The Impact of Interbank Market Interconnections to Indonesian Banking Efficiency

Ndari Surjaningsih, Januar Hafidz, Justina Adamaanti, Maulana Harris Muhajir, M. Sahirul Alim

Abstract

Banks are connected to each other in the interbank call money market to borrow and lend money. How banks interconnected in the interbank call money market gives benefit to banks will depend on the market structure. Bank's decision in this market will also impact on their efficiency. Therefore, the aims of this research are to study the structure of interbank call money market in Indonesian and see how the interconnectivity effects to bank efficiency in cost and profit. This research uses network statistics and stochastic frontier analysis, as in Guerra et.al. (2014) in assessing the impact of interconnections to efficiency in Brazil banking.

As the main findings, there is a tendency of concentration and segmentation in the interbank call money market which can be seen from a low value of clustering coefficient and low degree dominance in the scale-free distribution. Moreover, bank tends to be efficient in cost but inefficient in profit when acts as borrower. This is because bank transactions in the interbank call money market are more intended for short-term liquidity management, not for profit maximization.

Keywords: interconnections; banking efficiency; network analysis; Stochastic Frontier Analysis.

1. Introduction

Amid increasing competition in financial market and technology dynamics in banking operation, efficiency becomes an important factor that must be preserved by banks. Moreover, banks’ competition nowadays is heightened by competition with non-bank financial institutions and not only among banks themselves. Therefore, banks encounter effort to be more efficient in order to survive in such challenging environment (Spong et al., 1995).

Increasing competition reduces market power of a bank, hence it lowers bank’s efficiency. Reduced efficiency level also associates with excessive risk taking of the banks. In general, inefficient banks usually have problems in the following aspects, i.e operational, lending, market, and performance, which turn banks to have high-risk profile (Fiordelisi, Ibanez & Molyneux, 2010).

In financial stability context, potential pressure from excessive risk taking behavior may generate distress for other banks through contagion/domino effect. Interconnections
among banks may cause the financial system vulnerable as failure of a bank may spread rapidly into other banks.

In spite of its negative impacts, interconnections are useful as a means to manage liquidity and to transfer risk in a more efficient manner (Liu, Qulet & Roth, 2015). The interbank market structure also influences the benefits from interbank interconnections. Allen & Gale (2000) argue that the banks’ resilience to unexpected liquidity shocks will increase in a complex market, i.e. where all banks are interconnected. It is, therefore, important to analyze how the characteristic of Indonesian banking interconnectivity.

Banking interconnectivity may also affect its efficiency. Interbank market provides an alternative source of financing and placement of funds for banks, so it will affect the efficiency of costs and profit of banks. Therefore, it is necessary to examine the benefits of interbank as an alternative source of financing and placement of funds against bank efficiency.

Based on the above background, the goal of this research is to explore interbank transactions on interbank call money market using network statistics and to analyze interbank interconnectivity impacts on cost and profit efficiency of banks.

2. Related Literature

2.1. Efficiency

The definition of efficiency is often thought similar to productivity, though both terms have different meaning. The difference between the two can be explained using the Production Possibility Curve (PPC). PPC illustrates the relationship between output and input and also shows the maximum output that a company can produce with certain input combinations. A firm is efficient when it is capable of producing output along the PPC frontier. Otherwise, producing output below the PPC frontier is categorized as an inefficient firm. Meanwhile, productivity is measured using the ratio between output and input. In other words, a firm can still increase its productivity level when efficient (Coelli et al., 2005).

Efficiency level of a bank can be measured using several indicators, e.g. ratio of operating expenses to operating income, Cost to Income Ratio (CIR), and Net Interest Margin (NIM). Banks become more efficient when have lower ratio of operating expenses to operating income, since they can minimize costs while maximize its operating income at the same time. CIR represents the ratio of overhead costs to interest and non-interest income. Banks become more inefficient when have higher CIR. Meanwhile, NIM provides an overview on banks capability to manage assets for producing interest income and liabilities which generate interest expense (Hafidz & Astuti, 2013).

