THE ANALYSIS OF RISK PROFILE AND FINANCIAL VULNERABILITY OF HOUSEHOLDS IN INDONESIA

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ABSTRACT

This paper identifies the vulnerability of household in Indonesia using both Balance Sheet and Financial Margin Approaches with coping strategy analysis in response to financial pressure. The result concluded that the household sector is solvent and sound with high interconnectivity with the non-financial corporation, particularly with banks. The heatmap coping strategies are in the moderate zone. However, it cumulatively tends to change to a high and extreme zone which potentially creates imbalances in the financial system in Indonesia.

Keywords: Balance sheet analysis, financial margin, coping strategy
JEL Classification: D14, E52, G21

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I. INTRODUCTION

The real sector, including households and corporations, plays a vital role in the economy. The household sector has assets and exposure that are relatively large in the financial industry, indicating that the performance of the household sector can affect the overall financial system. The increased debt or household obligations, amid a sustained slowdown in the economy, prompted the need for monitoring of the household sector to prevent potential imbalances in the financial system from households.

The imbalance risks emanating from the household sector can be transmitted to the financial system through several channels (IMF, 2005). Households are exposed to risk in their capabilities as owners of financial assets in the form of third-party funds, securities, equity assets and insurance, and pension funds. Besides, households are also exposed to risks in their role as fund borrowers from the financial sector, particularly banks. The imbalance occurs when the household cannot pay off the liabilities to the bank, so the bank suffers losses. On the other hand, households experiencing financial difficulties will also reduce spending on consumption, thereby reducing the demand for goods and services that may subsequently have an impact on the economy. As a result, corporations experience a decrease in revenues that could lead to the decline in the ability of corporations in terms of repayment capacity to banks.

The US experience of sub-prime mortgage that led to the global crisis in 2008 showed that credit risks from the household sector could have a significant impact on the economy as a whole. A high interconnection between the household sector and the financial sector could potentially increase systemic risk in the event of a shock in the household sector. Therefore, a broader household risk profile is needed to mitigate the risks stemming from the household's financial imbalance.

Household balances are linked to other sectors balance sheets such as corporations, the public sector and the financial sector from both assets, and liabilities. Household exposure to all sectors of the economy can be analyzed using the Balance Sheet Approach (BSA) method as the IMF has done it. BSA is used for surveillance of financial system stability by analyzing position data, both assets and liabilities of each sector to measure risk in a country's economy (Haim & Levy (2007) and Allen et al. (2002)).

In 2014, Bank Indonesia in collaboration with other related institutions began to prepare National and Regional balance sheets starting with the preparation of Financial Account (FA). Through the use of National Balance Sheet (NBS) data, the economy can be viewed as an integrated system of sectoral balance sheets, comprising government sectors, central banks, households, banks, corporations, non-banking financial institutions, and external areas. The availability of integrated NBS data can illustrate inter-sectoral linkages and economic conditions so that it can be used to further analyze the inter-sector financial risks, financial imbalances between institutions, domestic, and overseas. It is expected to obtain information related to household sector risk profile as well as linkages between the household sector and other economic sectors through a more in-depth analysis of NBS data. Also, the study features a vulnerability assessment of households primarily derived from credit risk using the financial margin indicator. Using the Bank Indonesia Household Survey (SNRT BI) data in 2015, the financial margin values

for each sample in the survey can be used to indicate whether the household is experiencing distress on its financial condition or not.

This paper aims to identify the characteristics and risk profile of the household sector in Indonesia. Also, it develops an indicator of household financial imbalance through the Balance Sheet Approach (BSA) and Financial Margin Approach (FMA). The present paper further maps household heatmap coping strategies in facing of financial pressures, referring to the calculation of the balance indicator.

This paper has several limitations, namely the limited data on individual households. Second, financial margin analysis is limited to a regional coverage (12 provinces) and the number of samples used in the 2015 SNRT so as not to be aggregated nationally. Besides, the analysis did not involve inferential modeling and testing.

The next section of this paper reviews the theories and literature that are strictly related to this topic. The third section describes the research methodology, while Section 4 presents the results of calculating and mapping the level of household equilibrium in Indonesia. The fifth section presents the conclusions and closes this paper.

II. THEORY

2.1. Financial Margin

Financial margin is a liquid asset held by households after deducting the cost of debt including the cost of interest and principal debt as well as total household expenditures. This indicator represents household resilience to changes in macroeconomic conditions such as an increase in interest rates or a decrease in income. Furthermore, the financial margin may also provide information about the risk of a household's default on loans from financial institutions such as large banks that can affect the stability of the financial system (Vatne, 2007).

Households with negative financial margins can be considered as vulnerable households. The share of vulnerable households can be a crucial indicator in monitoring household resilience to various shocks such as employment shock as well as changes in interest rates, asset prices, exchange rates, and repayment vehicle yields (Albacete and Fessler, 2010).

To analyze the vulnerability of households, the financial margin can also be used as a financial distress indicator where households are assumed to be distressed when they have negative financial margins. The financial margin represents the difference between household income after tax and main expenditure including food, energy, transportation, health and rental, and debt repayment expenses (Hlavac, Jakubik, & Galuscak, 2014).

Pratama & Hidayat (2015) explains that financial margin can be used as a proximate measure of household credit risk that can describe the ability of households to pay both short-term and long-term debts. Households with negative financial margins are considered to be households that are in financial trouble and are characterized by the inability to meet basic needs and repay the debt so that households tend to have high default potentiality of repayment.

The vulnerability analysis of households in Norway using the financial margin indicator conducted by Vatne (2007) through the Income and Property Statistics

for Household 1987-2003 data, showed that 13% of households in Norway are vulnerable households or have financial value with negative margin in 2003, where the ownership of the household debt reached 17% of total household debt.

By income group, as many as 20% of the highest income households own 1/3 of the total household debt, where the debt held by vulnerable households is relatively small (7%). In the lowest income households group, more than 50% of the debt is owned by vulnerable households. Groups of households with productive-aged household heads (24-35 years) have almost 30% of total household debt where 40% of the debt is owned by vulnerable households.

Using OENB's Household Survey on Housing Wealth 2008 (HSHW, 2008) and financial margin calculation method, Albacete & Fessler (2010) found that the share of vulnerable households in Austria ranged from 9.2% to 15.6%. By income group, the highest income households have a relatively small percentage of susceptible households that varies around 1%. While the lowest income households have a share of households that reached 56.7% to 70.5%. In general, vulnerable households in Austria tend to have low incomes, massive debts, and are headed by women.

Bilston, Johnson, & Read (2015) conducted a household vulnerability analysis using a financial margin approach using the Households, Income, Labor Dynamics in Australia (HILDA) survey data. The results explained that the share of vulnerable households in Australia reached 12% in 2002, 10% in 2006, and 8% in 2010. Based on demographic characteristics, vulnerable households are those contracting household with relatively low income.

Another study, conducted by Johansson & Persson (2006) in Swedish households using HEK Survey data, found that the share of vulnerable households in Sweden accounted for 6.3% of all households with debts in which the household holds 5,6% of the total household debt in Sweden.

In the Indonesian case, Effendi (2015) used a financial margin approach to analyze the vulnerability of Indonesian households by utilizing the 2012 National Socio-Economic Survey (SUSENAS) data and found that the average share of vulnerable households in Indonesia is 5.39%. Based on income deciles, the most significant share of vulnerable households is found in decile-1 (lowest income class), reaching 41%. Meanwhile, the percentage of vulnerable households in decile-10 (highest income class) was recorded relatively small, i.e., less than 1%. The share of households based on income deciles tends to decrease as income increases.

Pratama & Hidayat (2007) also analyzed household vulnerability through financial margin indicator by using the 2007 Indonesian Family Life Survey (IFLS) data. In this research, there are two approaches, direct and indirect. In the immediate approach, the value of financial margin is calculated based on the difference between per capita expenditure which is the proxy of income and spending with a monthly payment. Meanwhile, the value of financial margin in the indirect approach is obtained from the difference between household expenditure which is the proxy of income with predicted essential consumption and monthly payment.

The result of the analysis, using the direct approach, showed that in total there are 16% of Indonesian households that are vulnerable to default with debt

ownership of 48%. Of the total households with debt to banks, 26% were vulnerable households with ownership of debt that reaches 52%.

The analysis, generated by the indirect approach, tends to be overestimated due to the double counting of the reduction in household expenditure as a proxy of income with basic consumption accounted for by the value of household expenditure. In total, the share of vulnerable households reached 49% with debt ownership of 45%. This result is not much different for households who have debt only to banks where as many as 49% of these households are vulnerable to default and have a debt of 46%.

By demographic characteristics, the results of the direct approach indicated that households with fragile share and high debt holdings are male-headed households at productive age with homes. While in the indirect method, household groups that have a share of vulnerable households with high debt holdings are households with houses as debt guarantees.

2.2. Household Coping Mechanism

There are three choices of coping strategies that can be done by the household which includes risk prevention, risk mitigation, and risk coping strategies (Tesliuc dan Vakis, 2004). A risk prevention strategy is a strategy used before a risky event occurs and is carried out with the purpose of reducing the likelihood occurrence of the event that can affect the welfare of the household. Unlike the risk prevention strategy, risk mitigation strategies are carried out by households to reduce the impact of an event that has been predicted to occur. Meanwhile, risk coping strategies are a household strategy when risky events have occurred. The general form of the strategy may be the withdrawal of savings, borrowing money, relying on assistance from private or government agencies, and so on.

These risk management strategies can be informally carried out between households (informal, based arrangements), market-based arrangements that are risk handling with the help of financial institutions, and public arrangements that are handling household risks with the assistance of the government.

Of the three risk management strategies mentioned above, the risk coping strategy is the most important strategy for households because it can measure the magnitude of household resilience to certain events that can cause household financial imbalance that if not handled properly can have an impact on the occurrence of financial pressure (distress) (Lusardi et al. (2009) and WHO (1998)).

Furthermore, Snel & Staring (2001) and Bhrami & Poumphone (2002) revealed that in general, coping strategies are carried out primarily when households are experiencing economic difficulties which may include strategies to find solutions to problems, strategies for dealing with stress and strategy to develop defense mechanisms. The form of coping strategies undertaken by households tends to vary, among others, can be either limitation of the expenditure or getting the additional income just to meet the basic needs and keep the level of welfare of life (not reduce).

Also, PEP-CBMS Network Coordinating Team (2011) explained that household risk coping strategies are conducted with the aim of minimizing the impact of pressure on the level of well-being. In general, these strategies are complicated

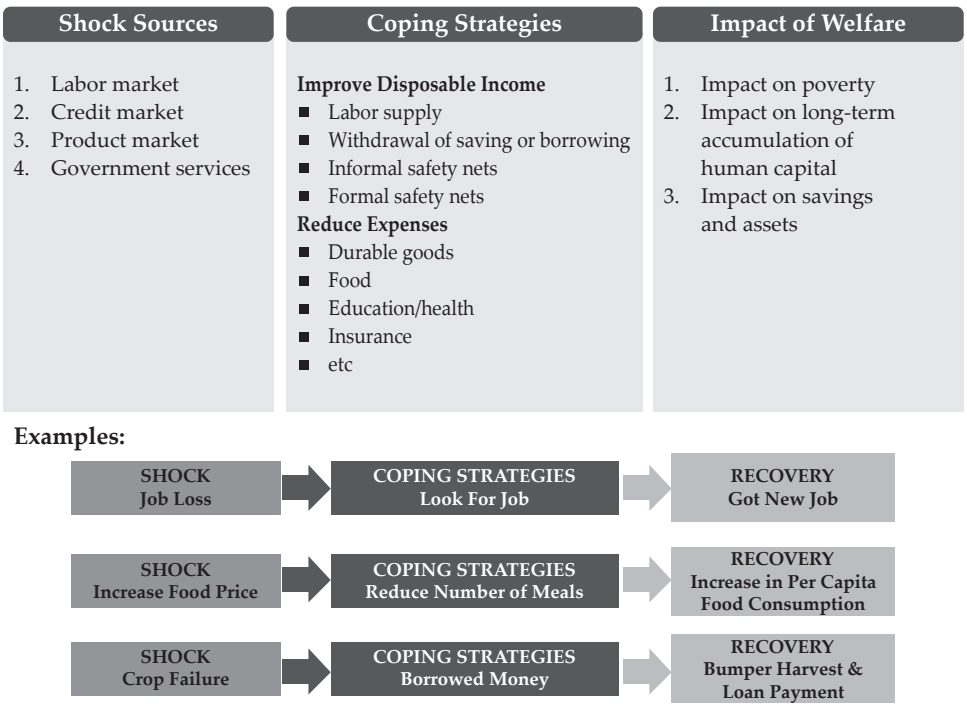
in that they depend on exogenous and endogenous factors such as household characteristics, experience, local economics, infrastructure, and networks.

Based on the classification of the generated effects (severity), risk coping strategies can be divided into three as follows.

1. Non-Erosive Coping includes borrowing strategies; reducing food consumption; substituting food for cheaper; reducing unnecessary spending; and selling non-productive assets.
2. Erosive Coping includes a high-interest borrowing strategy; sell productive assets such as land, animals, farmland, other productive equipment; borrowing wages for the next period payment; and employing minors.
3. Failed Coping is a situation where households have a high dependence on others to meet their needs, migrate, steal, beg, and so forth.

The World Bank (2011) explained that there are shocks from the labor market such as termination of employment, credit markets such as rising lending rates, product markets such as rising food prices and reducing government subsidies to society (in general) will be responded by the public through the increasing of revenues either via withdrawal of savings or doing additional work, and so on. Another response that can also be done by households regarding expenditure is to reduce spending including expenditures on valuables, food, education, health, insurance, and so forth.

The failure of the household to respond to the shock will affect the decline in the level of household welfare represented by the decrease in financial assets in the form of saving, decreasing non-financial assets, decreasing the accumulation of human capital such as employing children under the age of work, and so forth. More explicitly, the interaction between household shock sources and household responses and their impact on household welfare can be seen in the following diagram.



Source: World Bank (2011) in the PEP-CBMS Network Coordinating Team (2011)

Chart 1. Interactions between Shock Sources and Coping Strategies as well Impacts on Household Welfare

In more depth, coping strategies taken by households in response to particular pressures or events can also determine the degree of vulnerability they encounter. The Food Security & Early Warning Vulnerability assessment manual (USAID, 1999) describes that coping strategies undertaken by households can fall mainly into two categories: adaptation and divestment strategies for divestment of both liquid assets and productive assets. Both strategies can reflect the extent of the vulnerability faced by households. The level of vulnerability of households is divided into three, namely moderate, high, and extreme vulnerability level.

Households which have coping adaptation strategies in response to an event occurring, generally have relatively moderate vulnerability levels. Meanwhile, households that choose to divest on liquid assets tend to have high levels of vulnerability or even extreme especially for households who divest on productive assets.

The link between coping strategies and household vulnerability levels can be seen more comprehensively on heatmap coping strategies adapted from the Food Security & Early Warning Vulnerability USAID (1999) assessment manual and has been used internationally to identify household vulnerability levels by looking at what strategies are used in facing of financial pressures.

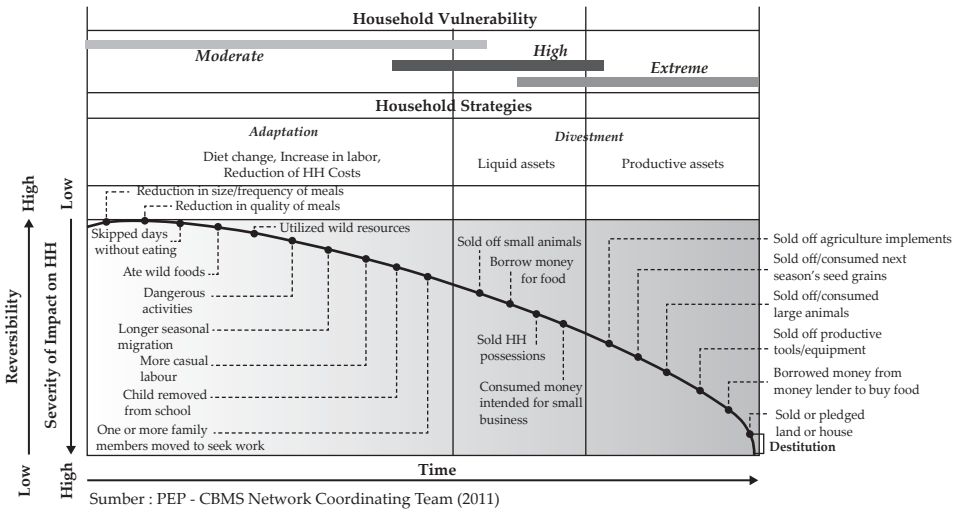


Chart 2. Heatmap Coping Strategies

III. METHODOLOGY

3.1. Model Framework

The framework in this research uses two approaches, namely macro (aggregate) using Balance Sheet Approach method and micro by using Financial Margin Approach. The macro analysis using BSA provides information on the household sector risk profile obtained either through individual sector risk analysis of the sector or an interconnectedness risk analysis of households with other institutional sectors. Individual household risk analysis is obtained through a balance sheet risk indicator, while the risk analysis of household linkages with other sectors is obtained through BSA matrix.

The FMA is done by using two approaches, namely income approach and expenditure approach. Both methods result in the share and demographic characteristics of households that have negative financial margins and further defined as vulnerable households. The results of such analysis can be input in decision making primarily for the provision of household credit by financial institutions.

In addition to both methods, the household vulnerability can also be assessed based on coping strategies taken in facing financial pressures. Information related to household coping strategies was obtained through survey results based on three primary answers selected by respondents in facing financial difficulties. The behavior of household coping strategies can lead to vulnerability as actions taken can directly impact the financial sector, such as withdrawing deposits in banks and so on, to affect the overall balance of the financial system. Also, information on household demographic characteristics obtained through FMA can also be an input in coping strategies given that the strategies adopted by vulnerable households potentially lead to higher vulnerability.

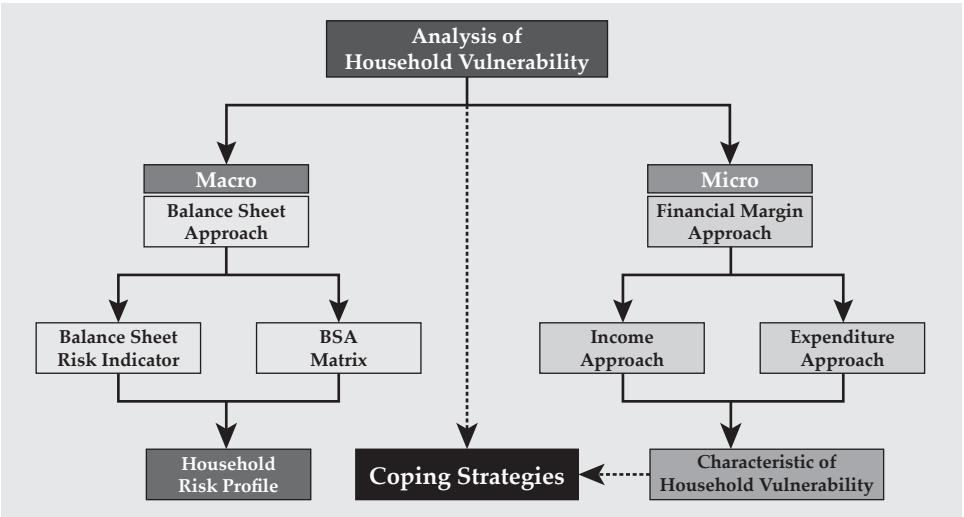


Chart 3. Domestic Vulnerability Framework Analysis

Balance Sheet Approach (BSA)

Analysis of household vulnerability in aggregate includes analysis of individual household risk profile of sectors as well as risk analysis of household linkages with other institutional sectors such as corporations, banks, and IKNB. An approach that can be used to analyze the vulnerability of households is BSA.

BSA is an approach that uses sectoral balance sheet data to analyze the interconnection between economic sectors and analyze the position of assets and liabilities of a sector and its changes caused by shocks in certain sectors and affect other sectors through the balance sheet channel (IMF, 2015).

The sectoral balance sheet data used in this study is national and regional data of FABS Bank Indonesia in 2015. The data is then used in calculating the balance sheet risk indicator to identify household risk profile. Risk indicators, used concerning data availability, are liquidity risk indicators such as the ratio of saving to expenditure and solvency risk such as the ratio of liabilities to assets and liabilities to GDP.

Also, interconnection analysis between the household sector and other sectors uses the whom-to-whom matrix or BSA matrix in the FABS data. The type of BSA matrix used is the BSA matrix for the net financial position indicator that can describe the household's financial position towards other sectors and is an indicator of the vulnerability of the economic sector. In general, the value of the net financial position is derived from the difference in total financial assets subtracted the total liabilities. The negative value of the net financial position implies that the sector is facing financial problems where the total financial assets are insufficient to meet all of the obligations (IMF, 2015).

Financial Margin Approach (FMA)

The identification of household vulnerability is also individually done to complement the results of the aggregate analysis individually using FMA. FMA is an approach used to calculate household margins derived from residual income after deducting expenditure, both basic expenditures, and expenditures to pay principal installments of debt and interest defined as financial margin (Bilston, Johnson, & Read, 2015).

Financial margins measure the ability of households to cover debts, both short-term and long-term. Households with negative financial margins are defined as vulnerable households. Such vulnerability, if not addressed properly, may result in difficulties in meeting basic needs and repay debt, increasing the possibility of default to the counterparty (Pratama & Hidayat, 2015).

This study focuses on households that have the debt to banks and have negative financial margin value. Such households may generate financial imbalances through exposure to other sectors, particularly banks.

The data used to calculate the financial margin of each household is the data of SNRT 2015. The value of financial margin is obtained through two approaches, namely income approach and expenditure approach. In the income approach, the financial margin value of households is obtained from the difference between income with expenditure for basic consumption and debt repayments. This approach is adapted from the Albacete & Fessler (2010) study utilizing OeNB's Household Survey on Housing Wealth 2008 (HSHW, 2008) data to analyze the vulnerability of households in Austria. Mathematically, the calculation of financial margin value by using income approach is as follows.

$$FM_i = Y_i - BC_i - DS_i$$

Where Y_i is the income of the household, BC_i represents the basic consumption of the household, and DS_i is the installment of household debt.

The household income in the 2015 SNRT is the total income of all ART within one year. The basic consumption component[4] is referring to the type of necessary expenditure used by BPS to calculate the poverty line, which includes food consumption, housing and household facilities, clothing and fashion, and the consumption of various goods and services. Meanwhile, the value of installments of household debt includes short-term and long-term debt repayments.

A second approach is an expenditure approach which is an expenditure approach where income data is proxied through household consumption (total consumption) which is done to minimize error-term (error) that occurs due to the use of revenue data from survey results that tend to be biased. Mathematically, the value of financial margin is calculated by the following formula.

$$FM_i = C_i - DS_i$$

[4] Information can be obtained at http://bps.go.id/Subjek/view/id/23#subjekViewTab1|accordion-daftar-subjek1.

where C_i is the total consumption of a household and DS_i shows the installment of household debt.

The total household consumption is calculated from all of the consumption items contained in SNRT 2015 data such as food consumption; housing and household facilities; clothing and fashion; various goods and services; recreation, taxes, levies, donations, insurance and zakat; party and ceremonial/feast purposes; transportation, service vehicles and fuel; and other consumption. The Basic Consumption variable (BC) is not included in the calculation to avoid double counting because it is included in the total consumption.

3.2. Data

Data used in this study include the 2015 National and Regional Financial Accounts & Balance Sheets (FABS) data used to analyze the aggregate household vulnerability and the 2015 Household Survey (SNRT) data used to identify the vulnerability of individual households.

National and Regional FABS Data (2015)

The FABS data is part of the Integrated Economic Account, which covers the framework of sectoral accounts developed through cooperation between Bank Indonesia (BI) and the Central Bureau of Statistics (BPS), in meeting the needs of integrated data and can describe the condition of the economy and financial system and the risk in an economic sector which may affect the overall financial system. The data requirement is in line with one of the data Gaps Initiatives # 15 of G-20 countries that were initiated by International Monetary Fund (IMF) and Financial Stability Board (FSB) in 2009.

BI and BPS multi yearly have implemented the effort to fulfill the recommendation since 2012. As part of the effort, BI has performed the preparation of FABS data as part of the sectoral account framework for each institutional sector, both nationally and regionally since the beginning of 2014 under the Strategic Program # 4 Architecture of Strategic Functionality of Bank Indonesia (AFSBI) - Preparation of National and Regional Balance Sheet.

FABS data is useful for analyzing inter-sectoral linkages, financial imbalances in individual sectors and analyzing the contagion effect of shock in a sector against other sectors that may cause systemic risks and potentially trigger a crisis. Regionally, FABS data is also useful for determining regional financial systems comprehensively and identifying regional financial imbalances.

In more detail, FABS data includes Financial Account (FA) and Balance Sheet (BS) data. FA data is the data of inter-sector asset and financial liabilities transactions, which shows the financial flows between institutional sectors both national and regional (certain regions). Meanwhile, the BS data is the position data of assets and liabilities owned by the institutional sectornationally or regionally (in a particular region) as well as in certain period. The BS data consists of the initial position balance sheet and the end position balance sheet.

FABS data are classified based on the classification of the institutional sector as well as financial instruments regarding assets and liabilities. The classification of the institutional sector used in the national FABS is as follows.

Table 1.
Classification of Institutional Sectors at National FABS

Institutional Sector	Institutional coverage
1. Non-Financial Corporation (NFC)	Public and Private Non-Financial Companies
2. Central Bank (CB)	Bank Indonesia
3. Deposit-taking other than the central bank (ODC)	- Conventional commercial bank - Islamic commercial bank - Conventional BPR - Islamic BPR
4. Other Financial Corporation (OFC)	- Pension Funds - Insurance - Finance Companies (Finance Companies, Pawnshops, Cooperatives, Savings and Loans, and Indonesia Exim Bank) - Financial Auxiliary (OJK, Forex Traders, KSEI, and BEI)
5. Central Government (CG)	Central Government and excluding Social Security
6. Local Government (LG)	Local Government (Provincial, District, and City Government)
7. Household (HH)	Household and Non-Profit Institution Serving Household
8. Rest of the World (ROW)	All Non-Resident

Source: Bank Indonesia (2015)

The classification of the institutional sector used in the regional FABS is based on a center of predominant economic interest in which a sector is considered as a part of a regional institutional sector when it has a large regional economic interest center. The classification of the institutional sector in the regional FABS is as follows.

Table 2.
Classification of Institutional Sectors at (FABS) Regional level

Institutional Sector	Institutional Coverage
1. Non-Financial Corporation (NFC)	Public and Private Non-Financial Companies
2. Deposit-taking other than the central bank (ODC)	- Conventional Commercial Bank - Islamic Commercial Bank - Conventional BPR - Islamic BPR
3. Other Financial Corporation (OFC)	- Pension Funds - Insurance - Finance Companies (Finance companies, pawnshops, cooperatives, savings, and loans)
4. Local Government (LG)	Local Government (Provincial, District, and City Government)
5. Household (HH)	Household and Non-Profit Institution Serving Household
6. Rest of Indonesia (ROI)	Other sectors outside the region but still in the region of Indonesia (Rest of NFC, Central Bank, Central Government, dan Rest of Others)
7. Rest of the World (ROW)	All Non-Resident Institutions

Source: Bank Indonesia (2015)

From the instrumental aspect, the classifications of financial instruments used in FABS data are Monetary gold and SDRs; Debt securities; Equity and investment fund share/units; Financial derivatives and employee stock options; Currency and deposits; Loans; Insurance, pension and standardized guarantee schemes; and Other accounts receivable/payable.

SNRT Data (2015)

Microdata, used in this research, is the 2015 SNRT data which is a routine survey result yearly conducted by Bank Indonesia. SNRT began in 2006 and was re-implemented in 2015 with different sample frameworks and aims to examine the structure of households' balance sheets in Indonesia, especially households that are expected to have access and influence to the banking system, establishing essential useful data for designing surveillance systems and a nationally representative balance sheet. Information on household balance in the 2015 SNRT data was obtained through three questionnaires, namely Household Questionnaire (KRT), Household Expenditure Questionnaire (KPRT), and Independent Individual Questionnaire (KIB).

The SNRT (2015) is implemented simultaneously in 12 provinces representing 71% of Indonesia's population based on the National Socio-Economic Survey (SUSENAS) in the first quarter of 2013. These provinces include North Sumatra, West Sumatera, South Sumatera, DKI Jakarta, West Java, Central Java, East Java, Bali, South Kalimantan, East Kalimantan, North Sulawesi, and South Sulawesi.

The number of households being sampled by the 2015 SNRT in the 12 provinces is 2,170 households. The sample is determined by taking into account

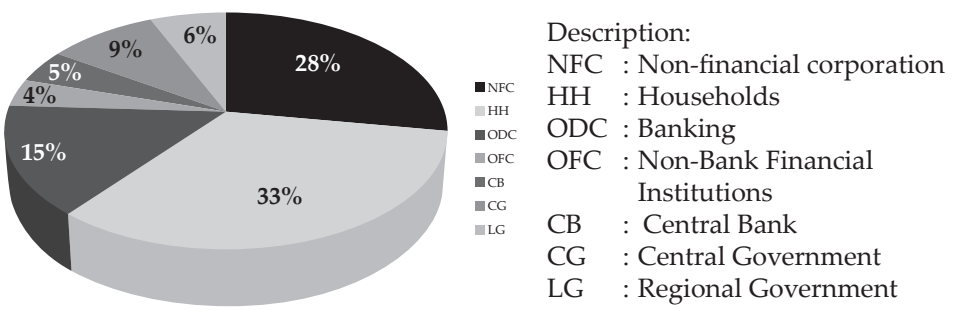
the percentage of the population working in each province as well as the average number of household members (ART) in each household.

Furthermore, the household balance sheet data in the SNRT (2015) can also be used for several analyzes such as macro analysis or analysis of household income nationally or provincially, microanalysis or analysis of household assets and household access to banking, household debt analysis or behavioral analysis of household debt, as well as analysis of household conditions, and resistance to crises.

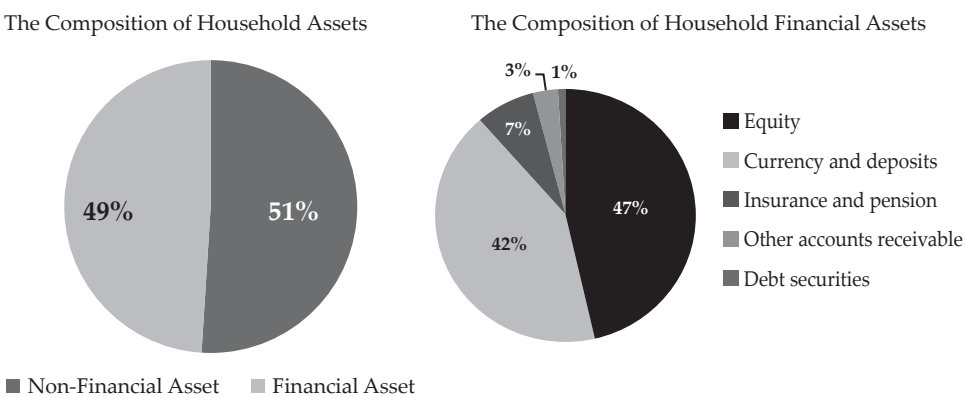
IV. RESULTS AND ANALYSIS

4.1. Stylized Fact

In 2015, households were the most significant contributor to the national assets, accounting for 33% of the total national economic assets, most of which are financial assets. The placement of household financial assets is still dominated by equity fund disbursement mainly to non-financial corporations accounting for 47% of financial assets followed by third-party funds channeling to banks (42%).

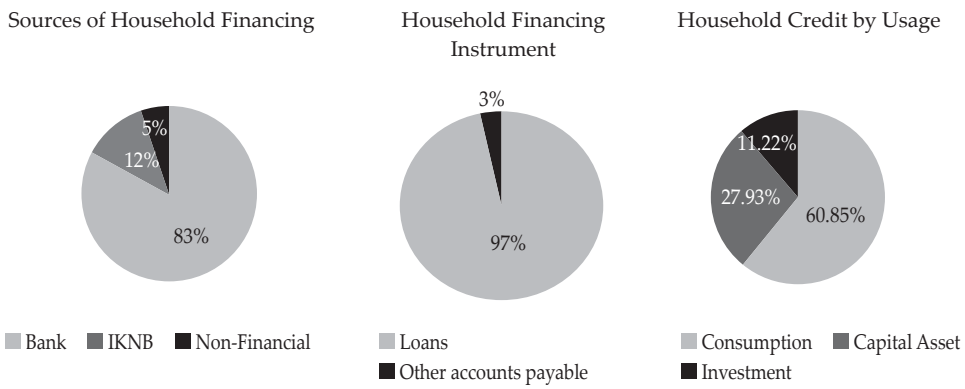


Graph 1. Composition of National Assets Per Economic Sector



Graph 2. Composition of Household Assets

Regarding financing, the majority of household debt sources came from banks reaching 83% followed by IKNB (12%) and non-financial sector (5%). Household debt instruments are dominated by loans (97%) mostly from banking. The share of individual loans to total bank loans was 44% in 2015, mostly used for the fulfillment of consumption (61%).



Graph 3. Financing Sources, Financing Instruments, and Household Based Credit Usage

Spatially, the province with the largest share of household financial assets to GRDP is DKI Jakarta with 132.26%, whereas the majority of the assets are channeled to non-financial corporations in equity (51%), implying the importance of the role of the household sector to the economy in the Province of DKI Jakarta through financing to corporations that can be used for business expansion.

The composition of household financial assets in DKI Jakarta is much higher than the obligation, indicating that Jakarta household sector has the potential to become a source of financing for the regional economic activity of DKI Jakarta.

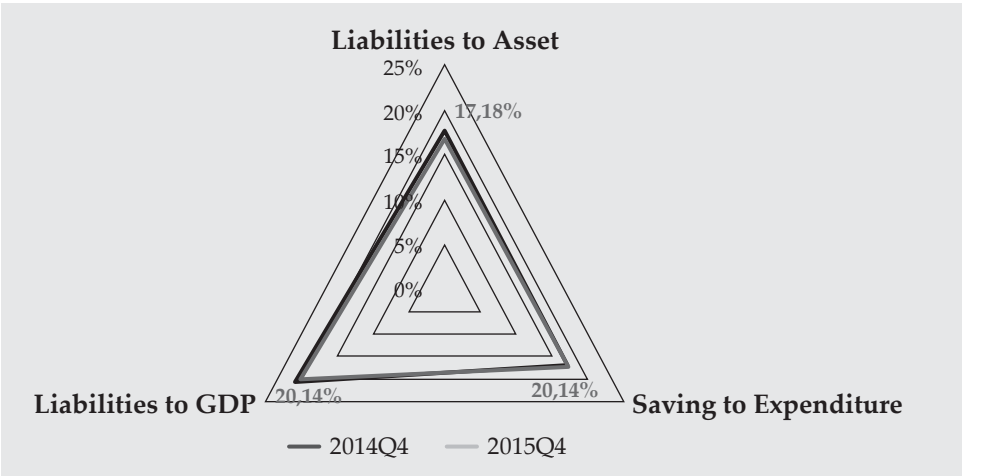
Table 3.
Financial Assets and Domestic Liabilities by Province (% to GRDP)

Balance Sheet	Province							
	DKI Jkt	West Java	East Java	East Kalimantan	North Sulawesi	North Sumatera	West Sumatera	South Sumatera
Financial Asset	132.26%	39.01%	38.95%	30.19%	38.52%	28.60%	24.34%	35.07%
Liabilities	16.87%	14.28%	11.73%	6.75%	26.01%	14.78%	14.78%	14.45%

Source: RFABS (2015)
* Some provinces can not be shown because the data are not complete

4.2. Vulnerability Analysis Using the Balance Sheet Approach (BSA)

The analysis of household vulnerability, using balance sheet risk indicator, indicated that generally, the liquidity and solvency risk indicator is relatively stable, although it has experienced pressure as a result of the continuing economic slowdown in 2015. From the solvency side, Liabilities to Asset and Liabilities to GDP of households are under 21% with a downward trend. The decline in Liabilities to Asset indicator value in 2015 was triggered by the growth of financial assets reaching 20% (yoy) which is much higher compared to the growth of liabilities of 6% (yoy). The slowing growth in household liabilities also led to a decline in the value of the Liabilities to GDP indicators from the previous period, indicating that the household sector in Indonesia is quite solvent, especially in covering short-term and long-term debt in 2015.



Source: NFABS 2015, processed data

Graph 4. Balance Sheet Risk Indicator

Cumulatively, the liquidity risk indicator proxied by the saving ratio showed an increasing trend compared to the previous period as a result of the increased growth of household savings to banks. The increase in household liquidity implies that households have sufficient liquid assets to meet basic needs and repay short-term debt.

Based on the BSA matrix of net financial position indicators, the household sector was the sector with the most significant financial surplus in 2015, which is represented by the total net financial position value representing 39.68% of the GDP. The value of the net financial position of households, among others, comes from the ownership of financial assets that reached 32% of the national financial assets, implying the importance of the role of the household sector in the economy as one of the largest sources of domestic financing. The distribution of household financial asset (majority) goes to the non-financial corporate sector with the net financial position value of households to the corporation that reached 28.95% of GDP.

Table 4.
BSA Net Financial Position Matrix in the Q4 of 2015

Issuer of the Liability (Debtor Sector)	Holder of Liability (Creditor Sector)							
	NFC	**HH**	**ODC**	**OFC**	**CB**	**CG**	**LG**	**ROW**
	(In percent of GDP)							
TOTAL	-70.34%	39.68%	0.98%	0.81%	1.10%	-14.26%	2.31%	39.72%
NFC		28.95%	6.19%	1.67%	-1.76%	5.80%	0.9%	28.60%
HH	-28.95%		-6.44%	-1.90%	-2.08%	-0.42%	0.11%	0.00%
ODC	-6.19%	6.44%		1.14%	-7.61%	-1.42%	1.56%	5.10%
OFC	-1.67%	1.90%	-1.14%		-0.13%	-2.04%	0.00%	2.27%
CB	1.76%	2.08%	7.61%	0.13%		-0.15%	0.03%	-12.57%
CG	-5.80%	0.42%	1.42%	2.04%	0.15%		-0.27%	16.32%
LG	-0.88%	-0.11%	-1.56%	0.00%	-0.03%	0.27%		0.00%
ROW	-28.60%	0.00%	-5.10%	-2.27%	12.57%	-16.32%	0.00%	

Source : NFABS 2015, data diolah

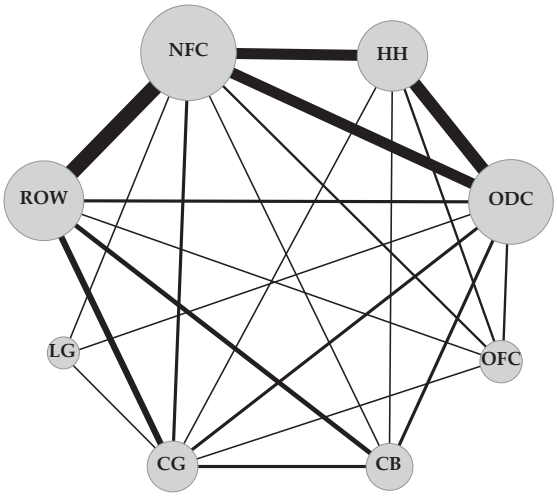
Equity instruments dominate household financing of the non-financial corporate sector[5] of which 98% of household financial assets in the form of capital (46.41% of total financial assets) are disbursed to non-financial corporations. The amount of household financing of the non-financial corporation's sector showed the high interconnection between the two sectors.

