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BANKING FRAGILITY IN INDONESIA: A PANEL VECTOR AUTOREGRESSION APPROACH

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Abstract: *The objective of this study was to investigate the dynamic causality relationship between competition and banking fragility in Indonesia. Banking fragility phenomena in the world as well as in Indonesia have exuded some interesting issues to be investigated more. In this study, banking fragility was measured by efficiency and z-score. The relationship between competition and banking fragility has long been a controversy before several crises taken place in the world, either in theoretical or in empirical landscape. Among them is whether competition will create banking efficiency (competition-efficiency hypothesis) or lead to inefficiency in the banking system (competition-inefficiency hypothesis). Next, whether competition will create banking stability or lead to fragility in the banking system was also analyzed. Likewise, the effect of efficiency on banking stability was also analyzed. Analysis unit of this research was commercial banks operated in the period of 2005-2013. In this study, efficiency was estimated by the Stochastic Frontier Analysis, stability was analyzed by the z-score method, and competition was measured by HHI. The relationship between competition, efficiency and stability was tested by state-of-the-art Panel Vector autoregression and Granger Causality Analysis. The results of the study indicated that competition will reduce the level of banking efficiency as well as banking stability, whereas efficiency has a positive relationship with stability in both directions.*

Keywords: *Bank, competition, efficiency, stability, panel vector autoregression.*

1. INTRODUCTION

Banking institution is very important in the intermediation process of the modern economic world. Bank has a role in connecting a group of people with surplus with a group of people in need of money. Banking institution can be likened to the heart in the body of economy that functions to pump the 'blood' in the form of money and to distribute it to the organs of the body in need of blood. Therefore, if the 'heart' is paralyzed, the economic system will crumble. Several world occurrences have strengthened the statement above. Malaise 1930 is one of the most concrete

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examples. Although the crisis had originated from the shock in the capital market, shortly following the aftermath of the shock hitting the banking sector in the U.S., the successive impacts were immensely felt. The economic performance of the world was also stalled for a decade (Sukarman, 2014). Thus, the banking industry is the main channel where fragility is transmitted to other sectors in the economy by disrupting the interbank lending market and payment mechanism, and/or by reducing the availability of financing (Berger et al., 2009).

The central role and strategic position of bank in gas described above has inspired the writer to conduct a study on banking fragility in Indonesia. Fragility was measured by banking efficiency and z-score. Efficiency was estimated by the Stochastic Frontier Analysis approach. In addition, the effect of competition on banking fragility in Indonesia was analyzed. The effect of competition on banking fragility has long been a controversy among the academics and practitioners. In this study, the terms of fragility and instability have the same definition, so their uses are interchangeable.

Banking Fragility Phenomena in the World

In the last 25 years, there are a number of banking fragilities in various countries around the world. Caprio and Klingebiel (2003) have recorded 117 cases of systemic banking crises[*] and 51 cases of non-systemic banking crises in developed countries and emerging market countries since 1970.

Banking fragility has evidently raised a large amount of costs, one of which is in the form of fiscal resolution cost for the government. These costs include various expenses to rehabilitate the banking system, among which are bank recapitulation cost and payment to depositors or savings through the deposit guarantee scheme (insurance).[**] This cost estimation is shown in Table 1 below which summarizes 33 banking fragilities in various countries around the world.

The fiscal resolution cost is averagely substantial, namely 15% of GDP. This cost is higher in the emerging market countries, particularly if it is accompanied by currency crisis. In this case, currency crisis is defined as a nominal depreciation in the domestic currency (against the USD) at 25% combined with a 10% increase in the depreciation rate in the year of the banking crisis. This latest condition has been designed to remove the influence of a nation with high inflation that has high depreciation rate (Frankel and Rose, 1996).

* Systemic is defined as a situation where all or most of the capital in the banking system has been eroded (Haldane et al., 2005).

** In Indonesia,this institution is called LPS (*Lembaga Penjaminan Simpanan* – Indonesia Deposit Insurance Corporation) that is responsible directly to the President. This institution guarantees deposits up to Rp2 billion.

Table 1
Banking systemic fragility in the world in 1977 – 2002[a]

	Total Fragility	*Fragility Length (year), measured in mean*	*Non-Performing Loan (% of total loan)[b], measured in mean*	*Bank Credit/ Yearly GDP (%)[c], measured in mean*	*GNP per capita (USD 000) At the start of fragility, measured in mean*	*Cumulative fiscal cost on banking resolution (% of GDP) [d], measured in mean*
All countries	33	4.3	26.7	44.2	6.6	15.0
Only banking fragility	10	4.6	23.7	44.9	7.3	7.8
Banking fragility and currency crisis	23	4.2	28.2	43.9	6.3	17.4

Source: Caprio and Klingebiel (2003), Hoggarth and Sapotra (2001)

[a] Systemic is defined when fragility leads to all or most of the capital in the banking system eroded.

[b] Non-performing loan is financing with arrears more than 90 days.

[c] At the start of the crisis.

[d] Bank recapitalization, government pays to liability holder and public sector buys non-performing loan.

For example, the cumulative resolution cost for the crisis in Indonesia that had begun in 1997 was approximately 50% of GDP, while that for the crisis in Turkey was 30% of GDP (Haldane et al., 2005). Fiscal cost for bank resolution is actually a transfer of income from the current and future taxpayers to the stakeholders of the bank. There is no other choice for the government aside from bearing this fiscal cost with the objective to limit greater cost expenses if a rescue is not implemented. In other words, if the government only covers half of this fiscal cost, then the impact of banking crisis will be more severe. For instance, banking crisis was an important characteristic of the Great Depression of 1929-1933, and this crisis occurred because the U.S. government did not cover the fiscal cost due to limited capital support to help problematic banks and at that time there was no deposit insurance.

Banking Fragility Phenomena in Indonesia 1997 – 2000

Systemic banking fragility phenomena in Indonesia occurred in 1997 .At that time, there were 16 banks closed, namely: Bank Pacific, Sejahtera Bank Umum, Bank Harapan Santosa, Bank Andromeda, Bank Guna International, Bank Industri, Bank Jakarta, Southeast Asia Bank, Bank Umum Majapahit, Bank Pinaesaan, Bank Dwipa Semesta, Bank Astria Raya, Bank Kosagraha Sejahtera, Bank Mataram Dhanarta, Bank Citrahasta Dhanamanunggal, and Bank Industri.

The closure of 16 banks also resulted in the fact that BI (Bank Indonesia) had to provide bailout funds at Rp1.6 trillion to refund depositors under Rp20 million. The bailout funds that later on called as BLBI (*Bantuan Likuiditas Bank Indonesia*–

Bank Indonesia Liquidity Support) was the function realization of BI as the lender of last resort. Bank Indonesia also created other bailout funds, still in BLBI category, in the form of special SBPU (*Surat Berharga Pasar Uang* – Money Market Securities) at the end of 1997. The objective was to help 28 banks facing liquidity difficulties. At the end of 1997, the disbursement of BLBI funds had reached Rp48.8 trillion.

Furthermore, on April 8, 1998,the government froze the operation of 10 banks, referred to as BBO (*Bank Beku Operasi* – Suspended Operation Bank), namely: Bank Surya, Bank Pelita, Bank Subentra, Bank Hokindo, Bank Istismarat, Bank Deka, Bank Centril International, Bank Umum Nasional, Bank Dagang Nasional Indonesia, and Bank Modern. Andalso on April 8, 1998, 13 banks were taken over, referred to as BTO (Bank Take Over).* These banks received Bank Indonesia bailout funds, also called asthe second stage of BLBI. The banks receiving BTO treatment were: Bank Danamon, Bank Tiara Asia, PDFCI, Bank Central Asia, Bank Duta, Bank Nusa Nasional, Bank Risyad Salim International, Bank Tamara, Bank Pos Nusantara, Jaya Bank International, Bank Rama, Bank Niaga, and Bank Bali. These banks received bailout funds in the form of BLBI** (Sukarman, 2014).

The six banks receiving Bank Indonesia bailout funds that were also called the second stage of BLBI at a total of Rp16.4 trillion were: Bank Dagang Nasional Indonesia, Bank Central Asia, Bank Danamon, Bank Umum Nasional, Bank Indonesia Raya, and Bank Harapan Sentosa.