In the economic literatures, efficiency of banks are influenced by several factors, such as organizational structure, regulation, and level of competition. Empirically, several studies discuss the determinants of banking efficiency. Repkova (2015) argues that level of capitalization, liquidity risk, and riskiness of portfolio have a positive impact on banking efficiency in the Czech Republic. The riskiness of bank’s overall portfolio is defined as a ratio of loan loss provision to total assets. Whereas return on assets (ROA), interest rates and GDP have a positive relationship to bank efficiency. In the EU, Mesa,
et al. (2014) finds that size, ratio of wholesale funding and diversification of sources of income have a positive effect on bank efficiency. Conversely, level of competition and diversification of loans has a negative relationship to efficiency. Moreover, Viverita & Ariff (2011) prove that size or market capitalization and non-performing loans negatively affect cost efficiency and banking profit in Indonesia.

There are two hypotheses discussing the relationship between level of competition and bank efficiency, namely competition-efficiency hypothesis and competition-inefficiency hypothesis. On the one hand, competition-efficiency hypothesis states that increasing competition levels will improve bank efficiency as competition will force banks to minimize costs, offer services at lower prices, and at the same time increase bank profits. On the other hand, competition-inefficiency hypothesis argues that increasing competition leads to instability in banks (Shaeck & Cihak, 2008).

2.2. Interconnections

Despite its beneficial to the financial system, the structure of financial networks in the interbank market is crucial in determining spill-over of a shock as stated by Allan & Gale (2000). In interbank market with fully complete network structure, i.e. all banks are interconnected, the share of assets owned by each bank is relatively small and there is no dominance among them. As a result, credit risk is more diversified compared to those with segmented market structure. However, contagion risk in the fully complete network structure is higher than the segmented market structure. In the existence of segmentation, banks outside a particular group may immune from the shock.

Interconnections can affect banks’ efficiency since banks have to manage its liquidity. In general, third-party funds serves as a main source of banks’ funds, while interbank money market as an alternative source. Banks take the advantage of interbank money market to maintain its daily liquidity adequacy. Meanwhile, in liquidity management framework, interbank money market becomes an alternative placement of funds or idle money for bank in order to maximize its revenue. Nevertheless, interbank funding may intensify or reduce both cost efficiency and banks’ profit. The impact to banks depends on the cost faced by the banks and purpose of using the interbank funds.

Guerra et.al. (2014), in his research on the interconnections impact on banks’ efficiency in Brazil, find that interbank interconnections increase banking costs efficiency. However, interconnections do not influence significantly banking profit efficiency. One possible argument for this finding is interconnections in the Brazilian banks are aimed mostly for managing liquidity rather than as an alternative source of income. This paper is the main reference in this study.

3. Methodology and Data

3.1. The Efficiency Measurement

This study uses Stochastic Frontier Analysis (SFA) based on Battese and Coelli (1995) model as parametric approach in analyzing banking inefficiency. This model consists of two equations, namely SFA equation and inefficiency determinant equation.
The efficiency frontier analysis covers both cost efficiency and profit efficiency. Cost efficiency is aimed to minimize cost, while profit efficiency is aimed to maximize profit. These different goals affect the SFA equation formulation.

The Cost function frontier is formulated as below:

\[
\ln(C/w_2)_{it} = \beta_0 + \sum_{j=1}^{3} \beta_j \ln\left(\frac{Y_j}{Z_{it}}\right) + \frac{1}{2} \sum_{j=1}^{3} \sum_{k=1}^{3} \beta_{jk} \ln\left(\frac{Y_j}{Z_{it}}\right) \ln\left(\frac{Y_k}{Z_{it}}\right) + \alpha_1 \ln\left(\frac{w_1}{w_{2it}}\right) + \frac{1}{2} \ln\left(\frac{w_1}{w_{2it}}\right) \ln\left(\frac{w_1}{w_{2it}}\right) + \sum_{j=1}^{3} \delta_j \ln\left(\frac{Y_j}{Z_{it}}\right) \ln\left(\frac{w_1}{w_{2it}}\right) + u_{it} + v_{it}
\]  

This equation is estimated in a translog functional form, where \(i, t\) refer to bank and time, and \(j=k=1, 2, 3\) are three variables for output (\(y\)). The outputs in this model are credit, obligation, and placement in other banks. Two input (\(w\)) variables are interest expenditures on total deposits and non-interest expenditures on total assets, and one variable for fixed input (\(z\)), total earning asset. The output is normalized by total earning asset in order to reduce heteroskedasticity and allows estimated residual comparison for bank’s inefficiency level. While the normalization by input price \(w_2\) aimed for price homogeneity. \(v_{it}\) is the random error term, while \(u_{it}\) is the bank’s efficiency level.