This causes the household sector to tend to be exposed to capital loss risk or liquidity risk when the corporation is under financial pressure or even default. The risk of capital loss occurs when a household sells an equity asset in the form of a corporation stock at a price lower than the purchase price. Liquidity risk occurs when the equity asset is difficult to liquidate, mainly due to adverse market sentiment over the company's long-term financial condition.

Also, BSA net financial position matrix also showed a high interconnection between household sector and banking. The value of household financial assets in the form of deposits (currency & deposit) of 42.15% is dominated by the distribution of deposits to the banking sector that reached 92%. Thus, the banking sector tends to be exposed to the risk of withdrawal of funds that can be done by households especially when experiencing a financial deficit to meet liquidity needs.

More comprehensively, the financial interconnection between the household sector and the banking sector, the household sector with non-financial corporations and other sectors can be seen in the graph below.

[5] Includes ownership of corporate equity by another corporation, assuming ultimate shareholder is an individual or a household



Source: NFABS 2015

Graph 5. *Network Gross Exposure*[6] on the Q4 of 2015

Meanwhile, the spatial analysis of household financial assets by instruments showed that in general households in some provinces in Indonesia (in the majority) still disburse financial assets in the form of deposits in banks. Also, household contributions in some provinces to the real sector are also relatively high. A large amount of financial assets indicates this in the form of non-financial corporate equity in some provinces, which reach more than 50%, such as East Kalimantan, South Sumatra, West Java, DKI Jakarta, and East Java.

Table 5.
Share of Household Financial Assets by Instruments in the Q4 of 2015

Components of Financial Assets	National	Province*							
		DKI Jkt	West Java	East Java	East Kalimantan	North Sulawesi	North Sumatera	West Sumatera	South Sumatera
Monetary gold and SDRs	-	-	-	-	-	-	-	-	-
Currency and Deposits	42.15%	36.66%	44.55%	49.17%	41.33%	65.27%	87.16%	58.68%	39.43%
Debt Securities	0.96%	0.04%	0.01%	0.002%	-	0.004%	0.004%	0.23%	-
Loans	0.02%	11.81%	0.0001%	0.0003%	-	0.01%	0.01%	-	0.00%
Equity	46.41%	50.92%	54.89%	50.36%	58.10%	32.59%	12.14%	41.09%	56.37%
Insurance and Pension	0.07%	-	-	-	-	-	-	-	-
Financial Derivatives	0.002%	0.01%	-	-	-	-	-	-	-
Other Accounts Receivable	3.10%	0.56%	0.55%	0.47%	0.57%	2.13%	0.69%	-	4.20%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: NBS & RBS (2015)
* Some provinces can not be shown because the data are not complete

[6] The size of each sector's nodes, is based on the Gross Exposure value of total financial assets plus total liabilities; Edges or lines are vague/invisible does not mean there is no connection between sectors, but there is a connection with a relatively small nominal.

Based on the financing aspect, both national and regional, the source of household financing outside the income is still dominated by debt in the form of loans, primarily from banking. Nationally, household debt in the form of loans reached 96.86%, of which 86% came from banks.

Table 6.
Share of Household Liability by Instruments in the Q4 of 2015

Components of Financial Assets	National	Province*							
		DKI Jkt	West Java	East Java	East Kalimantan	North Sulawesi	North Sumatera	West Sumatera	South Sumatera
Monetary gold and SDRs	-	-	-	-	-	-	-	-	-
Currency and Deposits	-	-	-	-	-	-	-	-	-
Debt Securities	-	-	-	-	-	-	-	-	-
Loans	96.85%	94.53%	98.42%	98.3600%	97.27%	99.65%	98.53%	99.29%	89.73%
Equity	-	-	-	-	-	-	-	-	-
Insurance and Pension	-	-	-	-	-	-	-	-	-
Financial Derivatives	0.01%	0.06%	-	-	-	-	-	-	-
Other Accounts Receivable	3.14%	5.41%	1.58%	1.64%	2.73%	0.35%	1.47%	0.71%	10.27%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: NBS & RBS (2015)
* Some provinces can not be shown because the data are not complete

Although most of the region is exposed to banking through loans with a share of above 90%, household credit risk remains relatively well maintained which is reflected in the average Non-Performing Loan (NPL) of local households that is still below the minimum of 5%. However, there are several provinces with household NPL values above national NPLs that need to be of concern to policymakers.

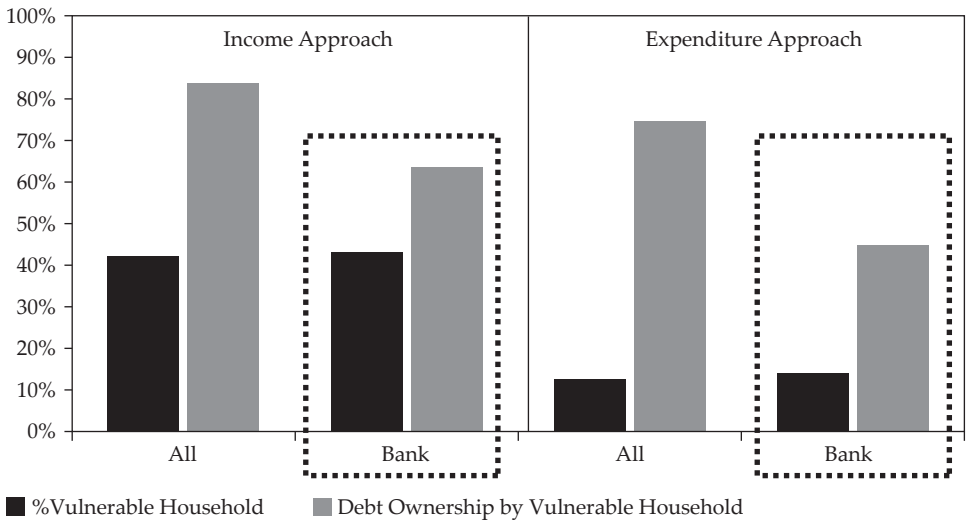
Table 7.
Share of Household Lending by Source

Components of Financial Assets	National	Province*							
		DKI Jkt	West Java	East Java	East Kalimantan	North Sulawesi	North Sumatera	West Sumatera	South Sumatera
Banking	83%	97%	99%	98%	100%	100%	97%	100%	97%
IKNB	12%	2%	1%	2%	-	-	3%	-	3%
Non-Financial Institution	5%	1%	-	-	-	-	-	-	-
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source : NBS & RBS (2015)
* Temporary data (some provinces can not be shown because the data are not complete)

4.3. Vulnerability Analysis Using a Financial Margin Approach (FMA)

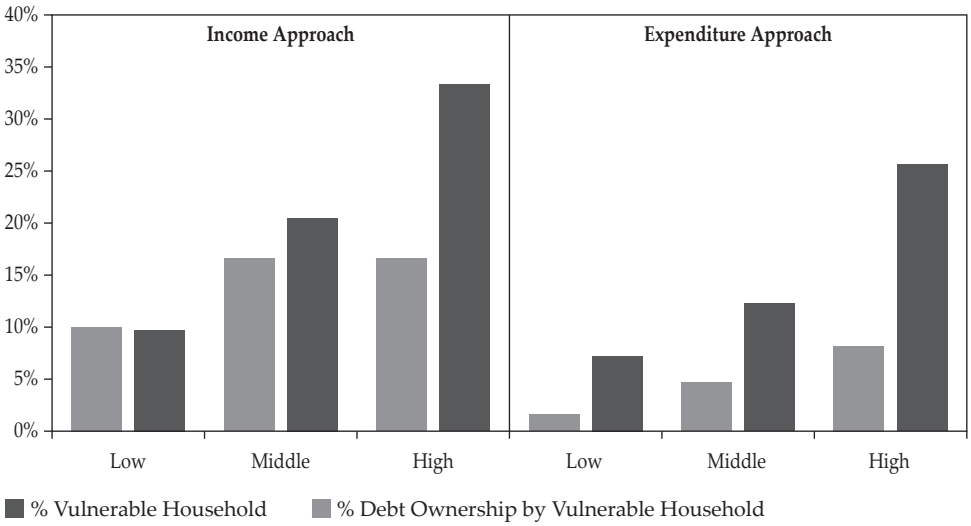
The analysis of household vulnerability using financial margin indicator showed that the overall result from the income approach tends to be overestimated compared to the expenditure approach. This is caused by the use of household income value in an income approach which tends to bias downward. Based on the expenditure approach, the share of vulnerable households from the total households owed to banks is 14% with debt holdings of 45%. While in the income approach, the share of vulnerable households that is borrowed to banks reached 43% with debt ownership of 63%.



Graph 6. Share of household Vulnerability and Share of Debt Ownership by Vulnerable Household

The relatively high share of vulnerable households that have the debt to banks in 2015, especially in the income approach implies that banks face high credit risk, especially if the household is experiencing difficulties in fulfilling its obligations. This is in line with the relatively high Non-Performing Loans (NPL) of individual banking loans in 2015 which was 2.40%. The increased NPLs for individual loans are suspected to be a result of the ongoing phase of the economic slowdown in 2015, where the slowdown has put pressure on both consumption and the ability to repay household debt (KSK, 2016).

By income group, both the income approach and the expenditure approach tend to show the same return pattern in which high-income households have the relatively large share of vulnerable and high debt holdings. Top debt holdings are triggered by the ease of access of high-income households to the financial system, the presence of large asset holdings as debt guarantees, predictable financial returns, and long-term revenue holdings.



Graph 7. Share of Household Vulnerability
and Share of Debt Ownership based on Revenue[7]

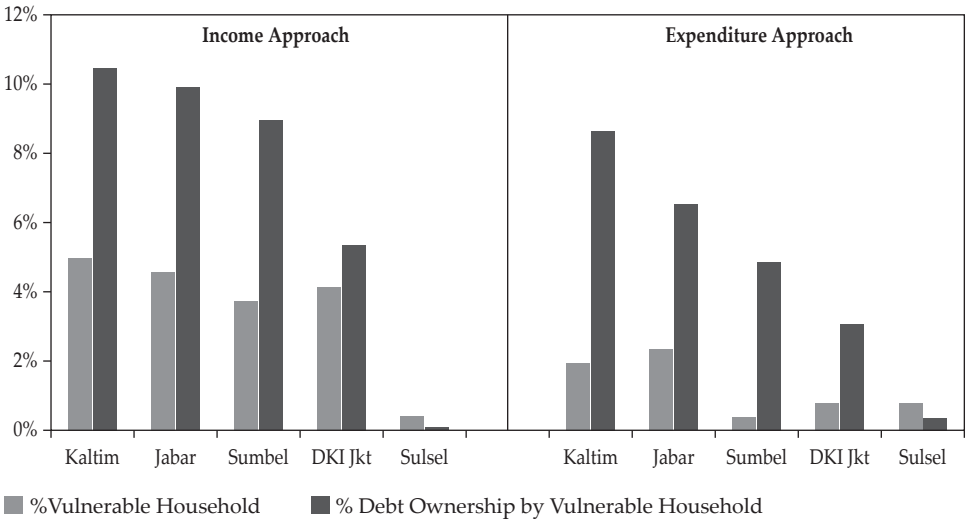
The large share of vulnerable households and high bank debt holdings by high-income households implied that these households tend to have a greater likelihood of default when experiencing financial deficits and insufficient liquid assets to cover the entire short-term debt. Nevertheless, the potential risk of these households in experiencing financial pressures is relatively small considering the ownership of assets that tend to be large as it can be used as a defensive strategy in closing the deficit. The survival strategy that can be done by the household is selling the productive asset and withdrawing the savings.

Another thing that needs attention is the relatively large share of vulnerable households coming from low-income groups. The result of the analysis, using the income approach, showed that the share of vulnerable households reaches 10% with a bank debt ownership of 10%. Low-income groups have a higher risk of experiencing distress which may impact on difficulties in meeting basic needs and paying the debt to banks. The difficulty of fulfilling low-income household obligations to banks in 2015 is also indicated by the high debt service ratio of low-income households in the second semester of 2015 which reached 2.34% (KSK, 2016).

The result of the spatial analysis of household vulnerability showed that East Kalimantan is the province with the highest share of vulnerable households and the highest share of debt ownership compared to other provinces. The high share of bank debt ownership by households in East Kalimantan is caused by the ease of access to banking services. In SNRT 2015, 30% of households in East Kalimantan

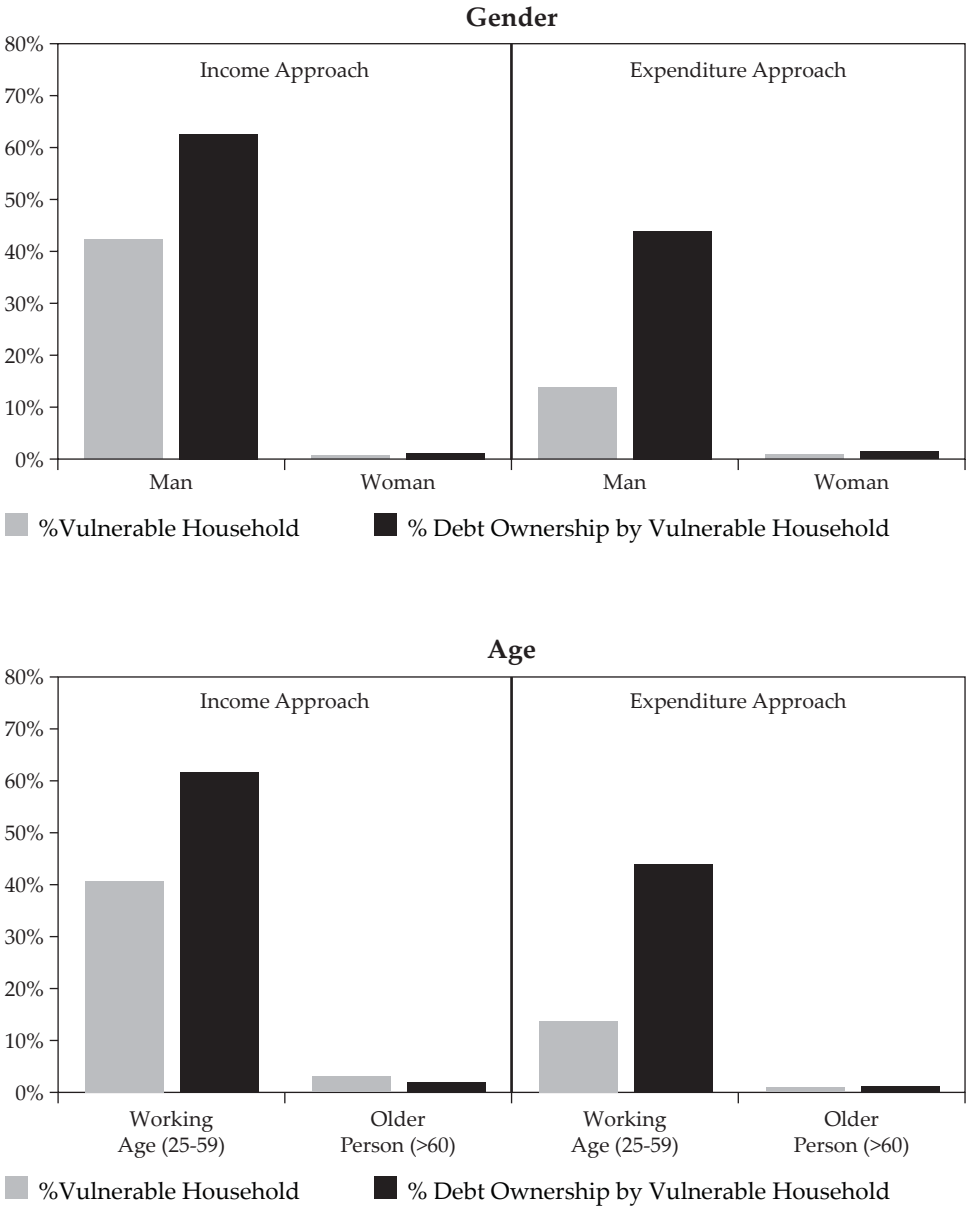
[7] High income> Rp 6,876,000, Medium income = Rp 2,631,000 – Rp 6.875.000, and Low income < Rp 2,630,000

province can access banking services with an average distance of less than 1 km. In addition to East Kalimantan, there are two other provinces with a share of bank debt owned by vulnerable households above 5%, i.e., South Sumatra and West Java.

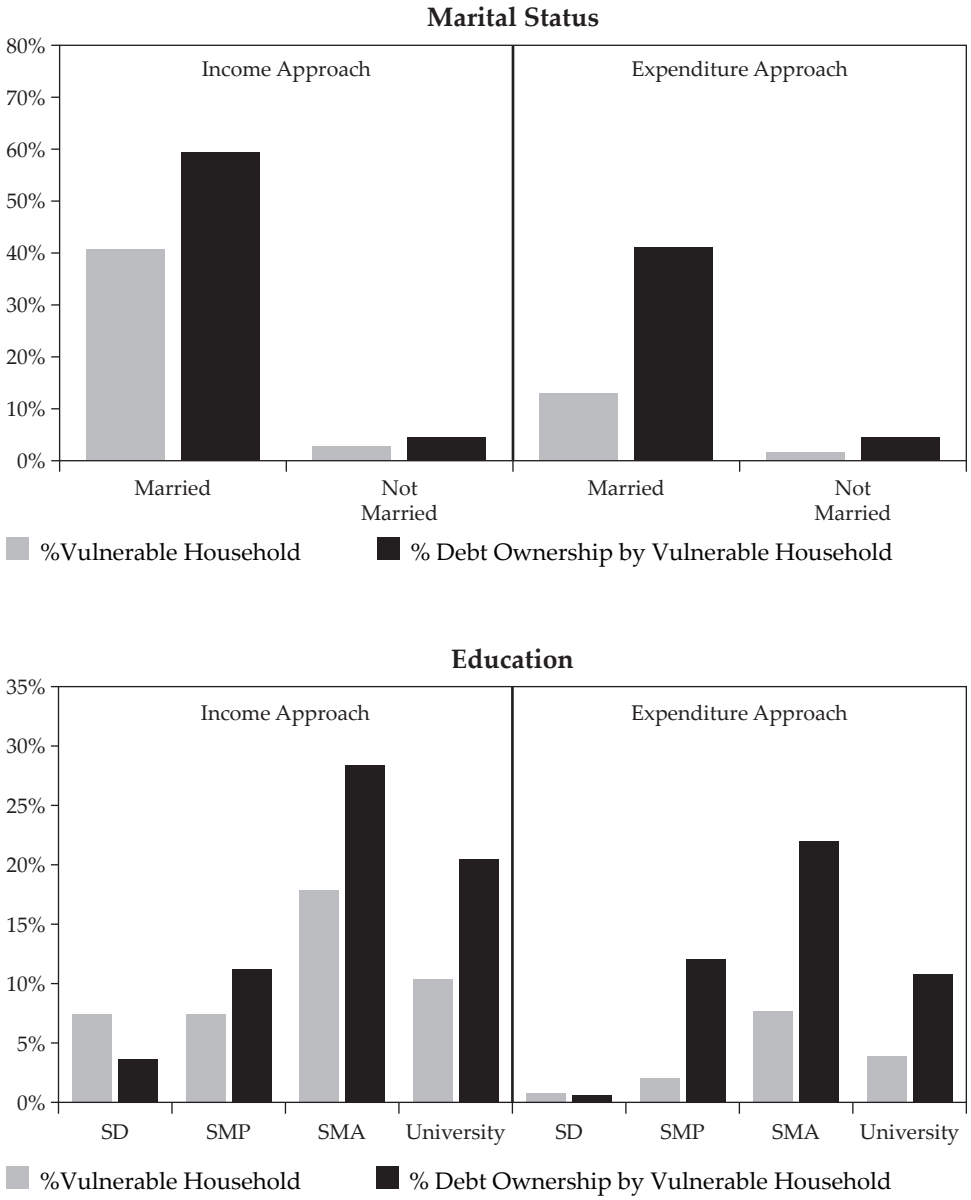


Graph 8. Share of Household Vulnerability
and Share of Debt Ownership based on Provinces

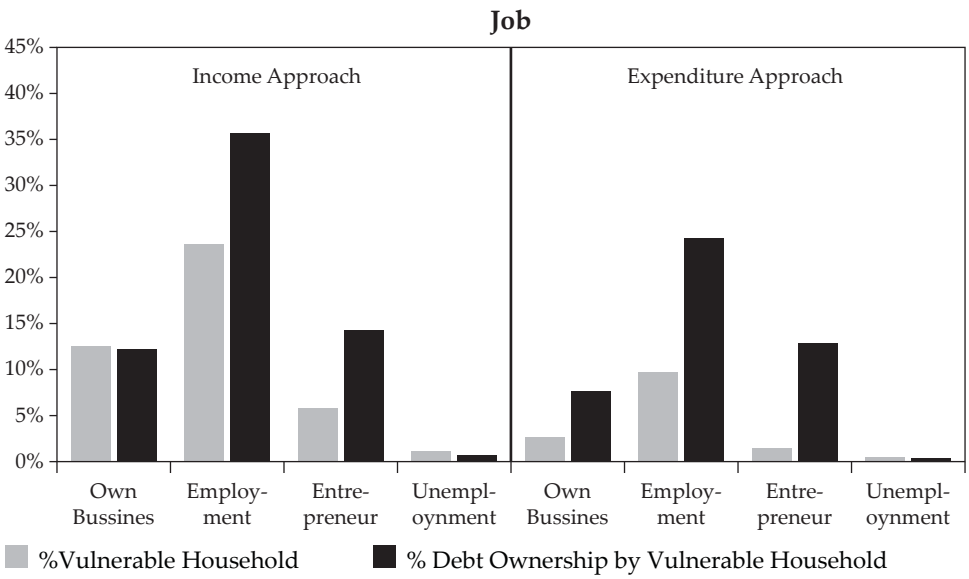
Based on household demographic characteristics, the results of the analysis with both approaches showed that vulnerable households exposed to the risk of default are male-headed households who are productive, married with high school degree, and jobs. Also, sensitive households also have exposure to banks through debt instruments with relatively high share. The results are similar to those of Pratama & Hidayat (2015) study in analyzing the vulnerability of households using financial margin through the Indonesia Family Life Survey (IFLS) data in 2007. From the results of this study, male-headed households and productive age tend to have a high vulnerability with the share of banking debt ownership which is also relatively large.



Graph 9. Share of Household Vulnerability and Share of Debt Ownership based on Demography



Graph 9. Share of Household Vulnerability and Share of Debt Ownership based on Demography (Continued)



Graph 9. Share of Household Vulnerability and Share of Debt Ownership based on Demography (Continued)

Overall, the household vulnerability analysis conducted by utilizing the 2015 SNRT data indicated that there is a positive correlation between the number of vulnerable households with bank debt ownership by the household. This is also in line with Vatne's (2007) study which found that there is a positive correlation between the default rate and the debt held by vulnerable households.

The vulnerability analysis of households based on the above characteristics can be summarized in an analytical matrix that provides a general correlation between the number of vulnerable households with the bank debt they have. Chart 4 shows that households with elderly, low-educated (primary and junior secondary) heads with no permanent employment, no marital status (or headed by a woman) tend to have relatively small banking debt with a relatively small number of vulnerable households.

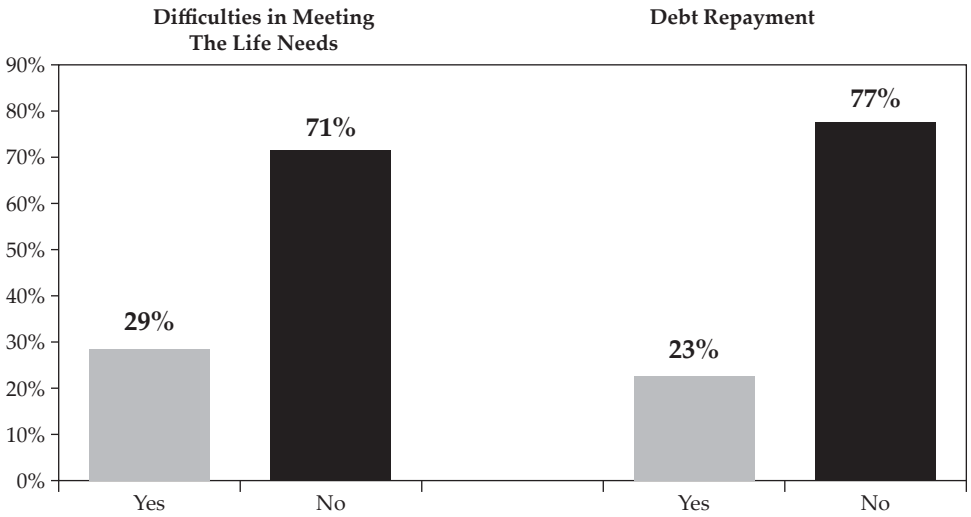
While households with the university as the last education of the head have jobs as entrepreneurs and tend to have large bank debt, but with a relatively small number of vulnerable households, indicating that the risks in this household group are relatively well maintained, given that the head of households works as entrepreneurs and can use bank debt for the capital venture. The return from the use of debt to investment and other financing makes this household have a relatively small potential to default.

The relatively high potential of default risk tends to come from household groups with household heads at productive age (25-59 years old), high school education, permanent employment, married, and men (head). This household group has considerable debt exposure to banks, and the number of vulnerable households from this group is also relatively high.

Chart 4. Vulnerability Analysis Matrix
Based on Household Characteristics

4.4. Coping Strategies Analysis of Household in Indonesia

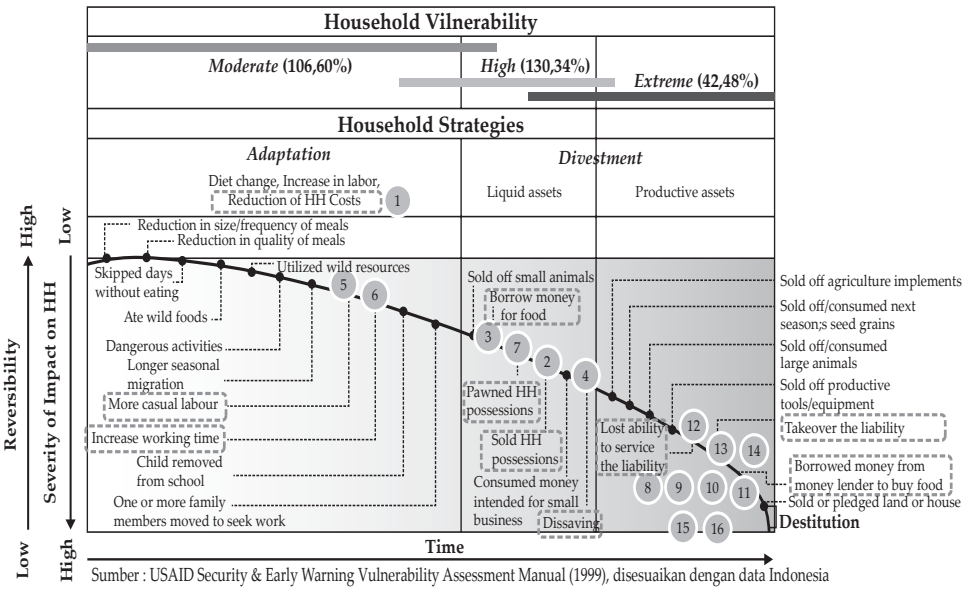
Coping strategies are analyzed to identify household vulnerability based on survival strategies adopted by households in facing financial pressures. Based on data from the 2015 SNRT, 29% of households with debt face financial difficulties in the form of difficulties in meeting the needs of life, while 23% of households have difficulties in paying the debt over the past year.



Graph 10. Share of Household Difficulties in Meeting
The Life Needs and Debt Repayment

In anticipating the risk of more profound financial pressures, 61% of households choose adaptive strategies by reducing expenditure. Other preferred strategies including selling valuables (40%), borrowing food or money from relatives and family (39%), withdrawing money from savings (37%), and finding additional employment (27%).

Referring to the heatmap coping strategies contained in the Food Security & Early Warning Vulnerability USAID (1999) assessment manual, the level of vulnerability of households with debt is still within the moderate zone because the majority of households still rely on adaptation strategies by reducing expenditure in response to financial pressure. However, it is important to be aware that in addition to adaptation strategy, cumulatively, household also chooses several divestment strategies in liquid assets, causing higher levels of vulnerability to be faced. Several divestiture strategies in the liquid assets carried out by these households include selling valuables owned, borrowing money from relatives, and withdrawing savings.

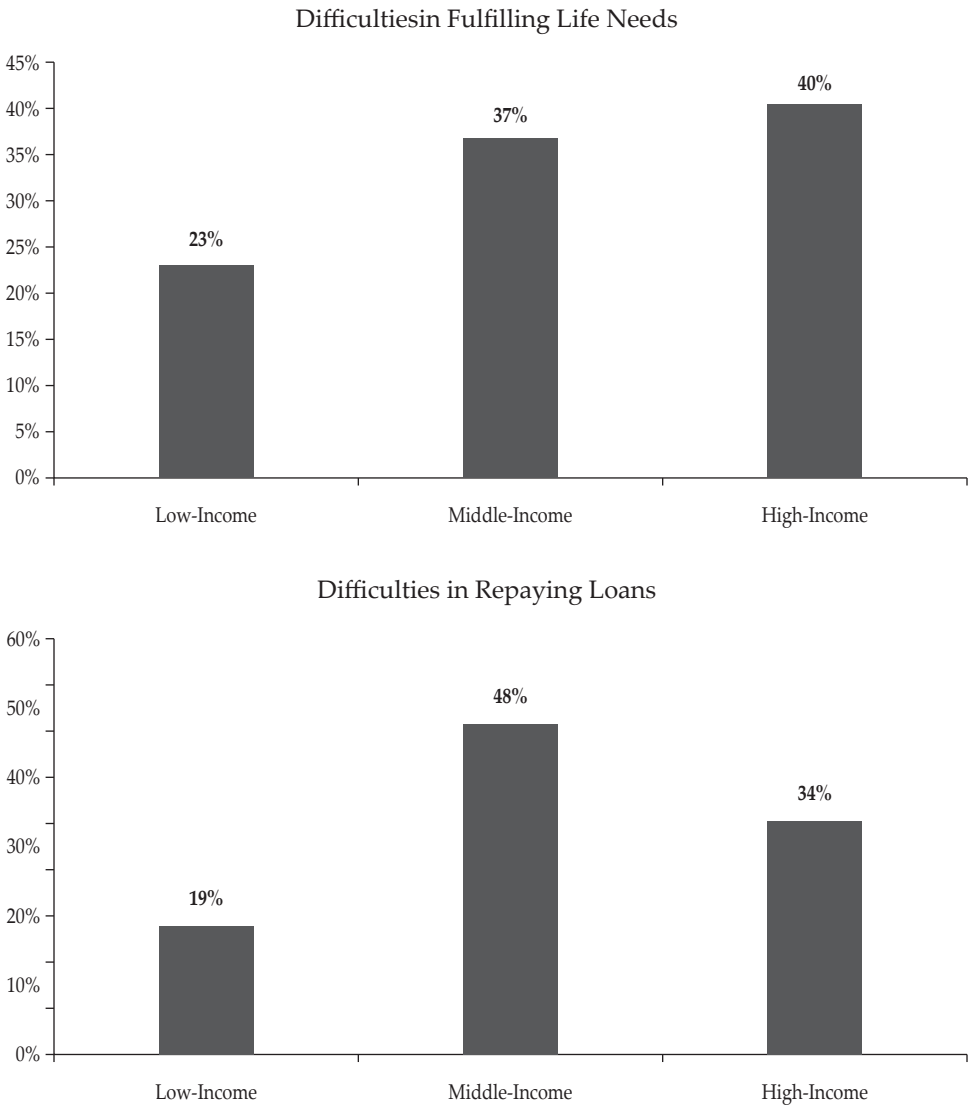


Sumber : USAID Security & Early Warning Vulnerability Assessment Manual (1999), disesuaikan dengan data Indonesia

Chart 5. Heatmap Coping Strategies of Households in Indonesia

Also, Indonesian households also tend to divest their earning assets if the liquidity strategy of adaptation and divestment took cannot cover the financial deficit. Failure to divest productive asset strategy will lead to the loss of household ability to repay short-term debt as well as long-term debt so that the vulnerability of the household is in extreme conditions and can affect the financial sector as well as the imbalance of the financial system as a whole.

Based on income groups, households that have debts and difficulties meeting the living needs in the past year are dominated by high-income households. Meanwhile, households that have difficulties to pay the debt (majority) come from the middle-income household group.



Graph 11. Share of Households having Difficulties in Fulfilling the Living Needs and Paying the Debt

The most survival strategy chosen by Indonesian households from high, middle and low-income groups is an adaptation strategy through the reduction of expenditure. Alternatively, high-income household groups also tend to withdraw savings, so there needs to be vigilance from banks to anticipate liquidity risks triggered by massive withdrawals from households. Furthermore, based on the 2015 SNRT, survival strategies chosen by households by income group are as follows.

High Income	Middle Income	Low Income
1. Reduce expenses 2. Withdraw money from savings 3. Selling valuables goods 4. Borrow food or money from family and friends 5. Doing additional work	1. Reduce expenses 2. Selling valuables goods 3. Borrow food or money from family and friends 4. Doing additional work 5. Withdraw money from savings	1. Reduce expenses 2. Selling valuables goods 3. Borrow food or money from family and friends 4. Withdraw money from savings 5. Work longer to earn extra money

Chart 5. Household Coping Strategy by Revenue Group

V. CONCLUSION

This paper analyzes the vulnerability of households in Indonesia at the micro level by reviewing the financial margin, and in aggregate using the Balance Sheet Approach. To identify the characteristics and risk profile of the household sector, this paper concluded that the household sector in Indonesia is quite solvent and sound, both regarding solvency and the adequacy of liquidity. Besides, the household sector is the sector with the largest financial surplus that plays an essential role as it is the largest source of domestic financing in Indonesia.

Related to risk profile, this paper concludes that there is a great risk potential considering the financial interconnection between household sector and a non-financial corporation which is high, as well as the interconnection between household sector and banking.

Through the financial margin approach, the household risk profile analysis in this paper provides a third conclusion that the potential for relatively high default risk comes from household groups with heads of households at productive age (25-59 years old), high school education level, employee, married, and men leader.

Finally, from the analysis of heatmap coping strategies, the fourth conclusion of this paper is that household vulnerability is still in a moderate zone with coping strategies in the form of reduced spending when there is financial pressure. However, this paper emphasizes the need for caution because cumulatively, the household vulnerability has the potential to rise to higher levels (high and extreme), and this can have an impact on the imbalances of the financial system.

As a further development effort, this paper suggests (i) using sensitivity analysis, through household resilience testing of a number of shock scenarios, among others from interest rate increases, unemployment rate and asset price reductions, and impacts; (ii) the need for refinement of SNRT 2015 data, particularly regarding the scope of respondents, question instruments regarding data income, and questions related to coping strategies with reference to the internationally used heatmap coping strategies; (iii) use the results and conclusions in this paper as initial information on developing debt to income ratio instruments within the macroprudential policy framework.

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CREDIT RISK MODELS FOR FIVE MAJOR SECTORS IN INDONESIA

Ndari Surjaningsih, Ina Nurmalia Kurniati[1], Reni Indriani[2]

ABSTRACT

This paper analyze Nonperforming Loan ratio to total credit (NPL), as a proxy for credit risk, for five major economic sectors by utilizing panel data of 117 commercial banks in Indonesia over period 2000Q1 to 2016Q3. Our empirical analysis shows that real economic growth is the main driver that is negatively correlated with credit risks in all sectors. The inverse relation is also found in commodity and housing price. Commodity price inflation affects NPL in manufacturing industry and trade sectors, meanwhile housing price inflation influences NPL in manufacturing industry, trade, and construction sectors. In addition, decreased in policy rate will decline credit risk in commodity, trade, and other sectors, meanwhile nominal exchange rate only affects credit risks in other sector. Our assessment shows that credit risks in commodity and other sectors are more sensitive to real economic growth than those on manufacturing industry and trade sectors. Real economic growth elasticities to credit risk for commodity and other sectors are almost twice higher than for manufacturing industry and trade sectors. Thus, during economic contraction phase, NPL in commodity and other sectors will increase higher than NPL in manufacturing industry and trade sectors.

Keywords: Banking, Panel Data Models.
JEL classification codes: G21, C33

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I. INTRODUCTION

The global financial crises in 2008 show us the importance of financial stability assessment to withstand shocks. As an authority that has to safeguard financial system stability, central bank need to have models to assess risks in the banking industry, especially credit risk. Credit risk, as the most significant risk in Indonesia banking industry, usually assess during banking top down stress test implementation. It is important to be able to evaluate the potential impact of macroeconomic variable shocks in to banking variables.

There are at least three approaches to assess credit risk in the banking industry. The first approach is to model Nonperforming Loan ratio (NPL) using macroeconomic variables as determinants. On the second approach, credit risks are estimated using probability of default, i.e evaluate transition matrix of performing loan into nonperforming loan for each bank. The third approach is to model bank's provision without computing bank's NPL.

From those approaches, the nonperforming loan model is the most commonly used to determine the impact of macroeconomic conditions on banking risk. Compared to the other two alternatives, the first approach is more flexible in data it can be modeled at the aggregate level (total credit) as well as at a more granular level – by types of credit allocation or economic sector.

Based on that background, this study aims to analyze the determinant of NPL ratio in the Indonesian economy which is grouped into five main sectors, namely commodity sector, trade sector, manufacturing industry sector, construction sector, and others. The analysis was conducted using dynamic panel data approach from 117 commercial banks in Indonesia, covering both conventional and islamic banks from 2000Q1 to 2016Q3.