The reason that these banks were closed was because at that time bank interest rose sharply (reaching up to more than 30%). This condition led to the occurrence of negative-spread because the earning-asset of banking did not have the ability to generate income that could cover high fund cost. These losses would erode bank capital down to below CAR requirement of 8%. Hence, complication in the banking sector occurred. On the asset side, NPL occurred. On the liability side, deposit withdrawals occurred because of the declining public confidence in banks.

Increased Bank Competition. The policy package of October 1988 had a positive impact on the increase in the number of banks. The number of private banks increased by nearly 50% from only 66 banks in 1988 to 91 banks in 1989. In 1990, the number rose to 94 banks, and the trend continued in 1991 and 1992, respectively to 114 banks and 144 banks. Meanwhile, foreign and joint-venture banks started to grow in number since 1990. While there was only an addition of 11 banks in 1988/1989, the addition was more than twice as many in 1990, i.e. 28 banks; and in 1991, 2 banks were added, becoming 30 banks.

* *Bank Beku Operasi* (Suspended Operation Bank)is a bank that has been closed or liquidated. Bank Take Over is a bank that has been taken over by the government.

** The settlement of debts was done by bank owners through the Master Settlement and Acquisition Agreement (MSAA) or Master Refinancing and Notes Agreement scheme.

Branch offices as the spearheads of banking expansion were increasing as well. Whereas in 1988 the number of branch offices was only 1,729 offices, in 1989 and 1990 the numbers were, respectively, 2,578 and 2,842 offices. In 1991 and 1992, the numbers of branch offices respectively increased to 3,710 and 4,402 banks. The complete information is presented in Table 2 below.

The increase of banks and branch offices of private banks has changed the structure of banking dominance. While before the deregulation the banking market share had been dominated by the state-owned banks, in 1993 the market share has started to balance. In 1989,the state-owned banks dominated the market share at 54.38%, whereas private bank only occupied 31.85%. In 1993,the state government only controlled 46.77% and private banks controlled 41%. This indicates that banking deregulation has strengthened the position of private banks in the competition against the state banks.

Table 2
Bank Growth in Indonesia in 1988-1992

Total Office/Bank	*1988*	*1989*	*1990*	*1991*	*1992*
Private Banks	66	91	94	114	144
Foreign and Joint-venture Banks	11	11	23	28	30
Total Commercial Banks	111	136	151	176	208
Total Offices of All Commercial Banks	1729	2578	2842	3710	4402

Source: Bank Indonesia, several years processed

2. LITERATURE REVIEW

Financial stability, as opposed to financial fragility or instability, refers to the situation where the functions of institution (banking stability) and market that forms the financial system run well. Financial and monetary stabilities are the main prerequisites for the functioning of an economic system. Financial stability is the basis for rational decision making on the allocation of real resources at all times, and therefore it improves the climate of savings and investments. Financial fragility will create dangerously uncertain condition that will lead to the misallocation of resources and the reluctance to perform inter temporal contract. In extreme cases, the disturbance in financial sector will cause a devastating impact on economic activities and even on political stability. Thus, maintaining financial stability is the main objective of financial authority (Crockett, 1997).

There is no generally accepted definition on financial stability. In simple terms, it can be said that financial stability is a situation where there is no financial fragility or instability. Financial fragility can be explained as a situation where economic performance is potentially weakened or worsened by the fluctuation of financial

asset prices and/or the inability of financial institution to perform its intermediary function according to its contractual obligations. This study examines the fragility caused by banking inability in performing its intermediary function.

Banking Fragility

The theory underlying banking fragility on the liability side is the Prisoners' Dilemma theory. It is known that the loss of public confidence in banks will lead to simultaneous and instantaneous fund withdrawals (rush or run). The behavior mechanism underlying these phenomena has been studied, for instance, by Diamond and Dybvig (1983). Basically, bank fragility occurs due to the interaction between the generally short-term liquid liabilities and the generally long-term illiquid assets.

The portfolio of a commercial bank will be stable if the withdrawals by depositors are not made simultaneously and instantaneously. With stable deposit basis, a commercial bank will have sufficient liquidity to face normal withdrawals (of course plus a margin to cope with measured fluctuation) and to invest the rest on less liquid assets but with adequately high return. If something happens, causing the escalated deposit liquidation, then it is very rational if all depositors will withdraw their funds. This is because all depositors know that if deposit liquidation continues, bank will have to sell itsilliquid assets that will lead to bank losses and erode its capital. Although the depositors trust that the bank will be solvent in normal deposit liquidation situation, and even if all depositors believe that the bank will serve the interest, depositors will still withdraw their funds.

Banking fragility on the asset side is due to asset quality problem, namely: disaster myopia, herd behavior, preserve incentives, and negative externalities. Disaster myopia occurs because financial disaster rarely happens, so it is impossible to use the actuarial probability to project an occurrence in the future; or there is a policy regime change that has not been accounted previously when the credit decision was made. In the terminology of Frank H. Knight (1985), the possibility of this occurrence is an unmeasured uncertainty and is not the understanding of risk that can be calculated actuarially. In this condition, it is certainly not worth it if banks devote their time to analyze such possibility. Banks also assume that impending disaster will be occluded by the financial authority. The hope in rescue is likely to be stronger when the magnitude of the disaster is greater or more extreme and results in greater impact on the financial institution.

***Herd Behavior*:** Furthermore, the different aspect from loan disbursement that often causes problem is herd behavior. This behavior can be a manifestation of irrationality, but it can also mirror the effort to act rationally in uncertain condition (Davis, 1995). The fact that other banks extend credit to certain customers is usually used as a reference regarding the creditworthiness of those particular customers. In addition, banks will assume that if there are many banks involved, then the

authority will be more concerned in conducting a rescue if there is a problem in the credit disbursement.

***Perserve Incentives*:** A fairly fundamental problem is that management compensation structure can create perverse incentives which in turn are a matter of principal-agent problem (Ross, 1973). For example, the expectation to receive bonus will make bank management act less cautiously in the process of financing decision making.

***Negative Externalities*:** These negative externalities phenomena occur when the cost of company decision is distributed to outside parties, such as bank creditors, in increasing numbers. These can happen in any industry, but these phenomena mostly occur in banking, caused by the relatively small cushion in the form of capital compared to its total assets. Smaller bank capital will lower owner's loss if disadvantageous occurrence happens, and it will increase the willingness to implement high-risk high-return strategy (Dewatripont and Tirole, 1994).

Principal-agent problem and negative externalities are examples of moral hazard. More generally, the whole rational explanation on bias leading to financial intermediary fragility is rooted on imperfect information (asymmetric information). The behavior mechanism leading to financial institution fragility can be worsened by competition. Market power, for instance, can encourage disaster myopia. Creditors that do not consider disastrous outcomes in their loan-pricing decision will surely be more competitive than creditors that take them into account, so it encourages the later creditor to leave the market or push the price into line. The disadvantage of negative result cannot effectively discipline credit decision because they appear rarely to influence healthy credit disbursement behavior.

Contagion: Another reason why financial industry is often seen as the main source of systemic fragility is because financial industry is considered highly vulnerable against failure contagion that hits financial institutions. Contagion is seen as more likely to occur in the financial industry compared to in other industries. There are two reasons for this:

- First,there is a network of interlocking claims and liabilities through the interbank market, over the counter derivative transactions, and payment and settlement system (Schoenmaker, 1996). This has become more important and complex these days because the national and international capital markets have been integrated.
- Second, asymmetric information makes it more difficult for creditors to assess the strength of a financial institution based on the information available to the public compared to assessing the strength of other industries. Therefore, creditors tend to consider a company's difficulties as the fragility indicative of other institutions that have the same business structure.

Compared with other industries, the contagion of bank failure is considered to: occur faster, spread widely, generate a number of more failures, cause higher creditor's loss, and prompt bigger distortion on the economy.

Payment and Settlement System: As previously described, the main source for contagion risk lies in the payment and settlement system. The banks participating in the payment system, on its own behalf or on behalf of its customers, have an exposure to credit risk starting from the time of payment to the counter value received. The linkage between financial institutions does not only occur at the national or domestic level, but also at the international level. Various payment systems in more than one geographical area in the world have formed the global payment system that raises a more complex risk level.