The level of inefficiency variable has positive sign in the cost function since cost is inefficient when above its frontier. Conversely, it has negative sign in the profit function since profit is inefficient when below its frontier. Therefore, the equation for the profit frontier is as follow:

\[
\ln(\pi/w_2z)_{it} = \beta_0 + \sum_{j=1}^{3} \beta_j \ln\left(\frac{Y_j}{Z_{it}}\right) + \frac{1}{2} \sum_{j=1}^{3} \sum_{k=1}^{3} \beta_{jk} \ln\left(\frac{Y_j}{Z_{it}}\right) \ln\left(\frac{Y_k}{Z_{it}}\right) + \alpha_1 \ln\left(\frac{w_1}{w_{2it}}\right) + \frac{1}{2} \ln\left(\frac{w_1}{w_{2it}}\right) \ln\left(\frac{w_1}{w_{2it}}\right) + \sum_{j=1}^{3} \delta_j \ln\left(\frac{Y_j}{Z_{it}}\right) \ln\left(\frac{w_1}{w_{2it}}\right) - u_{it} + v_{it}
\]  

As in Battese and Coelli (1995), the second equation explains the determinant of inefficiency:

\[
u_{it} = \theta_0 + \theta_{ix} x_{it} + \theta_{ib} b_{it} + m_{it}\]

where \(m_{it}\) is the truncation of the normal distribution with zero mean and variance \(\sigma^2\). The \(x_{it}\) is a vector of control variable which consists of Equity to Asset Ratio (ETA), asset, Herfindahl-Hirschman Index (HHI) and dummy for bank category. The ETA represents the level of bank leverage in optimizing its resource. The asset represents bank size, while the HHI represents the level of bank competition. While \(b_{it}\) is a vector represents interbank interconnections using several indicators from network statistic.
All equations above are estimated simultaneously using maximum likelihood method, which is solved by `spanel` function in *STATA* as in Belotti et.al. (2012). Referring to Guerra et.al.(2014) and Bos & Koetter (2007), this study also uses the Negative Performance Indicator in form of addition variable in profit frontier equation for solving the possibility of negative value in profit which cannot transform to logarithm.

### 3.2. The Network Statistics

The interbank interconnections measure network interlink between its contractual obligations which can impact to the interlinkage distress in a financial system and its conglomeration group. The contractual obligation is measured by the size of institution’s asset and liability. Interconnections can be represented using network theory.

A network is a collection of several vertices (or nodes) and edges that connect vertices. This study uses both directed and undirected network, which the most are directed network. A node is interpreted as a bank. A node $u$ to node $v$ with weight $W_{u,v}$ can be interpreted that node $u$ acts as the lender for node $v$ for the nominal transaction ($W$). The network statistics used in this study are as below:

<table>
<thead>
<tr>
<th></th>
<th>Directed Network</th>
<th>Undirected Network</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unweighted</td>
<td>Weighted</td>
</tr>
<tr>
<td>indegree</td>
<td>weighted indegree</td>
<td>degree</td>
</tr>
<tr>
<td>outdegree</td>
<td>weighted outdegree</td>
<td>power law</td>
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<tr>
<td>closeness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>clustering</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Degree is the number of edges that begin or end on a node. There are two types of degree, namely indegree and outdegree. Indegree is the number of edges that end at a node, while outdegree is the numbers of edges that begin from a node. In a directed network, degree is the sum of indegree and outdegree.

A weighted network is a network that has included the volume of interbank transactions in order to understand the dominance, whether as a lender dominance (weighted outdegree) or borrower dominance (weighted indegree). A path is a set of nodes connected by multiple edges. In an unweighted network, the path length is the number of edges between the first and last nodes in the path. On a weighted network, the path weight is the sum of all edge weight between the first and last nodes in the path.

Closeness is the average size of the distance from a node $v$ to another node in the network. This indicator states how close a node is to other nodes. The closeness formula is as follows:

$$ C_c(v) = \frac{|V| - 1}{\sum_{u \neq v} d(u, v)} $$

where $|V|$ is the number of nodes, and $d(u, v)$ is the shortest path between $u$ and $v$. 

\[4\]
Betweeness is a measure of the number of shortest paths through a given node, \( v \). This indicator describes the role of a node as an intermediary for other nodes in a network. The formula for betweenness is as follows:

\[
C_B(v) = \sum_{s,t \in V} \frac{\sigma(s, t | v)}{(n-1)(n-2)}
\] (5)

where \( \sigma(s, t | v) \) is the number of shortest path from \( s \) to \( t \), and \( \sigma(s, t) \) is the number of path from \( s \) to \( t \).