This study differs from previous studies in several aspects. In addition to using data of all commercial banks in Indonesia, this study aims to examine the impact of macroeconomic variable shocks on credit for differentiated economic sectors. The aggregate credit risk model (total credit) has some limitations as it could lead to an underestimation of credit losses for some specific banks. The disaggregation of credit provides a more detailed picture of credit risks in each sector.

The analysis showed that the credit risks, in all of the five sectors, are influenced by the real GDP growth as the primary macroeconomic variable. An increase in economic growth reduces loan risks as reflected in an increase in the NPL ratio, except in the construction sector. A fall in policy interest rates affects the NPL risks in commodity, trade and services sectors, as well as in other sectors. The nominal exchange rate only changes the ratio of the NPL to other sectors. The inflation, in the commodity prices, negatively affected the NPL ratio of both the trading and manufacturing sectors, while housing price inflation adversely affected the NPLs of three sectors, namely trade and services, manufacturing, and construction.

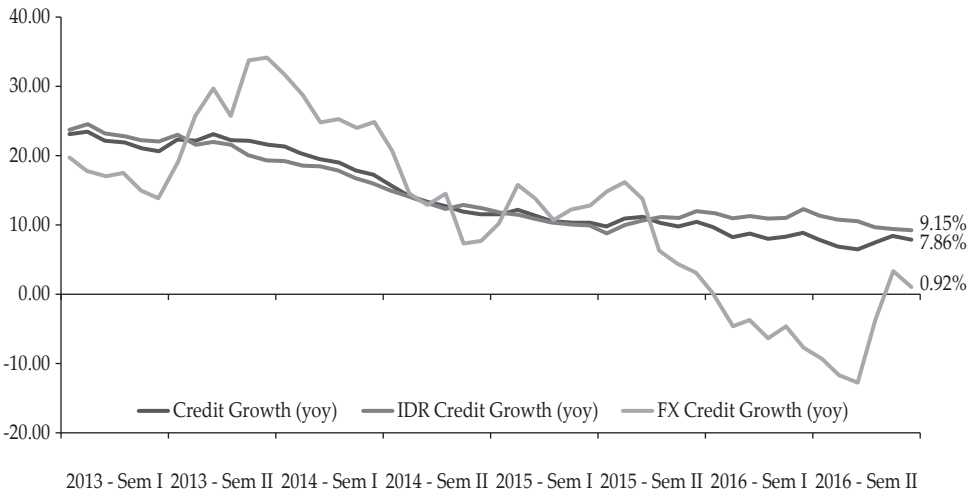
This study is divided into five sections. Chapter I provides a general introduction, while Chapter II describes stylized facts and literature review related to the determinants of bank loan risks. A description of the methodology and the data used are provided in Chapter III. Chapter IV discusses the results of estimation and analysis, while Chapter V will explain the conclusions and suggestions for further research.

II. THEORY

The credit risk is seen as one of the most essential and enormous risks in the banking industry. Poor credit quality affects credit supply from bank (supply) and in turn, will have an impact on investment. Banking, as the dominant sector in the Indonesian financial sector, plays a vital role in the stability of the financial system.

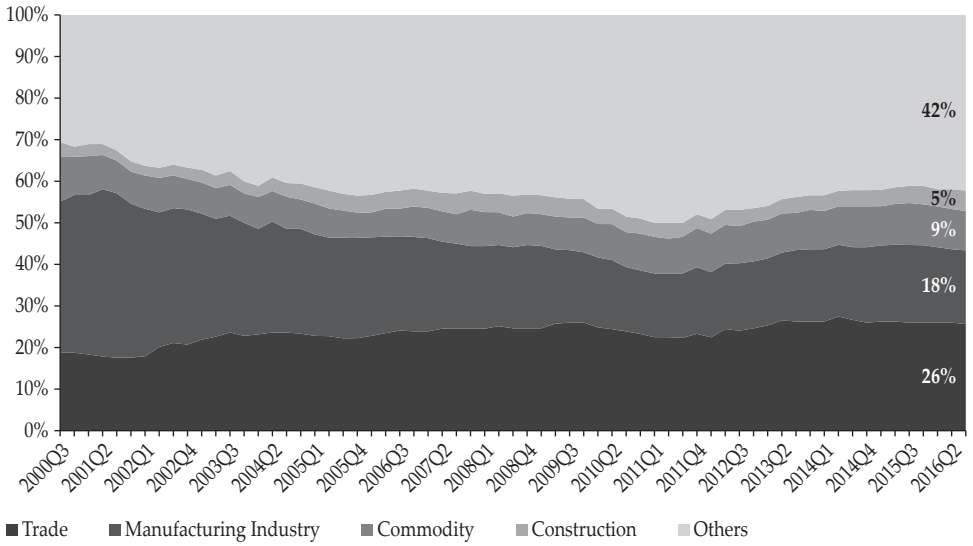
2.1. Overview of Banks Credit Disbursement

The credit growth was still in the sluggish trend until the second semester of 2016. Loan disbursement showed a 7.86% growth (yoy) lower than the first semester of 2016, which reached 8.89% (yoy). The combination between low demands of new loan with increasing level of prudential banking principle in disbursing credit contributed to the slower credit growth. The banking industry focused on the consolidation their nonperforming loans and took a more prudent approach in disbursing new loans (Bank Indonesia, 2017).



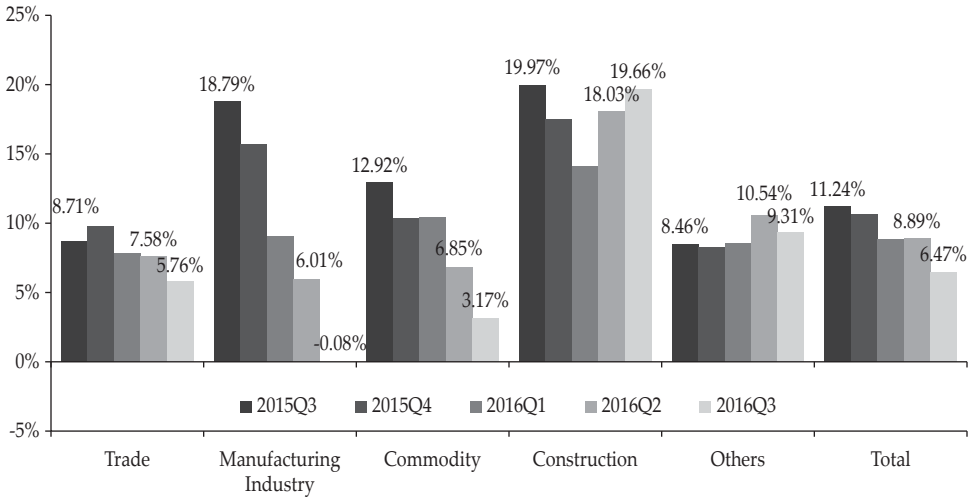
Graph 1. Bank Credit Growth

In this research, credit disaggregation was divided into five major economic sectors in Indonesia using data on credit between 2000Q1 through 2016Q3. Nominally credit distribution in the Indonesian banking system was dominated by other sector and the lowest credit distribution was noticed the construction sector (Graph 2). In the 2016Q3, the share of credit in other sectors to the total credits reached 42% (Rp 1.7 Trillion), while the percentage of the construction credit represented only 5% (Rp 0.21 Trillion).



Graph 2. Credit Shares per Economic Sector to Total Credit

Across economic sector, the most significant decrease in credit growth was experienced by the manufacturing with credit share of 18% to the total credits. In fact, the credit growth in that sector grew slowly from 18.79% (yoy) in 2015Q3 to -0.08% (yoy) in 2016Q3. Meanwhile, the sectoral credits with the most significant share (42%), represented by the credit for other sector, grew from 8.46% in 2015Q3 to 9.31% in 2016Q3 (Graph 3).

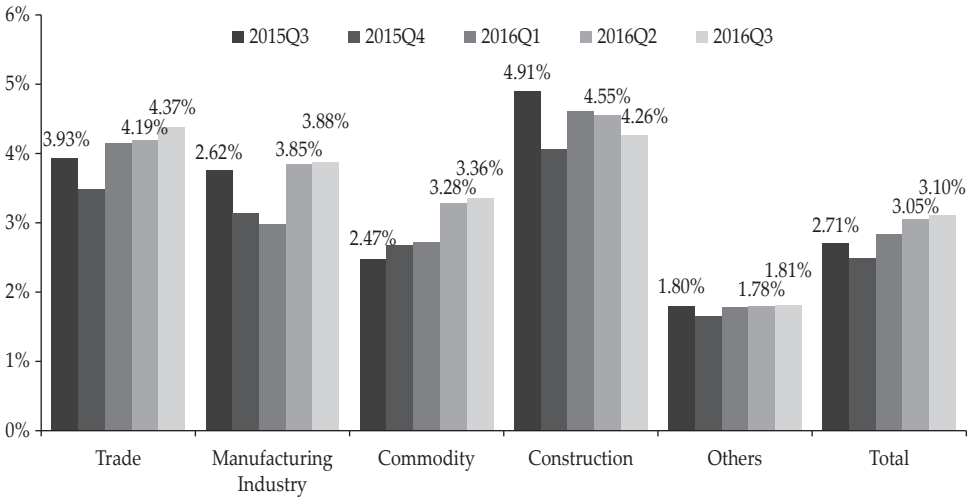


Graph 3. Credit Growth per Economic Sector

Despite the ongoing credit risk rising trend in the second semester of 2016, the nonperforming loan growth was decelerated. The decrease of corporation performance and the slowdown of the credit growth lead to the rising trend of the credit risk (Bank Indonesia, 2017). Historically, around 2000-2007, the highest NPL was in the manufacturing sector. In the past few years, the NPL of the trade and services sectors was rise and had the highest NPLs (Graph 4).

Graph 4. NPL shares per Economic Sector to Total NPL

Based on the 2016Q3 credit data, the highest NPL was in trading and services sectors with a ratio of 4.37%, followed by construction sector (4.26%), manufacturing sector (3.88%), commodity sector (3.36%), and other sectors (1.8%) These NPL ratio is calculated from the total credit for each sector (Graph 5).



Graph 5. NPL Ratio per Economic Sector

When compared with the NPL data in the 2015Q3, the manufacturing sector recorded a significant increase in credit risks during the 2016Q3. The NPL of this sector was recorded at 3.88% and higher compared to that of the 2015Q3 (2.62%) (Graph 5).

2.2. Literature Review

As mentioned earlier, there are at least three approaches that can be used to assess credit risk in the banking industry. The first approach is to model Nonperforming Loan ratio (NPL) using macroeconomic variables as determinants. On the second approach, credit risks are estimated using probability of default, i.e evaluate transition matrix of performing loan into nonperforming loan for each bank. The third approach is to model bank's provision without computing bank's NPL.

From those approaches, the nonperforming loan model is the most commonly used to determine the impact of macroeconomic conditions on banking risk. Compared to the other two alternatives, the first approach also has higher data-side flexibility as it can be modeled at the aggregate level (total credit) as well as at a more granular level – by types of credit allocation or economic sector.

There are several studies that analyzed the relationship between credit risk and macroeconomic variables. At the aggregate level, Vatansever and Hepsen (2013) examined the long-term relationship between NPL ratio with macroeconomic indicators and banking variables by using cointegration and linear regression analysis. The research cover the monthly Turkish data for the period between January 2007 and March 2013. Vatansever and Hepsen found that the NPL ratio was negatively affected by the industrial production index, the Istanbul Stock Exchange 100 Index, and the bank's inefficiency ratio. While the unemployment rate, Return on Equity (ROE), and Capital Adequacy Ratio (CAR) positively affected the NPL ratio.

Nkusu (2011) analyzed the determinant of NPL ratio by using the dynamic data panel for aggregate banking data in 26 advanced countries with annual periods from 1998 to 2009. Nkusu found that macroeconomic variables such as economic growth contraction (Real GDP), rising unemployment rate, high-interest rates, falling equity prices and falling housing prices will lead to an increase in the NPLs. He also added a Panel Vector Autoregressive (PVAR) analysis to estimate the feedback between the NPL ratio and its macroeconomic determinants.

Furthermore, Buncic and Melecky (2012) conducted an analysis of dynamic data panels (unbalanced) with the GMM (Arellano Bond estimator) method at the banking aggregate level in 54 high and middle-income countries for the annual period from 1994 to 2004. They found that the real GDP growth, inflation, and real interest rates are significant variables in influencing the NPL ratio. The control variables included the credit to GDP ratio and the share of FX loans in total loans, and the change in the nominal US dollar exchange rate for each country, which do not significantly affect the ratio of NPL.

By using a dynamic data panel analysis for banking aggregate data in 9 countries, in Central, Eastern, and Southeastern European (CESEE) within the period from the 2004Q1 to the 2012Q4, Jakubik and Reininger (2013) modeled the relationship of macroeconomic variables with NPL ratio. The approach applied in this research was the Difference Generalized Linear Model (GMM) and System GMM in order to evade problems of correlation between the explanatory variables and the error term and to obtain additional efficiency gains. Jakubik and Reininger found that the growth of real gross domestic product (first lag) and the national stock price index (fifth lag) had a negative effect to the NPL ratio. On the other hand, the exchange rate weighted by foreign currency share (first lag) and private sector-credit-to-GDP ratio (sixth lag) had a positive relationship with the NPL ratio.

Klein (2013) analyzed the determinants of the NPL ratio with individual bank data panels covering the top 10 largest banks in each of the CESEE countries within the annual period from 1998 to 2011. Klein consider three alternative estimation techniques including the fixed effects model, difference GMM, and system GMM. Klein stated that NPLs are indeed influenced by both macroeconomic variables and bank-specific factors, although the power of bank-specific factors as explanatory variables was found to be low. In his research, the increase in NPL was influenced by macroeconomic conditions such as declining real GDP growth, higher unemployment rate, higher inflation, exchange rate depreciation, and higher volatility index. While banking indicators such as increasing equity-to-assets ratio, increasing ROE, decreasing the loan-to-assets ratio and declining credit growth leads to lower the NPLs.

The global sample of 75 countries in the world was used by Beck (2015) to analyze the determinants of NPLs. His research used static and dynamic panel data estimation through fixed effects model and GMM method. The results revealed that the real GDP growth variables, share prices, the exchange rate, and lending interest rates significantly affect the NPL.

Curak *et al.* (2013) investigates the determinants of NPLs in 10 Southeastern European countries. The analysis is based on sample of 69 individual banks data in the annual period from 2003 to 2010 using GMM estimator for dynamic panel

data models. The results show that lower economic growth, higher inflation, and higher interest rate are associated with higher NPLs. Additionally, bank-specific factors such as bank size, performance (ROA), and solvency levels, measured by capital to total assets ratio, also affect the credit risk.

Beaton *et al.* (2016) estimates the determinants of NPLs by using bank level panel data of all domestic and foreign banks in Eastern Carribean Currency Union (ECCU). The sample includes 34 banks in 6 ECCU countries for the period from 1996Q1 to 2015Q4. The data are aggregated by individual bank. This research used dynamic panel regression with three alternative estimation techniques such as fixed effects, random effects, and GMM with instrumental variables. The results suggesting that stronger economic growth in advanced economies lowers NPLs in the ECCU. This result is consistent with the characteristics of the ECCU member countries which are small and open economies. Tourism growth as a proxy for domestic economic activity will potentially increase the NPLs. Bank specific factors such as higher bank profitability captured by Return on Assets (ROA) is found to lower NPLs, while bank's lending portfolios in loans to household and construction have potential to increase NPLs.

For the Indonesian case, Firmansyah (2014) analyzed the nonperforming loan and its determinant using the monthly data Islamic banks during 2010 through 2012. The data obtained was averaged data for all Islamic bank in Indonesia and estimated using linear regression. The research showed that size and efficiency of the banks do not affect the NPLs while both GDP and inflation negatively affect the NPLs.

Using the Regional Development Bank (RDB) panel data, Alexandri and Santoso (2015) conducted a determinant analysis on the NPL ratio to 26 RDB in Indonesia. The research used panel data regression analysis with random effects model for the sample period from 2009 to 2013. While using the sample period between the 2012Q1 and the 2015Q4, Sari *et al.* (2015) analyzed the NPL ratio determinants for 25 RDB with fixed effect model. Alexandri and Santoso stated that the level of bank efficiency, represented by the ROA, has a positive and significant impact on the NPL. While the variable bank size, GDP growth, CAR, and the rate of inflation did not significantly affect the NPL. Similarly, Sari *et al*. stated that the ROE, bank size, and credit growth had a negative impact on NPL, while bank efficiency, represented by operational cost to operating income ratio, had a positive effect on the NPL ratio. Macroeconomic variables such as exchange rate and GDP growth have a significant impact. Exchange rate has a positive effect on NPL, while GDP growth has negative effect on NPL.

Surjaningsih *et al.* (2016) built a credit risk model using credit risk disaggregation based on types of credit allocation (consumer and productive loans) and types of currency (rupiah and foreign currency). Estimations were performed using individual data of 118 commercial banks for the period between 2001Q1 through 2015Q1. The credit risk model uses the NPL ratio to total credits based on types of credit allocation as dependent variables and macroeconomic variables as independent variables, which includes the quarterly real GDP growth rate, the squares of the quarterly real GDP growth rate, change in the nominal BI policy rate (quarterly), and the change in nominal effective exchange rate (quarterly). The estimation results showed that the sensitivity of the NPL ratio to changes in

macroeconomic conditions varies significantly between the borrower types. The NPL ratio of productive loans is more sensitive to changes in macroeconomic conditions compared to consumer loans.

Surjaningsih *et al*. (2016) also conducted a study on the determinant analysis of NPL ratio that focused on macroeconomic variables as the primary driver. Besides the data period that used, the difference is the disaggregation of credit risk that grouped into five different economic sectors.

III. METHODOLOGY

3.1. Methodology

To model each bank's credit risk for five major economic sectors, as a result of macroeconomic condition, we utilized dynamic panel data models of 117 commercial banks in Indonesia. Two approaches were used to model credit risks: fixed effect autoregressive distributed lag and system generalized method of moment. The models follow previous model developed by Buncic and Melecky (2012), Klein (2013), Beaton et al. (2016), and Surjaningsih et al. (2016).

Fixed Effect – Autoregressive-Distributed Lag

The first approach used to estimate credit risk is the dynamic panel data with fixed effect and autoregressive distributed lag which has the following general representation:

$$LNPL_{i,t} = \mu_i + \alpha_1 LNPL_{i,t-1} + \alpha_2 LNPL_{i,t-2} + C(L).MACRO_t + \varepsilon_{i,t} \quad (1)$$

Where the index i indicates individual banking institution and t indicates quarterly time period. $LNPL_{i,t}$ denotes the logit transformation of the NPL ratio that can be expressed as:

$$LNPL_{i,t} = ln\left(\frac{NPL_{i,t}}{1 - NPL_{i,t}}\right) \quad (2)$$

The vector $MACRO_t$ denotes a set of macroeconomic explanatory variables that affect the NPL, μ_i represent bank specific fixed effects, and $\varepsilon_{i,t}$ represents error term. $C(L)$ denotes lag polynomials taking general form

$$C(L) = c_o + c_1.L + c_2.L^2 + c_3.L^3 + \cdots \quad (3)$$

Our study did not explicitly use internal banking variables as control variables but we incorporate lags from NPL as the independent variables. Our study focused on the macroeconomic impact on bank credit risk.

Panel data model contain one or more lagged dependent variables can produce a biased estimation because the strict exogenous characteristics of the regressor is no longer met. This bias is commonly known as Nickell's bias (1981)[3]. Nickell bias occurs when T is small, and N is significant due to the demeaning process which can cause correlation between error and independent variable. However, when the T is large enough, fixed panel data approach still produces consistent estimators.

Since the individual characteristics of each bank are important parameters to be analyzed in this study, the fixed effect approach will be the primary analysis and Arellano and Bond approaches (1991) System Generalized Methods of Moments (GMM) will be the additional analysis as the robustness check.

System Generalized Method of Moments (GMM)

The dynamic approach is adapted to take into account the persistence of time within the credit risk structure. The model is written as the following equation:

$$LNPL_{i,t} = \alpha + \sum_{j=1}^{J} \gamma_j LNPL_{i,t-j} + \mathbb{x}_{i,t}\beta + \varepsilon_{i,t} \quad (4)$$

With i = 1, ..., N and t = 1, ..., T denoting the dimension of cross section and time in panel data. α indicates the common intercept, $\mathbb{x}_{i,t}$ denotes the independent variable vector of k×1, β represents the vector coefficient of k×1, and $\varepsilon_{i,t}$ represents an error term.

Judson and Owen (1999) stated that, for a sample of data with a length of $t \leq 30$, the bias in the results could reach 20% from the actual estimator value. The problem can be solved by using the first-difference equation. This approach eliminates individual effects as well as the accompanying bias.

$$\Delta LNPL_{i,t} = \alpha + \sum_{j=1}^{J} \gamma_j \Delta LNPL_{i,t-j} + \Delta\mathbb{x}_{i,t}\beta + \Delta\varepsilon_{i,t} \quad (5)$$

Another alternative method (also known as Difference GMM) is using the System GMM. The System GMM estimator adds restriction to the instrument variable in the model. The instrument variables are then tested for validity by using Sargan and Hausman test.

3.2. Data

Data used for credit risk model were the ratio of NPL that have been grouped by types of credit per major sector in Indonesia: (i) commodity sector (including agriculture and mining); (ii) trade and service; (iii) manufacturing industry; (iv) construction (property and real estate); and (v) other sectors. Data cover 117 commercial banks consist of 104 conventional banks and 13 islamic banks during 2000 Q1 until 2016 Q3 (source: Bank Indonesia).

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[3] Nickell, S. (1981). Biases in Dynamic Models with Fixed Effects, Econometrica, 49, 1399-1416.

NPL ratio as the dependent variable was transformed using logarithmic transformation as stated on equation (2). This transformation not only ensures that the dependent variable spans over $-\infty$ and $+\infty$ (instead of between 0 and 1) but also ensures that NPL ratio symmetrically distributed. In reality, several banks might have NPL ratio equal to 0 in some period, this could be happen if banks own zero NPL or zero lending to a particular sector during a particular period. As a result, the logarithmic transformation becomes undefined. To overcome the problem we can replace the NPL ratio that equal to 0 into empty value, alternatively we can change NPL ratio value into small number near 0 (e.g. 10^{-6}). The drawback of the second approach is that the predicted value of NPL might inaccurate.

Macroeconomic explanatory variables in $MACRO_t$ is describe in Table 1. Quarterly real GDP growth rate – seasonally adjusted (*rgdpsa_q*) is expected to have an inverse relationship with NPL ratio. NPL ratio increases as real GDP growth declines and vice versa. Attempt to include GDP per sector terms in order to capture stronger relationship to credit risk is proved futile. This might be because share of lending per sector and share of GDP per sector was not comparable. Changes in policy rate (*chpolrate*) have a direct impact on the debitor repayment ability which affect NPLs. Quarterly house price inflation (*hp_q*) affects NPLs through debitor wealth (wealth effect) meanwhile quarterly commodity price inflation (*comp_q*) not only capture external risks but also expected to capture other specific factors. All macroeconomic data span from 2000Q1 until 2016Q3.

Table 1.
Macroeconomic Variable Determinants of Credit Risks

Variable	Description	Source
rgdpsa_q	Real GDP growth rate that has been seasonally adjusted, quarterly	BI
chpolrate	Quarter-on-quarter change in the nominal BI policy rate	BI
nexr_q	Quarter-on-quarter rate of change in the nominal exchange rate, a positive value indicates an appreciation of the Rupiah	BI
hp_q	Quarterly growth in house prices (house price inflation rate)	BI
comp_q	Quarterly growth in commodity price (commodity price inflation rate)	BI

IV. RESULTS AND ANALYSIS

4.1. Fixed Effect Panel Data Estimation

The empirical results for fixed effect regressions corresponding to different types of credit exposures (excluding fixed effect coefficients estimates) are presented in Table 2. Based on characteristics and behavior of credit risk in Indonesia, a credit quality (payment collectability status) from current and special mention does not automatically turn into NPLs within one quarter. Therefore, our analysis takes into account two lags (two quarters) of the NPL ratio as an explanatory variables. On the other hand, four lags of macroeconomic variables are used since macroeconomic variables affect credit quality in longer period.

In general, most of the explanatory variables have a significance level above 10% either individually or jointly in the joint t-test (Appendix) except the policy rate in the construction sector. All macroeconomic determinants have the expected

effect on NPL ratios. Real economic growth is the main driver that is negatively correlated with credit risks in all sectors. Increased in real economic growth will positively affect business activities so that the sustainability of credit payment is maintained. The inverse relation is also found in commodity and housing price. Commodity price inflation affects NPL in manufacturing industry and trade sectors, meanwhile housing price inflation influences NPL in manufacturing industry, trade, and construction sectors. In addition, decreased in policy rate will decline credit risk in commodity, trade, and other sectors, meanwhile nominal exchange rate only affects credit risks in other sector. We take into account dummy structural break (2010Q3 through 2016Q3) for credit risk model in construction sector.

Table 2.
Fixed Effect Panel Data (FE) Estimation Results

Variables	1. Commodity	2. Trade	3. Manufacturing Industry	4. Construction	5. Others
NPL Ratio (Logit transf), L2	0.061 **	0.089 ***	0.093 ***	0.109 ***	0.026
	(0.024)	(0.021)	(0.024)	(0.022)	(0.030)
NPL Ratio (Logit transf), L1	0.770 ***	0.712 ***	0.705 ***	0.719 ***	0.882 ***
	(0.021)	(0.027)	(0.030)	(0.047)	(0.037)
rgdpsa_q, L4	-0.086 **	-0.086 ***	0.023	-0.002	-0.064 **
	(0.035)	(0.026)	(0.031)	(0.040)	(0.027)
rgdpsa_q, L3	0.003	-0.017	-0.078 **	0.023	-0.005
	(0.029)	(0.027)	(0.034)	(0.039)	(0.023)
rgdpsa_q, L2	-0.066 **	-0.011	-0.067 **	0.079 *	-0.036 *
	(0.032)	(0.030)	(0.032)	(0.040)	(0.020)
rgdpsa_q, L1	-0.071 **	-0.034	-0.024	-0.077 *	-0.014
	(0.032)	(0.029)	(0.036)	(0.044)	(0.027)
chpolrate, L4	-0.116 ***	-0.046 **		-0.018	-0.080 ***
	(0.027)	(0.019)		(0.038)	(0.019)
chpolrate, L3	0.136 ***	0.043 *		-0.017	0.072 ***
	(0.041)	(0.025)		(0.050)	(0.025)
chpolrate, L2	-0.068 *	0.036		0.063	0.030
	(0.041)	(0.027)		(0.046)	(0.024)
chpolrate, L1	0.020	-0.010		0.018	-0.025
	(0.029)	(0.019)		(0.037)	(0.019)
nexr_q, L4					0.001
					(0.002)
nexr_q, L3					-0.003
					(0.002)
nexr_q, L2					0.000
					(0.002)
nexr_q, L1					0.002

Table 2.
Fixed Effect Panel Data (FE) Estimation Results (Continued)

Variables	1. Commodity	2. Trade	3. Manufacturing Industry	4. Construction	5. Others
					(0.003)
hp_q, L4		0.018	0.004	0.074 ***	
		(0.012)	(0.012)	(0.019)	
hp_q, L3		-0.030 **	-0.028 **	-0.032	
		(0.012)	(0.012)	(0.020)	
hp_q, L2		-0.009	0.018	-0.044 **	
		(0.014)	(0.014)	(0.021)	
hp_q, L1		-0.004	-0.067 ***	-0.021	
		(0.011)	(0.015)	(0.023)	
comp_q, L4		-0.001	0.002		0.001
		(0.001)	(0.001)		(0.001)
comp_q, L3		0.000	0.002 *		0.000
		(0.001)	(0.001)		(0.001)
comp_q, L2		-0.003 ***	-0.001		-0.002 *
		(0.001)	(0.001)		(0.001)
comp_q, L1		0.000	0.000		0.002
		(0.001)	(0.001)		(0.002)
Dummy				-0.054	
				(0.039)	
Common intercept term	-0.223 *** (0.103)	-0.414 *** (0.109)	-0.395 *** (0.119)	-0.534 *** (0.120)	-0.259 (0.164)
Total Observations	4076	5279	4903	3662	6390
Total Groups	107	114	115	107	115
R-squared (within)	0.684	0.625	0.625	0.621	0.681
R-squared (between)	0.971	0.995	0.990	0.983	0.763

Note: *** indicates significance at 1%, ** significance at 5%, * significance at 10%. Number in brackets represent Std Error (Robust).

4.2. Robustness Check

As mentioned earlier, to test the robustness of the Fixed Effect model above we conduct GMM estimation as a comparison. The estimation results are presented in Table 3.

Table 3.
Generalized Method of Moments (GMM estimation results)

Variables	1. Commodity	2. Trade	3. Manufacturing Industry	4. Construction	5. Others
NPL Ratio (Logit transf), L2	0.052	0.086 ***	0.067 *	0.155 ***	0.046
	(0.034)	(0.031)	(0.034)	(0.040)	(0.029)
NPL Ratio (Logit transf), L1	0.782 ***	0.724 ***	0.683 ***	0.782 ***	0.921 ***
	(0.032)	(0.037)	(0.034)	(0.051)	(0.036)
Rgdpsa_q, L4	-0.053	-0.065 **	0.008	0.002	-0.034
	(0.035)	(0.027)	(0.035)	(0.046)	(0.025)
Rgdpsa_q, L3	0.002	-0.008	-0.091 **	0.036	0.024
	(0.033)	(0.028)	(0.037)	(0.039)	(0.026)
Rgdpsa_q, L2	-0.072 **	-0.013	-0.082 ***	0.081 **	-0.018
	(0.036)	(0.029)	(0.032)	(0.039)	(0.020)
Rgdpsa_q, L1	-0.050	-0.033	-0.026	-0.058	0.016
	(0.033)	(0.030)	(0.036)	(0.043)	(0.023)
Chpolrate, L4	-0.120 ***	-0.049 **		-0.042	-0.082 ***
	(0.028)	(0.021)		(0.034)	(0.019)
Chpolrate, L3	0.145 ***	0.050 *		-0.008	0.083 ***
	(0.041)	(0.026)		(0.047)	(0.024)
Chpolrate, L2	-0.086 **	0.023		0.061	0.009
	(0.043)	(0.026)		(0.048)	(0.022)
Chpolrate, L1	0.032	-0.010		0.046	-0.011
	(0.028)	(0.017)		(0.041)	(0.020)
Nexr_q, L4					0.000
					(0.002)
Nexr_q, L3					-0.004 **
					(0.002)
Nexr_q, L2					-0.001
					(0.003)
Nexr_q, L1					0.002
					(0.003)
Hp_q, L4		0.015	0.007	0.097 ***	
		(0.014)	(0.012)	(0.021)	
Hp_q, L3		-0.025 **	-0.029 **	-0.011	
		(0.012)	(0.014)	(0.021)	
Hp_q, L2		-0.013	0.009	-0.041 *	
		(0.015)	(0.016)	(0.022)	
Hp_q, L1		-0.005	-0.075 ***	-0.017	
		(0.010)	(0.015)	(0.029)	
Comp_q, L4		-0.001	0.002		0.001
		(0.001)	(0.001)		(0.001)
Comp_q, L3		0.000	0.003 *		-0.002 **
		(0.001)	(0.001)		(0.001)

Table 3.
Generalized Method of Moments (GMM estimation results) (Continued)

Variables	1. Commodity	2. Trade	3. Manufacturing Industry	4. Construction	5. Others
Comp_q, L2		-0.002 *	-0.001		-0.002 **
		(0.001)	(0.001)		(0.001)
Comp_q, L1		0.000	0.000		0.001
		(0.001)	(0.001)		(0.001)
Dummy				-0.154 *	
				(0.081)	
Common intercept term	-0.276 **	-0.417 ***	-0.468 ***	-0.249	-0.149
	(0.139)	(0.163)	(0.150)	(0.190)	(0.113)
Total observations	4076	5279	4903	3662	6390
Total groups	107	114	115	107	115
Total Instruments	134	124	120	120	142
Hansen test p-value	0.937	0.464	0.404	0.827	0.844
A-B AR(1) test p-value	0.000	0.000	0.000	0.000	0.005
A-B AR(2) test p-value	0.370	0.419	0.775	0.029	0.544

Note: *** indicates significance at 1%, ** significance at 5%, * significance at 10%. Number in brackets represent Std Error (Robust).

In general, most of the explanatory variables significance at least at 10% confidence level either individually or collectively in the joint t-test (Appendix 1). The results of the GMM method confirmed those of the fixed panel data estimation. Furthermore, the results of Sargan and Hansen test (in Table 3) confirmed the validation of the model used. Thus, it can be concluded that the equation generated by the panel fixed effect was robust enough.

4.3. Elasticities

Elasticities indicated how NPL ratios would change in the long run if macroeconomic determinants changed in permanent basis. Equation (1) can be rewritten specifically according to model provided in Chapter 4.1 as follows:

$$\begin{aligned} LNPL_{i,t} = \mu_i &+ \lambda_1.LNPL_{i,t-1} + \lambda_2.LNPL_{i,t-2} + \alpha_1.rgdpsa_q_{i,t-1} \\ &+ \alpha_2.rgdpsa_q_{i,t-2} + \alpha_3.rgdpsa_q_{i,t-3} + \alpha_4.rgdpsa_q_{i,t-4} \\ &+ \beta_1.chpolrate_{i,t-1} + \beta_2.chpolrate_{i,t-2} \\ &+ \beta_3.chpolrate_{i,t-3} + \beta_4.chpolrate_{i,t-4} + \gamma_1.nexr_q_{i,t-1} \\ &+ \gamma_2.nexr_q_{i,t-2} + \gamma_3.nexr_q_{i,t-3} + \gamma_4.nexr_q_{i,t-4} \\ &+ \delta_1.hp_q_{i,t-1} + \delta_2.hp_q_{i,t-2} + \delta_3.hp_q_{i,t-3} + \delta_4.hp_q_{i,t-4} \\ &+ \theta_1.comp_q_{i,t-1} + \theta_2.comp_q_{i,t-2} + \theta_3.comp_q_{i,t-3} \\ &+ \theta_4.comp_q_{i,t-4} + \varepsilon_{i,t} \end{aligned} \quad (6)$$

The (long-term) elasticity of the NPL ratio with respect to a one percentage increase in real GDP Growth (rgdpsa_q), change in the policy rate (chpolrate), exchange rate growth (nexr_q), house price inflation (hp_q), and commodity price inflation (comp_q) can be calculated with formulas from (7) to (11) as follows:

$$\frac{\partial LNPL_{i,\infty}}{\partial rgdpsa_q} = \left(\sum_{j=1}^{4} \alpha_j\right).\left(LNPL_{i,t}\right).\left(1 - LNPL_{i,t}\right).\left(\frac{1}{1-\lambda_1-\lambda_2}\right) \quad (7)$$

$$\frac{\partial LNPL_{i,\infty}}{\partial chpolrate} = \left(\sum_{j=1}^{4} \beta_j\right).\left(LNPL_{i,t}\right).\left(1 - LNPL_{i,t}\right).\left(\frac{1}{1-\lambda_1-\lambda_2}\right) \quad (8)$$

$$\frac{\partial LNPL_{i,\infty}}{\partial nexr_q} = \left(\sum_{j=1}^{4} \gamma_j\right).\left(LNPL_{i,t}\right).\left(1 - LNPL_{i,t}\right).\left(\frac{1}{1-\lambda_1-\lambda_2}\right) \quad (9)$$

$$\frac{\partial LNPL_{i,\infty}}{\partial hp_q} = \left(\sum_{j=1}^{4} \delta_j\right).\left(LNPL_{i,t}\right).\left(1 - LNPL_{i,t}\right).\left(\frac{1}{1-\lambda_1-\lambda_2}\right) \quad (10)$$

$$\frac{\partial LNPL_{i,\infty}}{\partial comp_q} = \left(\sum_{j=1}^{4} \theta_j\right).\left(LNPL_{i,t}\right).\left(1 - LNPL_{i,t}\right).\left(\frac{1}{1-\lambda_1-\lambda_2}\right) \quad (11)$$

The elasticities of NPL ratios with respect to changes in macroeconomic variable for each sector are presented in Table 4.

Table 4.
Elasticites of NPL Ratios with Respect to Changes in Macroeconomic Variables

	1. Commodity	2. Trade	3. Manufacturing Industry	4. Construction	5. Others
Long run elasticity with respect to a one percentage point (permanent) change in quarterly rates of:					
Rgdpsa_q	-0.062	-0.035	-0.034	0.006	-0.061
Chpolrate	-0.008	0.005		0.013	-0.002
Nexr_q					-0.001
Comp_q		-0.006	-0.017	-0.006	
Hp_q		-0.001	0.001		0.001

From Table 4, the elasticities indicate how NPL ratio would change in the long run if the quarterly rates of the macroeconomic determinants increased by one percentage point on a permanent basis. A permanent one percentage point (pp) increase in real GDP growth (equivalent to 4 pp in an annual basis) would reduce the NPL ratio in the commodity sector by 0.062pp, 0.035pp in the trade sector, 0.034pp in the manufacturing sector, and 0.061 in the other sectors, and will increase the NPL ratio in the construction sector by 0.006pp.

Our assessment shows that credit risks in commodity and other sectors are more sensitive to real economic growth than those on manufacturing industry and trade sectors. Real economic growth elasticities to credit risk for commodity and other sectors are almost twice higher than for manufacturing industry and trade sectors. Thus, during economic contraction phase, NPL in commodity and other sectors will increase higher than NPL in manufacturing industry and trade sectors.

V. CONCLUSION

Previous researchs focused on how macroeconomic shocks impact the credit risk in aggregated loan. If it estimated in more granular level, the impact of those shocks may vary for each sector of the economy. The shock of one particular macroeconomic variable may not necessarily affect all sectors and the magnitude of its impact will be significantly affected by the sensitivity of each sector.

This paper analyze Nonperforming Loan ratio to total credit (NPL), as a proxy for credit risk, for five major economic sectors by utilizing panel data of 117 commercial banks in Indonesia over period 2000Q1 to 2016Q3. Our empirical analysis shows that in general there is a close relationship between NPL and macroeconomic variables. The details are as follows:

a. Real economic growth is the main driver that is negatively correlated with credit risks in all sectors.
b. Several variables only affect the NPL in particular sector. Changed in the policy rate affects the credit risks in commodity, trade and services sectors, as well as other sectors. If policy rate declined, credit interest rate declined and credit risks decline and vice versa. The change in nominal exchange rate only affects the NPLs of other sectors. Commodity price inflation rate only affects the NPL of trade and manufacturing sectors, while house price inflation rate affects the NPL in three sectors, namely trade, manufacturing industry, and construction sectors. Both commodity price and house price inflation negatively affect the NPLs.
c. The NPL ratios corresponding to commodity and other sectors are more sensitive to real GDP growth slowdown than those corresponding to manufacturing industry and trade sectors. The real GDP growth elasticities of NPL ratios corresponding to commodity and other sectors are about twice as large as the ones corresponding to NPL ratios of manufacturing industry and trade sectors. Thus, during an economic contraction phase, NPLs of commodity and other sectors will increase higher than NPLs in manufacturing industry and trade sectors.