Competition and Efficiency

There are two views on the relationship between competition and efficiency, namely the competition-efficiency and competition-inefficiency views. In the competition-efficiency view, an increase in competition will also increase profit efficiency. This hypothesis is based on the efficient structure hypothesis developed by Demsetz (1973). Exogenous factors such as deregulation will surely improve competition. Furthermore, this competition will encourage banks to minimize costs so that the banks will be more efficient. The assets and market share of efficient banks will naturally increase "at the expense" of inefficient banks. This in turn will increase market concentration (Vander Vennet, 2002). On the contrary, uncompetitive market will cause bank manager to enjoy a quiet life where costs are not controlled well, resulting in increased inefficiency (Pagano, 1993). Therefore, based on this hypothesis, competition is allegedly to Granger-cause efficiency.

In the competition-inefficiency view, competition will lead to decrease bank efficiency. This is because competition will result in short-term relationship between a bank and its customers (Boot and Schmeits, 2005), for example, because of "price war" in competitive environment. So, to maintain customers' loyalty, higher cost is needed, resulting in increased inefficiency level (Evanoff and Ors, 2002). In this case, competition Granger-causes declining of efficiency.

Bank Competition and Stability

The effect of competition on bank stability currently is still debated in banking literature (Berger et al., 2009). In the traditional view of "competition-fragility", increased competition will erode market power, decrease profit margin, and lead to decreased franchise value, namely on going concern or bank market value outside of its book value. In this situation,banking will take more risk to improve its profit (Keely 1990; Demsetz et al., 1996). For example, Keely (1990) has discovered that

increased competition and deregulation followed by restriction relaxation on branch opening in the U.S. in the 1980s had eroded profitability and resulted in bank failure.

Likewise, Helmann et al., (2000) has stated that the elimination of interest ceiling on deposits has eroded profit and increased moral hazard behavior in banks. Some of the latest empirical studies are consistent with this view, namely that increased competition is related to the increased risk of financing portfolio measured by problem loan level in Spain (Jimenez et al., 2007).

A different view from competition-fragility is known as competition-stability view. Boyd and De Nicolo (2005) have stated that increased market-power in the loan market will lead to increased bank risk because the rise of interest-rate charged to financing customers will make it difficult for customers to serve the debt. Increased interest will also burden customers with more risk due to adverse selection.

Another rational opinion from the competition stability view is that the highly concentrated banking market will cause banks to take higher risk if bank industry believes in the too big to fail view and it feels protected, explicitly and implicitly, by the government safety net. Several empirical studies have been consistent with this view. De Nicolo et al., (2004) have found that Z-index, the inverse measurement of bank risk, decreases along with the increasingly concentrated market measured by Herfindahl-Hirschman index. This means that bank failure risk will increase in increasingly concentrated market.

Schaeck et al., (2006) have implemented a log it model and duration analysis and found that more competitive banking system (measured by Panzar and Rosse H-statistic) has smaller chance of bank failure and takes longer period of time to enter to the crisis, and therefore is more stable compared to the monopolistic system.

Efficiency and Stability

Furthermore, the literature in industrial organization shows that competition improve company's efficiency (Tirole, 1998). At the same time, banking literature also points out that more efficient banks have better evaluation and monitoring procedures, so they reduce the occurrence possibility of non-performing loan, and it means that banking stability will be better (Peterson and Rajan, 1995; Berger and Mester L, 1997; William, 2004).

Research Objectives and Hypotheses

Banking fragility phenomena, whether in the world or in Indonesia in particular, described above have exuded several interesting issues to study further. Among them is whether competition will create banking stability or become the cause of fragility in the banking system. The relationship between competition and bank

stability had been debated before various crises in the world occurred whether in theoretical or empirical landscape.

Likewise is the relationship between competition and efficiency; whether competition will create banking efficiency (competition-efficiency hypothesis) or competition will cause in efficiency in the banking system (competition-inefficiency hypothesis).

Another interesting issue arising from banking fragility phenomena is how the dynamic causality relationship between the nexus of competition, efficiency, and stability is.

Furthermore, based on the above theoretical studies, the objectives and hypotheses of this study can be compiled as described in the following table:

Table 3
Table of Objectives and Hypotheses

Objective	*Hypothesis*	*Reference*
To analyze the effect of competition on banking stability in Indonesia	**H_1:** Banking competition disturbs or decreases banking stability.	Jimenez et al., 2007 Keely, 1990 Boyd and De Nicolo, 2005 Schaeck, 2006
To analyze the effect of competition on banking efficiency in Indonesia	**H_1:** Competition increases banking efficiency.	Demsetz, 1973 Berger and Hanan, 1989 Venet, 2002 Evanof and Ors, 2002 De Young, Hasan, Kirchoff, 1998
To analyze the effect of efficiency on bank stability in Indonesia.	**H_1:** Efficiency increases banking stability.	Peterson and Rajan, 1995
To analyze the effect of stability on banking competition in Indonesia	**H_1:** Banking stability decreases banking competition.	Research gap
To analyze the effect of efficiency on banking competition in Indonesia	**H_1:** Efficiency increases competition banking.	Research gap
To analyze the effect of stability on efficiency in Indonesia.	**H_1:** Stability increases efficiency banking.	Research gap

3. RESEARCH METHODOLOGY

The study was about banking research in Indonesia, so the study was fully located in Indonesia. The period for this study was from 2005 to 2013 or covering a research period of nine years. This study was formal and ex post facto. The depth and discretion of this study show that this study was a statistical study conducted cross-sectionally on a number of banks at the same time period and time series for the period of study of 2005 – 2013.

Therefore, the analysis unit in this study was the banking industry in Indonesia, consisting of commercial banks operating in Indonesia with the period of study of 2005-2013 or of nine years. The development in the number of banks in Indonesia is presented in Table 4 below:

Table 4
The Development in the Number of Commercial Banks in Indonesia

2005	2006	2007	2008	2009	2010	2011	2012	2013
131	130	130	124	121	122	120	120	120

Source: Indonesian Banking Statistics, Bank Indonesia (2005-2013)

However, based on Gamaginta (2009), not all banks were included in this study. In this study, Bank BPD group was removed from the observation considering that the market segment of BPD is more regional oriented and its operational focuses more on the support for each regional's financial activities which results in the high profitability level of BPD. As an illustration, based on the Indonesian Banking Statistics (Bank Indonesia, 2009), Bank BPD group has averagely 3.44 % ROA for the last five years (2005-2009), while the ROA for other bank groups (foreign bank group excluded) is approximately under 3%.

In addition, this study was also limited to conventional banks only, considering that the assets of sharia (Islamic) banks are still inconsiderable, namely still below 5% of the total assets of the national banking. This study was also limited to the banks with total assets more than Rp1 trillion per December 2013 position. This was to consider the significance with the total assets of banking in Indonesia (asset value of Rp1 trillion is equivalent to 0.4% of the total assets of banking).

The selection of the period of study of 2005-2013 was intended to see the stability dynamic of the banking system by including stressing conditions, namely the 2008 global financial crisis due to subprime mortgage crisis in the U.S.

Data Sources

The data used in this study were secondary data with quarterly frequency from the banking financial reports listed in BI during the period of 2005-2013, BI banking statistics, and the economic statistics of Indonesia listed in BI. The quarterly data frequency was chosen to conform to the financial report period of bank publication that has to be published in the mass media quarterly, which is an implementation of banking information disclosure. Several issues noted in the data collection from these sources were:

Accounting data on the financial performance and bank portfolio can be obtained from BI banking statistics and non-audited monthly financial report (LBU) that can be downloaded from BI website.

Banking industrial data was based on BI banking statistics that can also be obtained from BI website.

Sampling unit was the banking operating in Indonesia. Sampling frame was the banks listed in Bank Indonesia which had published Financial Reports for the period of 2004-2013. Sampling size was all banks listed in Bank Indonesia which had met the determined criteria. This study used purposive sampling and judgment sampling.