**Clustering Coefficient**

Clustering coefficient is a measure of the network density around a node. The higher clustering coefficient indicates a denser network. In other words, the network has many highly connected nodes. The formula for clustering coefficient is as follows:

\[
C^A_i = \frac{(A + A^T)^3_{ii}}{2[d^\text{tot}_i(d^\text{tot}_i - 1) - 2d_i^*]}
\] (6)

where \( d^\text{tot}_i \) is the total degree of node \( i \), \( A \) is the adjacency matrix, and \( d_i^* \) is bilateral edge between node \( i \) and \( j \).

**Degree Distribution**

The network degree distribution represents the level of connectivity between nodes, whether concentrated or evenly distributed. A concentrated network has a few highly connected node and many less connected nodes. In contrast, a distributed network has many nodes with similar degree, or every node connected with all other nodes.

The degree distribution is the distribution of nodes degree frequency within a network. \( P(d) \) is a part of nodes distribution having degree \( d \) in the distribution of degree \( P \). A network which all node having the same degree \( k \) refers to \( p(k) = 1 \). One distribution suitable for the characteristic of degree distribution is the scale-free distribution (power law distribution), with density function as below:

\[
P(d) = cd^{-\alpha}
\] (7)

This distribution has less highly connected nodes, so that the degree distribution relatively concentrated. The coefficient of power law, \( \alpha \), can be estimated using linear regression between degree frequency \( f(d) \) and degree \( (d) \) (Jackson, 2008), as in formula 11. The high value of coefficient of \( \alpha \) indicates the lesser node with high degree.

\[
\log(f(d)) = \log(c) - \alpha \log(d)
\] (8)

### 3.2. The Model

Based on the SFA and network statistic on previous section, table 3.2 summarizes all model used in analyzing the impact of interbank interconnections to banking efficiency.

**Table 3.2. The Model**
VCB is a vector of banking control variable which consists of Equity to Asset Ratio (ETA), asset, the Herfindahl-Hirschman Index (HHI) and dummy for bank category. There are two set of models, C for the cost profit frontier model, and P for the profit frontier model. For every type of frontier, there are two sets of equation. The first set is equation 1 to 4, and the second set is equation 5 to 8. Both sets use same variables, except for clustering and alpha. Clustering refers to clustering coefficient, while alpha refers to the coefficient of power law in scale free distribution. The interchanges of those variables are aimed for robustness check. Other than that, model without number (C and P) are intended for robustness check.

### 3.3. Data

This study uses detail data in quarterly format which is produced from Monthly Reports on Commercial Banks maintained by Bank Indonesia. The data covers 93 commercial banks in Indonesia from third quarter 2010 to fourth quarter 2015, not including sharia banks and banks with incomplete data. Table 3.3. shows the full list of variables used.

<table>
<thead>
<tr>
<th>Data</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit (Rp)</td>
<td>Total bank loans to non-banks</td>
<td>Monthly Report on Commercial Banks – Bank Indonesia</td>
</tr>
<tr>
<td>Interbank Placement (Rp)</td>
<td>Total bank placements in other banks</td>
<td></td>
</tr>
<tr>
<td>Earning Asset</td>
<td>All bank placements in loans, securities, equity investments, and other placements</td>
<td></td>
</tr>
<tr>
<td>Interest expense (Rp)</td>
<td>Total bank interest expense</td>
<td></td>
</tr>
<tr>
<td>Non interest expense (Rp)</td>
<td>Total bank expenses other than interest expenses</td>
<td></td>
</tr>
<tr>
<td>Asset (Rp)</td>
<td>Total bank assets</td>
<td></td>
</tr>
<tr>
<td>Equity (Rp)</td>
<td>Total bank capital</td>
<td></td>
</tr>
<tr>
<td>Third Party Funds (Rp)</td>
<td>Total third party funds</td>
<td></td>
</tr>
<tr>
<td>Profit (Rp)</td>
<td>Earning Before Interest Funds (EBIT)</td>
<td></td>
</tr>
<tr>
<td>Expenses (Rp)</td>
<td>Bank’s operational expenses</td>
<td></td>
</tr>
<tr>
<td>Market Transactions in The Interbank Call Money Market (Form $ in monthly report)</td>
<td>Bank placements in other banks via interbank call money market</td>
<td></td>
</tr>
</tbody>
</table>
4. Result

4.1. Network Statistics

This study uses data from 93 banks that perform transaction in the interbank call money market. As shown in figure 4.1, the composition is divided by 6 type of bank, namely 6 foreign branch banks, 9 joint venture banks, 26 regional development banks, 4 state-owned banks, and 48 private owned banks. This composition is fixed during all period used in this study.