This study analyzed the credit risk by looking at the NPL ratio and its macroeconomic determinants. This credit risk model can be used as one of the credit risk stress testing tools to complement previous models. Future researches can be conducted using credit that are disaggregated which corresponds to its GDP per economic sector so that it would possible to add GDP per economic sector as the explanatory variable. Future research can be done by adding internal banking variables such as ROA, ROE, CAR, etc. as the determinant of NPL ratio.

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APPENDIX

Table A1. presents results for fixed effect regressions corresponding to different types of credit exposures, where (lagged) coefficients of explanatory variables are added up to simplify the interpretation of results.

Variables	Commodity		Trade		Manufacturing Industry		Construction		Others	
	Sum of Coefficient	Marginal Significance	Sum of Coefficient	Marginal Significance	Sum of Coefficient	Marginal Significance	Sum of Coefficient	Marginal Significance	Sum of Coefficient	Marginal Significance
Rgdpsa_q	-0.2198	0.0032	-0.1471	0.0202	-0.1462	0.0185	0.0226	0.0286	-0.1185	0.0843
Chpolrate	-0.0272	0.0006	0.0221	0.0193			0.046	0.0551	-0.0035	0
Nexr_q										
Comp_q			-0.004	0.0519	0.0026	0.0533			0.0008	0.1625
Hp_q			-0.0248	0.0163	-0.0723	0	0.0223	0.0005		

Table A2. presents results for GMM estimation corresponding to different types of credit exposures, where (lagged) coefficients of explanatory variables are added up to simplify the interpretation of results.

Variables	Commodity		Trade		Manufacturing Industry		Construction		Others	
	Sum of Coefficient	Marginal Significance	Sum of Coefficient	Marginal Significance	Sum of Coefficient	Marginal Significance	Sum of Coefficient	Marginal Significance	Sum of Coefficient	Marginal Significance
Rgdpsa_q	-0.173	0.0655	-0.119	0.1885	-0.191	0.0034	0.060	0.0514	-0.012	0.3692
Chpolrate	-0.029	0.0002	0.015	0.0377			0.057	0.0070	-0.001	0.0001
Comp_q			-0.004	0.2680	0.004	0.1641			-0.003	0.0268
Hp_q			-0.029	0.0357	-0.088	0.0000	0.028	0.0001		

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CRYPTOCURRENCIES FROM ISLAMIC PERSPECTIVES: THE CASE OF BITCOIN

Ahmad Kameel Mydin Meera[1]

ABSTRACT

Cryptocurrencies' popularity has surged during the last few years. This is especially the case of bitcoin, one among cryptocurrencies which price has soared from USD1,000 in the first quarter of 2017 to USD20,000 by the end of 2017. It has now being used by merchants as a medium of exchange. Upon realizing its popularity, the CME Group that owns the Chicago Mercantile Exchange launched a futures contract on bitcoin. Yet, there are cases where bitcoin is banned by the country. This article examines the implication of bitcoin on Islamic finance and questions its acceptance as a medium of exchange (money) based on its compliancy with shari'ah. By analyzing its nature and characteristics, the paper concludes that, strictly speaking, cryptocurrencies that are not backed with real assets are not shari'ah-compliant. However, the majority of shari'ah scholars are leaning towards approving bitcoin on maslahah basis. Bitcoin is neither fiat money nor real money. The absence of an intrinsic value coupled with lack or zero supervision by the central bank will result in misusing bitcoin. Furthermore, we content that it has the elements of *maysir* and *gharar*. This can contribute towards socio-economic injustices, thereby jeopardizing the maqasid al-shari'ah. Hence, based on a thorough analysis, we conclude that fiat cryptocurrencies are not shari'ah compliant. However, gold-backed cryptocurrencies are argued to be desirable and consistent with the *maqasid al shari'ah*.

Keywords: Cryptocurrency, Bitcoin, Islamic money, Islamic finance, Shari'ah money, Fintech

JEL Classification: P44, O31

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I. INTRODUCTION

Cryptocurrencies are fast mushrooming throughout the world, particularly since the first worldwide cryptocurrency, bitcoin, was launched in 2009. Initially it did not attract much attention even though the technology behind it is very innovative and advanced. Using cryptography and distributed ledger techniques bitcoin became the first highly secure, non-regulated, global currency that is not issued by any central agency. Hence it is effectively a politically-free money. Lately it has attracted so much interest that just in the year 2017 the price of bitcoin rose from USD 1,000 on 1st January 2017 to USD 20,000 around 18th December 2017, i.e. a momentous increase of 1,900% within a year. Many reasons are given for this, which we shall discuss later. However, the tremendous interest and success of bitcoin have also caused more such cryptocurrencies to be created and launched. People now see bitcoin and other cryptocurrencies as potentially high return assets. Also more than 100,000 businesses have started accepting bitcoin for payment[2]. It is the most popular money for use in cryptocurrency e-wallets. Even Islamic finance is looking into ways to embrace this new development. Madina Kalimullina, the economic and finance adviser at Russia Mufti Council remarked recently that halal Islamic cryptocurrencies may soon become a reality (Thedailyeconomist.com, 2nd November 2017).

Observing the tremendous interest and demand for cryptocurrencies like bitcoin, even the CME Group, which owns the Chicago Mercantile Exchange (CME) and the Chicago Board of Trade (CBOT), announced that it would soon launch a bitcoin futures contract by the end of the year (www.cmegroup.com, 30th October, 2017). It indeed launched it. All these developments may not be good news for the US dollar's global hegemony.

The rise in cryptocurrencies, nevertheless, has taken the banking and finance industry by surprise and shock. Being a decentralized money, cryptocurrencies certainly touched the nerves of money issuing central authorities, like central banks of countries. It is indeed a threat to national fiat currencies and to the survival of the banking industry itself. Accordingly, some countries like China, India, and Egypt have resorted to banning bitcoin-based transactions. Bitcoin exchanges were ordered shut down. Nevertheless, cryptocurrencies which are new fintech products, are indeed disrupting global money, banking, and finance. Many have embraced them while others are still resisting them.

But what are the views regarding cryptocurrencies, like bitcoin, from Islamic money and finance perspectives? Does bitcoin, for example, fulfill the criteria for Islamic money? Will Islamic and shari'ah scholars embrace cryptocurrencies? This paper attempts to answer those questions. Section 2 discusses what cryptocurrencies are and its underlying blockchain technology. Sections 3, 4, and 5 discuss the concept of money, Islamic money, and payment systems. Sections 6 and 7 analyze bitcoin from the concept of money and Islamic perspectives. Lastly, section 8 provides the final contentions and conclusion.

[2] en.wikipedia.org

II. CRYPTOCURRENCIES

A cryptocurrency is a digital money that is made highly secure using some leading-edge cryptography technology. It secures the issuance of the digital money, its transfers and its historical chronological transactions record. Bitcoin is currently the most popular cryptocurrency.

Bitcoin uses cryptography for the issuance of new digital coins and uses the blockchain technology to record transactions and store them in all the network-nodes (computers, laptops, mobiles etc.) throughout the world in a distributed ledger called blockchains, i.e. without any central data storage. While cryptography has been around for quite some time now, it is the blockchain technology that is considered an innovation in computer science. This technology is indeed disrupting many ways how human beings organize their economic interactions. All transactions are transparent, verified, grouped together, and stored in many locations.

Therefore, the bitcoin system is a global digital money, an e-payment system, and a public ledger, all in one. It's a peer-to-peer system, managed collectively, with high transparency. It, therefore, entails direct transactions between users without any intermediary like banks or other financial institutions. As such it is not centrally issued and it has no single administrator or regulator. Transactions are verified by the network nodes and recorded in a distributed ledger. These make bitcoin a highly secure money and payment system.

In the bitcoin network, say X wants to buy an iPhone from Z for 0.1 BTC[3]. X would send a message to the network indicating his wish to transfer 0.1 BTC to Z. He would provide his own and Z's account numbers, the amount to be transferred, his digital signature and a proof that he actually has the required BTCs. This is done using **private keys** and **public keys** that are secured through cryptography.

The private key is used by the participant to initiate a transaction by issuing both his digital signatures and public keys that would allow others in the network to verify information and permit the execution of the requested transaction. This request would be floating in the network until someone in the network pick it up for verification and validation. These people are called miners and they verify the digital signature and the proof of funds. Once verified and approved, the transaction executed and stored in a digital block.

A block consists of a number of verified, chronologically ordered transactions that took place within a time span, say about 10 minutes. Verifying transactions chronologically prevents double spending of funds. The miners, thereafter, would compete to find the cryptography hash-key[4] that would lock the block, for which the miner who found it would be rewarded with bitcoins. This is how bitcoins originate[5].

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[3] BTC is the currency symbol for bitcoin.

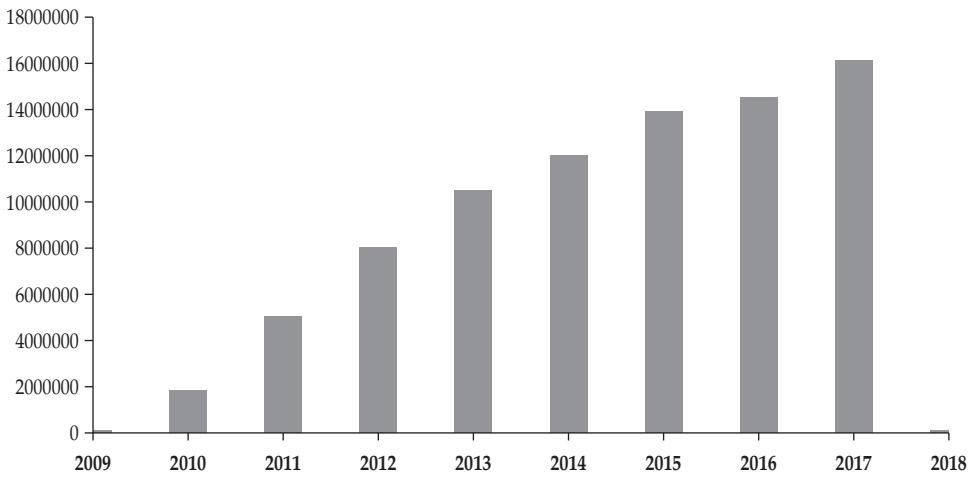
[4] This cryptography hash-key is formed through some complex mathematical formula that is a function of the information contained in the block.

[5] Others can obtain bitcoins by selling goods or services for bitcoins or buying them from a cryptocurrency exchange using national currencies.

In short, the blocks are time-stamped, locked and interlinked, all using cryptography. To change a record in a particular block, for example, one would have to find the cryptography keys for all the locks from the latest block up till that intended block, and complete the desired changes before a new block is added by anyone in the network. Moreover, altering records will also alter the cryptographic locks of that block and all subsequent blocks. This unique structure makes information in the block practically **irreversible**. It is this irreversibility of data in blockchain technology that is considered as an innovation and a significant contribution to the field of computer science. In summary,

> Blockchain is decentralized database that stores registry of assets and history of transactions across a peer-to-peer network, i.e. on every computer in the network. It is therefore a Public Registry of who owns what and who transacted what. Transactions are secured through cryptography and over time the transactions history is locked in blocks of data that are cryptographically linked together and secured, i.e. immutable, unforgeable, hard to temper-with…Blockchain can record not only money, like bitcoin, but many other kinds of assets too – history of custodianship, ownership, location of assets, title of ownership, a certificate, a contract, real objects, personal identifiable information etc…[It is therefore,] a revolution in the way money, assets and securities are stored, transferred, accounted for and reconciled.
>
> Bettina Warburg, TEDTalk

Hence to recap, bitcoins are created through a reward mechanism called mining. In order to obtain a bitcoin, sophisticated mathematical problems need to be solved, that gets more and more difficult over time. Bitcoin is not backed by any asset, i.e. not redeemable for any tangible asset. The maximum number of bitcoins is apparently limited to 21 million coins only. About 16,000,000 bitcoins have already been issued by November 2017. See Diagram 1 below.



Source: Wikipedia

Diagram 1. Total Number of Bitcoins in Circulation

Some cryptocurrencies are, however, also backed by real assets, like gold. These are issued by private parties. One such cryptocurrency is OneGram that was issued in Dubai recently. Table 1 below gives a comparison between fiat national currencies and cryptocurrencies, both asset-backed, and unbacked ones.

Table 1.
Comparison between Fiat Currencies and Cryptocurrencies

	Usual Fiat Currencies	**Cryptocurrencies Not Backed by Real Assets**	**Cryptocurrencies backed by Real Assets, like Gold**
Asset Backed?	No	No	Yes
Examples	National currencies notes, coins, e-money, like ringgit	Bitcoin	OneGram
Issuer	Central authorities like central banks and commercial banks.	Issued by the system to Private individuals for performing some task. Not issued by central authorities.	Private issuers. Not issued by central authorities like central banks but the issuer is known.
Secure from Counterfeit?	Low	High	High
Asset or Liability	Liability of the Issuer	Not a liability of anyone. A new Asset Class[6] - Digital Asset	Real Asset
Regulator	Central Bank	No Regulator	No regulator but members abide by rules commonly set or by the operator
Guarantor	Government is the guardian and protector of the money and monetary system	No ownership of system and no guarantor. Highly risky and uncertain	Guaranteed by system owners or operator. There is system ownership and rules.

Source: Author

In order to evaluate cryptocurrencies from Islamic perspective it would be wise to review our knowledge on money and its functions in Islam.

III. WHAT IS MONEY?

It is common knowledge that mankind invented money to initially solve the two problems associated with barter exchanges, i.e. 1) The double coincidence of wants, and 2) The indivisibility of items of exchange. Hence societies introduced

[6] CME Group's Chairman Emeritus, Leo Melamed, sees bitcoin likely becoming a new asset class in its own right and be traded in a regulated market soon. Reuters 7 November, 2017.

money into their markets and business transactions basically to address those two problems. A society could practically use anything that they can agree upon as money. Bernard Lietaer in his classic book *The Future of Money*, defines money as below.

> Money is an *agreement*, within a *community*, to use something as *a medium of exchange.*

Hence, they could practically use anything as money. This money-agreement is observed historically made freely or coerced, formally or informally, and even consciously or unconsciously. Most Islamic and shari'ah scholars too seem to agree with such definition of money. Whatever a society takes as money, so long the item is a halal item, shari'ah scholars seem to approve it based on the concept of *maslahah*, and hence the rules of *as-sarf* and *riba* are applied upon it. All subsequent Islamic business contracts and exchanges and finance would then be based on that 'money' which the society has agreed upon. In other words, money is taken as given and, therefore, subsequent contracts, discussions, and deliberations on shari'ah issues do not question the nature of money. In this regard, mankind has used various commodities and materials as money, for example cowry shells, leather, gold, silver, wheat, salt, etc. Later, fiat money like national paper currencies and electronic money came into the picture. Now we see the interesting phenomenon of cryptocurrencies where these are neither issued by central authorities nor even regulated.

Nonetheless, over time, societies discovered that for an item to play an effective and efficient role as money, it must meet certain requirements:

1. **Accepted** – the item must be desired for its own sake, i.e. having intrinsic value
2. **Divisible** – it must be easily divisible into smaller units
3. **Homogenous** – it must be uniform so that is easily divisible
4. **Durable** – it has to be long lasting and not easily destroyed
5. **Mobile** – it lends itself to be easily carried around
6. **Rare** – this allows a small quantity of it to have a large value
7. **Stable value** – it has a stable value relative to other things, particularly those naturally occurring things

The first criterion, "Acceptance" is tricky. In most cases of today, the acceptance of money having no intrinsic value is forced upon the people by governments through the legal tender law.

An item having at least the first five characteristics makes it good money. Having the additional last two makes the item excellent money. Societies have used many items in the past, that have the above criteria, as money including cowry shells, beads, and items mentioned in a hadith of the Prophet (peace be upon him) regarding *ribawi* items, i.e. gold, silver, wheat, barley, salt and dates, etc. Societies have similarly evolved to use paper currencies, coins, cheques, electronic money, and now cryptocurrencies as money. Note that all those items fulfill most of the above- mentioned criteria. Saidina Umar r.a. is said to have apparently wanted to use camel skin as money, which also in a way fulfills the above criteria, but was short of implementing it apparently for fear that people might start killing or stealing camels in order to create money. Nonetheless, any item chosen by the

society as money would then automatically would fall under the rules of *as-sarf* and *rib*a.

However, Abdullah (2016) noted that most of the general items mentioned above were referred to as *wasilat at-tabadul*, or a wider medium of exchange by the notable classical Islamic scholars like Al-Mawardi, Abu Ubayd, Al-Ghazali, Ibn Khaldun, and Al-Maqrizi, relative to their unanimous preference and definition of the *dinar* and *dirham* as *an-Nuqud al-Islamiyyah*, i.e. Islamic money. On top of playing the normal funtions like medium of exchange, unit of account, standard of deferred payment and store of value, money in Islam is also used as a standard in shari'ah legal requirements of 1. *Zakat* (poor tax); 2. *Jizya* (tribute tax); 3. *Kharaj* (tax on conquered territory); 4. *Diyat* (blood-money); 5. *Sariqa* (theft); 6. *Mahar* (dowry); and 7. *Sarf* (currency exchange).

IV. ISLAMIC MONEY AND THE 'STORE OF VALUE' FUNCTION

Is there such a thing as "Islamic money"? When we say something is 'Islamic', it means that something contributes to the attainment of the *maqasid al shari'ah*. If something causes a movement away from the attainment of the *maqasid al shariah,* we say that thing is 'unislamic'. Therefore Islamic economics, Islamic banking and finance, etc must contribute towards attaining the *maqasid al shari'ah*. Hence if there is an item that can help society attain some of the objectives of shari'ah, then that item is 'Islamic'. Accordingly, if there is a money or payment system that can assist us in the attainment of the *maqasid al-shari'ah*, we may term that as Islamic money and payment system and vice-versa.

In this respect, the store of value function is crucial because if money fails to preserve its value reasonably well in the long run then that would jeorpardize the *maqasid al-shariah*, particularly the protection of wealth (*hafiz al-mal*) function. If people save money for the future but the value of money keeps depreciating over time, then people would lose that money wealth in time. This is counter to the *maqasid al-shariah*. Hence it is of paramount importance that an islamic money plays the 'store of value' function well. The store of value function is indeed a litmus test as to the validity of a medium of exchange in Islamic economics and finance (Abdullah, 2016).

V. DESIGNING AN ISLAMIC MONEY AND PAYMENT SYSTEM

From the foregoing discussion, the first and foremost thing in designing an Islamic money and payment system is for the society to decide on the Reference Material, i.e. what item to use as a measure of value in socio-economic interactions. It is imperative and unavoidable that the Reference Material must be something real[7] and fulfill the criteria of money discussed section 3 earlier, at least the first five

[7] The reference material must have its own intrinsic value in the sense that utility can be potentially derived from it, either in the form of non-destructible utility as in gold and silver since their use is more of ornamental, or destructible utility as in commodities like dates, wheat, air-time etc. since these are destroyed in the process of consumption.

criteria or best all the seven (Please see Diagram 2 below). This reference material necessarily will have to be some kind of commodity or some standardized service[8]. The reference material is of paramount importance in order to eliminate seigniorage and all its socio-economic negative effects so that the *maqasid al-shari'ah* is not jeopardized. In other words, there exists a direct link between this Reference Material and "monetary justice" in the economy.

Once the Reference Material has been decided, then a certain quantities of it are then identified as units of money. For example, classical Islamic societies have decided upon using gold and silver as the Reference Material and used 4.25gm of pure gold as dinar and 3gm of silver as a dirham, i.e. as reference units. These standardized coins of monetary units then circulate as money in the society. For modern applications, including e-money, these quantities may also be used as the standard monetary units.

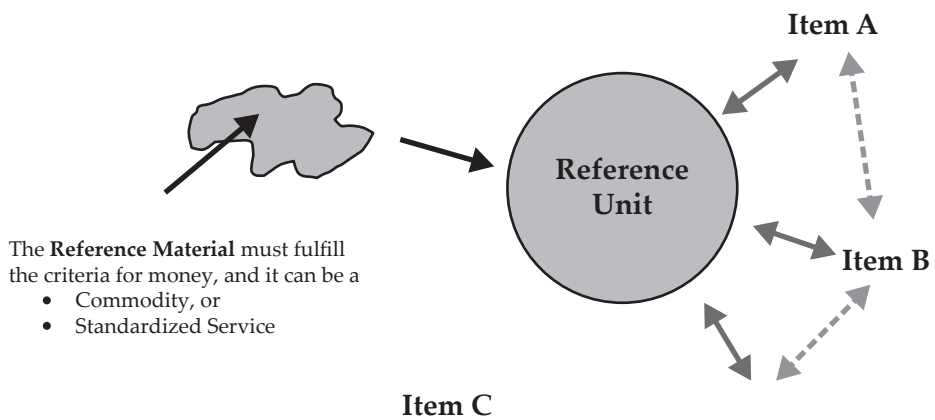


Diagram 2. Money as Medium of Exchange (Commodity) and as Unit of Account or Measure of Value (Information)[9]

When the Reference Unit, like gold dinar, is used for, say, buying item A, then it is being used as a medium of exchange. Here money is a commodity and being exchanged for another real thing. It is effectively like a barter exchange and a fair transaction because both of the items exchanged have intrinsic value.

 When the Reference Unit like gold dinar is used for pricing, say item A and item B as being one dinar, then it is being used as a measure of value or unit of account. Hence A and B can be exchanged directly without using gold dinar at all. Here, money is INFORMATION.

[8] Like mobile air-time as in the case of M-Pesa in Kenya

[9] K. M., and Mubasheera, Hamida. (2015). Revisiting the Concepts of Money, Profit and Interest from the Perspective of Value and Diminishing Marginal Utility. *Journal of Islamic Monetary Economics and Finance*, *1*(1), pp. 25-53.

Nyazee (2008)[10] illustrates the concept of *riba* as derived and expounded by the classical scholars. The learned professor concluded as follows:

> The truth is that if the strict legal position of Islamic law is adopted, all transactions in paper currency [fiat money] will become invalid.
>
> Nyazee, Imran K. (2008)
> *The Concept of Riba and Islamic Banking*
> Advanced Legal Studies Institute, p129

Analyzing Nyazee (2008), one can deduce that four types of payment methods are permissible in Islamic muamalat. These are illustrated in Diagram 3 below:

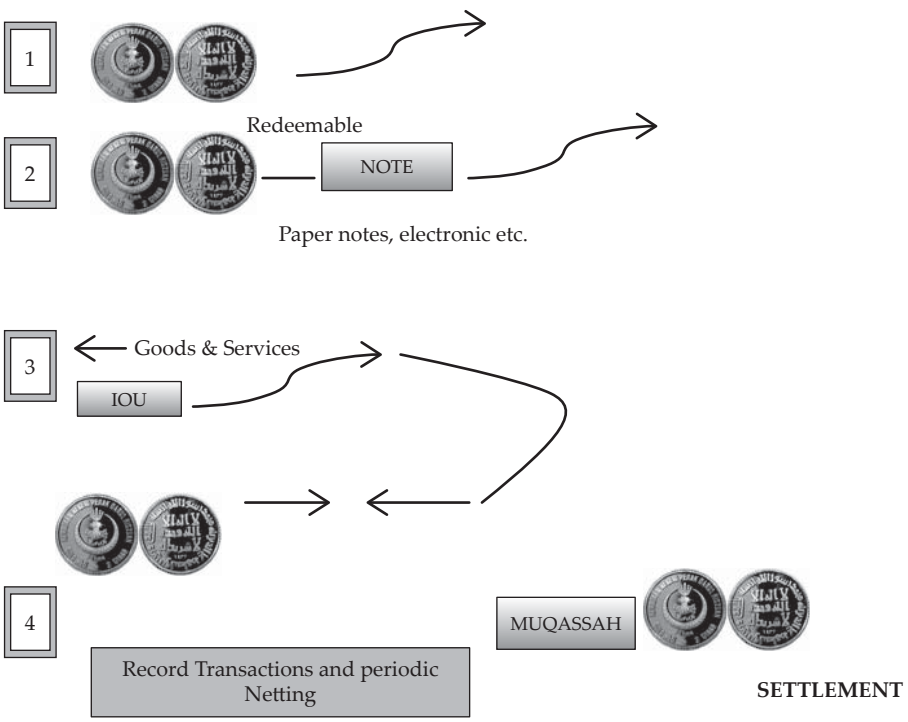


Diagram 3. Four Types of Permissible Payment Methods

In Diagram 3, the 1st permissible transaction is quite straightforward. One has the Reference Unit that is made of the Reference Material, for example a gold dinar and exchanges it for goods and services. This is a direct fair transaction. In the 2nd case, one has a redeemable note as money. The note, which is representative money, is redeemable for a gold dinar, for example, from the issuer of the note. The

[10] Nyazee, Imran K. (2008). *The Concept of Riba and Islamic Banking*. Advanced Legal Studies Institute.

note simply eases transactions by being easy to be moved about and is effectively similar to the 1st transaction. The 3rd case is where goods and services are purchased on a credit basis by issuing an IOU for a certain period, say 1 month.

The IOU can be circulated as money in the society and whomsoever holding it at the end of the month can then redeem it, for a gold dinar for example, from the issuer of the IOU. In this case, however, it is not permissible to circulate an IOU as money if it originated from a monetary loan. This is easily reasoned because if that were allowed, then both the loaned-money and the IOU would circulate as money, thereby putting inflationary pressures on the economy. The final 4th case is where all transactions are simply captured in an accounting ledger, i.e. debits and credits, among the participants but then periodically net-off and balances settled among the participants using the Reference Units, i.e. gold dinars in this example. This netting off and settlement is call *muqassah* in *shari'ah*, and is permissible. Those are effectively the four permissible money transactions or payment methods allowed in shari'ah, that are devoid of *riba*, as deduced from Nyazee (2008). Having discussed the characteristics of good money and Islamic money/payment methods, let's analyze if bitcoin has these characteristics.

VI. DOES BITCOIN HAVE GOOD-MONEY CHARACTERISTICS?

From the foregoing discussion, this section analyzes bitcoin from the Islamic money and payment methods perspective. First of all, does bitcoin fulfill the seven criteria for good money? This is summarized in Table 2 below.

Table 2.
Does Bitcoin Fulfill The Good Money Criteria?

	Criteria	Remarks	
1	Accepted	It is quite accepted by people on their own free will even though it has no intrinsic value	×
2	Divisible	Being an electronic currency, it is easily divisible	√
3	Homogenous	Being electronic it is effectively homogenous	√
4	Durable	Being stored as electronic bytes in a distributed ledger, it is highly durable	√
5	Mobile	Being electronic, it is highly mobile	√
6	Rare	The issuance of bitcoin is through a mining process that makes bitcoin rare	√
7	Stable Value	Lately the value of bitcoin has been fluctuating rather 'violently' i.e. depicting high volatility	×

Hence it is clear from the above Table 2 that bitcoin fulfills at least five of the seven criteria, except for two criteria; it is accepted for its own intrinsic value and it has a stable value. Bitcoin has no intrinsic value and its monetary value is not stable (See Figures 1 to 3). Note that having a stable value, i.e. being a good store of value, is a litmus test for shari'ah money, so that it can function as a protector of wealth, which is one of the *maqasid al-shari'a*h. Without having intrinsic value, the element of economic injustice would creep in, through the seigniorage of fiat

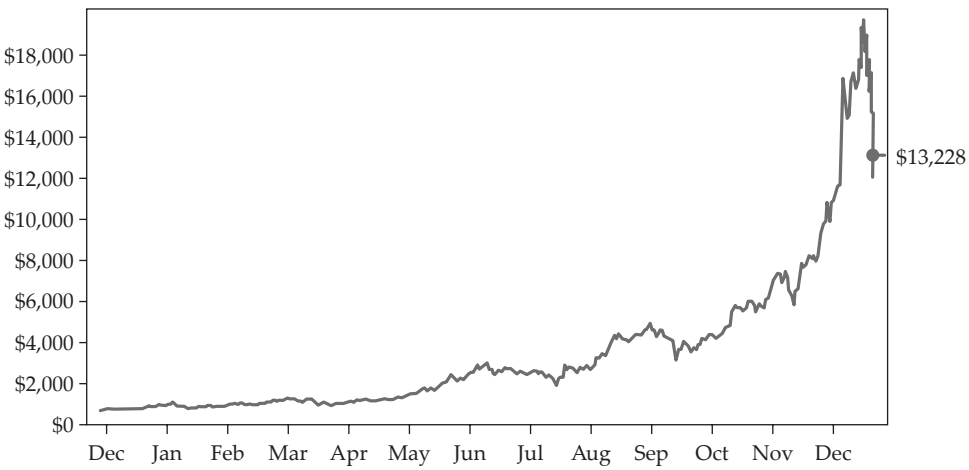
money. Also note that without intrinsic value, or having *'ain'*, it does not fall into any of the four permissible money transactions deduced from Nyazee (2008). In other words, it has no Reference Material.

However, since bitcoin is accepted by thousands of merchants throughout the world, it is therefore, still 'money' by modern definition of it and shari'ah scholars are likely to approve it and make it subject to the rules of *as-sarf* and *riba*. Nonetheless, countries that aspire to 'control' its people are likely to ban bitcoin and other cryptocurrencies since these bypass monetary authorities in terms of their creation and transfers.

VII. ANALYSIS OF BITCOIN, A FIAT CRYPTOCURRENCY, FROM ISLAMIC MONEY PERSPECTIVES

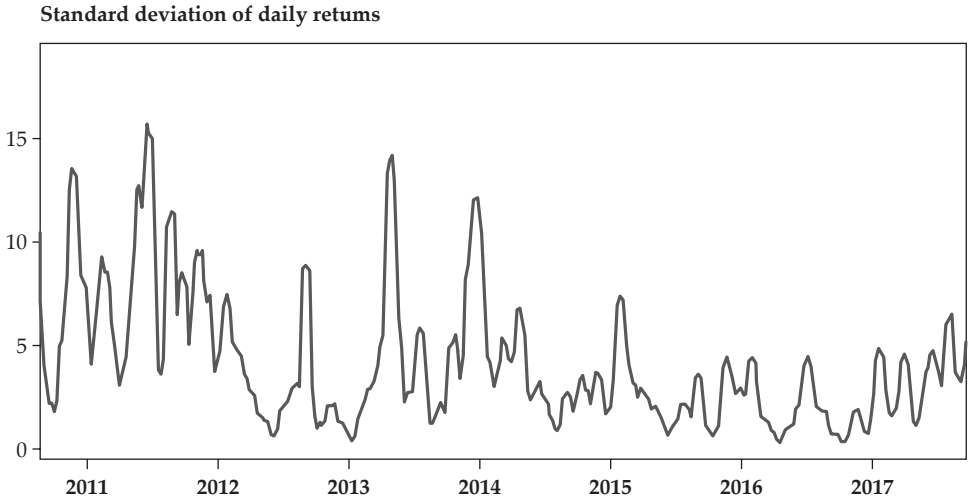
We have established that a cryptocurrency like bitcoin is indeed money so long a group of subjects like individuals and merchants accept it for payment among themselves. It is no different from normal e-money (which is also fiat money) except that it is not centrally issued and neither regulated nor guaranteed by any authority. However, the following further issues and observations are noted regarding bitcoin.

First of all, the price of bitcoin has been soaring lately. Just in 2017 its price has increased by more than 1,900%, from a USD1000 per bitcoin to USD20,000 by mid-December (Figure 1 below). Also the price has been highly volatile (Figure 2 below).



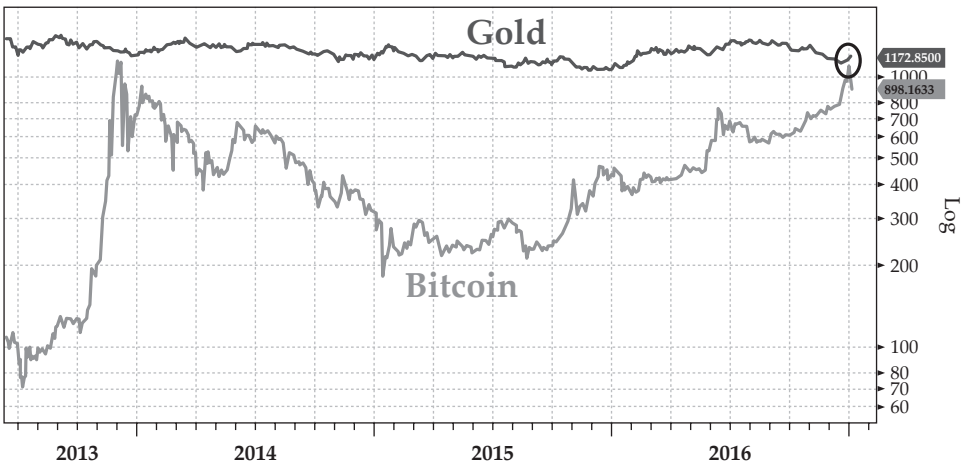
Source: Coindesk.com

Figure 1. Bitcoin Value, Jan 1 – Dec 22, 2017



Source: https://www.quora.com

Figure 2. Volatility of Bitcoin, 2010 to 2016



Source: http://www.zerohedge.com/news/2017-01-07/bitcoin-good-gold

Figure 3. Price Volatility of Bitcoin and Gold

Figure 3 shows the high volatility of bitcoin value compared to that of gold. Hence, it is obvious that bitcoin does not adhere well to the 'store of value' function of money.

Other issues and observations regarding bitcoin:

1. No one knows for sure who is behind the bitcoin software. It is attributed to one Satoshi Nakamoto, but no one knows if this is a true person, a group of people or what. It was indeed released as an open-source software. Hence,

there is no one actually taking responsibility for the bitcoin 'money' or for the system as a whole.

8. How does one know or confirm that the bitcoin system does not reward its creator(s) handsomely, say periodically giving its creator(s) thousands of bitcoins free? Some might argue that this is not possible because all codes and transactions are transparent and known to all. But then,
9. How does one know that the system made available in the open source is also the system that is operating in actuality? People may argue that the codes are available for all to see, but then hidden codes etc. are all possibilities nowadays. Hence, even the statement that the maximum amount of bitcoin is capped at 21 million units only, can be disputed or yet to be seen. Basically there is no one who is truly auditing the system in the interest of all, eventhough most bitcoin users seem to believe in the authenticity and transparency of the system.
10. Bitcoin is not 'real money', i.e. it is digital money not backed by some real commodities or services. Bitcoin's value is highly volatile. Its value has also gone up tremendously over the years. Hence, there is a possibility that bitcoin value is being manipulated into a bubble. As such, the World Bank called bitcoin a Ponzi scheme.
11. Also, since bitcoin has no intrinsic value and issued privately, issuance of hundreds or even thousands of similar cryptocurrencies are expected, as have been observed. The mushrooming of such multitude of cryptocurrencies are bound create inflation on a global scale.
12. What if people get their bitcoin e-wallet hacked and stolen? There were some such cases in South Korea and Japan lately. To whom to complain? Similarly, what if the system crashes, sometime in the future? The absence of a central administrator makes all these uncertain.

The above discussion reveals that there is tremendous uncertainty (***gharar***) present in bitcoin and its payment system. Table 3 below summarizes the evaluation of bitcoin relative to fiat currencies and asset-backed cryptocurrencies, from Islamic perspective.

Table 3.
Comparison between Fiat Currencies and Cryptocurrencies from Islamic Perspective

	Usual Fiat Currencies	**Bitcoin & Cryptocurrencies Not Backed by Real Assets**	**Cryptocurrencies backed by Real Assets, like Gold**
Degree of Gamble (*maysir*)	Medium[11]	High	Low
Degree of Uncertainty (*gharar*)	Medium[12]	High	Low
Islamic money? i.e. Does it contribute to *maqasid al shari'ah*?	No	No	Yes

VIII. FINAL CONTENTIONS AND CONCLUSION

From the foregoing discussion and arguments, we assert the following regarding bitcoin and similar fiat cryptocurrencies:

1. The surge in bitcoin value, particularly in 2017 suggests that it is simply a bubble, a bubble that can be compared with the 'tulip bubble' of Dutch that crashed in 1637. It's a bubble that would soon burst and cause many to lose a lot of money. Of course some would profit handsomely from the whole episode. Hence, anyone buying a bitcoin now at such high price would indeed be gambling. Accordingly, there is element of gamble or *maysir* in current bitcoin.
2. We also contend that the surge in bitcoin price and the growing interest in cryptocurrencies worldwide is a sign that global fiat money system is fast collapsing and folding up. Bitcoin, particularly, seem to be a global choice for that alternative money the world is searching for. But nonetheless, it is still fiat.
3. Bitcoin also seem to have been designed to mimic gold. There is a possibility it was artificially propped up in 2017 to counter the recent attempt by China to use Yuan benchmarking for oil trading, backed by gold. This action by China is indeed the greatest threat to dollar's position as the internationally preferred reserve currency and to the US global hegemony.
4. The above is further accentuated by the fact that the CME Group, which owns the Chicago Mercantile Exchange and Chicago Board of Trade, launched bitcoin futures contracts, at the end of 2017.
5. Notwithstanding the above points and arguments, gold-based cryptocurrencies, like OneGram, that was launched in Dubai is acceptable as an Islamic cryptocurrencies. This is because OneGram has all the required characteristics of money compared to bitcoin, including having intrinsic value, issuer, administrator, auditor, and guarantor.

From the foregoing discussion, cryptocurrencies like bitcoin may be placed in perspective, within the wider concept of money, as summarized in Diagram 4 below:

[11] All fiat currencies lose value over time and ultimately become obsolete.

[12] Due to their fiat nature, their value tend to fluctuate greatly hence the high volatility of exchange rates between fiat currencies.