Variable Operationalization

Variables, definitions, and indicators used in this study are outlined in the table below:

Table 5
Variable Operationalization

Variable	*Definition*	*Indicator*	*Scale*
ROA	The ability of a company to produce profit based on the total assets owned.	$\text{ROA} = \frac{\text{net income}}{\text{total aset}}$	ratio
Z-score	Reflects bank stability measured by probability of insolvency of a bank. Source: Schaeck and Cihak (2008)	$Z_{it} = \frac{\text{ROA}_{it} + \left(\frac{\text{EQ}}{\text{TA}}\right)_{it}}{\sigma_{\text{ROA}}}$	ratio
HHI	Is a measure of concentration and sum of squares of market share multiplied by 10,000. HHI is between 0 and 10,000. The number 10,000 occurs if there is only a single company in the market, and the number 0 occurs if there is an infinite number of small companies in the market. Source: Baye (2010)	$\text{HHI} = 10.000\ \Sigma w_i^2$	ratio
Cost Inefficiency	The amount of cost (input) that can be reduced without decreasing output. Source: Kumbhakar (2015), Battese and Coelli (1995)	$\text{TE}_{it} = \exp\left(z_{it} \cdot \delta + w_{it}\right)$	ratio
Input price	Is a price of input from a bank in a production process. *Source:* Rouissi and Bouzgarrou (2012)	$\text{Price of employee} = \frac{\text{employee cost}}{\text{total aset}}$ $\text{Price of operating cost} = \frac{\text{operating cost}}{\text{total asset}}$ $\text{Price of fund} = \frac{\text{total interest cost}}{\text{total purchased fund}}$	ratio

Efficiency Analysis with SFA

The estimation of cost efficiency in this study was conducted by using the Stochastic Frontier Model* developed by Battese and Coelli (1995). In this case, the term of inefficiency was drawn from the truncated normal distribution.

Several points that become the main features of this model are (Kasman and Carvallo, 2005):

This model enables the implementation of environmental differences and analyzes the effect of these variables on estimated efficiency scores.

This model is able to observe bank-specific and intercept shift which varies against time in the distribution of inefficiency term, and the intercept shift itself is a function of exogenous environmental variables that can vary if, for instance, the study was conducted between nations.

Furthermore, by assuming that the cost for bank-*i* and on time-*t* are a function of output *Y*, input price *w*, inefficiency *u*, and random error *v*, then the cost function can be formulated as follows:

$$\ln TC_{it} = f(Y_{it}, w_{it}) + v_{it} + u_{it} \tag{3.1}$$

where:

- *TC* reflects total cost with $u_{it} \geq 0$
- *Y* reflects output, in this case is bank's earning asset.
- *w* is input price
- v_{it} is the random error of bank-*i*on time-*t* distributed by $N(0, \sigma_v^2)$ independently and identically; and distributed independently from u_{it}.
- u_{it} is distributed independently and is obtained by truncation (at zero value) of normal distribution, where:
  - Mean $m_{it} = z_{it} \cdot \delta$
  - Variance σ_u^2 where $N(m_{it}, \sigma_u^2)$
  - Whereas z_{it} is a vector (1xm) consisting of ROA_{it}, $EQTA_{it}$, and $LLPCR_{it}$.

    Description:

    - $ROA_{it} = \dfrac{\text{Earning before tax}}{\text{Asset}}$ for bank-*i*on time-*t*

* The decision of using SFA method instead of the non-parametric method of Data Envelope Analysis was because SFA has an advantage, namely it considers that the deviation of frontier is not mainly due to inefficiency factor. The distance between input or output observed and frontier is caused by both inefficiency and the noise from the data as a result of imperfect measurement of input or output as well as unstable economic environment (Kuchler, 2013; Reynaud and Rokhim, 2004).

- $EQTA_{it} = \dfrac{\text{Equity}}{\text{Aset}}$ for bank-*i*on time- *t*
- $LLPCR_{it} = \dfrac{\text{Loan Loss Provision}}{\text{Total Loans}}$ for bank-*i*on time- *t*

◦ The inefficiency effect, u_{it}, in the equation (3.1) can be stated as:

$$u_{it} = z_{it} \,.\, \delta + w_{it} \tag{3.2}$$

Explanation:

- δ is a vector (m x 1) of unknown coefficient.
- w_{it} is defined by the truncation of normal distribution, where the truncation point is $z_{it} \,.\, \delta$

Maximum likelihood method was used to conduct simultaneous parameter estimation in the stochastic frontier and technical inefficiency models. Furthermore, Battese and Coelli (1995) have shown that cost inefficiency for an individual bank can be defined as follows:

$$TI_{it} = \exp(u_{it}) = \exp(z_{it} \,.\, \delta + w_{it}) \tag{3.3}$$

In the cost function modelling, a trans log functional form was adopted because it did not need many restrictive assumptions on the nature of technology. A Stochastic frontier cost function with three inputs can be specified as follows:

$$\begin{aligned}
\ln\left[\frac{TC}{w_3}\right]_{it} &= \beta_0 + \beta_1 \,.\, \ln\left[\frac{w_1}{w_3}\right]_{it} + \beta_2 \,.\, \ln\left[\frac{w_2}{w_3}\right]_{it} + \beta_3 \,.\, \ln Y_{1it} + \beta_4 \,.\, \ln Y_{2it} \\
&+ \frac{1}{2}\beta_5\left[\ln\left(\frac{w_1}{w_3}\right)\right]^2_{it} + \frac{1}{2}\beta_6\left[\ln\left(\frac{w_2}{w_3}\right)\right]^2_{it} + \beta_7\left[\ln\left(\frac{w_1}{w_3}\right)\ln\left(\frac{w_2}{w_3}\right)\right]_{it} \\
&+ \frac{1}{2}\beta_8(\ln Y_1)^2_{it} + \frac{1}{2}\beta_9(\ln Y_2)^2_{it} + \beta_{10}(\ln Y_1 \ln Y_2)_{it} \\
&+ \beta_{11}\left[\ln\left(\frac{w_1}{w_3}\right)\ln Y_1\right]_{it} + \beta_{12}\left[\ln\left(\frac{w_1}{w_3}\right)\ln Y_2\right]_{it} \\
&+ \beta_{13}\left[\ln\left(\frac{w_2}{w_3}\right)\ln Y_1\right]_{it} + \beta_{14}\left[\ln\left(\frac{w_2}{w_3}\right)\ln Y_2\right]_{it} + v_{it} + u_{it}
\end{aligned} \tag{3.4}$$

where:

- TC is bank's total cost in certain year.
- Y is output. Y_1 is the loan extended. Y_2 is other earning asset.

- u_{it} and v_{it} are respectively inefficiency and error terms.
- w is input price:
  - w_1 = employee cost divided by total asset
  - w_2 = price of operating cost = operating cost/total asset
  - w_3 = total interest cost/interest bearing funding
- For cost function, composite error term is $v_{it} + u_{it}$
- Cost efficiency scores are estimated using translog functional mode.

Competition Analysis

Following Wen and Yu (2013), competition measurement used Herfindahl-Hirschman Index based on bank assets:

$$\text{HHI} = 10.000.\ \Sigma(\text{market share based on asset})^2 \tag{3.5}$$

Bank Stability Analysis

Bank stability estimated by using Z-score based on the following formulation:

$$Z_{it} = \frac{\text{ROA}_{it}}{\sigma_{\text{ROA}}} + \frac{\left(\frac{\text{EQ}}{\text{TA}}\right)_{it}}{\sigma_{\text{ROA}}} \tag{3.6}$$

where,

- ROA is ratio of return on asset.
- EQ/TA is ratio of equity on total asset.
- σ_{ROA} is the standard deviation of return on asset in the observed period.

Z-score increases in accordance with the increase of profitability and solvency and decreases in line with the increase of the standard deviation of return on asset. High Z-score represents lower probability of insolvency (bank failure). By using the Z-score formula, bank stability level can be calculated for each bank and each year.