![Figure 4.1 Bank Composition based on Type](image)

The network statistics analysis is aimed at understanding the characteristic of transactions in the interbank call money market. This analysis uses two views for understanding bank type characteristic better. The first is based on the proportion per bank type to total transaction, which can explain the dominance by bank type in the interbank market. While the second is based on the individual average per bank type in related transaction, which can explain which bank type individually is dominant. These two different views becomes important considering the banking variation in Indonesia.

**Degree**

Degree represents the intensity of bank transactions, while weighted degree represents the volume of bank transactions in interbank call money market. Based on the total intensity, the highest are in private owned bank and regional development banks, as shown by figure 4.2. This fact is simply because both bank types have most members. However, based on the individual average of every bank type, the most frequent transaction happens in state-owned banks. This fact is due to the larger size of state-owned banks compared to other types.

![Figure 4.2. Proportion and Individual Average of Degree by Bank Type](image)
Indegree

Indegree is the degree when bank acts as borrower. The bank type which dominant as borrower are private owned bank and regional development bank, both in intensity (the left panel in figure 4.4) and volume (the left panel in figure 4.5). However, based on the individual average of indegree for intensity (the right panel in figure 4.4) and volume (the right panel in figure 4.5), the dominant borrowers are state-owned bank, joint venture bank, and foreign-branches bank.

Outdegree

Outdegree is the degree when bank acts as lender. The most frequent bank type that acts as lender in interbank call money market is private owned bank (the left panel in figure 4.6). But by the individual average, the state-owned bank is the dominant lender (the right panel in figure 4.6). In terms of transaction volume, private-owned bank and regional development bank have the largest proportion. However, the state-owned bank individually has the highest average of transaction intensity and volume (the right panel in figure 4.6 and figure 4.7).
Interaction between Large and Small Banks

The large bank is categorized based on its size, complexity, and interconnections. Based on the proportion of transaction intensity, large banks tend to have transaction within its group. This fact possibly caused by the risk adverse behavior of large banks in intermediate their funds to smaller banks. Based on the proportion of volume, the transaction between large banks became the largest proportion in interbank call money market, followed by the transaction between small bank to large bank, and between small banks. Therefore, it can be concluded that the segmentation in the interbank market exists.

Closeness and Betweenness

Closeness shows the distance between nodes, while betweenness shows the role of a node as an intermediary within a network. Both indicators are categorized as the degree of centrality that explains how influence a node in a network. As shown in figure 4.9, the average of closeness increases from year to year. This is in line with the increasing
of bank’s role as intermediary as shown by the increasing of betweeness in the right panel of figure 4.9, even though it slightly declines in the recent year.

**Figure 4.9 Average of Closeness and Betweenness**

**Clustering coefficient**

The clustering coefficient indicates a small world effect, the node’s relation with other nodes in the closest network. The higher clustering coefficient value exhibits a more clustered network. The average clustering coefficient value remains similar in last five years, the changes are only slightly different. Therefore, the segmentation in the interbank call money market remains similar.

**Figure 4.10 Average of Clustering Coefficient**
Degree Distribution

The left panel in figure 4.11 shows the degree distribution is concentrated on the left side, which can be interpreted that commonly banks only have few transactions in the interbank call money market. One suitable distribution to figure out this condition is the scale-free distribution. The right panel in figure 4.11 shows the estimation for alpha coefficient (power law). As alpha increases, more banks have low degree, which reflects low degree domination in the network. Recently the concentration in the interbank call money market remains similar, as reflected by similar alpha coefficient in last 5 years.

4.2. The Relation between Interconnectedness and Efficiency

This part will discuss the analysis result of the impact of interbank interconnections to banking efficiency using SFA. The analysis is done separately for cost and profit frontier. As explained before, inefficiency is a part of error term. When the value of estimated coefficient for inefficiency is negative, then the efficiency is decrease. Conversely, when the value of estimated coefficient for inefficiency is positive, then the efficiency is increase. As robustness check, every frontier is analyzed in two sets of equations with same variables, except for clustering and alpha and alpha (power law).