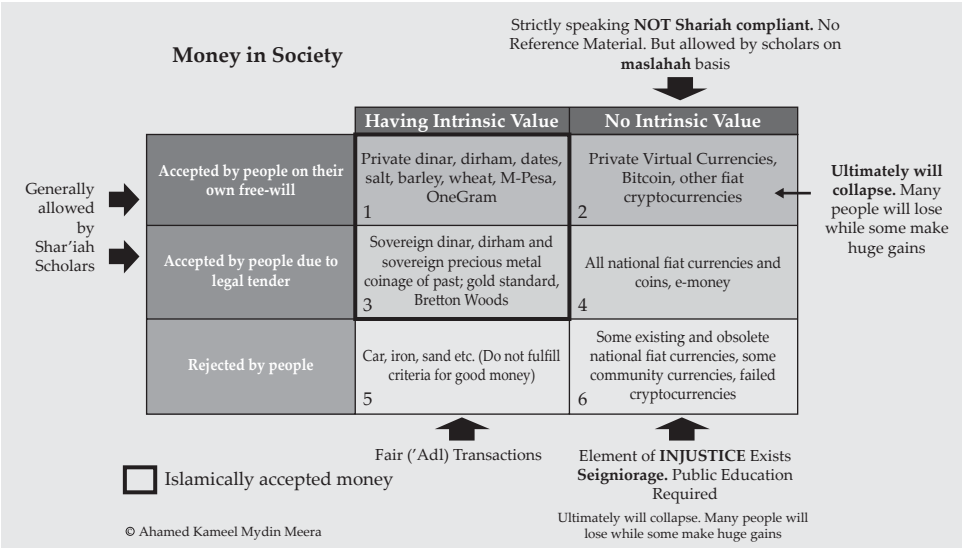


Diagram 4. Cryptocurrencies within a wider classification of money

We firstly divide money into two categories, i.e. as those having intrinsic value and those not having intrinsic value. We further subdivide into three categories, i.e. those accepted as money by people on their own free-will, those accepted due to the legal tender law, and money rejected by the people. Examples of money falling into each of the six subgroups of money are given in the respective quadrants.

Shari'ah scholars generally tend to approve any money accepted by the people irrespective of whether they accepted them on their own free-will or coerced through legal tender law or the like. This stand seems to agree with Bernard Lietaer's definition of money i.e. it is anything a society agrees to use as medium of exchange, whether willingly or coerced. Hence all money accepted by people, so long they do not involve haram items, are allowed on *fiqh* grounds, particularly on the basis of *maslahah*. Hence, money that falls in quadrant 1, 2, 3, and 4 in Diagram 4 are generally acceptable forms of money by shari'ah scholars and conforms to modern definition of money.

Some scholars, however, like Monzer Kahf, opine that for fiat money to be acceptable, i.e. having no intrinsic value, it must be termed legal tender by the government. In other words, the government must accept it for payment of taxes, levies, fines, etc. for a fiat money to be shari'ah permissible. This view effectively eliminates quadrant 2, rendering only quadrants 1, 3, and 4 as shari'ah permissible money, from such scholars' perspective.

On top of that, there are scholars who reject all forms of money that do not have intrinsic value, i.e. fiat money, on the basis of their negative implications for *maqasid al-shari'ah*. They say the seigniorage of fiat money is at the root of substantial social, economic, political, and environmental problems of today (See for example Lietaer (2001), Meera & Larbani (2006 and 2009)). Hence, money without intrinsic value has an element of injustice embedded in them and that

they promote *fasad* on earth, while money with intrinsic value is compatible with the *maqasid al-shari'ah* and promote socio-economic justice ('adl). This argument effectively eliminates quadrants 2 and 4 in Diagram 4, leaving only quadrants 1 and 3 as acceptable forms of money in Islam.

Bitcoin, together with other fiat virtual currencies fall in quadrant 2, i.e. the 'accepted on free-will' but 'no instrinsic value' region. Hence in our perspective, this money will promote socio-economic problems. Most shari'ah scholars will, however, allow them while scholars who insist on legal tender or intrinsic value will reject them[13]. Nevertheless, if accepted as money by the people then rules of *as-sarf* and *riba* would apply. In our opinion, the public should, however, be educated to reject such money. Bitcoin does not have a Reference Material and hence is bound to create much socio-economic problems.

On the contrary, any money having intrinsic value would promote socio-economic justice and should be supported by both the people and the government. Such money even if forced on people through legal tender law should be acceptable since they promote socio-economic justice in society. Hence, sovereign precious metal coinage of past including the gold dinar and silver dirhams, gold standard etc. are acceptable even if these were forced upon the people. Such money will have stable value over time and space and hence able to play the 'store of value' function well. Accordingly, we contend here that any money that falls in quadrants 1 and 3 in Diagram 4 is Islamically appealing and should be promoted while those falling in other quadrants, including bitcoin, should be rejected by both the people and governments.

Money having no Reference Material will eventually lose its value and result in an utter collapse. Bitcoin is the closest example of this.

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THE DENOMINATION EFFECT ON SPENDING THROUGH EXPERIMENTAL APPROACH

Bambang Juanda[1]

ABSTRACT

This paper discusses the denomination effect on shopping decisions in a more realistic spending scenario with various types of goods and relatively adequate denominations, including the specimen of IDR 200,000 banknote which was being investigated, in 2015, to be printed by Bank Indonesia, and some other factors affecting spending. This research used an experimental design in a laboratory study and quasi-experimental design in a field study. In the field study, the denomination of IDR 200,000 was represented by using two pieces of the existing IDR 100,000 banknote, considered as a single IDR 200,000 banknote. Therefore, if it was used for shopping, both two banknotes of IDR 100,000 must be given to the seller even though the price of the purchased goods was below IDR 100,000.

This research showed consistent results between the laboratory and field studies, which can be summarized as follows: (1) total spending is not significantly different when using large or small denominations; (2) total expenditure is greater for consumers with low self-control; and (3) the large denomination is very influential for goods with high price, especially during unplanned shopping. This result implies the need for larger denominations for regions with high priced goods.

Keywords: denomination, spending, laboratory study, field study.
JEL Classification: C91, C93, D12, E42, E52, E58

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I. INTRODUCTION

Although the economic theory has largely explained the role of the amount of money, it has not yet explained, in detail, how different representations or denominations, of the same nominal, affect the spending decisions (Raghubir and Srivastava, 2009). Mishra *et al*. (2006) argued that the individual feels the value of money based on a single large denomination which is higher than the same nominal if represented by multiple banknotes of small denominations, resulting in relatively little spending (for one or more goods at low prices) when using money or large denominations.

Similar to the above opinion, Gourville (1998) stated that the community will make more transactions when the seller uses a marketing strategy on the consumer. The seller can make them look cheaper by framing the cost of production or the price of goods of the same nominal, in the form of small denominations. For example, promoting that the cost is only $ 1 per day (Pennies-a-Day Strategy), instead of aggregate nominal of $ 365 a year. Raghubir and Srivastava (2009) have examined the influence of the domination effecting three studies. The first study, through three surveys, (field study) concluded that the amount of spending tends to be smaller when using a single banknote of large denominations. If the large denominations are used and the spending decisions are planned, two out of the three survey results showed that the shopping is larger. The second study shows that consumers will choose money with large denominations when they need self-control in shopping. A third study shows that the denominational effects depend on individual differences in controlling spending or reducing the inconveniences of spending. Overall, it is concluded that the denominational effect occurs, because psychologically, large denominations are used as a strategic tool to control or manage the spending. In other words, individual spending decisions are influenced by denominations of the same nominal as well as other factors such as self-control and spending plan of the concerned individual.

Further research on self-control and denomination have been carried out by Baumeister (2002) as well as Hoch and Loewenstein (1991), who stated that individuals often use various efforts with the existing constraints or change incentives to control short-term behavior in order to obtain long-term benefits. Raghubir and Srivastava (2009) argued that individuals tend to spend less and prefer to receive money in large denominations than small denominations to control their spending.

The systematic influence of denominations on spending decisions has important implications in the perspective of consumer welfare as well as the perspective of monetary policy. Several studies have evaluated the influence of denominations on macro indicators such as inflation and monetary policy, for example, by Chen (1976) who only used mathematical economics or the mathematical approach of the hypothesized economic structural relationships. Such studies usually consider the level of aggregate and interdependent factors and no experimental or empirical studies have been conducted, making it difficult to explain the various causal relationships. Therefore, further research is needed in the micro scope to examine how and why the denomination affects individual decisions in terms of spending.

Further research in the micro scope explaining how and why money denominations influence spending decisions on more realistic spending scenarios

with sufficient variety of goods and denominational representation is essential. In addition, what is the influence of the denomination of money that have not been printed yet and will review its psychological effects on spending. Denomination or banknotes with the highest nominal value in Indonesia at this time is IDR 100,000 which was first printed in 2004. With the annual inflation rate during 2004-2015 between 4% and 10% (the highest in 2008), it is likely that Bank Indonesia will issue banknotes with larger nominal value, such as denominations of IDR 200,000.

Therefore, the present study uses a large denomination that does not exist yet i.e. a banknote of IDR 200,000. Thus, it is necessary to use an experimental study approach. The experimental design in this study used two approaches, the laboratory and field studies. In the field study, a fractional IDR 200,000 is represented by using two IDR 100,000 denominations considered as a single banknote. Thus, if used for shopping, the two banknotes should be given to the seller even if the price is below IDR 100,000.

Specifically, this paper aims to assess the determinant of on shopping behavior. This includes currency denominations, goods price, consumer self-control, spending plan, consumer needs, market type or place of purchase, occupation, income, education, and residence of consumers. Furthermore, this paper will also formulate the policy implications related to the proposed IDR 200,000 denomination.We use two experimental designs i.e. laboratory study and field study. In contrast to previous studies, the present study was conducted with denominations and types of goods that are quite representative. Indeed, the respondents could buy anything at the minimarket and traditional markets in the field of study.

The next section of this paper outline the theory and related empirical studies. Section three discusses the methodology and the setting of experimental design. Section four provide result of the experiment and its analysis, while section five provide conclusion and policy recommendation.

II. THEORY

The research on the denominational influence on shopping behavior has been limited, so far, to one or several goods, as Raghubir and Srivastava (2009) have carried out in research to assess the influence of denominations. Shopping behavior, in addition to being influenced by denominations, can also be influenced by other factors, such as income (Henderson and Quandt, 1980; Blanchard, 2009; Sumarwan, 2014), prices (Henderson and Quandt, 1980), education (Sumarwan, 2014), planning (Raghubir and Srivastava, 2009; Mishra *et al*., 2006; Baumeister, 2002; Hoch and Loewenstein, 1991), and self-control (Raghubir and Srivastava, 2009). Furthermore, Sumarwan (2014) stated that in making purchasing action, consumers are influenced by individual difference factors (needs and motivation, decision, self-concept, information processing and perception, learning process, knowledge, attitude, and religion), environmental influence (demographics, social and economic, family and household, reference group, consumer situation, and technology), and decision-making process.

Research on denominational effects has been done using the existing denominations, as in Raghubir and Srivastava (2009) study using small

denominations (4 coins of $ 0.25) and large denominations (a 1 $ banknote) to buy sweets in the university cafeterias. In other surveys, they use 3 denominations (5 banknotes of $ 1, 5 coins of $ 1, and a $ 5 banknote) with a nominal of $ 5 that was given to the driver who stops at a gas station to spend in the existing minimarket at the gas station. In this simple experiment, which is not associated with the price of the goods, it was concluded that the chances of spending are smaller when using a single large banknote, and the will be higher if the spending decision is planned.

The experimental study approach is an effective data collection method for assessing causal relationships among variables. The use of the experimental design allows the researcher to change the values of a variable or the studied factor, but retain the values of other factors so that the influence of the studied factors can be clearly identified (Juanda, 2009). Associated with the economic studies, Juanda (2012) stated that economists often refer to it as experimental economics which is the economics of the study method applying experimental design using experimental actors whose decisions are motivated to obtain rewards so that other factors can be controlled. This experimental economy is to test various economic theories, develop economic theory, examine an economic policy (which has been or before it is implemented), and the process of economic learning.

Experimental methods, in economics, are very good ways to get better quality data (and lower costs) than the existing data (from surveys or secondary data) to observe causal relationships. At a minimum, the experimental method provides an alternative way to get the data needed to solve the problem of economic research (Juanda, 2017). One study of an economic policy before it is implemented, using an experimental approach, is a study conducted by Juanda *et al.* (2017) and Pambudi *et al.* (2014) on the determinants of a successful currency redenomination.

III. METHODOLOGY

Economists have developed various concepts of thought and analysis to examine economic phenomena. One of the theories that led to the revolution in the development of economic theory is the induced-value theory developed by Smith (1976). In controlling the environment (one of the basic principles of experimental design that makes better than survey design) to make other factors equal or ceteris paribus, this theory uses appropriate reward media aimed at generating certain characteristics of economic actors, so that innate characteristics become no longer influential. Therefore, the experimental design in economics, which uses this induced-value theory, can produce true or valid conclusions in the study of causal relationships.

There are three sufficient conditions to elicit the basic characteristics of the subject: monotonicity (the subject always likes greater rewards), salience (the reward received by the subject depends on the actions of the subject in the experiments according to the rules of the institution they understand) and dominance (the dominance of experimental actors' interests in experimental execution i.e. they prefer the reward to be received from their decision in the experiment). The experimental environment in the economic assessment is a controlled environment, and the subject will behave or make decisions in such a way as to earn high rewards, as explained in the experimental instructions. This

trial instruction consists of a description of the experimental conditions, choices, and actions that the subject must perform and the reward rule that depends on the actions of the subject. The decision taken by the subject is written in the decision sheet of the subject.

Economic research through the experimental method using induced-value theory in laboratory study generally uses students as the subjects. The selection of students as experimental actors is because: (1) they are readiest to enter into experimental groups; (2) opportunity costs; (3) backgrounds from campus where most researchers appear; and (4) can reduce external influences that can be a buffer variable in the causal impact research because it requires the homogeneity of the subject (Juanda, 2009; Juanda, 2012).

The experimental design, in the present research, applied both laboratory and field studies. There were four main factors studied in the laboratory: denominations (F1); goods prices (F2); consumer self-control (F3); and consumer planning (F4). Similarly, in the field study, there were 4 main factors studied, namely: denomination (F1); the price of goods (F2), consumer expenditure planning (F4); and market types (F5). The experimental instructions and decisions, in this experimental study, can be seen in Juanda (2015).

For the field study, the subject was the respondent representing the various types of consumers in Indonesia according to the target consumers of this denominational effect study. Therefore, the congenital characteristics of the respondent (the level of needs, occupation, income, education, and residence) that may affect spending are also analyzed. These five characteristic variables are referred to as covariates, which may affect the response, although not the factor or treatment given in this experiment. While the type of market or place of consumer spending (minimarkets and traditional markets) is considered as a factor or treatment that can affect spending and its effect was analyzed.

3.1. Experimental Design for the Laboratory Study

In laboratory study, we implement the basic principle of experiment design, ie. how to maintain the other factors equal or cateris paribus, within the framework of induced-value theory. In this experiment, the subject always sees the incentive (reward) he will gain when making a decision, which in this case is shopping or not shopping (saving).

The experimental design in the laboratory study used a Factorial Complete Random Design (FCRD) with 4 factors as follows:

$$Y_{ijklm} = \mu + \alpha_i + \beta_j + \gamma_k + \delta_l + (\alpha\beta)_{ij} + (\alpha\gamma)_{ik} + (\alpha\delta)_{il} + (\beta\gamma)_{jk} + (\beta\delta)_{jl} + (\gamma\delta)_{kl} + (\alpha\beta\gamma)_{ijk} + (\alpha\beta\delta)_{ijl} + (\beta\gamma\delta)_{jkl} + (\alpha\beta\gamma\delta)_{ijkl} + \omega(Keb_{ijkl} - \overline{Keb}) + \varepsilon_{ijkl.} \quad (1)$$

Y_{ijklm} : Individual spending with k-th level of self control, l-th spending plan, price of good j, denomination i, and m-th experiment replication.

μ : Average Y in general (regardless of the 4 factors)

α_i : The influence of i-th denomination, (i = 1 for small denominations i = 2 for large denominations)

β_j : Influence of the price of the j-th good, (j = 1 for the low price, j = 2 for the high price)

γ_k : Effect of the degree of self-control k-th, (k = 1 low, k = 2 high)

δ : Influence of expenditure planning level l-th, (l = 1 do not have; l = 2 have)

$(\alpha\beta)_{ij}$: The effect of interaction between the i-th denomination and the price of the j-th good (The influence of denomination on shopping conditional to the price of the goods).

$(\alpha\gamma)_{ik}$: The influence of the interaction between the i-th denomination and the k-th self-control (The effect of the denomination on the expenditure conditional to self-control of individual/community).

$(\alpha\delta)_{il}$: The influence of the interaction between the i-th denomination and l-th level of expenditure planning (The effect of the denomination on expenditure conditional to the level planning of the individual/ community expenditure).

$(\beta\gamma)_{jk}$: The effect of interaction between the price of the j-th good and the k-th self-control (The influence of price on the spending conditional to the self-control of the individual/community).

$(\beta\delta)_{jl}$: The influence of the interaction between the j-th price and the l-th level of expenditure planning (The influence of price on the expenditure depends on level expenditure planning i.e. individual/community).

$(\gamma\delta)_{kl}$: The influence of the interaction between the k-th self-control and the l-th level of expenditure planning (The influence of self-control on spending conditional to the level of individual/community expenditure planning).

$(\alpha\beta\gamma)_{ijk}$: The effect of the interaction between the i-th denomination and the j-th price of the goods and the k-th self-control (The influence of denomination on spending conditional to the price of goods and the individual's self-control).

$(\alpha\beta\delta)_{ijl}$: The influence of the interaction between the i-th denomination and the j-th price of goods and the l-th level expenditure planning (The influence of denomination on spending conditional to the price of goods and the level of individual/community expenditure planning).

$(\beta\gamma\delta)_{jkl}$: The influence of the interaction between the j-th price of goods, the self-control, and k-th level of expenditure planning (The influence of good prices on expenditure conditional to self-control and level of individual/community expenditure planning).

$(\alpha\beta\gamma\delta)_{ijkl}$: The influence of the interaction between the i-th denomination and j-th price of goods, the k-th self-control, and the level of the l-th expenditure planning (The denominational effect on spending

conditional to the price of goods, self-control, and the level of individual/community expenditure planning).

ε_{ijkl} : Error for individual spending with k-th level of self control, l-th spending plan, price of good j, using denomination i.

In addition to the above four main factors, the present analysis also examines the characteristics of respondents that can influence the behavior of the shopping, which is whether to buy goods because of the needs (1) or just trial (0), which is symbolized by:

$\omega(Keb_{ijkl} - \overline{Keb})$: The influence of the level of needs on the individual/community expenditure with the level of the k-th self-control and the level of the l-th expenditure planning for the j-th good price using the i-th denomination, which is corrected with the average level of respondent's overall needs.

The response variable (Y) is the amount of expenditure and also the savings/investment of the IDR 200,000 received. The analysis focuses only on spending since spending and saving are two sides of the same coin. There are 4 (four) factors or variables hypothesized affecting the spending decision and studied in this laboratory study, namely:

1. The denominational factor (F1) consists of 2 levels of treatments as follows:
   - Level 1 : Small denominations (K_1) with details as follows: (1 banknote of IDR 50,000) + (3 banknotes of IDR 20,000) + (6 banknotes of IDR 10,000) + (6 banknotes of IDR 5,000)
   - Level 2 : Large denominations (B_1) consisting of 1 banknote of IDR 200,000
   - Hypothesis : Shopping with small denominations tends to be higher than that of the large denominations.

2. Prices of goods (F2) consist of 2 treatment levels as follows:
   - Level 1 : Low prices of goods (R_2) i.e. goods that cost a maximum of IDR 50,000. In laboratory study activities, low priced goods provided include food (IDR 15,000), headset (IDR 25,000), umbrella (IDR 40,000), sandals (IDR 45,000), and clothes (IDR 50,000).
   - Level 2 : High prices of goods (T_2) i.e. goods that cost more than IDR 100,000, consisting of bags (IDR 120,000), shoes (IDR 150,000), and jacket (IDR 190,000).
   - Hypothesis : Large denominational purchases (IDR 200,000) will be bigger for high priced goods, compared to low-priced goods.

3. Level of self-control (F3) consists of 2 levels of treatments as follows:
   - Level 1 : Low level of self-control (R_3), where the subject will get information that if there is money left (not spent) he will get a Return on Investment (ROI) of 1.5% from the remaining money that is not spent.
   - Level 2 : High level of self-control (T_3), where the subject will get information that if there is money left (not spent), he will get a

Return on Investment (ROI) of 2.5% from the remaining money (that is not spent).

Hypothesis : People with low self-control tend to have high shopping level.

4. Expenditure planning (F4) consists of 2 levels of treatments as follows:

   Level 1 : Without planning (N4), where the subject can immediately spend part/all the given money, or not spend at all or the money is saved for future use or saving.

   Level 2 : With planning (P4), where the enumerator provides information on the list of goods (and unit price estimates) that can be purchased, then the subject is required to make a purchase plan by filling (on the decision sheet provided), what goods will be purchased. The subject can plan to spend some/all the given money, or not spend at all or the money is saved for future use or saving. Subject must purchase goods that have been written on the decision sheet but are allowed to buy goods that have not been written as well (not planned).

   Hypothesis : Large denominational spending (IDR 200,000) will be greater when the expenditure is planned compared to when it is not planned.

This RALF uses 4 factors, each factor consisting of 2 levels. Thus, there are 2x2x2x2 = 16 treatment combinations (treatments). To minimize the experimental bias, this study was replicated 5 times, so, a total of 80 experiments were conducted. Each of the 80 experiments was applied to a group of experimental actors consisting of 3 people. Therefore, the total of respondents involved in experimental activities of this laboratory study was 80x3 = 240 students. Determination of treatment combinations for each experimental actor was carried out randomly.

To examine whether the influence of denominations (and 3 other factors) on spending is statistically significant or not, and to examine the effect of interactions between these factors, or, in another sense, whether denominational influences are dependent on other factors, an analysis of covariance (Analysis of Covariance, or ANCOVA) was used. The ANCOVA is an analytical technique that combines analysis of variance (ANOVA) with the regression analysis to improve the accuracy of an experiment (Neter *et al.*, 1996).

As mentioned earlier in this laboratory study, there are 16 combinations of treatments. Therefore, 16 kinds of instruction (technical instructions) of the experiment, which can be seen in Juanda (2015), will be used so that the subject understands the experiments to perform. Each of these experimental instructions has been tested prior to the actual experiment.

In the design of the experiment in laboratory study, related to the price factor of goods (F2), there are respondents (120 students) who are requested to buy only goods with maximum price of IDR 50,000 (low price), and there are also respondents that are requested to (120 students) goods that cost more than IDR 100,000 (high price). The stipulation of high-priced thresholds is adjusted to the largest denomination that already exists today, which is IDR 100,000. If the price determination is more than IDR 50,000, then it can still be bought by the existing

denominations. The determination of the price selection of goods purchased for each experimental actor was done randomly.

For expenditure planning factors (F4), some respondents (120 students) were asked to make the planning first (what items will be purchased), and the remaining 120 respondents were not asked to make the planning first. The determination of planning characteristics for each experimental actor was carried out randomly.

The application of induced-value theory in this experiment is as follows. Respondents will get rewards in the form of incentives for each decision that they took. The incentives are the level of satisfaction from the goods they buy and the benefits of the remaining money that is not spent. So, each subject will take these incentives into account when making a spending decision (or saving).

The consumers will know the level of satisfaction after buying (and using/consuming) the goods, with three possible satisfaction, namely: very satisfied; quite satisfied; and less satisfied. These three levels of customer satisfaction, in this experiment, are represented by a consumer surplus (SK) or the difference between maximum price he or she is willing to spend, with the transaction price. For simplification, the possible consumer surplus category obtained by consumers is 3% of the price of the goods (if very satisfied), 1.5% of the price of the goods (if fairly satisfied), and 0% of the price of the goods (if less satisfied). The determination of consumer surplus is done randomly after the consumer obtains the goods (which are exhibited in the laboratory setting).

In reality, the rest of the money that is not spent can be used later, for savings, investments, or purchases of the same or different goods with better quality and unit value. The amount of the remaining benefits of money that is not spent can describe the level of consumer self-control (F3). The greater the benefits of the remaining money that is not spent, the higher the consumer's self-control in shopping or the less spending. The actual decision of participant may differ from the characteristic assigned to them. Prior the experiment, the self-control characteristics for each experimental actor was carried out randomly.

The benefit of the spare money, in this experiment, is represented by Return on Investment (ROI). Respondents with high self-control level will get 2.5% ROI from the money they spare; whereas respondents with low self-control will get an ROI of 1.5%. The level of customer satisfaction or surplus for each item exhibited in the laboratory setting is designed so that the expected value of the consumer surplus equals to the ROI. In general, the incentives from the satisfaction level of buying goods can be lower, equal to or higher than the incentives of the benefits of the spare money (ROI).

In the laboratory study, the number of experiments performed per day, on average, was 5 experiments. It took between 10-15 minutes per experiment, depending on the treatments. This strategy is effective because it has been previously socialized in three classes that are large enough to run 3 replications for each treatment. The number of enumerators on duty is 9 people, with the division of tasks as follows:

a. Two people acted as officers, explaining the purpose of the study and the treatment undertaken.
b. Five people acted as shopkeepers, and provided additional explanations to the respondents, and helped the respondents to fill out the decision sheets.

c. One person acts as the officer who enters the data of the respondent's decision and counts the number of incentives provided by the respondent.
d. One person acts as a cash officer, who pays incentives to respondents.

The steps undertaken are as follows:

a. The enumerator prepares the lab/class used to perform the experiment in accordance with the treatment.
b. Five respondents enter the lab and occupy the space provided for an explanation.
c. The officer provided an explanation on the purpose of the study and the type of treatment performed on the respondent. The explanation is accompanied by props (consumer surplus value and Return on Investment/ROI) brought by the officer.
d. After getting an explanation, the respondents were given a decision sheet and a specimen (money) with a total nominal value of IDR 200,000 (small or large denomination).
e. Respondents make purchases of goods in stores that have been displayed with the types of goods in accordance with the treatment.
f. After conducting the transaction, the respondent heads to the cashier.
g. The cashier records the type of goods purchased and calculates the amount of incentive received.
h. Respondents receive incentives from the officers and sign the attendance list to prove that they had conducted the experiments.
i. The experiment finishes and the respondent leaves the lab.

3.2. Subject Incentives in the Laboratory Study

In the laboratory study, in addition to incentive money for arrival (e.g. IDR 200,000/X), the subject can get a bonus consisting of customer satisfaction of the goods he purchased (SK), and ROI of the remaining money that is not spent. The total incentives obtained by the subject are as follows:

$$\text{IDR } 200{,}000/X + (SK+ROI) \tag{2}$$

The correction factor X in this experiment depends on the availability of the research funding, for example, using the correction factor X = 10, so the total incentive given is IDR 20,000, - plus bonus, that represents the consumer surplus (SK) of the total expenditure and the ROI of the remaining money (not spent), based on the simulation results conducted by the subjects.

3.3. Experimental Design of the Field Study

The experimental design of the field study, used in assessing the factors that influence community spending, is the Factorial Complete Random Design (FCRD). Similar to the design of the laboratory study, there are four main factors studied that are namely the denomination (F1), prices of goods (F2), expenditure planning (F4), and market types (F5). The self-control is the characteristic of innate respondents, which may affect the pattern of shopping. It serve as covariate in field study, while

serve as main factor (F3) in previous laboratory study. The characteristics of the respondent may include "residence", education, employment, income per capita, and level of need. The consumers who "reside in the city" are thought to have "low self-expenditure control", so their spending tends to be higher than those living in the district or village. Response variable from this research is respondent's purchase, using the allocated IDR 200,000 banknote. Data obtained from the field study activity was analyzed with ANCOVA. In addition to examining the four key factors that are applied, ANCOVA also examines other uncontrolled variables, which may affect the response variables (spending). This uncontrolled variable is called a covariate. In general, the ANCOVA model can be represented by:

$$Y_{ijklm} = \mu + \alpha_i + \beta_j + \delta_k + þ_l + (\alpha\beta)_{ij} + (\alpha\delta)_{ik} + (\alpha þ)_{il} + (\beta\delta)_{jk} + (\beta þ)_{jl} + (\delta þ)_{kl} + (\alpha\beta\delta)_{ijk} + (\alpha\beta þ)_{ijl} + (\beta\delta þ)_{jkl} + (\alpha\beta\delta þ)_{ijkl} + \omega(Keb_{ijkl} - \overline{Keb}) + \zeta(Pdd_{ijkl} - \overline{Pdd}) + \tau(Pkj_{ijkl} - \overline{Pkj}) + \upsilon(Pdpt_{ijkl} - \overline{Pdpt}) + \varrho(TT_{ijkl} - \overline{TT}) + \varepsilon_{ijklm.} \quad (3)$$

Y_{ijklm} : Total individual/community spending with the k-th level expenditure planning for the j-th price of goods using the i-th denomination on the l-th market

$\mu, \alpha_i, \beta_j, \delta_k$: Similar with the previous model

$þ_l$: Influence of the l-th market types, (l = 1 minimarket; l = 2 traditional market)

$(\alpha þ)_{il}$: The influence of interaction between the i-th denomination and the l-th market type
(The effect of denominations on spending depends on the type of market)

$(\beta þ)_{jl}$: The effect of interaction between the j-th value and l-th market type (The effect of price on spending depends on the type of market)

$(\delta þ)_{kl}$: The effect of interaction between the k-th level of expenditure planning and the l-th market type (The influence of expenditure planning level on shopping depends on the market type)

$(\alpha\beta þ)_{ijl}$: The effect of the interaction between the i-th denomination, the price of the j-th goods and the l-th market type (The denominational effect on spending depends on both the price of the goods and the type of market)

$(\beta\delta þ)_{jkl}$: The effect of the interaction between the price of the j-th goods, the level of the k-th expenditure planning and the l-th market type (The influence of the price of goods on spending depends on the level of expenditure planning and market type)

$(\alpha\beta\delta þ)_{ijkl}$: The influence of the interaction between the i-th denomination with the j-th price of goods, the k-th expenditure planning, and the l-th market type (The denominational effect on spending depends on the price of goods, the level of expenditure planning, and the type of market)

ε_{ijkl} : Error for individual/community spending with the level of k-th expenditure planning for the j-th price of goods using the i-th denomination on the l-th market, in the m-th replicate

In addition to the main factors, this analysis also examines the innate characteristics of respondents as covariates that may affect the pattern of their spending. The influence of these characteristics consists of:

$\omega(Keb_{ijkl}-\overline{Keb})$: Similar with the previous model.

$\zeta(Pdd_{ijkl}-\overline{Pdd})$: The effect of education on individual/community with the i-th denomination expenditures the j-th price goods, the level of k-th expenditure planning, and the l-th type of market, corrected with the average level of education of all respondents.

$\tau(Pkj_{ijkl}-\overline{Pkj})$: The effect of employment on individual/community shopping with the i-th denomination, the j-th price of goods, the level k-th expenditure planning, and the type of the l-th market.

$\upsilon(Pdpt_{ijkl}-\overline{Pdpt})$: The effect of per capita income on individual/community spending with the i-th denomination, the j-th price of goods, the level of the k-th expenditure planning, and the type of the l-th market, corrected with the average per capita income rate.

$\varrho(TT_{ijkl}-\overline{TT})$: The effect of the place of residence on the spending of individuals/community with the i-th denomination, the j-th price of goods, the level of the k-th expenditure planning, and the type of the l-th market. The residence here is used as a proxy for self-control.

3.4. Sampling Method in the Field Study

The sample of field study involve 120 respondents from two locations, Bogor district and Bogor city. The sampling method on selecting respondent uses purposive sampling with quota. The predetermined quota is 60 respondents for the city and 60 respondents for the district. All respondents selected are subject to predetermined selection criteria.

As described in the previous laboratory study, the present study aims to examine the influence of denominations and the other three factors (price, planning, and place of shopping) on shopping. In the application of denominational and price factors, respondents were randomly selected by the researchers. The approach used for the denominational factor (F1) is to give two pieces of IDR 100,000 denominated together with a paperclip for large denominations; and one IDR 50,000, three IDR 20,000, six IDR 10,000 and six IDR 5,000 for a small denomination, similar to the Laboratory Study design. As for the level of price factor of goods (F2), high prices include goods with prices above IDR 100,000 while low prices were goods with a maximum price of IDR 50,000.

This present study was conducted in two shopping places (factor of market type or F5) i.e. minimarket (Alfamart and Alfamidi) and traditional market which are located in the Regency and City of Bogor. The division of regions into districts and cities is done because "residence" is expected to represent the respondent's self-control which is one of the factors studied in this study. Nevertheless, in the implementation was found respondents who come from districts shop in the city

or vice versa. This happens because the selected respondent is a community that is located in the research location. To address this, the location of the respondents' residence was analyzed as a covariate affecting the pattern of community spending.

Another studied factor is the presence or absence of shopping planning by the respondents. The approach taken for this F4 factor is the selection of people who already intend or will shop as respondents who have a plan, and the people who are around the research area but do not intend or not are spending as respondents who have no plan.

The respondents, in this study, are expected to represent every layer of the society in terms of economy. Therefore, the selected respondents are expected to represent the lower, middle, and upper classes of people who are represented based on the respondents' incomes. In addition, the selection of respondents also paid attention to the background of the respondent's work, which is expected to represent the works such as civil servants, self-employed, private, labor, student, job seeker, housewife, and retired. The selected respondents will be given an explanation of the treatment applied. The distribution of more complete respondents can be seen in Juanda (2015).

IV. RESULTS AND ANALYSIS

4.1. Laboratory Study Analysis Results

The results of the analysis revealed that the price of goods (F2) and self-control (F3) significantly affect the individual decision to spend. Meanwhile, the denominational factor affect the spending decision when interacting with the price of goods and planning (F1xF2xF4). In other words**,** the influence of denominations depends on the prices of goods and planning factors. Table 1 provide the ANCOVA model form Laboratory Study.

By only considering the denomination regardless of the good prices (F2), self control (F3), and spending plan (F4), there is no statistically significant difference in terms of total spending between small denomination consumers (Rupiah) and large denominations (or IDR 200,000). In individual interviews too, almost all of the (over 90%) consumers thought that there was no difference in spending patterns when using large or small denominations. The average consumer spending with large denominations was IDR 119,043, which tended to be slightly smaller (but not significant) compared to consumers with small denominations (IDR 117,208). Some consumers felt that IDR 200,000 was more convenient or more practical to spend on various goods needs.

Overall there is a statistically significant difference between total consumer spending on low priced goods (maximum IDR 50,000 / unit) with total consumer spending on high priced items (above IDR 100,000 / unit) (regardless of the other three factors). From Figure 1, the average consumer spending on low-priced goods is IDR 94,375, smaller than consumer spending on high priced goods (IDR 141,875). For high-priced goods, tend to be high in the total shopping, since the variety of goods available in these two price categories (in this laboratory study) is relatively similar.

Overall, there is a (statistical) significant difference between the total consumer spending on low priced goods (maximum IDR 50,000/unit) and the total consumer

spending on high priced goods (above IDR 100,000/unit) (regardless of the other three factors). In Figure 1, the average consumer spending on low-priced goods was IDR 94,375 which was smaller than that of the high-priced goods (IDR 141,875). For high-priced goods, the trend of high total shopping was large, since the variety of goods available in these two price categories (in this laboratory study) was relatively similar.

Regardless of the other 3 factors, there is (overall) a statistically significant difference between the total low self-control consumer spending and the total high self-control consumer spending. Seen from Figure 2, the average consumer spending with low self-control was IDR 124,375 which was bigger than the high self-control consumer spending (IDR 111,875). Consumers, who highly control themselves, will be more efficient in spending because they take into account the benefits of the remaining money for various purposes the benefits of which can be higher than that of the money spent immediately.