Testing the Relationship between Competition, Efficiency, and Stability

The next step was to test the relationship between the competition, efficiency, and stability of banking by using state-of-the–art *t* Panel Vector Autoregression model. The dynamic relationship between variables was tested using the Granger-causality Analysis. Like in the simple VAR model, all variables were assumed to be endogenous and independent. But in Panel VAR model, the cross-sectional element was added because the research data was of panel nature.[*] Following Rezitis and Ahammad (2015), the models used were:

* More detailed explanation on Panel VAR model can be found onCanova and Ciccarelli (2013).

$$\text{Kompetisi}_{it} = f_1\,(\text{Kompetisi}_{it,\,\text{lag}},\ \text{Efisiensi}_{it,\,\text{log}},\ \text{Stabilitas}_{it,\,\text{lag}}) + \varepsilon_{1,\,it} \quad (3.7a)$$

$$\text{Efisiensi}_{it} = f_2\,(\text{Efisiensi}_{it,\,\text{log}},\ \text{Kompetisi}_{it,\,\text{lag}},\ \text{Stabilitas}_{it,\,\text{lag}}) + \varepsilon_{2,\,it} \quad (3.7b)$$

$$\text{Stabilitas}_{it} = f_3\,(\text{Stabilitas}_{it,\,\text{lag}},\ \text{Kompetisi}_{it,\,\text{lag}},\ \text{Efisiensi}_{it,\,\text{log}}) + \varepsilon_{3,\,it} \quad (3.7c)$$

Explanation: Competition is measured using HHI. Efficiency is obtained based on the Stochastic Frontier Analysis. Stability is measured using Z-score. $\varepsilon_{1,\,it}$, $\varepsilon_{2,\,it}$, $\varepsilon_{3,\,it}$ are random error terms. Equation (3.7a) tests whether efficiency and stability changes will lead to (Granger cause) a change in competition. Equation (3.7b) tests whether competition and stability changes will lead to (Granger cause) a change in bank efficiency. Equation (3.7c) tests whether competition and efficiency changes will lead to (Granger cause) a temporary change in bank stability.

4. RESEARCH RESULTS AND DISCUSSION

Sample Data

From data collection with limitation determined previously, 73 conventional commercial banks as samples were obtained. With cross-sectional data of 73 banks and 36 periods of time series in the observation period of 2005-2013, then 2,628 observation data per variable were obtained. Therefore, for 3 variables (HHI, efficiency and stability), the number of observations was **7,884**. The data observed was of quarterly frequency in line with the financial report period of bank publication that has to be published in mass media in order to meet bank information disclosure. Thus, the financial reports were considered reliable. The average percentage of asset of sample bank against total banking assets during the period of study was 89% as seen in the table below.

Table 7
The Percentage of Assets of Sample Bank against Total Banking Assets in 2005-2013

Period		*Sample Bank Asset (Rp trilliun)*	*Total Bank Asset (Rp trilliun)*	*Percentage of Sample Bank Asset against Total Bank Asset*
Year	*Quarter*			
2005	March	1,166.55	1,280.57	91%
	June	1,229.06	1,344.60	91%
	September	1,286.05	1,418.62	91%
	December	1,348.02	1,469.83	92%
2006	March	1,316.31	1,465.30	90%
	June	1,349.16	1,519.44	89%
	September	1,394.03	1,578.19	88%
	December	1,493.65	1,693.85	88%

Period		*Sample Bank Asset (Rp trillion)*	*Total Bank Asset (Rp trillion)*	*Percentage of Sample Bank Asset against Total Bank Asset*
Year	*Quarter*			
2007	March	1,463.21	1,704.63	86%
	June	1,515.24	1,770.97	86%
	September	1,574.57	1,850.57	85%
	December	1,802.84	1,986.50	91%
2008	March	1,685.22	1,944.69	87%
	June	1,768.63	2,040.82	87%
	September	1,843.41	2,125.40	87%
	December	2,096.02	2,310.56	91%
2009	March	2,027.80	2,352.11	86%
	June	2,131.68	2,353.14	91%
	September	2,185.10	2,388.62	91%
	December	2,331.13	2,534.11	92%
2010	March	2,250.54	2,563.66	88%
	June	2,441.67	2,678.27	91%
	September	2,518.58	2,758.07	91%
	December	2,773.31	3,008.85	92%
2011	March	2,842.64	3,065.83	93%
	June	2,913.70	3,195.12	91%
	September	2,986.55	3,371.45	89%
	December	3,314.27	3,652.83	91%
2012	March	3,332.88	3,708.73	90%
	June	3,500.54	3,891.12	90%
	September	3,592.44	4,009.37	90%
	December	3,854.85	4,262.59	90%
2013	March	3,677.01	4,313.83	85%
	June	3,794.17	4,461.78	85%
	September	4,007.77	4,737.31	85%
	December	4,279.45	4,954.47	86%
			Average	89%

Competition Analysis

The descriptive statistic of the data of banking competition level in Indonesia per quarter from 2005 to 2013 are presented in the table below:

Table 8
The descriptive statistics of the data of banking competition level per quarter in 2005-2013

Mean	Median	Maximum	Minimum	Std. Dev.	Skewness
10,46145	10,46518	12,38181	8,905425	0,73055	0,003137

Source: Results of data processing

The range HHI values of all observation data are from 8.905425 to 12.38181. It can be seen that the mean and median values are relatively the same and skewness approaches zero. Therefore, it can be said that data distribution is symmetrical (Mason and Lind, 1996).

Furthermore, the condition of banking competition in Indonesia is presented in the following chart. From the chart below, it can be seen that HHI values decreasing during the period of study. This shows that banking market is not dominated by major banks only. The chart below also demonstrates that the level of banking competition in the time horizon of 2005 – 2013 points out an increasing trend.

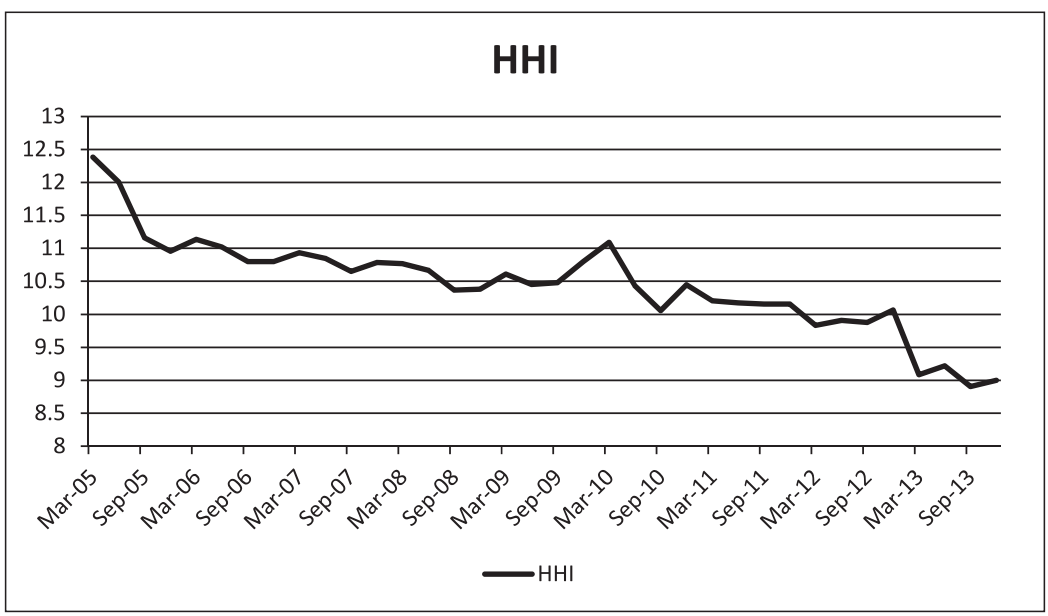

Figure 1: The Level of Banking Competition in Indonesia in 2005 - 2013

Efficiency Analysis

The descriptive statistics of banking efficiency data in Indonesia per quarter from 2005 to 2013 are presented in Table 9 below:

Table 9
The descrptive statistics of bank efficiency data in2005-2013

Mean	*Median*	*Maximum*	*Minimum*	*Std Dev.*	*Skewness*
0,750984	0,757013	0,809771	0,695267	0,031205	-0,158978

Source: Results of data processing

During the period of study, the highest efficiency score ever achieved by Indonesian banking is 0.8098 which was around March 2009. The lowest score is 0.6953 which was on March 2010. It can be observed that the mean and median values are relatively the same and only differ at the third digit behind comma; and based on the negative skewness value, the form of data distribution is a bit skewed-left (Mason and Lind, 1996). Furthermore, the banking efficiency level in Indonesia is presented in the chart below. From the following chart, it can be seen that the global financial crisis in 2008-2009 has influentially decreased banking efficiency in Indonesia. The global financial crisis, of which its symptom began at the end of the third quarter of 2008 (Bank Indonesia, 2009), has led to a sharp decrease in banking efficiency level up to 10% starting from September 2009 (79%) to March 2010 (69%). Starting from 2011, banking efficiency has begun to improve again, but until September 2013 the level of banking efficiency in Indonesia has not been able to go beyond the level of banking efficiency such as on March 2009, that was above 80%.