Cost Frontier

The left panel in table 4.1. summarizes the estimation result of cost frontier equation using clustering coefficient. Banks are more efficient when act as borrower. This fact is shown by windegree variable in C4 model which has coefficient value -0.002 and significant. Conversely, bank are inefficient when act as lender. This fact is shown by outdegree and woutdegree variable in C3 and C4 model which has positive coefficient and significant. This result can be explained by the fact that the interest of interbank call money is lower than the interest of other funds placement, such as credit.

Moreover, banks become inefficient when banks that act as intermediary in interbank call money market exist. This fact is shown by betweenness variable in model C2. The positive and significant coefficient of closeness variable in model C2 shows the increasing of inefficiency when a bank closer to other bank. This is probably because of different interbank interest rate based on bank size as the impact of market of segmentation in the interbank call money market.

The robustness check by changing clustering coefficient variable with alpha (power law) shows insignificant coefficient for alpha, as shown in the right panel in table 4.1. Nevertheless, the model robustness is proved since all of coefficient sign and significance still the same.
### Table 4.1 The Estimation Result for Cost Frontier

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model C</th>
<th>Model P1</th>
<th>Model P2</th>
<th>Model P3</th>
<th>Model P4</th>
<th>Model P5</th>
<th>Model P6</th>
<th>Model P7</th>
<th>Model P8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HHI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.240 ***</td>
<td>3.318 ***</td>
<td>3.307 ***</td>
<td>3.358 ***</td>
</tr>
<tr>
<td><strong>ETA</strong></td>
<td>-0.367 ***</td>
<td>-0.376 ***</td>
<td>-0.394 ***</td>
<td>-0.402 ***</td>
<td>-0.393 ***</td>
<td>-0.348 ***</td>
<td>-0.377 ***</td>
<td>-0.381 ***</td>
<td>-0.379 ***</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>-0.084 ***</td>
<td>-0.091 ***</td>
<td>-0.105 ***</td>
<td>-0.103 ***</td>
<td>-0.091 ***</td>
<td>-0.070 ***</td>
<td>-0.098 ***</td>
<td>-0.088 ***</td>
<td>-0.080 ***</td>
</tr>
<tr>
<td><strong>State_Owned</strong></td>
<td>-0.120</td>
<td>-0.112</td>
<td>-0.167</td>
<td>-0.115</td>
<td>-0.109</td>
<td>-0.078</td>
<td>-0.125</td>
<td>-0.074</td>
<td>-0.075</td>
</tr>
<tr>
<td><strong>Private</strong></td>
<td>-0.314</td>
<td>-0.337</td>
<td>-0.313</td>
<td>-0.349</td>
<td>-0.330</td>
<td>-0.249</td>
<td>-0.253</td>
<td>-0.286</td>
<td>-0.283</td>
</tr>
<tr>
<td><strong>Joint_Venture</strong></td>
<td>-0.082 **</td>
<td>-0.088 **</td>
<td>-0.081 **</td>
<td>-0.092 **</td>
<td>-0.081 **</td>
<td>-0.086 **</td>
<td>-0.082 **</td>
<td>-0.091 **</td>
<td>-0.087 **</td>
</tr>
<tr>
<td><strong>Regional_Dev</strong></td>
<td>-0.453 ***</td>
<td>-0.465 ***</td>
<td>-0.421 ***</td>
<td>-0.431 ***</td>
<td>-0.401 ***</td>
<td>-0.483 ***</td>
<td>-0.458 ***</td>
<td>-0.471 ***</td>
<td>-0.443 ***</td>
</tr>
<tr>
<td><strong>Clustering</strong></td>
<td>0.115</td>
<td>0.001</td>
<td>0.028</td>
<td>0.016</td>
<td>0.004</td>
<td>0.050</td>
<td>0.040</td>
<td>0.023</td>
<td>0.039</td>
</tr>
<tr>
<td><strong>Degree</strong></td>
<td></td>
<td>-0.013</td>
<td></td>
<td></td>
<td></td>
<td>-0.017</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Closeness</strong></td>
<td></td>
<td>0.309 ***</td>
<td></td>
<td></td>
<td></td>
<td>0.274 ***</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Betweenness</strong></td>
<td></td>
<td>2.823 ***</td>
<td></td>
<td></td>
<td></td>
<td>2.601 ***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Indegree</strong></td>
<td></td>
<td>-0.006</td>
<td></td>
<td></td>
<td></td>
<td>-0.003</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Outdegree</strong></td>
<td></td>
<td>0.042 ***</td>
<td></td>
<td></td>
<td></td>
<td>0.029 **</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Windegree</strong></td>
<td></td>
<td>-0.002 **</td>
<td></td>
<td></td>
<td></td>
<td>-0.002 **</td>
<td></td>
<td></td>
<td></td>
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### Table 4.2 Hasil Estimasi Profit Frontier