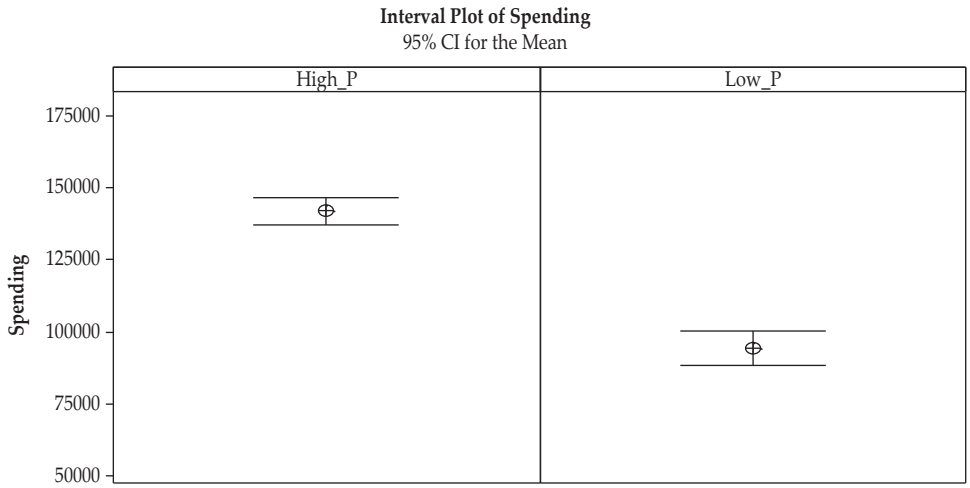
Table 1.
ANCOVA of the Laboratory Study

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	51772496908.303[a]	16	3235781056.769	13.132	.000
Intercept	19993810831.864	1	19993810831.864	81.139	.000
Level of Needs	34859431.359	1	34859431.359	.141	.708
F1: Denomination	53336458.016	1	53336458.016	.216	.643
F2: Prices	44958401356.233	1	44958401356.233	182.451	.000
F3: *Self-Control*	2736573448.883	1	2736573448.883	11.106	.001
F4: Planning	83356716.025	1	83356716.025	.338	.563
F1 * F2	125217672.191	1	125217672.191	.508	.479
F1 * F3	68140813.314	1	68140813.314	.277	.601
F1 * F4	18272330.624	1	18272330.624	.074	.786
F2 * F3	473232131.527	1	473232131.527	1.920	.171
F2 * F4	99119432.153	1	99119432.153	.402	.528
F3 * F4	322820421.093	1	322820421.093	1.310	.257
F1 * F2 * F3	34260083.740	1	34260083.740	.139	.710
F1 * F2 * F4	1374922112.766	1	1374922112.766	5.580	.021
F1 * F3 * F4	622494093.435	1	622494093.435	2.526	.117
F2 * F3 * F4	27961366.849	1	27961366.849	.113	.737
F1 * F2 * F3 * F4	1754066.087	1	1754066.087	.007	.933
Error	15524028893.086	63	246413157.033		
Total	1183577763988.890	80			
Corrected Total	67296525801.389	79			

a. R Squared = .769 (Adjusted R Squared = .711)

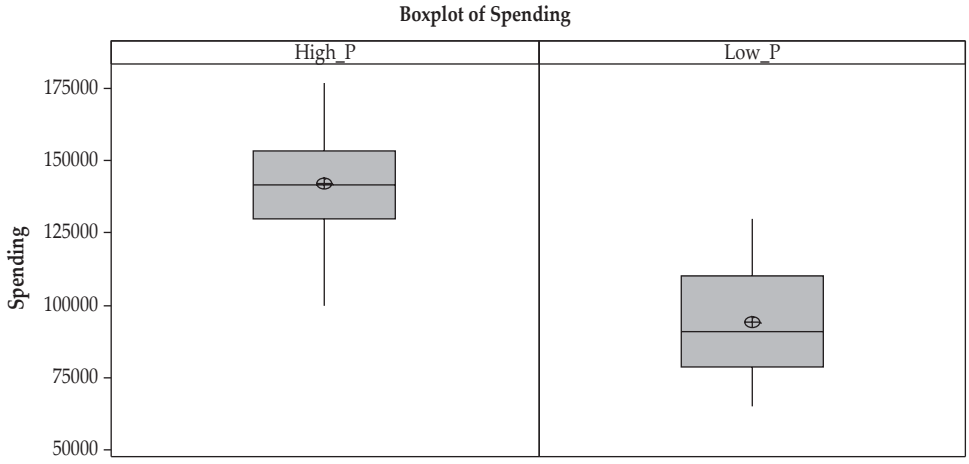
Where F1 is the influence of denomination, F2 the price influence, F3 the influence of self-control and F4 the influence of shopping planning

Source: Juanda (2015)



Panel variable: F2

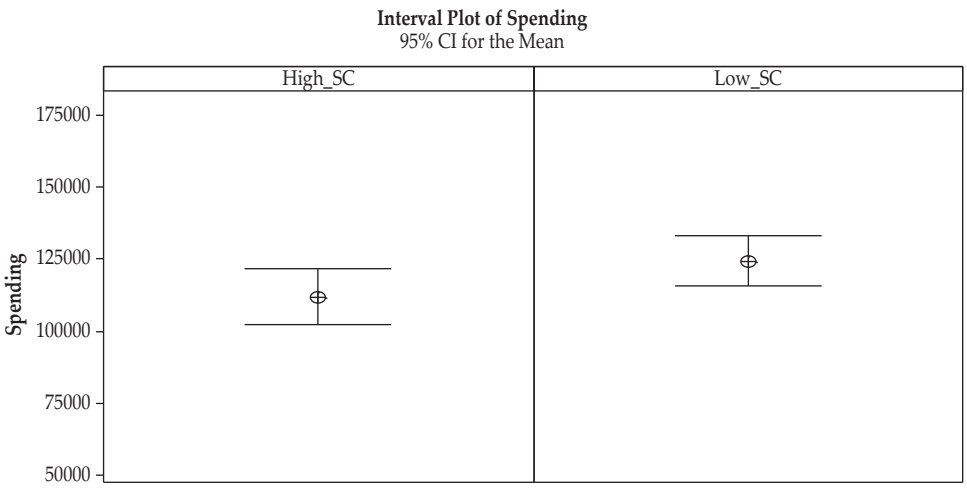
Source: Juanda (2015)



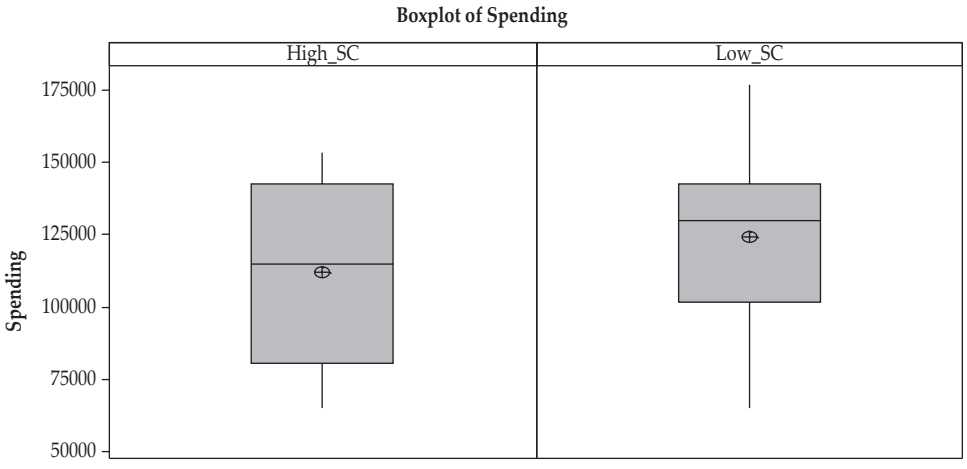
Panel variable: F2

Source: Juanda (2015)

Figure 1. Confidence level and Shopping Boxplot of 24 Consumer Groups for Low Price and 24 Consumer Groups for High Price



Source: Juanda (2015)



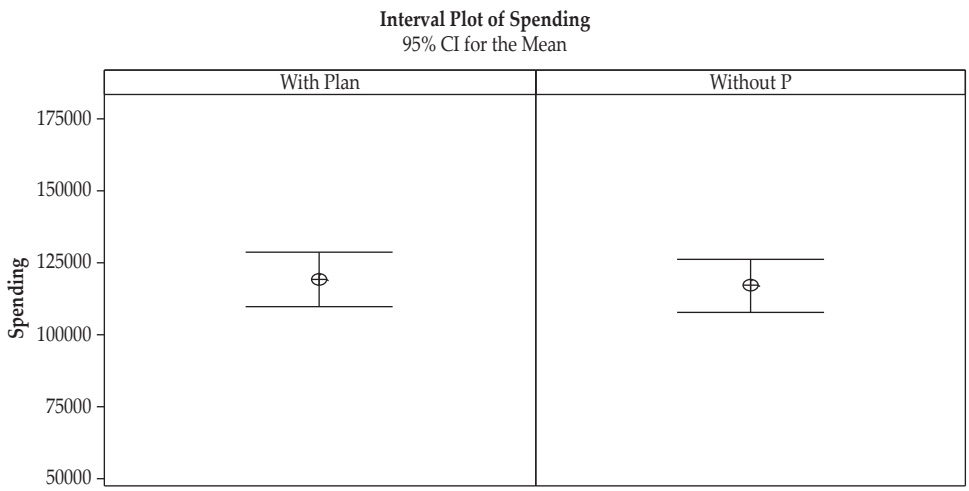
Source: Juanda (2015)

Figure 2. Confidence level and Shopping Boxplot of 24 Consumer Groups for Low Self-Control and 24 Consumer Groups for High Self Control

The planning factor (regardless of the other three factors) was not significant in influencing the total expenditure (Table 1), although Figure 3a shows the average of consumer spending with pre-planned spending of IDR 119,166 which tends to be slightly larger than that of consumers without prior planning (IDR 117,083). Some consumers, who do have a shopping plan, tend to spend more because they already have the intention to spend before; although, it is not significant in this laboratory study, which may be due to the time difference in planning with relatively short shopping times (minutes). In a recent study by Juanda *et al*. (2016),

where the planning was done at least one day before the respondent conducted an experimental simulation so that the consumer can do the planning carefully, has been proven that consumers who have planned the shopping are relatively higher as they take into account the long-term needs as well (see Figure 3b).

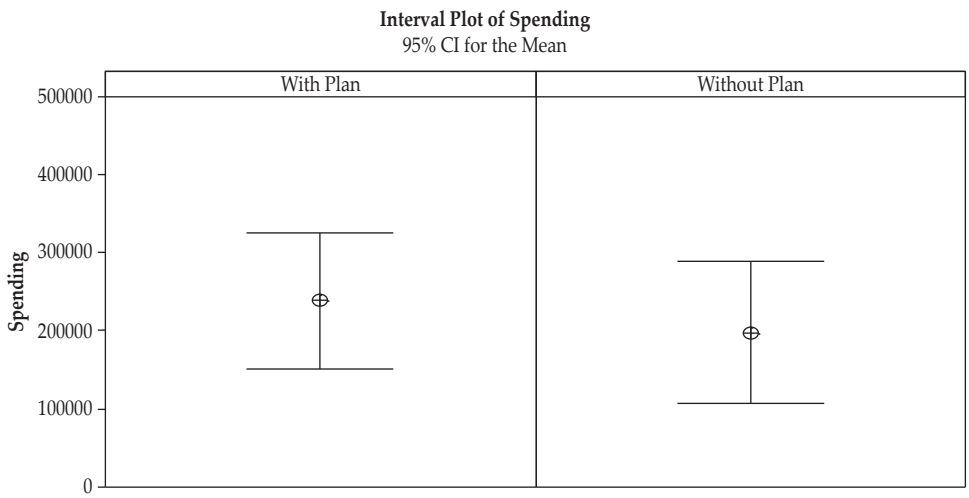
(a)



Panel variable: F4

Source: Juanda (2015)

(b)



Panel variable: Planning

Source: Juanda *et al.* (2016)

Figure 3. Confidence level of Consumer Group Shopping Without Planning and Consumer Groups Without Planning

Based on Figure 4a, there is a tendency of denominational influence depending on the price of goods. For high-priced goods, the respondents with large denomination have a tendency to spend more (IDR 144,000) than respondents holding small denominations (IDR 139,750). This is because respondents feel that the large denominations are more practical for high priced goods. Conversely, for low prices, respondents with small denominations have more spending tendencies (IDR 94,667) than large denominations (IDR 94,083). Respondents argued it is more efficient to use small denominations to purchase low price goods.

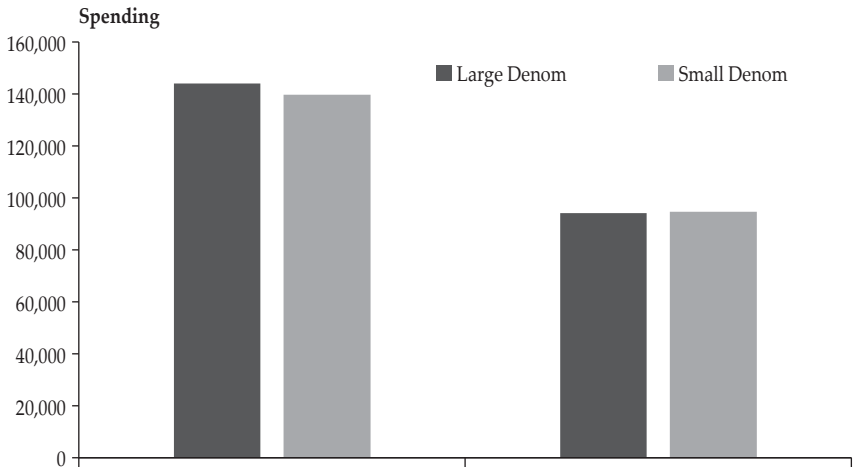
In Figure 4b, it can be clearly seen that (in the analysis) the denominational influence tends to depend on the price of goods. When the price of goods are hight, the effect of large denomination on spending is larger than the small denomination. From the results of this analysis, it can be implied that regions with relatively high-priced goods such as eastern Indonesia, need to be provided with (more) larger denominations.

As mentioned in the ANCOVA results in Table 1, the influence of the denomination depends on the price of the goods and the planning of the shopping. For the group of respondent without spending plan, the average spending on high-priced goods when using large denominations is relatively larger than when using small denominations.

Consumers feel that fractions of IDR 200,000 are easier or more practical for shopping various needs of goods. While respondents with planning, average spending on goods with high prices, is relatively the same using small denominations, as well as the large denominations (Figure 5a).

In Figure 5b, it can be seen that respondents without planning, average spending on goods with low prices are relatively larger when using small denominations compared to large denominations. Consumers are reluctant to spend large denominations on low-priced goods. As for the planning, the average spending on goods with low prices is relatively larger when using large denominations compared to small denominations as the consumers feel that fractions of IDR 200,000 are easier or more practical for shopping various needs of goods that have been planned to be purchased.

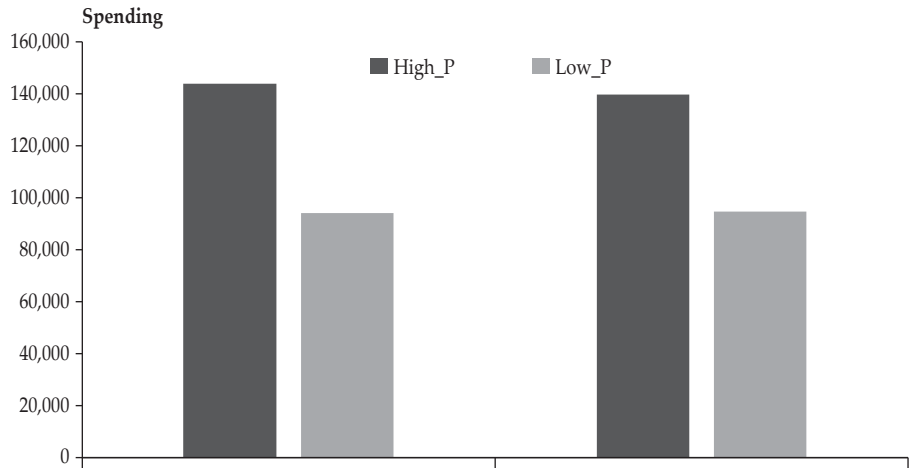
(a)



	High_P	Low_P
Large Denom	144,000	94,083
Small Denom	139,750	94,667

Source: Juanda (2015)

(b)



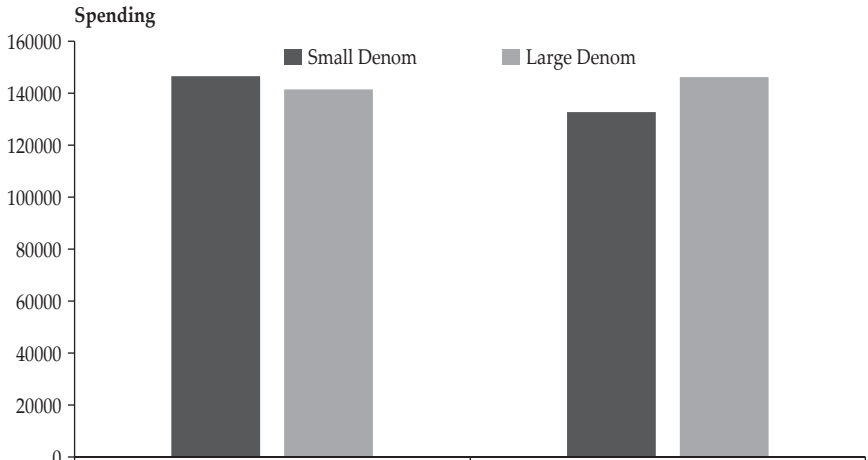
	Large Denom	Small Denom
High_P	144,000	139,750
Low_P	94,083	94,667

Source: Juanda (2015)

Figure 4. Average Shopping When Using Large Denominations and Small Denominations at Each Price Level (Low Price and High Price)

(a)

High Price

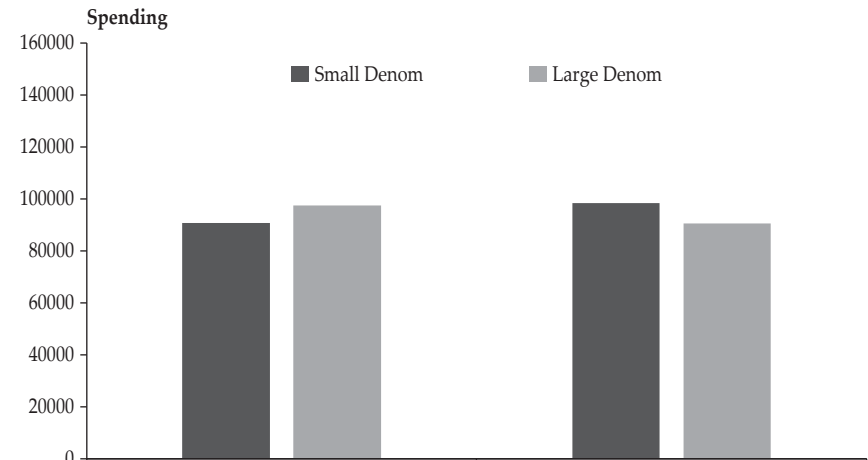


	With Plan	Without P
Small Denom	146667	132833
Large Denom	141667	146333

Source: Juanda (2015)

(b)

Low Price

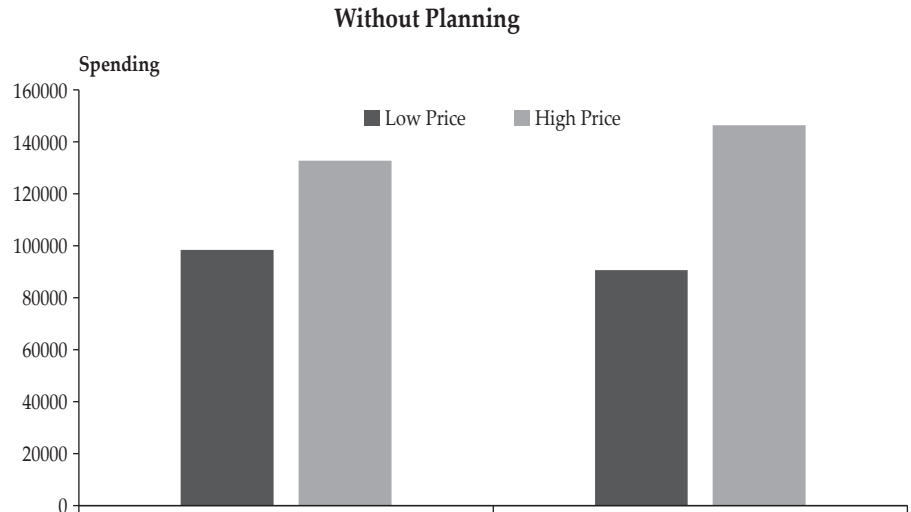


	With Plan	Without P
Small Denom	90833	98500
Large Denom	97500	90667

Source: Juanda (2015)

Figure 5. Average Expenditure When Using Large Denominations and Small Denominations for Respondents Who Have Planned and Not Planned Based on Group of Goods at Different Prices (Low and High)

In Figure 6, it is also clear that the effect of large denominations on the difference in spending between high-value and low-value goods is greater than that of small denominations (if not planned). From this analysis, it can also be implied that areas with relatively high prices of goods such as eastern Indonesia, need to be provided with larger denominations as the relatively high price of goods requires larger denominations.



	Small Denom	Large Denom
Low Price	98500	90667
High Price	132833	146333

Source: Juanda (2015)

Figure 6. Average Shopping Using Large Denominations and Small Denominations for Each Price (Low Price and High Price) without Planning

4.2. Field Study Analysis Results

The field study location was divided into two areas i.e. city and district. In each region, surveys were conducted on Alfamart and Alfamidi minimarkets and traditional markets. In the city area, the selected minimarket was Alfamart Citra Gandaria located on Jl. Achmad Adnawi Jaya, North Bogor and Alfamidi Bangbarung on Jl. Bangbarung Raya kav. 13-15 RT. 05/014 Kelurahan Tegal Gundil, North Bogor. While the selected traditional market was Pasar Induk Warung Jambu which is located in Jl. Pajajaran and Pasar Anyar on Jl. Dewi Sartika in the City of Bogor. Research in the district area was conducted at Alfamart Cihideung Ilir which is situated on Jl. Raya Cibanteng, KM. 10 Cihideung Ilir Ciampea, and Alfamidi Babakan Raya located on Jl. Babakan Raya. As for the traditional market, Pasar Dramaga which is located at Jl. Dramaga Desa Dramaga Kec. Dramaga Kab. Bogor was selected.

The result of ANCOVA model analysis can be seen in Table 2. The result shows the price (F2), planning (F4), and the market type (F5), significantly affect the individual spending decision. While the influence of denominations (F1) on expenditure depended on the type of market for shopping (F5) and the price of goods (F2), in the form of the interaction effect between 2 Factors F1xF5, and interaction influence between 3 Factors F1xF2xF5. On the other hand, the effect of planning (F4) on spending depended on the type of market where the shopping (F5) was carried out which was an interaction between 2 Factors F4xF5.

In Table 2, it can also be observed that respondent's residence (District of City) influenced shopping. The average of total expenditure of Respondents live in the city (IDR 128,361) was greater than that of respondents living in the district (IDR 118,603). The likelihood of urban respondent needs is higher, more extravagant, or self-control for shopping is low.

Without taking into account the other 3 factors, overall, there is no statistical significant difference in terms of the total spending between small denomination (Rupiah) consumers and those using large denominations such as IDR 200,000. In individual interviews as well, almost all (88%) of the consumers believed that there is no difference in spending patterns when using large and small denominations. Respondents with different shopping patterns argued that if they hold large denominations they are reluctant to shop and prefer to keep the money if the price of goods is low. In Figure 7, the average consumer spending with large denominations was IDR 123,110, which was slightly smaller (but not significant) compared to consumers with small denominations (IDR 118,916). Some consumers felt that the IDR 200,000 was easier or more practical for shopping various needed goods. The results of the analysis for this field of study were consistent with the results of the analysis for the laboratory study.

Table 2.
ANCOVA for the Field Study

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	54351986733.398[a]	20	2717599336.670	2.298	.004
Intercept	30387826330.395	1	30387826330.395	25.692	.000
LEVEL OF NEEDS	1932892886.761	1	1932892886.761	1.634	.204
JOB	322500723.171	1	322500723.171	.273	.603
INCOMES_KPT	72334659.020	1	72334659.020	.061	.805
EDUCATION	973457278.947	1	973457278.947	.823	.366
RESIDENCE	4291188291.658	1	4291188291.658	3.628	.060
F1: Denomination	448195216.237	1	448195216.237	.379	.540
F2: Price	6036967887.085	1	6036967887.085	5.104	.026
F4: Planning	8387348438.352	1	8387348438.352	7.091	.009
F5: Shopping Center	3513766386.817	1	3513766386.817	2.971	.088
F1 * F2	68738611.971	1	68738611.971	.058	.810

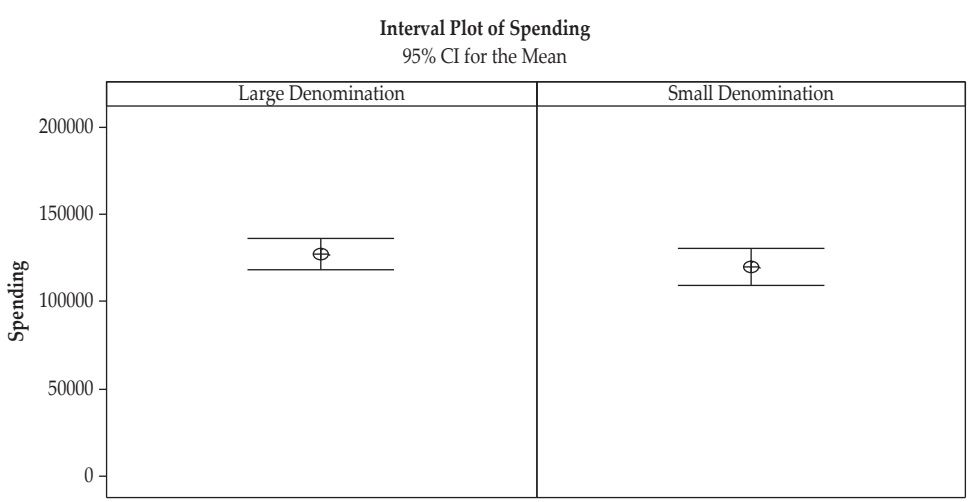
Table 2.
ANCOVA for the Field Study (Continued)

Source	Sum of Squares	df	Mean Square	F	Sig.
F1 * F4	20659354.006	1	20659354.006	.017	.895
F1 * F5	4342356549.413	1	4342356549.413	3.671	.058
F2 * F4	885977184.493	1	885977184.493	.749	.389
F2 * F5	575986618.332	1	575986618.332	.487	.487
F4 * F5	9669085619.282	1	9669085619.282	8.175	.005
F1 * F2 * F4	2271805492.760	1	2271805492.760	1.921	.169
F1 * F2 * F5	8853106192.773	1	8853106192.773	7.485	.007
F1 * F4 * F5	248878275.060	1	248878275.060	.210	.647
F2 * F4 * F5	18673071.133	1	18673071.133	.016	.900
F1 * F2 * F4 * F5	14061424.874	1	14061424.874	.012	.913
Error	117095112402.193	99	1182778913.153		
Total	1989154820109.000	120			
Corrected Total	171447099135.592	119			

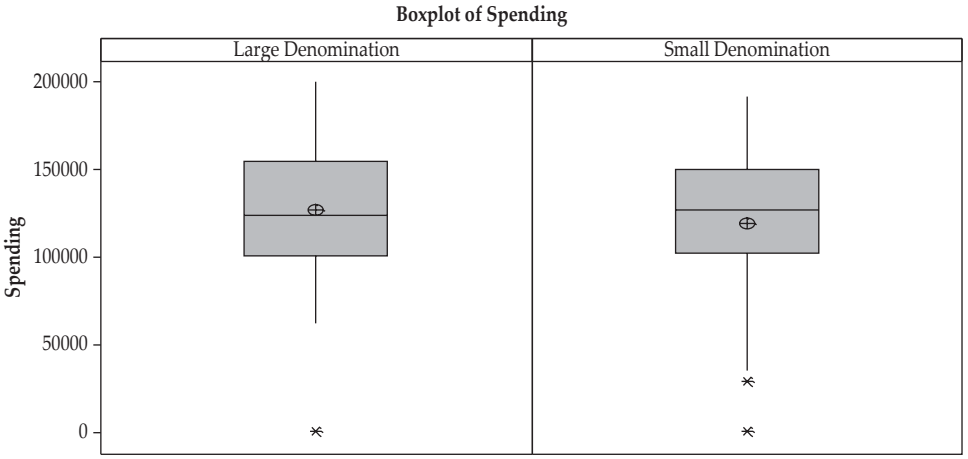
a. R Squared = .317 (Adjusted R Squared = .179)

Where F1 is the influence of denomination, F2 price influence, the F4 influence of shopping planning and F5 the type of shopping place.

Source: Juanda (2015)



Source: Juanda (2015)

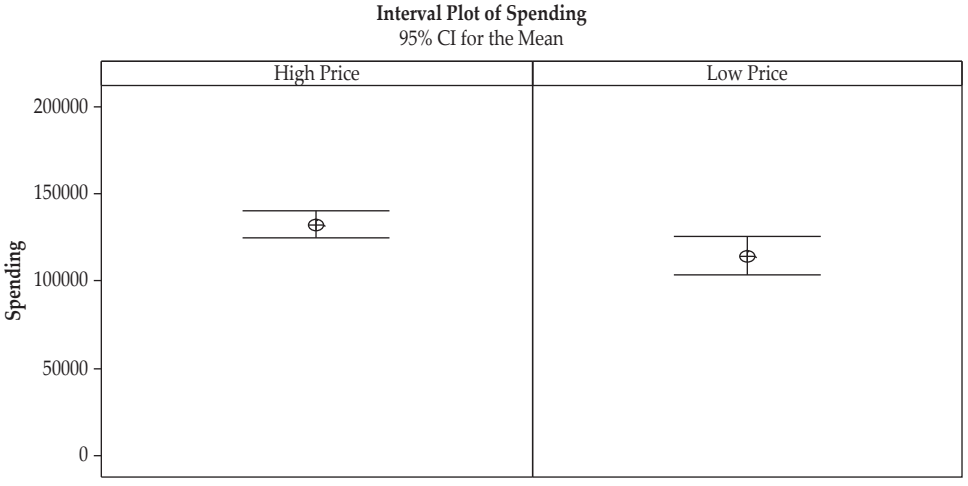


Panel variable: Denomination

Source: Juanda (2015)

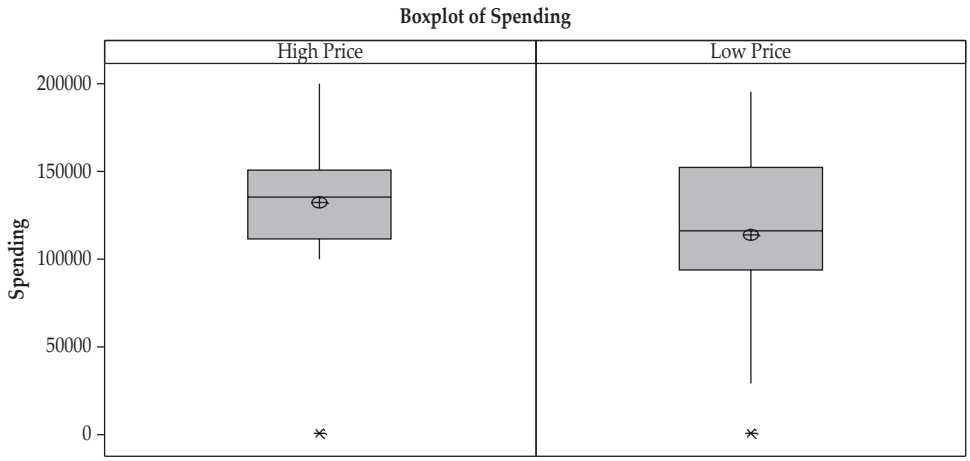
Figure 7. Confidence level and Boxplot of Shopping for 60 Consumers Using Small Denominations and 60 Consumers Using Large Denominations

The price factor has a significant effect on consumer spending (if no regard for the other three factors). Overall, the total consumer spending on low priced goods (maximum IDR 50,000/unit) differed from the total consumer spending on high priced goods (above IDR 100,000/unit). In Figure 8, the average consumer spending for low priced goods was IDR 113,114 which was smaller than the average consumer spending on high priced goods (IDR 128,882). The goods with high prices tended to have a higher total shopping. As for low-priced goods, most consumers wanted to keep some of their money for "other purposes" or will spend when it is really needed. The results of this analysis are also consistent with the results of the analysis for the laboratory study.



Panel variable: Price

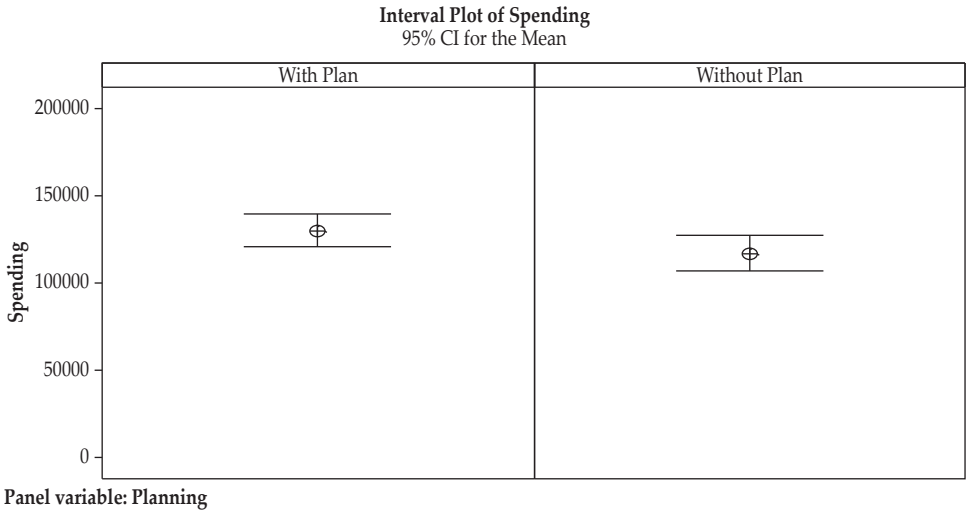
Source: Juanda (2015)



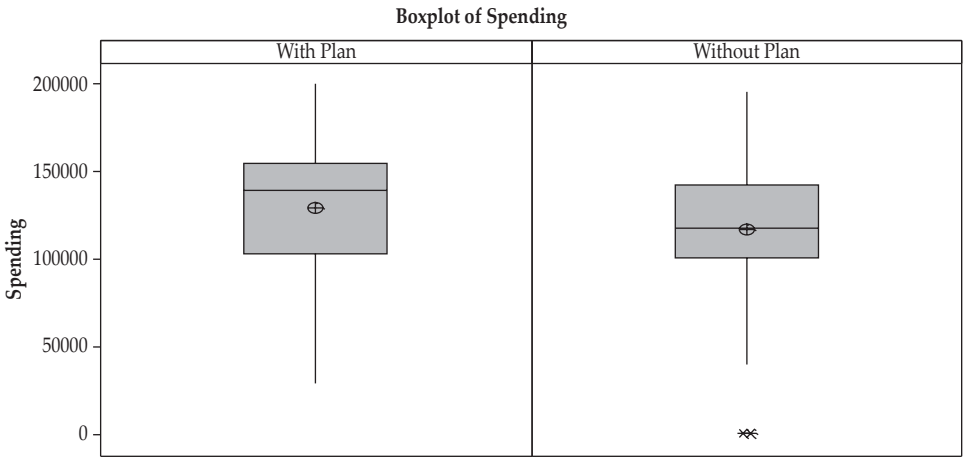
Source: Juanda (2015)

Figure 8. Confidence Levels and Boxplot Shopping for 60 Consumers for Low Price and 60 Consumers for High Price

Regardless of the other 3 factors, there is, overall, a statistically significant difference between the total spending of consumers that made planning prior to shopping and those who had not planned the shopping. In Figure 9, the average consumer spending, for those who have not yet made a plan, is IDR 111,962 which is smaller than the consumer spending with prior planning (IDR 130,064). The consumers, who already have a plan, already know what items to buy and respondents can also buy items that have not been planned. This trend is consistent with laboratory study results.



Source: Juanda (2015)

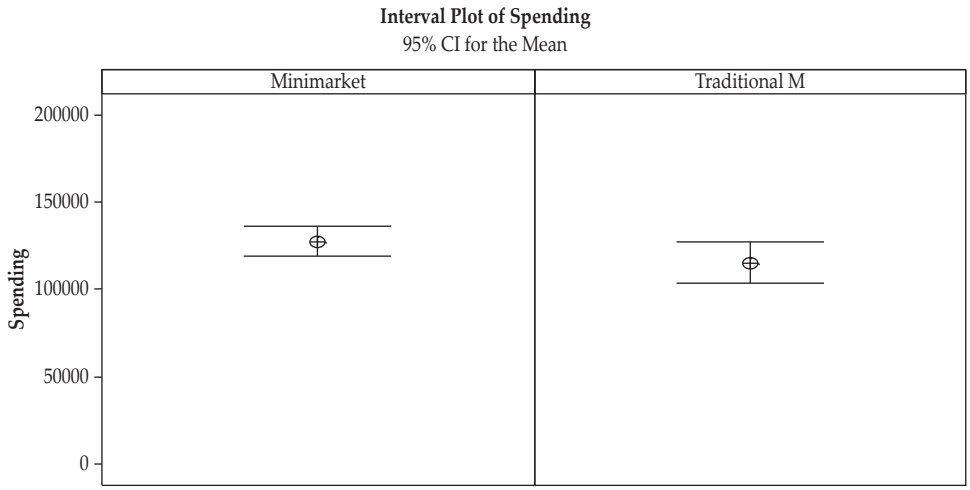


Source: Juanda (2015)

Figure 9. Boxplot and Confidence Level of Shopping for 60 Consumers with Planning and 60 Consumers without Planning

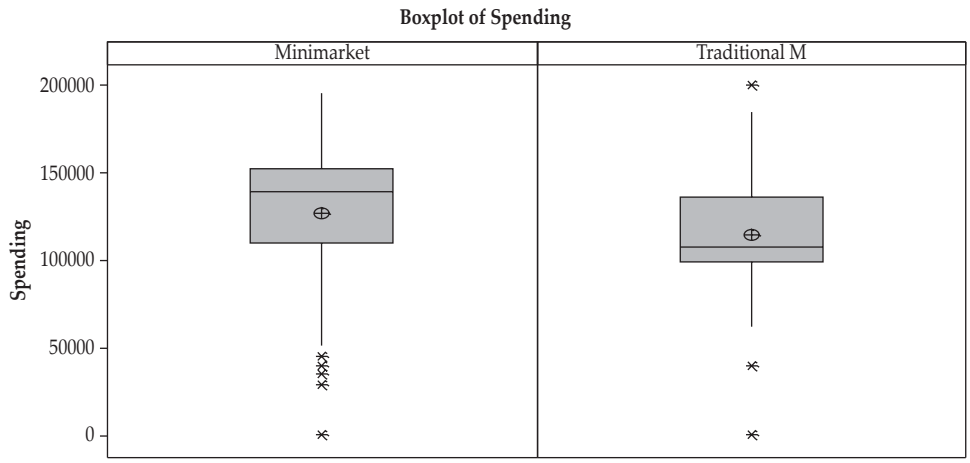
Overall, there is a statistically significant difference in terms of total shopping expenditures of consumers in the minimarket and consumers who shop in traditional markets, without paying attention to all of the three other factors. Based on Figure 10, the average consumer shopping expenditure, in the traditional market, was IDR 114,896 which was smaller than the average consumer spending in minimarket (IDR 127,165). This difference is due to the variety of goods in the mini market that are in a single location, making it easier for consumers to shop, in contrast to traditional markets where the shopping locations are spread out on market areas.

In addition to the four main factors studied, the total consumer spending was also influenced by the inherent characteristics of the respondents which, in this analysis, became covariates. These characteristics included the level of needs, education, occupation, expenditure, per capita income, and respondent's residence. Based on the results of ANCOVA as presented in Table 2, the covariates that have significant effect on consumer spending decisions was the respondents' residence, where respondents who live in the city spend higher on average (IDR 128,361) compared to those living in the district (IDR 118,603), as seen in the Figure 11. This is a consequence of the fact that the level of needs of the people living in cities is larger than those living in the districts. There is a (though insignificant) tendency that the total spending tends to be higher for people with higher per capita incomes, larger monthly expenditures, and higher levels of education of the respondents.