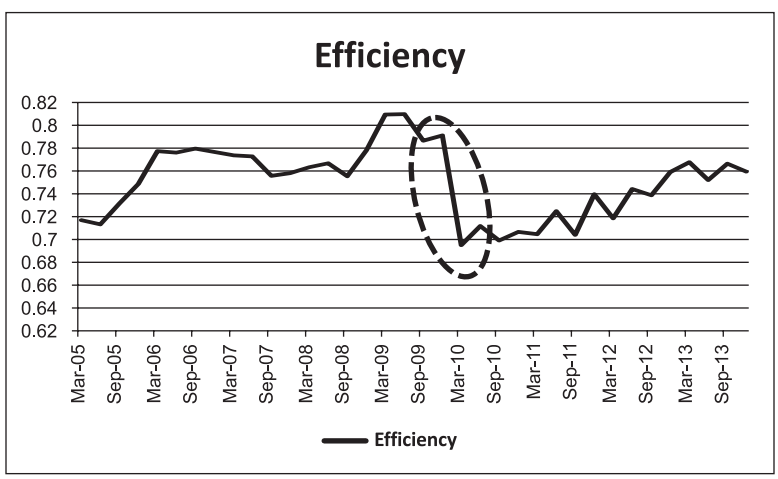

Figure 2: Indonesian Banking Efficiency in 2005-2013

From the study of nine-year data from 2005 to 2013, it can be concluded that a major crisis, such as a global financial crisis, will reduce efficiency level by 10%. Efficiency approach cannot be used as an Early Warning System because its impact moves backward around 9 months from the beginning of crisis which was on September 2008. This is because problem loan process needs time. In line with OJK (*Otoritas Jasa Keuangan* - Financial Services Authority) regulation, problem loan is listed after 90 days of arrears. However, efficiency method can "catch" crisis

occurrence well. It can be seen that since March 2010 the level of national banking efficiency has started to recover and move upward to the national average level.

Stability Analysis

The descriptive statistics of Z-Score data of banking in Indonesia per quarter from 2005 to 2013 are presented below:

Table 10
The descriptive statistics of Z-Score data of Indonesian banking in 2005-2013

Mean	*Median*	*Maximum*	*Minimum*	*Std. Dev.*	*Skewness*
36,36627	35,88349	54,90751	20,57886	7,24935	0,16385

Source: Results of data processing

During the period of study, the highest Z-Score is 54.91 and the lowest is 20.58. Mean values are higher than median values and positive skewness shows that data distribution is skewed-right.

Furthermore, the level of banking stability in Indonesia is presented in the chart below. From the following chart, it can be seen that the global financial crisis of 2008-2009 has had a direct effect on banking stability in Indonesia. The global financial crisis began at the end of the third quarter (September) in 2008 (Bank Indonesia, 2009). It can be observed from the chart below that starting from the end of September 2008, Z-score has sharply decreased from 54.91 in September 2008 to 34.83 at the end of March 2009, and afterwards since March 2009, Z-score has been fluctuating at around 40.

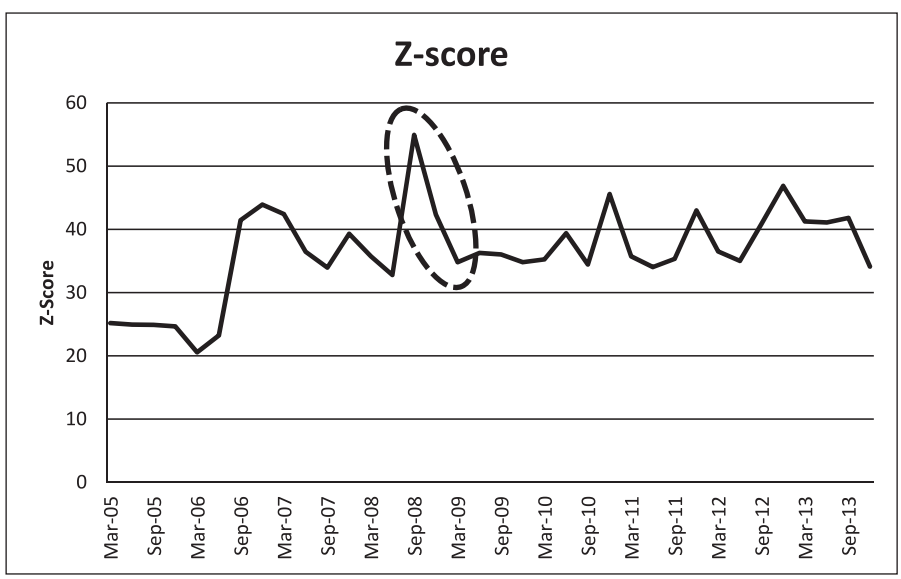

Figure 3: Indonesian Banking Stability in 2005-2013

The chart above demonstrates that starting from June 2008 the level of national banking stability increased sharply approximately a month after President SBY signed the Presidential Instruction (Inpres) Number 5 of 2008 on May 22, 2008 on the economic policy package consisting of 8 sectors, namely: investment climate improvement policy, macroeconomic and financial policy, energy security policy, natural resources policy, environmental and agricultural policy, UMKM (Micro, Small, and Medium Scale Enterprises) empowerment policy, infrastructure policy, manpower and infrastructure policy, and AEC commitment implementation policy. A month after the launching of this Economic Policy Package, Z-Score increased from 32.79 on June 2008 to 54.91 on September 2008.

Likewise, a month after President SBY launched the Investment Climate Improvement Policy Package on February 27, 2006 (Presidential Instruction Number 3 of 2006), Z-Score increased quite significantly from 20.58 on March 2006 to 43.92 on December 2006.

Testing the Relationship between Competition, Efficiency, and Stability

The Panel Vector Autoregression models used in testing the relationship between competition, efficiency, and stability are:

$$\ln HHI_{it} = \alpha_{1i} + \sum_{m=1}^{p} \beta_{11mi} \ln HHI_{i,t-m} + \sum_{m=1}^{p} \beta_{12mi} Eff_{i,t-m} + \sum_{m=1}^{p} \beta_{13mi} \ln Z_{i,t-m} + e_{1it} \quad (4.1)$$

$$Eff_{it} = \alpha_{2i} + \sum_{m=1}^{p} \beta_{21mi} \ln HHI_{i,t-m} + \sum_{m=1}^{p} \beta_{22mi} Eff_{i,t-m} + \sum_{m=1}^{p} \beta_{23mi} \ln Z_{i,t-m} + \varepsilon_{2it} \quad (4.2)$$

$$\ln Z_{it} = \alpha_{3i} + \sum_{m=1}^{p} \beta_{31mi} \ln HHI_{i,t-m} + \sum_{m=1}^{p} \beta_{32mi} Eff_{i,t-m} + \sum_{m=1}^{p} \beta_{33mi} \ln Z_{i,t-m} + \varepsilon_{3it} \quad (4.3)$$

Where, i = 1 to 73

t = quarter-1/2005 to quarter -3/2013

p = the length of lag

Following Firdaus (2011), the method to test the relationship between competition, efficiency, and stability was done using the following steps: (1) Unit

root test, (2) Lag Optimum test, (3) Panel VAR stability test, (4) Granger Causality Analysis and Panel VAR Estimation, (5) Impulse Response Function.