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<td></td>
<td>2.960 ***</td>
<td>3.097 ***</td>
<td>3.160 ***</td>
<td>3.065 ***</td>
<td>-0.348 ***</td>
<td>-0.377 ***</td>
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<tr>
<td><strong>ETA</strong></td>
<td>-0.070 ***</td>
<td>-0.098 ***</td>
<td>-0.088 ***</td>
<td>-0.080 ***</td>
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<td>-0.040</td>
<td>-0.023</td>
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<td><strong>Joint_Venture</strong></td>
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<td>-0.458 ***</td>
<td>-0.471 ***</td>
<td>-0.443 ***</td>
<td>0.050</td>
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<td><strong>Regional_Dev</strong></td>
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<td>-0.458 ***</td>
<td>-0.471 ***</td>
<td>-0.443 ***</td>
<td>0.050</td>
<td>-0.040</td>
<td>-0.023</td>
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<tr>
<td><strong>Alpha</strong></td>
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<td>-1.061 ***</td>
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<td>-0.976 ***</td>
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<td><strong>Degree</strong></td>
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### Profit Frontier

The left panel in table 4.2 summarizes the estimation result of profit frontier equation using clustering coefficient. Banks become inefficient in profit maximization when increase the intensity of transaction in interbank call money market, as shown by the positive and significant coefficient value of **degree** variable in model P2. More specific, bank become inefficiency when act as lender, since **indegree** and **windegree** variable have positive and significant coefficient value. The similar conclusion is achieved by Guerra et al. (2014), the interbank market is not optimal in increasing the profit efficiency. In the other hand, bank is efficient in profit maximization when closer to other banks, as shown by **closeness** variable. One possible reason is bank can earn more profit from lending their idle funds to other banks.

The robustness check in the right panel in table 4.2 shows similar results in general. However, the coefficient for alpha is negative and significant. This indicates that bank become more efficient in profit when transact infrequently in interbank market. This result is in line with previous result for degree.

### Control Variable

- **HHI**: Highly significant coefficient value.
- **ETA**: Significant coefficient value. The similar conclusion is achieved by Guerra et al. (2014), the interbank market is not optimal in increasing the profit efficiency. In the other hand, bank is efficient in profit maximization when closer to other banks, as shown by **closeness** variable. One possible reason is bank can earn more profit from lending their idle funds to other banks.
All control variables have similar coefficient sign and significant in cost and profit frontier. As a proxy for competition, HHI has positive sign, which indicates banks inefficiency when HHI increase. Higher HHI exhibits high concentration, which can be interpreted as lower competition and contribute to banks inefficiency.

The negative sign of ETA exhibits banks efficiency when own more equity in order to reduce the possibility of maturity mismatch since they can reduce the cost for expensive funding to fulfill their needs. Meanwhile, the negative sign of size exhibits banks efficiency as its size become larger. This fact is in line with the economies of scale principle in microeconomic literature.

5. Conclusion

From this study, it can be concluded that based on network analysis, there is a tendency of concentration and segmentation in the interbank call money market. This can be seen from a low value of clustering and low degree dominance in the scale-free distribution.

Based on the SFA analysis, banks tend to be efficient in cost but inefficient in profit when acts as borrower. This is because bank transactions in the interbank call money market are more intended for short-term liquidity management, not for profit maximization. In addition, the existence of banks that act as the intermediary in the interbank call money market could lead banks to become less efficient. Meanwhile, banks tend to be inefficient in cost when close to each other. This is probably because of different interbank interest rate based on bank size as the impact of market of segmentation in the interbank call money market. On the contrary, banks tend to be efficient in profit when close to each other. One possible reason is bank can earn more profit from lending their idle funds in the interbank call money market.

6. References