Panel variable: Shopping Center

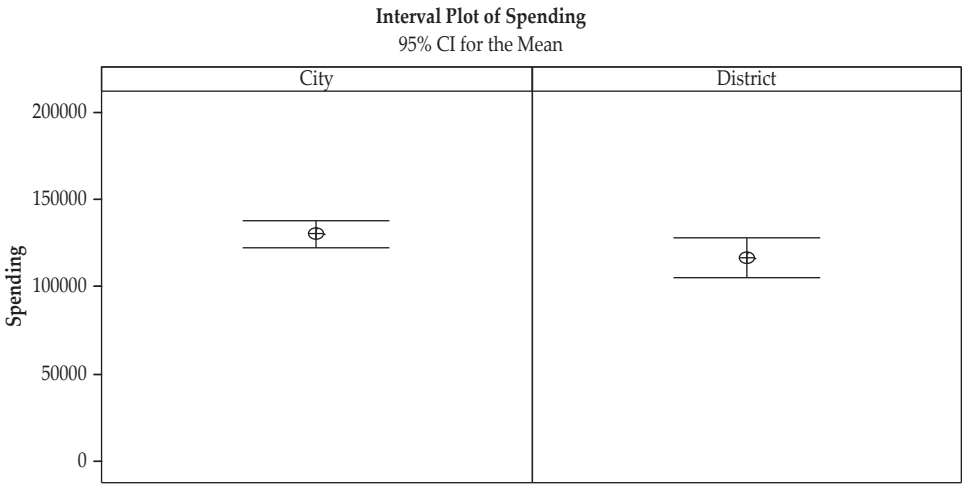
Source: Juanda (2015)



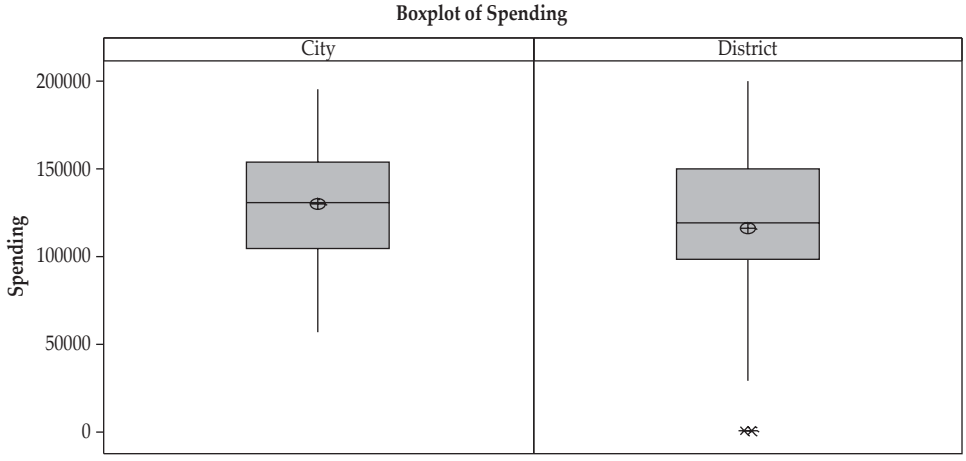
Panel variable: Shopping Center

Source: Juanda (2015)

Figure 10. Confidence Level and Shopping Boxplot of Shopping for 80 Consumers at Minimarkets and 40 Consumers at Traditional Markets



Source: Juanda (2015)

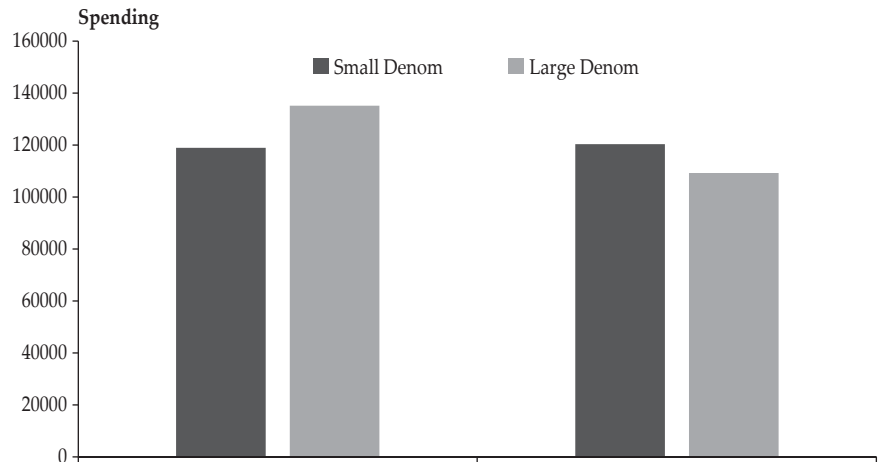


Source: Juanda (2015)

Figure 11. Confidence Level and Shopping Boxplot of 55 Consumers Living in the District and 65 Consumers Living in the City

Based on the ANCOVA results in Table 2, the influence of the denomination (F1) on spending depends on the type of shopping places (F5) with a p-value = 0.058. In Figure 12, it appears that for Minimarket, the average consumer spending is higher when using large denominations (IDR 135,290) than that of using small denominations (IDR 119,040). The consumers feel that 1 banknote of IDR 200,000 is easier or more practical in spending on various needed goods through a single payment. As for the Traditional Market, the average consumer spending is higher when using small denominations (IDR 120,510) than that of using large denominations (IDR 109,293). Consumers tend to be reluctant about spending a single IDR 200,000 banknote because the trader must provide the changes for each item, especially for relatively low-price items.

Based on Table 2 ANCOVA results, it can be also seen that the influence of the denomination (F1) on spending, other than depending the type of marketplace of shopping (F5), depends on the price of goods (F2) with a p-value = 0,007. In Figure 13a, it appears that the low-priced goods group has the average consumer spending in Minimarkets which is higher when using large denominations (IDR 136,930) than that of using small denominations (IDR 104,375). The consumers feel that a single IDR 200,000 banknote is more convenient or more practical in spending on various needed goods, through a single payment. While the average consumer spending in the Traditional Market is higher using small denominations (IDR 114,760) than that of using large denominations (IDR 87,315). Consumers tend to be reluctant to spend a single IDR 200,000 banknote because the trader must provide the changes for each goods expenditure, especially the relatively low-price goods.



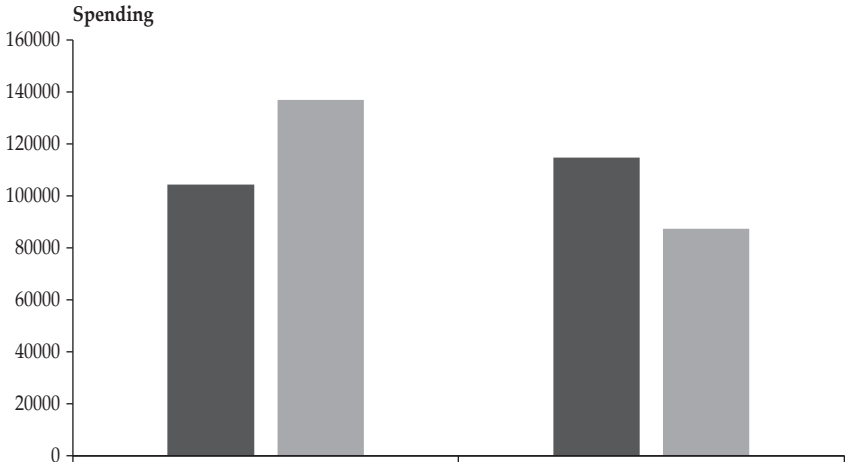
	Minimarket	Traditional Market
Small Denom	119040	120510
Large Denom	135290	109283

Source: Juanda (2015)

Figure 12. Average Shopping Using Large and Small Denominations at the Minimarkets and Traditional Markets

(a)

Low price

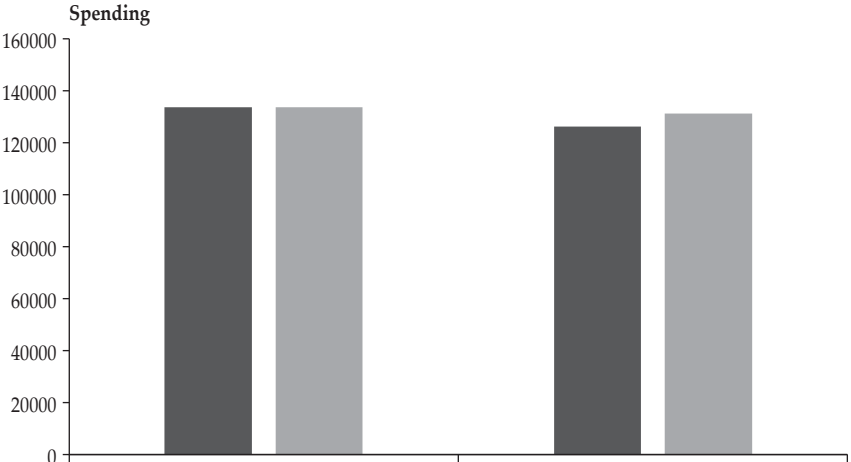


	Minimarket	Traditional Market
Small Denom	104375	114760
Large Denom	136930	87315

Source: Juanda (2015)

(b)

High price



	Minimarket	Traditional Market
Small Denom	133705	126260
Large Denom	133650	131250

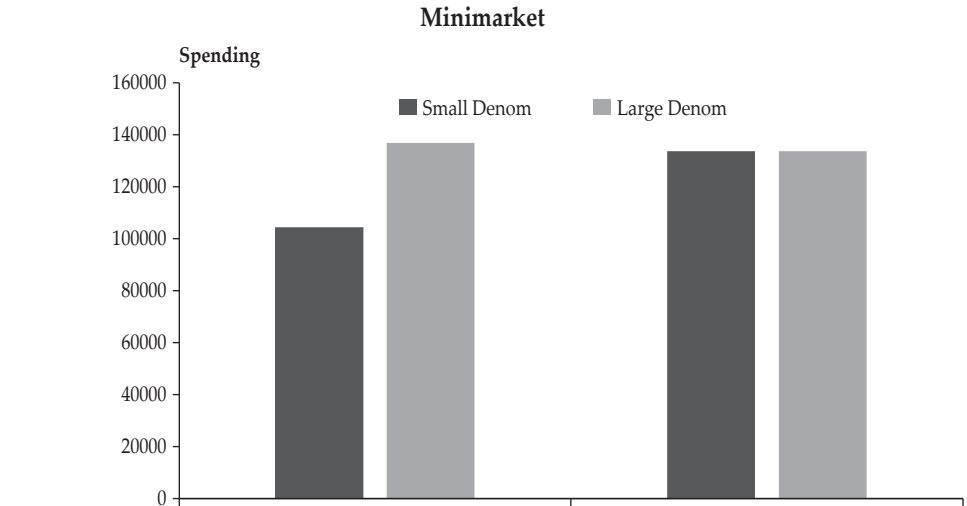
Source: Juanda (2015)

Figure 13. Average Shopping Using Large and Small Denominations for Each Type of Market (Minimarket and Market) by Group of Goods with Different Prices (Low and High)

As for the high-priced good groups in Figure 13b, it appears that the average consumer spending in Minimarket is "relatively similar" when using either large denominations (IDR 133,650) or small denominations (IDR 133,705). The consumers will try to spend small denominations at a high price (above IDR 100,000/unit), thus, it makes no difference using small or large denominations. While the average consumer spending in the Traditional Market is not so significantly different using large denominations as well as small denominations.

In Figure 14a, it can be seen that consumers who shop at Minimarkets have an average spending on goods at low prices that are higher when using large denominations (IDR 136,930) than the small ones (IDR 104,375). The consumers feel a banknote of IDR 200,000 is simpler or more practical in spending on various needed goods, through a single payment. Meanwhile, the average spending on goods with high prices is "relatively the same" using small denominations (IDR 133,705) or larger ones (IDR 133,650). The consumers will try to spend small denominations on high price goods (above IDR 100,000/unit), leading to no differences small or large denominations. While, in Traditional Markets in Figure 14b, it can be seen that the average goods expenditure with low price is "higher" when using small denomination (IDR 114,760) than larger ones (IDR 87,315). The consumers tend to be reluctant on spending an IDR 200,000 banknote because the merchant must provide the changes for each item, especially the relatively low price (maximum IDR 50,000/unit). In addition, the average spending on goods with high prices (above IDR 100,000/unit) is "higher" when using large denominations (IDR 131,250) than using small ones (IDR 126,260). The consumers feel that an IDR 200,000 banknote is easier or more practical in purchasing the needed goods at high prices. This result is consistent with the output obtained in the laboratory study (Figure 4a).

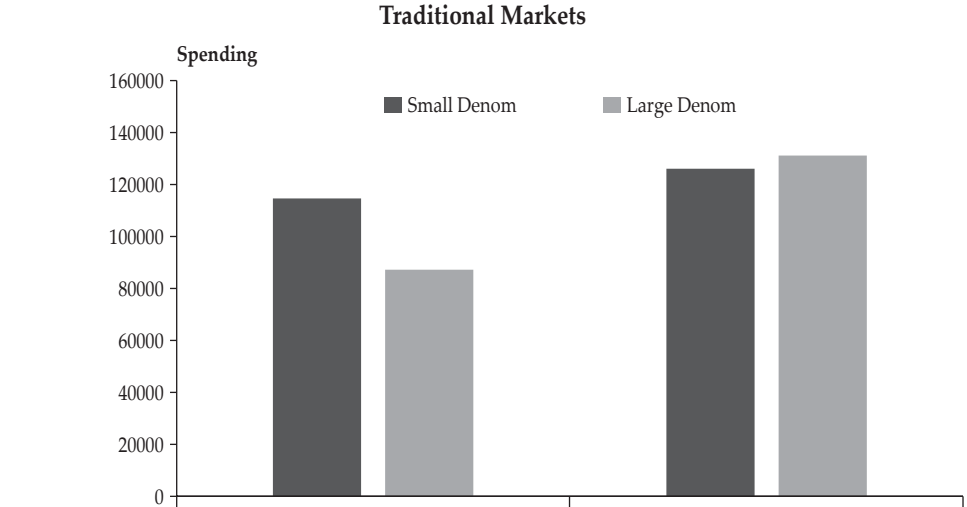
(a)



	Low Price	High Price
Small Denom	104375	133705
Large Denom	136930	133650

Source: Juanda (2015)

(b)



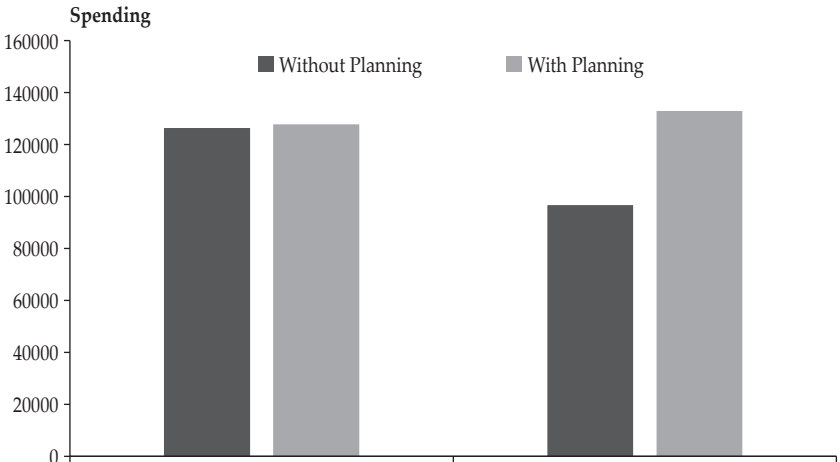
	Low Price	High Price
Small Denom	114760	126260
Large Denom	87315	131250

Source: Juanda (2015)

Figure 14. Average Spending of Each Group of Goods at Different Prices (Low and High) Using Different Denominations (Large and Small) Based on the Types of Markets (Minimarket and Market)

As can be seen in Table 2. of the ANCOVA, the influence of planning (F4) on spending is dependent on market types of the shopping places (F5), with a p-value = 0,005. Based on Figure 15, it appears that in Minimarket, the average spending is "relatively the same" for consumers who already have planned or not. The consumers feel that using large denominations as well as multiple banknotes of small denominations of the same nominal value (IDR 200,000) makes no difference in terms of spending at the Minimarkets because the availability of needed goods varies somewhat in a place relatively close to purchasing. As for the Traditional Market, the average consumer spending, that has already planned, is higher (IDR 133,050) than the unplanned consumer. The consumers, who have a shopping plan in a traditional market, relatively know to which merchant he is going to buy, while the consumers around the traditional market (without a shopping plan) should find a trader who is widespread in the traditional market to buy the required goods which are relatively reluctant to put all the money (IDR 200,000).

Based on the field study, the majority of the respondents agree with the issuance of IDR 200,000 banknotes because it feels bigger more practical and flexible. However, spending on large denominations is also influenced by the price level and place of purchase. Areas with relatively high price levels, such as in eastern and urban areas, where there are many modern markets, require larger denominations. This is because the use of large denominations is felt more practical. In contrast, regions with relatively low-price levels and districts which are still found in traditional markets, need smaller denominations.



	Minimarket	Traditional Markets
Without Planning	126461	96743
With Planning	127869	133050

Source: Juanda (2015)

Figure 15. Average Shopping with Planning and without Planning for Each Type of Markets (Minimarket and Traditional Market)

V. CONCLUSIONS

This paper provides several interesting findings, which are consistent across laboratory study and field study:

1. Regardless the consumer characteristic, location, group of good price, and type of market, the total spending using large denomination do not differ significantly than using small denomination.
2. Related to the consumer's self-control, the laboratory study shows it affects the consumer's spending. Consumers with better self-control can manage to spend fewer than those without self-control. The field study shows that consumers in the city, with averagely higher needs, income, and education level, tend to spend more than consumers in village.
3. Related to purchasing plan, this paper find that the average spending of consumer with purchasing plan tend to be higher than those without purchasing plan.
4. Related to goods price, the total spending on high price group product is larger when using large denomination, relative to when using small denomination.
5. Related to market location, in modern market (such as retail minimarket), the total spending is always larger when using large denomination compared to small denomination. This applies both for the group of low and high price goods. The reasons behind this are (i) simplicity and (ii) larger good variation. Furthermore, the total spending of consumer in traditional market is higher when they are planned; while for modern market, the spending plan does not affect the total spending.

These findings lead to the main conclusion of this paper that the denomination will affect the spending across goods price categories, market type, and the absence of purchasing plan. The conclusion implies the possibility to issue the IDR 200,000 in Indonesia. Furthermore, the amount and the distribution of denomination need to address the characteristic of consumer, good prices, and the condition of physical market.

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DISAGGREGATION AND FORECASTING OF THE MONTHLY INDONESIAN GROSS DOMESTIC PRODUCT (GDP)

Profita Sumunar Luthfiana[1], Nasrudin[2]

ABSTRACT

Gross Domestic Product (GDP) is considered as the best measure of economic performance. However, in Indonesia, the GDP is presented in quarterly aggregate value. As a result, the monthly economic outlook is known, and analysis with other monthly economic variables becomes limited. Therefore, this study will disaggregate quarterly GDP into monthly GDP and its forecasting by using one of the coincident indicators which are monthly Production Index of Large and Medium Manufacturing (industrial production index). Disaggregation is done on National GDP data of Indonesia period 2000/I to 2016 / IV, whereas forecasting is made on monthly and quarterly GDP 2017. This study uses a combination of the simple linear regression model and ARIMA model with some modifications. The disaggregation result indicates that the monthly GDP moves volatile and has a different pattern between quarter. Also, the monthly GDP disaggregation and forecasting are proven that can be used by industrial production index that becomes a coincident indicator. GDP 2017 shows that the highest quarterly GDP will have occurred in the third quarter, whereas the highest monthly GDP will have occurred in June (second quarter). The result of disaggregation can be used further to the study of economic outlook will be more comprehensive.

Keywords: disaggregation, monthly GDP, coincident indicator, industrial production index, ARIMA

JEL Classification: C22, C53, E01, E32

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1. INTRODUCTION

Economic, monetary and banking policies are inseparable from the growth dynamics of a developing economy. Gross Domestic Product (GDP) is considered to be the best measure in displaying the economic performance of a country[3]. It summarizes all economic activity in particular units of money over a specified period. As an indicator that represents a comprehensive economic development, the GDP is not only the basis for determining government policy but also a need for businesspeople, economists, and analysts. The Central Bureau of Statistics (BPS) was able to present data of Quarterly GDP with a lag presentation of fewer than two months. However, the dynamic of the economic movement is sudden and quick, allowing for changes in the indicator from month to month. As the leading indicator, the quarterly GDP was not able to describe the economic movement on a monthly basis.

In some countries, the monetary policy can be formulated in less than three months. Thus, it is necessary to understand what happened within the quarter[4]. In Indonesia, at least once a month, Bank Indonesia as the central bank conducts a Board of Governors Meeting (BGM) to establish a general policy on monetary affairs[5] The determination of macroeconomic policy should be based on actual and up to date state, which fluctuates from month to month, to anticipate the shock/ pressure that occurs. Government policies made at an inappropriate time could lead to a lack of potential economic growth and even recession[6].

The research on economic, monetary and banking policy-making is often confronted with different series of data. Financial, monetary and banking indicators such as interest rates, money supply, inflation, lending, foreign direct investment, and similar indicators are available monthly. If the data on the GDP is only available quarterly, then the analysis will be limited and insufficient. From a statistical point of view, time series patterns are often not well captured when the data series are short, so the estimates and forecasting results are less precise. Therefore, monthly GDP data is critical to analysis, research and economic, financial, monetary and banking policymaking.

On the other hand, available short-term (monthly) indicators reflect the actual economic changes that occur[7]. In the business cycle theory, the indicators are called the coincident indicators which are variables that correlate with current economic

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[4] Bank Indonesia. "Board of Governors Meeting Schedule (RDG)" http://www.bi.go.id/id/ruang-media/agenda/rapat-dewan-gubernur/Default.aspx, 2017

[5] Bank Indonesia. "Board of Governors Meeting Schedule (RDG)" http://www.bi.go.id/id/ruang-media/agenda/rapat-dewan-gubernur/Default.aspx, 2017

[6] Rianto and Hendranata, Anton. "Updating Leading Indicators of the Indonesian Economy." Final report by the Ministry of Finance of the Republic of Indonesia Fiscal Policy Office Macroeconomic Policy Center, 2014, p. 1.

[7] Bruno *et al*. "Short-run GDP Forecasting in G7 Countries: Temporal Disaggregation Techniques and Bridge Models". Europan Communities Working Paper Studies, July 2005.

activity[8]. Coincident indicators will move in line with the reference series that is usually represented by the value of the GDP. Several indicators are suspected to be coincident indicators such as industrial production, sales price, unemployment rate, and real income (Moauro and Proietti, 2005). In Indonesia, the data that could be possibly used is the production index of Large and Medium Manufacturing Industry (IBS) as it is observed monthly, available in long series, and up to date.

The monthly IBS production index is considered as a coincident indicator so that it has the same movement at the same time as the GDP. Therefore, by utilizing the same movement pattern, the disaggregation and forecasting of monthly GDP will be done with the monthly IBS production index.

Thus, the objectives of this research are: (1) to conduct quarterly GDP disaggregation into the monthly GDP in Indonesia; (2) testing the conformity of the IBS production index as a coincident indicator; (3) forecast quarterly and monthly GDP of 2017.

II. THEORY

Gross Domestic Product (GDP) is the amount of value added generated by all business units within a given country or the total value of final goods and services produced by all economic units[9]. The release of GDP is always awaited by all parties because GDP is a barometer of the ups and downs of a country's economy. As a macroeconomic indicator, analysts, politicians, mass media, the business community, and the public await the release of the GDP as a form of anticipation of the economic policies undertaken[10].

According to Mankiw, the GDP can be used as reference series in business cycle theory. The business cycle is the rise and fall of many simultaneous economic activities that will reoccur in the future. Reference series is a variable that can describe economic conditions in aggregate. Three kinds of indicators are known in the business cycle analysis, namely leading, coincident, and lagging indicators. Leading indicator is an indicator that moves ahead of coincident or reference series. Coincident indicators are indicators that move along the reference series. Lagging indicator is a moving indicator (lag) of coincident or reference series[11].

The actual economic growth is assumed to have movement in line with the series/other indicators so-called co-movement. Thus, coincident indicators are variables that correlate with current economic activity (actual). Because it has the same movement at the same time, the coincident indicator will represent the actual state of the economy in real time. Indicators that are considered to be sources of

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[8] Mongardini, Joannes and Saadi-sedik, Tahsin. "Estimating Indexes of Coincident and Leading Indicator: An Application of Jordan," IMF Working Paper, August 2003.

[9] Central Bureau of Statistics. "Understanding National Income" https://www.bps.go.id/ Subjek/view/ id/11#subjekViewTab1|accordion-daftar-subjek1

[10] Sutomo, Slamet, (2016), Data System and Tools of Macroeconomic Analysis, CorBooks, Bandung.

[11] Rianto and Hendranata, Anton., *op.cit*., p. 4.

movement from the actual state of the economy include industrial production, sales, unemployment, and real income.

Meanwhile, Friedman in 1962 disaggregated on a variable by utilizing other variables that are considered to correlate with the variable on which the disaggregation is to be performed[12]. The temporal disaggregation method is used to disaggregate from series with low to high-frequency series. For example, from yearly to quarterly or from quarterly to monthly. Disaggregation will result in the consistent, average, and consistent beginning or ending numbers between high and low frequencies.

For example, the temporal disaggregation, from now on is referred to as disaggregation, is carried out from the quarterly series (low frequency) to the monthly series (high frequency) by utilizing other related variables (indicator series). First, we determine the initial estimate of the monthly value calculated from the series indicator. Then, calculate the difference between the actual monthly value and the estimated value of quarterly time observation. Furthermore, the difference is distributed to the series difference with monthly time observation. The disaggregation equation is denoted as follows[13].

$$\hat{z} = p + Du_l \tag{1}$$

with:

$\hat{z}$: series from disaggregation results;
p : initial estimation series;
D : distribution matrix;
u_l : the difference between the actual value and the initial monthly estimate in quarterly time observation

Here is a summary of some of the methods that can be used for disaggregation.

Table 1.
Some Disaggregation Methods

Methods	Initial estimation Series (p)	Analysis
Cubic Spline	With or without indicator series	Regression
Denton, Denton-Cholette	With one indicator series	Regression time series
Chow-lin, Fernandez, Litterman	with >= 1 indicator series	Regression time series

Source: Sax, Christop & Steiner (2013) and Katz (2006).

[12] Guerro, M. Victor. "Monthly Disaggregation of a Quarterly Time Series and Forecast of Its Unobservable Monthly Values," Journal of Official Statistics, Vol. 19, No. 3, 215-235.

[13] Sax, Christop and Steiner, Peter. "Temporal Disaggregation of Time Series", The R Journal, December 2013, 80-87.

The Cubic Spline method is often used in the process of changing the data frequency. The interpolation method uses the function approach as a connecting polynomial. However, the Cubic Spline has the disadvantage that the interpolation results, before the first knot (point change function) and after the last knots, tend to be linear (Katz, 2006). Meanwhile, the Chow and Denton method use the primary time series analysis. However, according to Guerrero (2003), the determination of the autocorrelation structure is still subjective.

As a consequence, Guerrero, a professor of statistics in 2003, developed a technique of disaggregation based on previous studies. He assumes that $\{Z_t\}$ with $t = 1,\ldots,mn$ is a time series data that which is unobserved/unmeasured (high frequency). $n \geq 1$ represents the sum of all observed periods (low frequencies), e.g., quarterly. $m \geq 2$ shows the number of frequencies in the observed period such as the number of months in a quarter. It is assumed that $\{W_t\}$ is a *series* from the *preliminary estimates* from unobserved data that do not allow stationary. Next, the relationship between $\{Z_t\}$ and $\{W_t\}$ becomes as follows.

$$Z_t = W_t + S_t \tag{2}$$

With S_t being the difference from unobserved stationary data with zero average. The model comes with the following assumptions.

The Autoregressive Moving Average (ARMA) model can explain the pattern of series $\{S_t\}$ with the following equation.

$$\phi_S(B)S_t = \theta_S(B)e_t \tag{3}$$

with ϕ_S and θ_S representing the AR (p) and MA (q) polynomial models expressed in the form of backshift notation (B) as follows.

$$\phi_S(B) = 1 - \phi_{S,1}B - \phi_{S,2}B^2 - \cdots - \phi_{S,p}B^p \tag{4}$$

$$\theta_S(B) = 1 + \theta_{S,1}B + \theta_{S,2}B^2 + \cdots + \theta_{S,q}B^q \tag{5}$$

With the unit root being outside the unit circle and satisfying the invertibility conditions. $\{e_t\}$ is white noise with zero average and variance σ_e^2.

Series $\{W_t\}$ can be expressed with the autoregressive integrated moving average (ARIMA) model as follows.

$$\phi_W(B)d(B)W_t = \theta_W(B)u_t \tag{6}$$

With $d(B)$ as the differencing rate so $\{d(B)W_t\}$ is stationary. $\phi_W(B)$ and $\theta_W(B)$ have unit root outside the unit circle. $\{u_t\}$ is white noise with zero average and variance σ_u^2. Between $\{e_t\}$ and $\{u_t\}$ there is no correlation.

The equation of the difference value (S) can be written as follows.

$$S_t = \psi_S(B)e_t \tag{7}$$

With $\psi_S(B) = 1 + \psi_{S,1}B + \psi_{S,2}B^2 + \cdots$ as a real polynomial MA obtained from the relation $\psi_S(B) = \frac{\theta_S(B)}{\phi_S(B)}$. Thus, the above equation can be written in matrix form as follows.

$$\boldsymbol{S} = \boldsymbol{\Psi}_S \boldsymbol{e} \tag{8}$$

With $\boldsymbol{S} = (S_1, \ldots, S_{mn})'$ and $\boldsymbol{e} = (e_1, \ldots, e_{mn})'$ $\boldsymbol{\Psi_S}$ representing the lower triangular matrix of *mn*×*mn* size with the main diagonal being one (1), the first sub-diagonal is worth $\psi_{S,1}$, the second sub-diagonal is worth $\psi_{S,2}$, and so on.

Series at time observation which is in the unobserved value unit (mean), i.e. $(Y_1,\ldots,Y_n)'$, can be written as follows:

$$Y_i = \sum_{j=1}^{m} c_j Z_{m(i-1)+j} \tag{9}$$

with $i = 1,2,\ldots,n$.

c_j is a constant whose value depends on the type of disaggregation. Disaggregation has a type of distribution if Y_i is a flow variable so that $\boldsymbol{c}' = (c_1, \ldots, c_m) = (1, \ldots, 1)$. For a flow variable with quarterly time observations, the disaggregated vector is expressed by $\boldsymbol{c}' = \left(1/m, \ldots, 1/m\right)$ with m=3 stating the number of months in a quarter. Next, the **C** matrix (aggregation matrix), **Y**, and **Z** are defined as follows.

$$\boldsymbol{C} = \boldsymbol{I} \otimes \boldsymbol{c}' \tag{10}$$

$$\boldsymbol{Y} = (\boldsymbol{Y_1}, \ldots, \boldsymbol{Y_n})' \tag{11}$$

$$\boldsymbol{Z} = (\boldsymbol{Z_1}, \ldots, \boldsymbol{Z_{mn}})' \tag{12}$$

With $\boldsymbol{I}$ as the identity matrix and ⊗ as a notation for Kronecker product.

Equation 9 can be written as follows.

$$\boldsymbol{Y} = \boldsymbol{CZ} \tag{13}$$

Equation 2 can be written as follows.

$$\boldsymbol{Z} = \boldsymbol{W} + \boldsymbol{S} \tag{14}$$

With $\boldsymbol{W} = (W_1,\ldots,W_{mn})'$. $E(\boldsymbol{Z}|\boldsymbol{W})=\boldsymbol{W}$ denoting that $\boldsymbol{W}$ is the Minimum Mean Squared Error Linear Estimator (MMSELE) of $\boldsymbol{Z}$ with the term $\boldsymbol{W}$. Besides, equation 8 implies that $\sum_S = \sigma_e^2 \boldsymbol{\Psi}_S \boldsymbol{\Psi}_S'$. Therefore, Guerrero proposes that the value of the MMSELE from $\boldsymbol{Z}$ with terms $\boldsymbol{W}$ and $\boldsymbol{Y}$ is as follows.

$$\widehat{\boldsymbol{Z}} = \boldsymbol{W} + \widehat{\boldsymbol{A}}(\boldsymbol{Y} - \boldsymbol{CW}) \tag{15}$$

with $\boldsymbol{A}$ as the disaggregation matrix with the following equation.

$$\widehat{\boldsymbol{A}} = \boldsymbol{\Psi}_S \boldsymbol{\Psi}_S' \boldsymbol{C}' \left(\boldsymbol{C}\boldsymbol{\Psi}_S \boldsymbol{\Psi}_S' \boldsymbol{C}'\right)^{-1} \tag{16}$$

In correcting the non-constant variance, the main diagonal matrix $(\boldsymbol{\Psi_s}\boldsymbol{\Psi_s}')$ is replaced by theoretical variance. The modified matrix is denoted by $(\boldsymbol{\Psi_s}\boldsymbol{\Psi_s}')_m$.

The compatibility test aims to find out that $\{W_t\}$ is compatible (matching) with $\{Z_t\}$ or not. From the available series $\{W_t\}$, the following equations are determined:

$$\boldsymbol{Y - CW = C\Psi_S e} \sim N\left(0, \sigma_e^2 \boldsymbol{C\Psi_S \Psi_S^{'} C^{'}}\right) \tag{17}$$

The statistics compatibility test is as follows.

$$K = \frac{(\boldsymbol{Y - CW})^{'} (\boldsymbol{C\Psi_S \Psi_S^{'} C^{'}})^{-1} (\boldsymbol{Y - CW})}{\widehat{\sigma}_e^2} \sim \chi^2_{(n)} \tag{18}$$

Several studies on monthly GDP disaggregation have been conducted. The study, entitled "An Indicator of Monthly GDP and An Early Estimate of Quarterly GDP Growth" by Mitchell et al. (2005) is based on the fact that macroeconomic policy in the UK is faced with problems concerning the actual state of the economy. One of the variables used to generate monthly GDP is the manufacturing industry output. Meanwhile, one of the methods of temporal disaggregation was proposed by Guerrero in 2003 under the title "Monthly Disaggregation of a Quarterly Time Series and Forecast of Its Unobserved Monthly Values" study. In the study, quarterly GDP data of Mexico was disaggregated to obtain monthly GDP by using a combination of linear regression and time series ARIMA model analysis as well as some modifications. Another study was conducted by Moauro and Proietti in 2003 under the title "An Index of Coincident Indicators for the Euro Area based on Monthly and Quarterly Series." In that study, the monthly GDP value was obtained by using coincident indicators or indicators that have the same movement with the current economic condition. One of the coincident indicators used was industrial production which is reflected by the industrial production index value. The national monthly GDP of both the US and EU were compared in the study.

Based on the results of related research, it can be summarized that one of the goals of disaggregation of monthly GDP is to meet the needs of picturing the economic situation that occurred. There are several techniques in disaggregating, and one of them is the use of variables associated with applying linear regression model and time series model. The related variables can be coincident indicator one example of which is industrial production index.

III. METHODOLOGY

3.1. Types and Sources of Data

This study uses data obtained from the Central Bureau of Statistics (BPS) from 2000 through 2016. The first data is the quarterly Gross Domestic Product at constant prices (ADHK) in 2000 and 2010. The second data is the monthly production index of the Large and Medium Manufacturing Industry (IBS) of the reference year of 2000 and 2010. To simplify the naming, the production (IP) indices in question in the next section is the IBS production index.

The two data with different reference years are the same as the reference year of 2010 by using the comparison technique between the value of the year 2010 with the reference year of 2000 and the value of the year 2010 with the reference year of 2010. The forecasting will use production index data in January, February, and

March. The results of forecasting will be compared with the value of GDP that has been released, i.e., the GDP of Quarter I and II of 2017.

3.2 Definition of Time Observation Aggregate and Disaggregate

The variable to be disaggregated in this research is GDP. These variables include the flow variable. That is, annual GDP is the sum of quarterly GDP so that quarterly GDP is also the sum of monthly GDP. In contrast, the annual GDP value may be distributed or distributed during the quarterly observation period. Thus, quarterly GDP allows being distributed (disaggregated) to monthly GDP. If the disaggregation process is done from quarterly GDP to monthly GDP, the disaggregated order (m) is m=3 stating the number of months in each quarter the disaggregated vector is expressed as $\boldsymbol{c}' = \left(\frac{1}{m}, \frac{1}{m}, \frac{1}{m}\right) = \left(\frac{1}{3}, \frac{1}{3}, \frac{1}{3}\right)$. If the elements of the vector are summed, the result is expressed as the monthly averages of the quarter from now on referred to as the aggregate value. That is, the value has a monthly unit but is measured every three months/quarter. Meanwhile, a monthly value measured per month is called a disaggregated value. Thus, both aggregates and disaggregates have the same unit of value, i.e., monthly with different time observations, i.e., quarterly for aggregate and monthly for disaggregate. The variables used are GDP and production index (IP) the values of which will be calculated (aggregate and disaggregate values). The monthly GDP, that is the primary objective of calculation, can be named as disaggregated GDP. Meanwhile, the released GDP is still a quarterly value while the IP is a disaggregated value. Both series are converted into aggregate form. The GDP and aggregate IP can be calculated in the following way.

$$Y_i = \frac{PDB_i}{3} \tag{19}$$

$$IPAGR_i = \frac{IP_{3i} + IP_{3i-1} + IP_{3i-2}}{3} \tag{20}$$

With:

Y_i : average monthly GDP of quarterly or aggregate GDP of the quarter ith (billion rupiahs)
PDB_i : Gross Domestic Product ADHK 2010 ith quarter (billion rupiahs)
$IPAGR_i$: index of production (IP) aggregate ith
IP_t : index of production of Large and Medium Manufacturing Industry (IBS) base year 2010 tth month
i : 1, 2, ..., 68 (2000/I until 2016/IV)
t : 1, 2, ..., 204 (2000/1 until 2016/12).

3.3. Monthly GDP disaggregation Procedure

It is defined that the GDP of disaggregated or monthly/disaggregated GDP is the sum of the initial estimates of the monthly/disaggregated GDP and the disaggregate difference. Series preliminary monthly GDP estimate, from now on

referred to as preliminary monthly estimate, is a proper value of a simple linear regression model with an independent variable which is the monthly production index (IP). The initial disaggregated estimation value is aggregated every three months, so it becomes the initial estimate of aggregate.

Meanwhile, the series that is known is the average monthly quarterly GDP or GDP aggregate. The difference between aggregate GDP and the initial aggregate estimate is called the aggregate difference. Furthermore, the aggregate difference will be distributed by using the disaggregation matrix (distribution) to obtain the disaggregate difference. Then, the disaggregate difference will be added to the initial monthly estimate so that monthly GDP can be generated.

The autocovariance relationship between the aggregate and disaggregated series, in which case the difference value will be identical (similar) to both series when the seasonal effect, is omitted (deseasonalization)[14]. Series, the seasonal effect of which that has been omitted, is called seasonally adjusted series. By utilizing an autocovariance relationship between seasonally adjusted series of aggregate and disaggregated differences, seasonally adjusted models of disaggregated disparity can be obtained. Then, the combination of aggregate difference model parameters and seasonally adjusted series model of disaggregate difference will form the disaggregated difference model. From the disaggregated difference model, the disaggregated matrix will be derived. The disaggregation matrix is a matrix that converts the value of the aggregate difference to the disaggregated difference value.