***Unit Root Test*:** Although it can be identified visually, it is often necessary to conduct a formal test to discover data stationarity. This formal test is known as unit root test (Juanda and Junaidi, 2012). Unit root test was conducted using ADF-Fisher Chi-square and ADF-Choi Z-Stat methods. The followings are the complete results:

Table 11
Unit Root Test Results of ln HHI data

Method	*Statistic*	*Prob.***
ADF - Fisher Chi-square	226.146	0.0000
ADF - Choi Z-stat	–2.16598	0.0152

Source: Results of data processing

Table 12
Unit Root Test Results of Efficiency Data

Method	*Statistic*	*Prob.***
ADF - Fisher Chi-square	1299.39	0.0000
ADF - Choi Z-stat	–29.7396	0.0000

Source: Results data of processing

Table 13
Unit Root Test Results of ln Z-Score Data

Method	*Statistic*	*Prob.***
ADF - Fisher Chi-square	98.8602	0.0004
ADF - Choi Z-stat	–2.82284	0.0024

Source: Results of data processing

From the unit root tests, for ln HHI, Efficiency, and ln Z-Score, it can be observed that all probability values are smaller than significant level of 5%. Therefore, H_0 is rejected, which means that the whole data does not contain unit root or the whole data is stationary.

***Optimum Lag Test*:** The stipulation of the number of optimal lag used five methods or criteria, namely: Sequential Modified LR Test Statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwartz Information Criterion (SC), and Hannan-Quinn Information Criterion. The results can be seen in the table below:

Table 14
Lag Length Criteria

Lag	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	NA	7.737172	10.55967	10.56792	10.56269
1	20302.66	0.000372	0.616188	0.649197	0.628295
2	475.7817	0.000297	0.391424	0.449191	0.412611
3	50.09259	0.000292	0.375603	0.458127	0.405870
4	341.4272	0.000249	0.216301	0.323583	0.255649
5	189.8490	0.000229	0.131493	0.263532*	0.179922*
6	26.53505	0.000228	0.127196	0.283992	0.184705
7	24.12545	0.000227	0.124071	0.305624	0.190660
8	35.20769*	0.000225*	0.115439*	0.321750	0.191108

Source: Results of data processing

It can be seen that the optimal lags are on the fifth lag, based on the criteria of Schwartz (SC) and Hannan-Quinn (HQ), and on the eighth lag, based on the criteria of Final Prediction Error (FPE) and Sequential Modified LR Test Statistic (LR). Furthermore, the fifth lag will be used because in general the effect of shorter lag is greater than that of the longer lag (Nachrowi and Usman, 2006).

***Panel VAR Stability Test*:** Panel VAR stability test was done by calculating the roots of polynomial function or known as roots of characteristic polynomial. If all roots from the polynomial function are inside the unit circle or if the absolute value is smaller than 1, then Panel VAR model is considered stable, so the Impulse Response Function produced is valid (Firdaus, 2011). From the table below, it can be seen that all roots of the polynomial function are inside the unit circle or all absolute values are smaller than 1, so Panel VAR model has met the stability condition on the fifth lag.

Table 15
Stability Test Results of Panel VAR

Root	*Modulus*
0.998460	0.998460
0.991718	0.991718
0.918124	0.918124
–0.827683	0.827683
–0.784908	0.784908
–0.039982 – 0.761663i	0.762712
–0.039982 + 0.761663i	0.762712
0.035862 - 0.680418i	0.681362

Root	*Modulus*
0.035862 + 0.680418i	0.681362
0.613304	0.613304
–0.499831	0.499831
0.114378 – 0.476121i	0.489667
0.114378 + 0.476121i	0.489667
0.269318	0.269318
0.200042	0.200042

No root lies outside the unit circle.
VAR satisfies the stability condition.
Source: Results of processing

Panel VAR Estimation and Granger Causality Analysis: Granger causality analysis basically was done to observe whether two-way relationship occurs or not by testing the null hypothesis that "X does not Granger-cause Y" andvice versa. If the probability value is smaller than the significant level usually used, then it means the hypothesis is rejected, whereas the hypothesis test on Panel VAR is based on its *t*-statistics (Firdaus, 2011; Gujarati and Porter, 2009). From the table below, it can be concluded that:

- Efficiency as endogenous variable:
  - HHI affects (Granger-cause) the level of banking efficiency with positive relationship. This means that in Indonesia increased competition (indicated by decreased HHI) will lead to the decreased level of banking efficiency. Therefore, banking behavior in Indonesia follows the competition-inefficiency hypothesis (Evanoff and Ors, 2002; De Young et al., 1998).
  - Stability affects (Granger-cause) the level of banking efficiency in Indonesia with positive relationship. This means that in Indonesia increased stability will also increase the level of banking efficiency. The result of the study can fill in the research gap from the previous banking studies particularly in Indonesia.
- HHI as endogenous variable:
  - Efficiency affects (Granger cause) the HHI of banking with negative relationship. This means that in Indonesia increased efficiency will eventually increase banking competition (indicated by decreased HHI). This finding can also fill in the research gap from the previous banking studies particularly in Indonesia.
  - Stability does not significantly affect (not Granger cause) competition.

- Stability as endogenous variable:
  - HHI affects (Granger-cause) stability with positive relationship. This means that in Indonesia increased competition (indicated by decreased HHI) will reduce banking stability. This is in line with the competition-fragility hypothesis as stated by Keely (1990), Jimenez et al., (2007) and Berger et al., (2009).
  - Efficiency affects banking stability in Indonesia with positive relationship. This means that more efficiency will increase banking stability (Peterson and Rajan, 1995).

Table 16
Estimation Results of Panel VAR

	Eff	*ln HHI*	*ln Z-Score*
Eff_{t-1}	0.484783*	0.078790	0.139305**
	(0.02094)	(0.06931)	(0.07306)
	[23.1556]	[1.13675]	[1.90669]
Eff_{t-2}	0.190522*	–0.014102	–047795
	(0.02250)	(0.07448)	(0.07851)
	[8.46873]	[–0.18933]	[–0.60878]
Eff_{t-3}	–0.068885*	–0.160954*	0.042936
	(0.02315)	(0.07666)	(0.08080)
	[–2.97501]	[–2.09969]	[0.53136]
Eff_{t-4}	0.340898*	–0.132808**	–0.145093**
	(0.02293)	(0.07590)	(0.08000)
	[14.8699]	[–1.74983]	[–1.81357]
Eff_{t-5}	–0.085403	0.122567	0.031975
	(0.02112)	(0.06992)	(0.07370)
	[–4.04395]	[1.75305]	[0.43385]
$\ln HHI_{t-1}$	0.030399*	0.685563*	0.083855*
	(0.00607)	(0.02009)	(0.02118)
	[5.00863]	[34.1194]	[3.95913]
$\ln HHI_{t-2}$	–0.000201	0.210052*	–0.028525
	(0.00703)	(0.02326)	(0.02452)
	[–0.02863]	[9.03102]	[–1.16347]
$\ln HHI_{t-3}$	–0.010015	0.017628	0.001747
	(0.00710)	(0.02351)	(0.02478)
	[–1.41025]	[0.74977]	[0.07048]

	Eff	*ln HHI*	*ln Z-Score*
ln HHI_{t-4}	–0.012113	0.362323*	–0.125144*
	(0.00697)	(0.02307)	(0.02432)
	[–1.73806]	[15.7035]	[–5.14549]
ln HHI_{t-5}	–0.007572	–0.285583*	0.069313*
	(0.00599)	(0.01982)	(0.02089)
	[–1.26488]	[–14.4098]	[3.31787]
ln Z $Score_{t-1}$	0.016651*	–0.006793	0.928715*
	(0.00610)	(0.02018)	(0.02127)
	[2.73129]	[–0.33658]	[43.6543]
ln Z $Score_{t-2}$	–0.005452	0.027028	–0.010785
	(0.00864)	(0.02861)	(0.03016)
	[–0.63081]	[0.94459]	[–0.35755]
ln Z $Score_{t-3}$	–0.012085	0.009021	–0.021724
	(0.00902)	(0.02986)	(0.03147)
	[–1.33988]	[0.30213]	[–0.69019]
ln Z $Score_{t-4}$	–0.001621	–0.028069	0.128111*
	(0.00906)	(0.02999)	(0.03161)
	[–0.17890]	[–0.93595]	[4.05247]
ln Z $Score_{t-5}$	0.002086	–0.000761	–0.026230
	(0.00678)	(0.02245)	(0.02367)
	[0.30751]	[–0.03390]	[–1.10825]
C	0.102174*	0.085338*	–0.020571
	(0.01189)	(0.03935)	(0.04148)
	[8.59673]	[2.16883]	[–0.49597]
R-squared	0.630489	0.990761	0.994382
Adj. R-squared	0.628022	0.990699	0.994345
Granger Causality (*p*-value)			
Eff		0.0055*	0.1731
ln HHI	0.0000*		0.0000*
ln Z-Score	0.0503*	0.7499	

Source: Results of data processing

Note: *,** significance respectively at 5% and 10% significant levels. On the estimation results of Panel VAR, the first row shows estimation coefficients, the second row in bracket shows the standard error, and the third row in square brackets shows the values of *t*-statistic. The critical values for 5% and 10% significant levels are respectively 1.6905 and 1.3065 (Firdaus, 2011; Mason and Lind, 1996).

