOVit**	**SIZEit**	**DIVit**	**LI-QUID-it**	**GSPGit**	**UN-EMP-Git**	**HERFit**	**EEF-FRit**
EFFit	1													
STBit	-0.3206	1												
TRB-CRit	-0.1076	0.2244	1											
FAMI-LYit	-0.0496	-0.0282	-0.0478	1										
INSTit	-0.1072	-0.2546	-0.1107	0.1915	1									
FIit	0.0158	-0.1554	-0.0779	0.0527	0.408	1								
GOVit	-0.1762	-0.1844	-0.105	0.1747	0.8238	0.2769	1							
SIZEit	-0.1355	-0.2937	-0.1036	0.1896	0.6983	0.2812	0.8001	1						
DIVit	0.0559	-0.1335	-0.0427	0.1559	0.3065	0.1071	0.3708	0.4827	1					
LI-QUIDit	-0.0406	-0.1119	-0.3157	0.028	0.1504	0.0832	0.1214	0.1384	-0.0338	1				
GSPGit	-0.1136	0.0151	0.0065	-0.0106	0.0099	0.0059	0.0188	0.0127	0.0269	-0.039	1			
UN-EMP-Git	0.0504	-0.0187	-0.0548	0.0157	-0.0122	-0.0043	-0.0074	-0.027	-0.0274	0.0492	-0.6191	1		
HERFit	-0.0279	-0.1686	-0.0493	-0.0051	0.162	0.0456	0.1714	0.22	0.0677	0.0109	0.007	-0.0044	1	
EEF-FRit	-0.1845	-0.0263	-0.1594	-0.0094	-0.0151	-0.0067	-0.0057	-0.081	-0.1182	0.1125	0.1681	-0.0983	0.0574	1

Table 3: Estimation Results for Efficiency, Risk and Ownership.

Variables	Expected sign	(Estimation 1) EFFit	(Estimation2) EFFit
PANEL A:			
EFFit-1		0.5155***	0.5894***
		(0.0546)	(0.0505)
STBit		-0.1120***	-0.0977***
		(0.0115)	(0.0116)
TRBCRit	+	0.0020	0.0010
		(0.0018)	(0.0015)
FAMILYit	+/-	0.0021	-0.0137**
		(0.0018)	(0.0057)
INSTit	+/-	-0.0007***	-0.0035***
		(0.0002)	(0.0007)
FIit	+/-	-0.0007	-0.0157***
		(0.0014)	(0.0052)
GOVit	+/-	0.0235***	0.0059
		(0.0078)	(0.0218)
FAMILYit×STBit			0.0039***
			(0.0015)
INSTit×STBit			0.0009***
			(0.0002)
FIit×STBit			0.0044***
			(0.0013)
GOVit×STBit			0.0019
			(0.0054)
SIZEit	-	-0.0297***	-0.0224***
		(0.0064)	(0.0053)
DIVit	+/-	-0.0751	-0.1084*
		(0.0686)	(0.0572)
LIQUIDit	-	-0.0764***	-0.0644***
		(0.0266)	(0.0202)
GSPGit	+/-	-0.7551***	-0.7138***
		(0.1255)	(0.1245)

UNEMPGit		-0.0184	-0.0045
		(0.0143)	(0.0139)
HERFit	+	-0.0708***	-0.0559***
		(0.0249)	(0.0204)
EFFRRit		-0.0083***	-0.0063***
		(0.0016)	(0.0013)
Constant		1.2750***	1.0681***
		(0.1381)	(0.1228)
PANEL B: Model fit			
F-TEST		F(14,366)56.32***	F(18, 366) 65.08***
AR(1) test stat		-5.42***	-5.74***
AR(2) test stat		0.24	0.13
Hansen J-stat		361.99	357.30
Observations		3,421	3,421
Number of id		367	367

This table shows the estimation results of equations (1), (2), (3) and (4) using the dynamic panel data estimation IV GMM model. The dependent variable for efficiency is denoted as EFFitandmeasures the efficiency of US BHC in the sample. Sample period is from 2004-2015. Standard errors in parentheses.*** p<0.01, **p<0.05, * p<0.1.

Table 4: Robustness Check with Return-on-Equity (ROEit) as the Dependent Variable

Variables	**(Estimation 3) ROEit**	**(Estimation 4) ROEit**
PANEL A:		
ROEit-1	0.6254***	0.6672***
	(0.0632)	(0.0602)
STBit	-0.1226***	-0.0771***
	(0.0266)	(0.0213)
TRBCRit	-0.0067**	-0.0090***
	(0.0029)	(0.0026)
FAMILYit	0.0019	-0.0144
	(0.0023)	(0.0109)

INSTit	-0.0015**	-0.0037*
	(0.0006)	(0.0022)
FIit	-0.0016	-0.0187***
	(0.0017)	(0.0057)
GOVit	0.0539***	0.0957
	(0.0195)	(0.0791)
FAMILYit× STBit		0.0039
		(0.0029)
INSTit × STBit		0.0009
		(0.0006)
FIit × STBit		0.0050***
		(0.0014)
GOVit × STBit		-0.0183
		(0.0197)
SIZEit	-0.0586***	-0.0422***
	(0.0136)	(0.0102)
DIVit	0.2184***	0.1862***
	(0.0811)	(0.0525)
LIQUIDITYit	-0.0052	-0.0040
	(0.0447)	(0.0360)
GSPGit	0.0957	0.2004
	(0.1339)	(0.1364)
UNEMPGit	0.0117	0.0132
	(0.0280)	(0.0285)
HERFit	-0.0168	-0.0229
	(0.0416)	(0.0312)
EFFRRit	0.0224***	0.0229***
	(0.0019)	(0.0017)
Constant	1.5703***	1.1761***
	(0.3267)	(0.2676)
PANEL B: Model fit		
F-TEST	F(14,366)252.56***	F(18, 366)314.55***
AR(1) test stat	-1.87***	-1.88***
AR(2) test stat	0.95	0.77

Hansen J-stat	362.37	357.8
Observations	3,421	3,421
Number of id	367	367

This table shows the robustness check for the model using equations(1), (2), (3) and (4) using the dynamic panel data estimation IV GMM model using return on equity as dependent variable.Sample period is from 2004-2015. Standard errors in parentheses. *** p<0.01, **p<0.05, * p<0.1.