***Impulse Response Function*:** Impulse Response Function is a method used to determine the response of an endogenous variable against a certain shock. This is because the shock variable *i*, for instance, does not only affect variable *i* but is also transmitted to all other endogenous variables through the dynamic structure (Firdaus, 2011).As observed from the figure below, the efficiency response caused by the occurrence of shock or impulse from HHI moves positively. The response increases until the second quarter and afterwards fluctuates but relatively flat. Likewise, the efficiency response due to shock from stability moves positively. The response increases until the end of the second quarter and then decreases until the middle of the seventh quarter, and furthermore slightly rises.

Competition does not respond to shock caused by stability. This is in accordance with the results of Granger Causality Analysis. The response of HHI to the occurrence of shock by efficiency moves negatively mainly after the third quarter.

Stability provides positive response to shock by efficiency and is in line with the results of Granger Causality Analysis. Stability responds positively to shock caused by HHI. In the middle of the fourth quarter, the response moves downward but then it moves upward again.

5. CONCLUSIONS

Competition, Efficiency and Stability

For the period of study of 9 years, from 2005 to 2013, the average percentage of bank assets used as samples against the total banking assets in Indonesia was close to 90%. The calculations of competition, stability, and efficiency were done for each quarter from 2005 to 2013, there were 36 quarters for 9 years with total observations of **7,884** observations.

During the period of study, HHI values showed a decreasing trend. This explains that the level of banking competition in the time horizon of 2005 – 2013 showed an increasing trend. This also indicates that the bank groups outside the biggest bank group are able to accumulate their assets, so their market are also expanding.

During the period of study, the highest efficiency score ever achieved by the Indonesian banking industry is 0.8098 which was around March 2009. The lowest score is 0.6953 which was on March 2010. The mean efficiency score is 0.750984. From the study, it can be seen that the efficiency of Indonesian banking industry is highly affected by the occurrence of shock such as the global economic crisis.

During the period of study, the highest Z-Score is 54.91 and the lowest is 20.58. The mean score is 36.36627. From the study, it can be observed that the stability of banking industry is highly affected by the government's economic policy as well as by the occurrence of shock such as the global economic crisis.

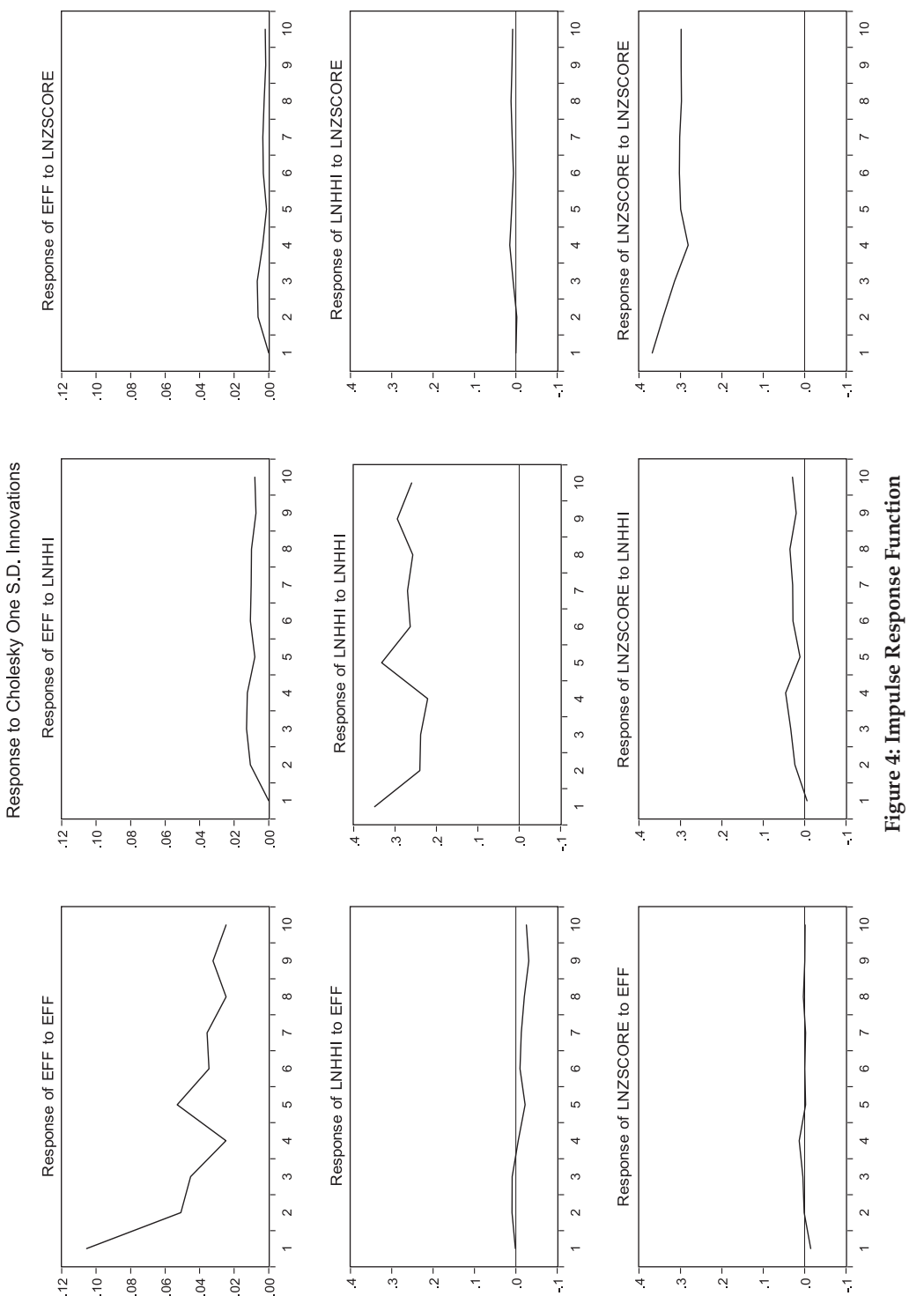

Figure 4: Impulse Response Function

The Granger Causality Dynamic Relationship between Competition, Efficiency, and Stability

HHI affects (Granger-cause) the level of banking efficiency with positive relationship .This means that in Indonesia increased competition (indicated by decreased HHI) will lead to the decreased level of banking efficiency. Therefore, banking behavior in Indonesia follows the competition-inefficiency hypothesis.

Stability affects (Granger-cause) the level of banking efficiency in Indonesia with positive relationship. This means that in Indonesia increased stability will increase the level of banking efficiency. The result of this study can fill in the research gap from the previous banking studies particularly in Indonesia.

Efficiency affects (Granger cause) the level of banking competition with negative relationship. This means that in Indonesia increased efficiency will eventually increase banking competition (indicated by decreased HHI). The finding can fill in the research gap from the previous banking studies particularly in Indonesia. Stability does not significantly affect (not Granger cause) competition.

HHI affects (Granger-cause) stability with positive relationship. This means that in Indonesia increased competition (indicated by decreased HHI) will decrease banking stability. This is in line with competition-fragility hypothesis.

Efficiency affects banking stability in Indonesia with positive relationship. This means that increase in efficiency will increase banking stability as well.

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