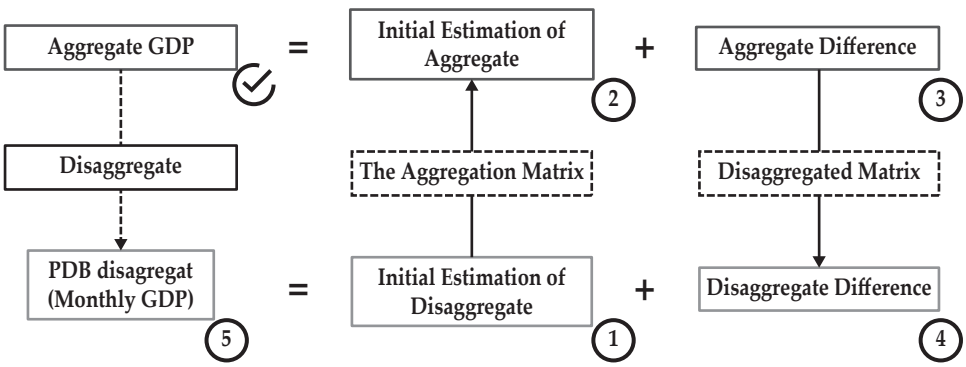


Figure 1.
The Quarterly GDP Disaggregation Stages in becoming Monthly GDP

[14] Wei, William W. S dan Stram, Daniel O. "Disaggregation of Time Series Models", Journal of the Royal Statistical Society, Series B (Methodology), Vol. 52, No. 3 (1990), 453-467, p. 466

The above disaggregation equation can be expressed in the form of a matrix. Aggregate series has the following equation.

$$\underset{68\times1}{(\boldsymbol{Y})} = \underset{68\times1}{(\boldsymbol{E})} + \underset{68\times1}{(\boldsymbol{D})} \tag{21}$$

Series of disaggregated results or monthly GDP ($\boldsymbol{Z}$) can be expressed as follows.

$$\underset{204\times1}{(\widehat{\boldsymbol{Z}})} = \underset{204\times1}{(\boldsymbol{W})} + \underset{204\times1}{(\boldsymbol{S})} \tag{22}$$

(S)

The value of the disaggregate disparity ($\boldsymbol{S}$) can be further elaborated so that the monthly GDP equation is expressed as follows.

$$\widehat{\boldsymbol{Z}} = \boldsymbol{W} + (\widehat{\boldsymbol{A}} \times \boldsymbol{D}) \tag{23}$$

$$\widehat{\boldsymbol{Z}} = \boldsymbol{W} + [\widehat{\boldsymbol{A}} \times (\boldsymbol{Y} - \boldsymbol{E})] \tag{24}$$

$$\widehat{\boldsymbol{Z}} = \boldsymbol{W} + \widehat{\boldsymbol{A}}[\boldsymbol{Y} - (\boldsymbol{C} \times \boldsymbol{W})] \tag{25}$$

with:

$\boldsymbol{Y}$: average monthly GDP of the quarter
$\boldsymbol{E}$: initial estimation of aggregate
$\boldsymbol{D}$: the aggregate difference
$\hat{\boldsymbol{W}}$: monthly GDP
$\boldsymbol{W}$: preliminary monthly estimates/disaggregate
$\boldsymbol{S}$: disaggregate difference
$\hat{\boldsymbol{A}}$: disaggregated matrix
$\boldsymbol{C}$: the aggregation matrix

The aggregate initial estimation model is a simple linear regression model as follows.

$$Y_i = \beta_0 + \beta_1 IPAGR_i + \varepsilon_i \tag{26}$$

The monthly preliminary estimation model (disaggregate) is a model with the same parameters as the initial aggregate estimation model but with the independent variable converted to IP as follows.

$$W_t = \widehat{\beta}_0 + \widehat{\beta}_1 IP_t \tag{27}$$

The aggregate difference is assumed to follow the original seasonal ARMA model (pure seasonal) with the following equation.

$$\Phi_D(L^4)D_i = \Theta_D(L^4)a_i \tag{28}$$

The parameter estimation results from the model, used as the seasonal disaggregation difference model by replacing the following seasonal periods.

$$\Phi_S(B^{12})S_t = \Theta_S(B^{12})e_t \tag{29}$$

In addition to being a seasonally disaggregated difference model, the aggregate difference model is also used to compute the seasonally adjusted series of aggregate offsets or FDs in the following ways.

$$FD_i = \Phi_D(L^4)\Theta_D(L^4)^{-1}D_i \tag{30}$$

Meanwhile, a series of disaggregated disparities was eliminated as a seasonal effect (FS).

$$FS_t = \Phi_S(B^{12})\Theta_S(B^{12})^{-1}S_t \tag{31}$$

The seasonally adjusted series of the disaggregation difference model will be used as a non-seasonal disaggregation difference model with the following equation.

$$\phi_S(B)FS_t = \theta_S(B)e_t \tag{32}$$

Series disaggregate increments are assumed to follow the seasonal (multiplicative) ARMA model as follows.

$$\phi_S(B)\Phi_S(B^{12})S_t = \theta_S(B)\Theta_S(B^{12})e_t \tag{33}$$

4. RESULTS AND DISCUSSION

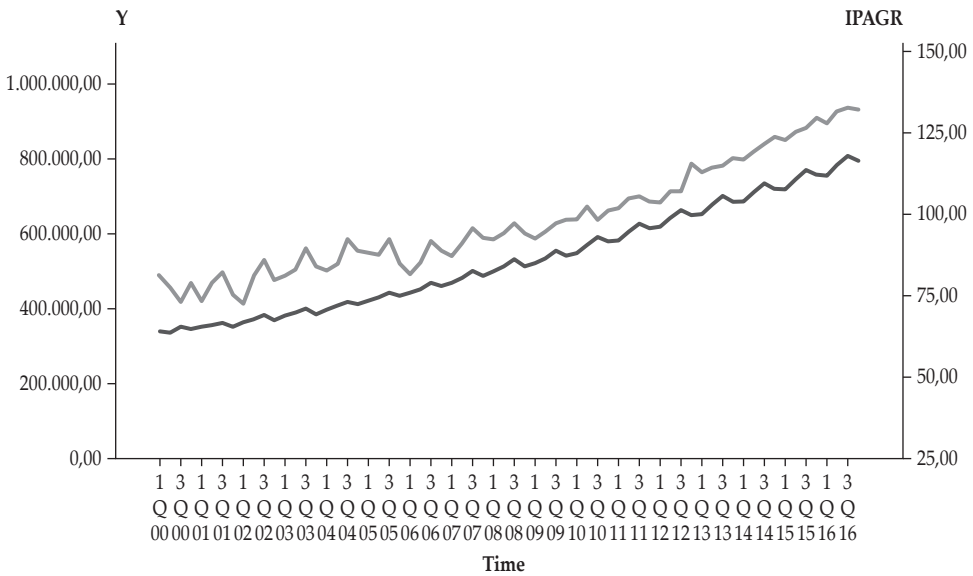
4.1. The patterns of GDP and Production index (IP) movement

In general, from Q1, the GDP always rose to the highest level in the Q3 with a slight decrease in the Q4. Furthermore, the increase occurred again in the first quarter of the following year with a value higher than the same quarter of the previous year so that overall, the GDP continues to move up. The pattern repeatedly occurs in each year, enabling the determination of a seasonal effect (Figure 2).

A coincident indicator of the economic circumstances that can be represented by GDP is the index of industrial production. It will move following the current state of the economy. This happens because the industrial sector has a strategic role, among other sectors, in generating added value (GDP). In conducting production activities, the industrial sector needs inputs from other sectors such as agriculture and mining so that it will increase the added value of the sector. Furthermore, the output of the industrial sector that has been generated will be used by many other sectors such as building, trade, hotel, transportation, and communications. That is, the industrial sector will boost the added value of the other sectors. In other words, all the added value generated, i.e., the value of GDP will move following the movement of the industrial sector.

Based on the data, among the nine sectors/fields of business, the manufacturing sector contributes the most to the formation of the GDP in Indonesia. From 2012 to 2015, the manufacturing industry has an average distribution of 21.31%[15]. Also, the output value of Large and Medium Manufacturing Industry (IBS) always has a dominant contribution compared to the Micro and Small Manufacturing Industry (IMK). In 2015, the value of the IBS output amounted to 4,286,862 billion[16]. Meanwhile, IMK's output value amounted to 57,036.9 billion[17]. That is, the IBS output is dominant with 98.68% of the total industrial output, meaning that IBS is more representative than IMK.

The same pattern of movement between the GDP and the production index (IP) can be shown after both are converted into aggregate size or monthly averages of the quarter. In general, the GDP and IP move in tandem occupying the top position in the third quarter and dropping in the fourth quarter and rising again. The pattern repeats simultaneously every year so that the movement between the production index and GDP will be simultaneous or co-movement.



Source: BPS, processed

Figure 2. GDP Aggregate (Y) and Production Index Aggregate (IPAGR) of 2000-2016

[15] Central Bureau of Statistics, (2016), Indonesia Gross Domestic Product Quarterly 2012-2016, BPS, Jakarta.

[16] Central Bureau of Statistics. "Value of Large and Medium Manufacturing Outputs for 2012-2015"https://www.bps.go.id/linkTabelStatis/view/id/1081, 2017.

[17] Central Bureau of Statistics. "Value of Micro and Small Industry Output According to 2-digit KBLI year 2010-2015"https://www.bps.go.id/linkTableDinamis/view/id/1014, 2016.

4.2. Disaggregation of quarterly GDP into monthly GDP

The first step is to form an aggregate of the initial estimation model in the form of a simple linear regression model with IPAGR as the independent variable and Y as the dependent variable. From the model formed, the obtained statistical value (DW) is 1.05. This value leads to the conclusion that there is an autocorrelation problem that violates the standard assumption. Therefore, the autocorrelation problem is solved by the Cochrane-Orcutt variable transformation procedure. In that procedure, the $\hat{\rho}$ value is obtained by forming a regression model without intercepting with the independent variable which is the residual model t^{th}- (t-1) and the dependent variable which is the t-residual. The $\hat{\rho}$ is the regression coefficient of the model. From the calculation results, the obtained $\hat{\rho}$ value is 0.448.

Afterward, the $\hat{\rho}$ is used to perform the transformation of variables, i.e., $Y_t'=Y_{t-0},448Y_{t-1}$ and $IPAGR_t' = IPAGR_{t-0},448IPAGR_{t-1}$. Then, the two transformed variables are remodeled. In returning to the real value, the intercept of the transformed model is changed to $\widehat{\beta}_0 = \frac{\widehat{\beta}_0'}{1-0{,}448}$.

Thus, the aggregate initial estimation model resulting from the transformation is as follows.

$$Y_t' = E_i = -221434{,}57 + 7695{,}404\, IPAGR_t', \;\; R^2 = 0{,}9068 \quad (35)$$
$$\qquad\qquad (16988{,}20) \qquad (305{,}95)$$

Description: numbers in brackets indicate standard error.

The transformation model has been freed from autocorrelation problems as indicated by DW statistics of 1.86 or near 2. The p-values of the Jarque-Bera test and the Glejser test of the transformed model are 0.3011 and 0.1752, respectively, leading to the assumptions that the normality and homoscedasticity requirements were met. The model shows a strong relationship between the two variables as evidenced by the large R^2. From the significance test of parameters, i.e., t-test and F test, it is concluded that the IPAGR have the positive and significant effect towards Y.

Furthermore, the model is used as the initial monthly estimation model (W_t) by substituting the independent variable with the following monthly IP.

$$W_t = -221434{,}57 + 7695{,}404 IP_t \quad (36)$$

The aggregated and disaggregated initial estimates are the fitted values of each model. Then, the values of the aggregate difference are calculated by subtracting the actual GDP (Y) from the initial estimate of aggregate (E). Then, the aggregate difference is modeled in the annual ARMA form. Based on the Box-Jenkins method, the aggregate difference model, that is ARMA $(1,0)_4$, can be obtained as follows.

$$\left(1 - 0{,}6527L^4\right)D_i = \hat{a}_i \quad (37)$$

The result of the diagnostic test with Ljung-Box test shows that residual is white noise so that the model is ready to be used. The next stage is to form a model of disaggregate difference.

The disaggregated difference model consists of seasonal and non-seasonal (multiplicative) models. The seasonal disaggregation difference model is formed from the aggregate difference model by substituting the previous 4 to 12 seasonal order. Based on equation 37, the seasonal disaggregation difference model is as follows.

$$\left(1 - 0{,}6527B^{12}\right)S_t = \hat{e}_t \tag{38}$$

The non-seasonal disaggregation difference model is obtained based on the disaggregated difference model the seasonal effects of which have been omitted. The first step is to eliminate the seasonal effect (deseasonalization) on the series of aggregate differences. Series deseasonalization results are also called seasonally adjusted series. The value for seasonally adjusted series of aggregate differences was calculated based on the estimation of aggregate difference model parameters in equation 37 as follows.

$$FD = D_i - 0{,}6527D_{i-4} \tag{39}$$

Then, the defined seasonally adjusted series of aggregate (FD) and disaggregate (FS) relationships can be expressed in the form of backshift notation (B) as follows.

$$FD_i = \frac{1}{3}\left(1 + B + B^2\right)FS_{3i} \tag{40}$$

After the seasonally adjusted series of aggregate differences (FDs) were obtained, the series was used to determine the order of the seasonally adjusted series disaggregated (FS) difference model identified through the autocorrelation coefficient of FD. Based on autocorrelation plot (ACF) and partial autocorrelation (PACF), the indicated model was formed in the MA model so that the AR order value (p) is *p*=0. Then, the determination of MA order (q) is done based on Wei and Stram method [18]For the order, MA (q), *q*=*p*+1 until *q*=1.

Based on equation 40, the relationship between autocovariance lag 0 (variance) FD and autocovariance FS is expressed as follows.

$$\gamma_{FD}(0) = \frac{1}{9}(1 + B + B^2)^2\gamma_{FS}(2)$$

$$= \frac{1}{9}\left[\gamma_{FS}(-2) + 2\gamma_{FS}(-1) + 3\gamma_{FS}(0) + 2\gamma_{FS}(1) + \gamma_{FS}(2)\right] \tag{41}$$

Autocovariance relationship of first lag of FD and autocovariance FS is as follows.

$$\gamma_{FD}(1) = \frac{1}{9}(1 + B + B^2)^2\gamma_{FS}(5)$$

$$= \frac{1}{9}\left[\gamma_{FS}(1) + 2\gamma_{FS}(2) + 3\gamma_{FS}(3) + 2\gamma_{FS}(4) + \gamma_{FS}(5)\right] \tag{42}$$

[18] Wei, William W. S and Stram, Daniel O., *op.cit*., h. 461.

Then, the MA model parameter is calculated. For q=1 or MA (1), the following assumption is used γ_{FD} (k) = 0 for $k \neq 0$, ±1 and γ_{FS} (k) ≠ 0 for k = 0, ± 1 in both equations (above) to obtain the following equation.

$$\begin{bmatrix}\gamma_{FD}(0)\\ \gamma_{FD}(1)\end{bmatrix} = \begin{bmatrix}3/9 & 4/9\\ 0 & 1/9\end{bmatrix} \times \begin{bmatrix}\gamma_{FS}(0)\\ \gamma_{FS}(1)\end{bmatrix} \tag{43}$$

By moving the segment, the autocovariance equation FS is as follows.

$$\begin{bmatrix}\gamma_{FS}(0)\\ \gamma_{FS}(1)\end{bmatrix} = \begin{bmatrix}3 & -12\\ 0 & 9\end{bmatrix} \times \begin{bmatrix}\gamma_{FD}(0)\\ \gamma_{FD}(1)\end{bmatrix} \tag{44}$$

Since the FD series is available, the autocovariance FD value can be determined so that the autocovariance value of FS can be calculated in the following way.

$$\begin{bmatrix}\hat{\gamma}_{FS}(0)\\ \hat{\gamma}_{FS}(1)\end{bmatrix} = \begin{bmatrix}3 & -12\\ 0 & 9\end{bmatrix} \times \begin{bmatrix}479256955{,}6\\ 199066584{,}6\end{bmatrix} = \begin{bmatrix}-951028147{,}8\\ 1791599261{,}05\end{bmatrix} \tag{45}$$

From the autocovariance value, the lag one autocorrelation value is calculated in the following way.

$$\hat{\rho}_{FS}(1) = \frac{\hat{\gamma}_{FS}(1)}{\hat{\gamma}_{FS}(0)} = -1{,}8 \tag{46}$$

However, the value is not significant because the range of the autocorrelation values is defined when -1 ≤ ρ ≤ 1 so that the MA model with the q=1 or MA (1) order is not possible. Then, the next level 1 order is selected, i.e., q=2 assuming that γ_{FD} (k) = 0 for k ≠ 0 ± 1 and γ_{FS} (k) ≠ 0 for k = 0, ± 2. In the same way, the $\hat{\rho}_{FS}$ (2)=1.06 is obtained so that MA (2) is also not possible. Next, q = 3 is selected with the assumption that γ_{FD} (k) = 0 for $k \neq 0$, ± 1, and γ_{FS} (k) ≠ 0 for k = 0, ± 3 to obtain $\hat{\rho}_{FS}$ (3) = 0.415. The autocorrelation value is significant so that the selected model is MA (3). In general, the MA equation (3) is as follows.

$$FS_t = (1 + \theta_1 B + \theta_2 B^2 + \theta_3 B^3) e_t \tag{47}$$

Based on previous autocorrelation calculations, MA (1) and MA (2) are not possible so that the seasonally adjusted series disaggregated (FS) model for MA (3) is expressed as follows.

$$FS_t = (1 + \theta_3 B^3) e_t \tag{48}$$

The autocovariance value of FS obtained is then used to calculate the MA model parameter value. Without including θ_1 and θ_2 parameters, the MA (3) model for the FS has theoretical variance and autocovariance formulas which are γ_{FS} (0)=(1 + θ_3^2)σ_e^2 and γ_{FS} (3) = θ_3 σ_e^2. By substituting $\sigma_e^2 = \frac{\gamma_{FS}(0)}{(1+\theta_3^2)}$ into the equation γ_{FS} (3), the following equation is obtained.

$$\gamma_{FS}(3)\hat{\theta}_3^2 - \gamma_{FS}(0)\hat{\theta}_3 + \gamma_{FS}(3) = 0 \quad (49)$$

Thus, the $\hat{\theta}_3$ value can be obtained by using the following formula[17].

$$\hat{\theta}_{(3)1,2} = \frac{\left(\hat{\gamma}_{FS}(0) \pm \sqrt{[\hat{\gamma}_{FS}(0)]^2 - 4[\hat{\gamma}_{FS}(3)]^2}\right)}{2\hat{\gamma}_{FS}(3)} \quad (50)$$

From the calculations results, the following values were obtained $\hat{\theta}_{(3)1}$= 0.533 and $\hat{\theta}_{(3)2}$= 1.873. Like the MA model of order 1, the model will be defined when -1 < θ < 1, so the value of $\hat{\theta}_3$ that is possible is 0.533. The seasonally adjusted series model of disaggregate differences can be written as follows.

$$FS_t = (1 + 0{,}533B^3)\hat{e}_t \quad (51)$$

Because of the identic nature, the seasonally adjusted series model of disaggregate difference is used as a non-seasonal disaggregation model.

Thus, the disaggregated difference model is a multiplicative ARMA between the seasonal model of equation 38 and the non-seasonal model of equation 51 to form the following model.

$$\left(1 - 0{,}6527B^{12}\right)S_t = \left(1 + 0{,}533B^3\right)\hat{e}_t \quad (52)$$

With $\hat{\sigma}_e^2 = {\hat{\gamma}_{FS}(3)}\big/{\hat{\theta}_3} = 1119071291{,}11.$

Next, there is a balanced matrix ($\boldsymbol{\Psi}_s$) consisting of pure MA parameter/weigh (ψ) of the disaggregated difference model. The disaggregated model that is formed is (1-Φ B^{12}) S_t = (1+θ B^3)$\hat{e}_t$ so that the model needs to be converted into pure MA model form. The seasonal and non-seasonal (multiplicative) weighing values of the pure MA model is as follows.

$$\psi_{q+12(j-1)} = \Phi^{j-1}\theta = (0{,}6527)^{j-1} \times 0{,}533 \; for \; j = 1{,}2{,}3 \ldots \quad (53)$$

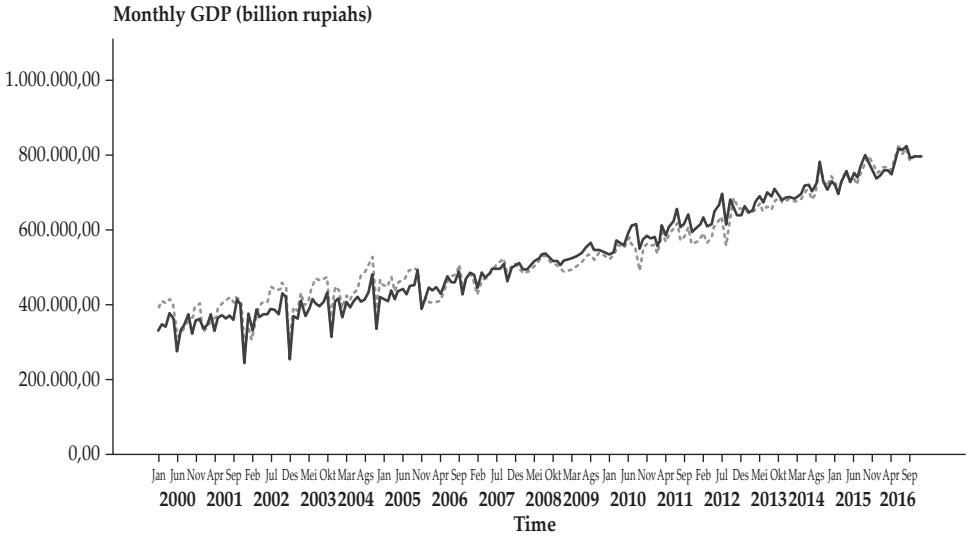
Seasonal weights are as follows.

$$\psi_{12j} = \Phi^j = (0{,}6527)^j \; for \; j = 0{,}1{,}2 \ldots \quad (54)$$

While ψ_j = 0 for other j. The weighting matrix is a lower triangular matrix with value one as the main diagonal, ψ_1 as the first sub-diagonal, ψ_2 as the second sub-diagonal. In overcoming the variance which is not constant, the main diagonal of the matrix $\boldsymbol{\Psi}_s \boldsymbol{\Psi}_s'$ is modified by the theoretical variance, i.e., $Var(S_t)/\hat{\sigma}_e^2 = (1 + \theta^2)/(1 - \Phi^2)$. After the balanced matrix is obtained, the disaggregated matrix is calculated according to equation 16.

[17] Box, George E. P., Jenkins, Gwilym M., and Reinsel, Gregory C, (2008), Time Series Analysis: Forecasting and Control (4th ed), John Wiley & Sons, Inc, New Jersey.

Furthermore, the disaggregation matrix is multiplied by the series of aggregate differences to obtain the disaggregated difference series. Between the monthly preliminary estimate series and the disaggregate gap is summed to obtain monthly GDP. Monthly GDP of disaggregated results along with initial estimation values can be seen in the following figure.



Source: processing results

Figure 3. Disaggregated Results of Monthly GDP and Initial Estimates of 2000/1-2016/12

From the figure, it can be seen that the monthly GDP fluctuates with an increasing trend. If the quarterly pattern is observed, the GDP changes (variation) for example up and down or vice versa. The monthly GDP figures of complete disaggregation results can be seen in the appendix.

Series between preliminary GDP estimates and disaggregated GDP appear to have the same or compatible movement. In ensuring the similarity of the two series, a compatibility test is performed. The results of the compatibility test yield statistical test of K = 61.89. The value is smaller than the table value of χ^2 with 68 degrees of freedom (quarterly amount) resulting in the decision that the monthly GDP series of disaggregated $\hat{Z}$ and initial monthly (W) estimates are similar or compatible. Thus, it can be deduced that there is a standard motion between actual GDP and initial estimates (compatible). These conclusions imply that the disaggregation and forecasting of monthly GDP can be done with a production index that acts as a coincident indicator.

4.3. Quarterly and Monthly GDP Forecasts in 2017

To determine the GDP growth in 2017, the forecasting with ARIMA model based on initial monthly estimation series of the GDP (from now on referred to as

monthly GDP estimation results). In order to have a better model, a comparison is needed between the model estimated monthly GDP without entering the latest IP data (Model A) and monthly GDP estimates by entering the latest IP data (Model B). To estimate the results can be added and compared with the original quarterly GDP data, the amount of the latest IP data was used in 3 data from January to March 2017 with the value of each as follows: 131.05; 133,43; and 135.79. Based on the model estimation, the accuracy level of model A and B in the data in the sample is as follows.

Table 2.
Comparison of Accuracy between Model A and Model B (data in a sample)

Comparison	Model A	Model B
(1)	(2)	(3)
RMSE (Billion)	31.849,12	31.700,87
MAPE (%)	4.50	4.46
MPE (%)	-0.52	-0.52

Source : Processed results

The value of the three criteria shows a corresponding result that Model B has a smaller criterion value than Model A. The smaller the value, the more accurate the model for forecasting. Thus, Model B is a better model for forecasting and is also an ARIMA model $(1,0,1)(2,1,0)_{12}$ with the following equation.

$$(1 - 0{,}8315B)(1 + 0{,}2503B^{12} + 0{,}3113B^{24})\left(1 - B^{12}\right) W_{t}_17 = 2122{,}0106 + (1 - 0{,}5009B)U_{t}_17 \quad (55)$$

With W_{t}_17 as a notation for monthly GDP estimation results by entering the latest IP data.

In addition to the model selection criteria, the determination of Model B as a more appropriate model for forecasting can be done by comparing the value of forecasting results summed every three months with the actual value of the GDP in the first and second quarters of 2017. Model B provides the result of forecasting which is closer to the actual value of the GDP.

Table 3.
Forecasting of Model A and B in The First and Second Quarters of 2017 (billion rupiahs)

Periods	Quarterly GDP (actual data)	Forecasting with Model A	Forecasting with Model B
(1)	(2)	(3)	(4)
January		781,391.80	781,725.20
February	2,377,574.70	791,144.90	793,253.70
March		788,193.60	794,235.40
Total	2,377,574.70	2,360,730.30	2,369,214.30
Difference		16,844.40	8,360.40
April		779,160.50	794,070.10
May	2,472,771.50	812,620.00	824,995.50
June		836,896.90	847,387.20
Total	2,472,771.50	2,428,677.40	2,466,452.80
Difference		44,094.10	6,318.70
RMSE		33,376.81	7,410.20

Source : processing results

Also, when viewed from the value of forecasting accuracy on quarterly data, model B was proved to be a better model for forecasting due to the high accuracy shown by smaller MAPE and MPE values.

Table 4.
Comparison of Forecasting Accuracy of Model A and B on Quarterly Data

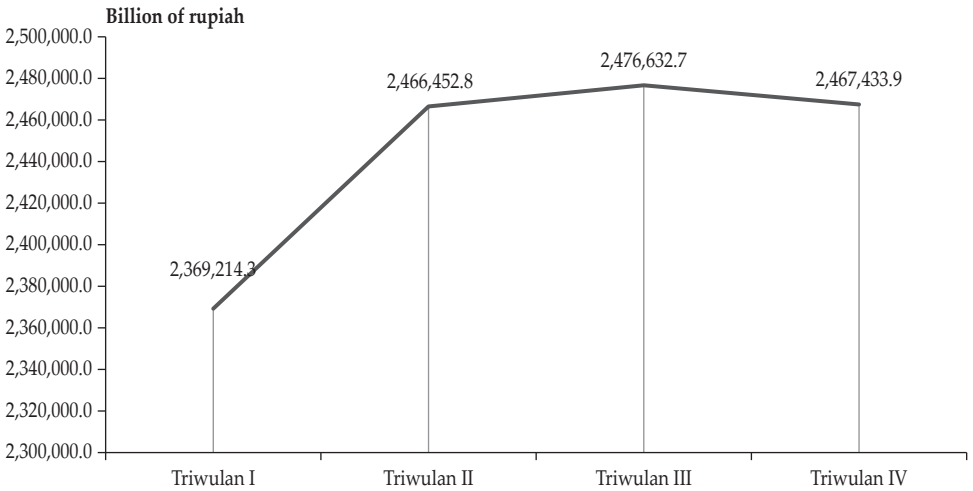
Periods	MAPE (%)	
	Model A	Model B
-1	-2	-3
Quarter I	0,71*	0,35
Quarter II	1,78*	0,26*
Quarters I and II	1,25	0,30

Source : Processed results

Description : the "*" mark= value is calculated based on data out the sample.

The MPE value is not listed because the value is the same as MAPE.

If summed up to the quarterly values, the forecasting results remain consistent with the general pattern of the GDP movement that reached the highest value in the third quarter as shown in the figure below.



Source: Processed results

Figure 4. Results of Indonesia's Quarterly GDP Forecasting in 2017 (billion rupiahs)

Although the highest quarterly GDP was in quarter III, the highest monthly GDP occurred in June (second quarter). This is possible because the month coincided with both school and Ramadam holidays so that some business fields experience a surge in demand. Those business fields are Manufacturing Industry, Trade, Hotel and Restaurant, and Transportation and Communication.

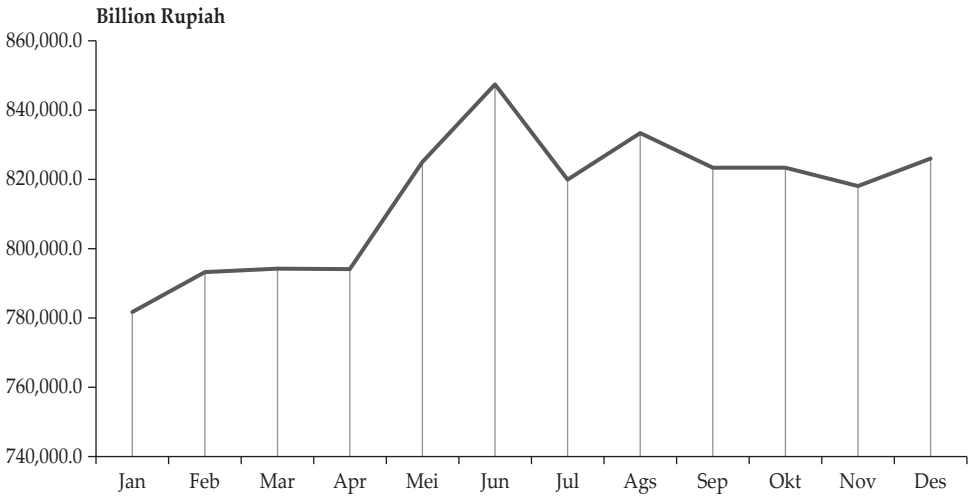


Figure 5. Indonesia's Monthly GDP Forecasts for 2017 (billion rupiahs)

Besides, the monthly GDP movements vary from month to quarter. Monthly GDP in the first quarter, III, IV change in a fluctuating way, i.e., up and down or vice versa. In contrast to the other quarter, monthly GDP in the second quarter in a row continues to increase. Also, it appears that the economic activity increased gradually in the first half to reach the peak position in June 2017. For the next semester of July to December 2017, the economic situation is predicted to run stable.

5. CONCLUSION

Several conclusions are made from the results and discussion. First, the disaggregation results indicate that the monthly GDP volatilely moves with different patterns between nations. Second, the disaggregation and monthly GDP forecasting can be proven by the production index of Large and Medium Manufacturing Industry (IBS) which acts as a coincident indicator. Third, the result of GDP forecasting in 2017 shows that the highest quarterly GDP remains consistent in the third quarter. However, the highest monthly GDP occurred in June (second quarter). The pattern of quarterly GDP movement is not always in line with the pattern of monthly movement. The monetary policy formulated through empirical studies, linking it to GDP variables, can be miss-leading if the quarterly GDP aggregate is used.

Based on the above conclusions, some suggestions may be submitted. In fact, policymakers are wary of fluctuating economic growth from month to month. Therefore, further analysis of the monthly GDP has been made. Also, the results of monthly disaggregated GDP can be explored with other monthly economic variables, especially financial variables so that the economic state analysis becomes comprehensive. Furthermore, in enacting policy, the government must pay attention to the peak of the economic activities. Although the highest GDP was in a particular quarter, the highest monthly GDP was unlikely to occur during the quarter.

For general data users, disaggregation and forecasting of monthly GDP can be done using the Large and Medium Manufacturing Industry Production Index (IBS) that acts as a coincident indicator. Data users need to monitor the development of the production index in anticipation of the resulting estimate being improper. For more accurate forecasting, the model needs to be updated on a regular basis based on the latest production index data. Related to further research, we can use some method of disaggregation so that an inter-method comparison can be made.

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APPENDIXES

Appendix 1. Data with 68 observations

Year	Quarter	GDP	Y	IPAGR	E	D
-1	-2	-3	-4	-5	-6	-7
2000	I	1016818,5	338939,50	81,02	402021,48	-63081,98
	II	1010924,9	336974,97	77,62	375908,41	-38933,44
	III	1053704,0	351234,67	73,22	341997,32	9237,34
	IV	1040278,9	346759,63	79,03	386758,93	-39999,30
2001	I	1056151,9	352050,63	73,22	341997,32	10053,31
	II	1069254,9	356418,30	79,03	386758,93	-30340,63
	III	1089969,0	363323,00	82,29	411845,95	-48522,95
	IV	1056524,1	352174,70	75,38	358619,40	-6444,70
2002	I	1093329,2	364443,07	72,57	337020,96	27422,10
	II	1114298,6	371432,87	81,48	405612,67	-34179,81
	III	1150477,1	383492,37	86,20	441883,68	-58391,31
	IV	1106008,1	368669,37	79,79	392556,14	-23886,77
2003	I	1146990,2	382330,07	81,14	402996,23	-20666,17
	II	1170350,3	390116,77	82,94	416796,66	-26679,89
	III	1202935,5	400978,50	89,56	467791,54	-66813,04
	IV	1157238,1	385746,03	83,88	424030,34	-38284,31
2004	I	1194007,6	398002,53	82,87	416257,98	-18255,45
	II	1221702,5	407234,17	84,52	428981,05	-21746,89
	III	1257044,9	419014,97	92,51	490492,99	-71478,02
	IV	1240079,0	413359,67	88,84	462250,85	-48891,19
2005	I	1265229,8	421743,27	88,25	457659,26	-35915,99
	II	1293431,8	431143,93	87,74	453760,26	-22616,32
	III	1330433,8	443477,93	92,42	489749,10	-46271,17
	IV	1303405,1	434468,37	84,84	431469,23	2999,13
2006	I	1330100,5	443366,83	81,45	405330,51	38036,33
	II	1357241,7	452413,90	85,26	434650,00	17763,90
	III	1408450,6	469483,53	92,05	486927,45	-17443,92
	IV	1382344,8	460781,60	88,75	461506,96	-725,36
2007	I	1410639,9	470213,30	87,28	450194,72	20018,58
	II	1448540,6	482846,87	91,15	480001,59	2845,28
	III	1503442,4	501147,47	95,75	515374,80	-14227,33
	IV	1463103,6	487701,20	92,70	491955,12	-4253,92
2008	I	1498358,5	499452,83	92,38	489492,59	9960,25
	II	1539837,1	513279,03	94,16	503164,76	10114,28
	III	1597480,8	532493,60	97,28	527148,77	5344,83
	IV	1540392,0	513464,00	94,10	502703,03	10760,97

Data with 68 observations (continued)

Year	Quarter	PDB	Y	IPAGR	E	D
1	(2)	(3)	(4)	(5)	(6)	(7)
2009	I	1566089,7	522029,90	92,55	490800,81	31229,09
	II	1603521,5	534507,17	94,76	507782,00	26725,17
	III	1665681,5	555227,17	97,36	527815,70	27411,46
	IV	1626658,3	542219,43	98,30	534998,08	7221,35
2010	I	1642356,3	547452,10	98,41	535895,88	11556,22
	II	1709132,0	569710,67	102,35	566215,77	3494,89
	III	1775109,9	591703,30	98,12	533664,21	58039,09
	IV	1737534,9	579178,30	101,11	556622,17	22556,13
2011	I	1748731,2	582910,40	101,86	562419,37	20491,03
	II	1816268,2	605422,73	105,02	586711,20	18711,53
	III	1881849,7	627283,23	105,56	590866,72	36416,51
	IV	1840786,2	613595,40	103,94	578451,47	35143,93
2012	I	1855580,2	618526,73	103,62	575937,64	42589,10
	II	1929018,7	643006,23	107,16	603205,02	39801,21
	III	1993632,3	664544,10	107,27	604025,86	60518,24
	IV	1948852,2	649617,40	115,47	667179,49	-17562,09
2013	I	1958395,5	652798,50	112,93	647633,16	5165,34
	II	2036816,6	678938,87	114,41	659022,36	19916,51
	III	2103598,1	701199,37	115,00	663562,65	37636,72
	IV	2057687,6	685895,87	117,20	680492,54	5403,33
2014	I	2058584,9	686194,97	116,91	678209,57	7985,40
	II	2137385,6	712461,87	119,21	695934,65	16527,22
	III	2207343,6	735781,20	121,64	714634,48	21146,72
	IV	2161552,5	720517,50	123,68	730333,11	-9815,61
2015	I	2157848	719282,67	122,82	723715,06	-4432,39
	II	2238761,7	746253,90	125,47	744082,23	2171,67
	III	2312640	770880,00	126,51	752111,11	18768,89
	IV	2273261,6	757753,87	129,56	775582,09	-17828,22
2016	I	2264089,7	754696,57	127,89	762730,76	-8034,20
	II	2354797,7	784932,57	131,76	792486,33	-7553,76
	III	2428569,9	809523,30	132,67	799540,45	9982,85
	IV	2385577,1	795192,37	132,26	796385,34	-1192,97

Appendix 2. Data with 204 observations

Month	Year	IP	Initial Estimations (W)	Monthly GDP (Z)	Year	IP	Initial Estimation (W)	Monthly GDP (Z)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	2000	79,73	392120,06	329038,08	2001	71,04	325246,99	335300,30
2		82,03	409819,49	346737,51		72,47	336251,42	346304,73
3		81,29	404124,89	341042,91		76,14	364493,56	374546,87
4		82,57	413975,01	375041,57		75,51	359645,45	329304,82
5		81,02	402047,13	363113,69		80,49	397968,57	367627,94
6		69,28	311703,08	272769,64		81,1	402662,77	372322,14
7		71,04	325246,99	334484,34		82,13	410589,03	362066,08
8		72,47	336251,42	345488,76		83,33	419823,52	371300,57
9		76,14	364493,56	373730,90		81,42	405125,30	356602,35
10		75,51	359645,45	319646,16		83,87	423979,04	417534,34
11		80,49	397968,57	357969,27		81,13	402893,63	396448,93
12		81,1	402662,77	362663,47		61,13	248985,53	242540,83
1	2002	74,05	348410,16	375832,27	2003	79,71	391966,15	371299,99
2		68,05	302237,73	329659,84		78,63	383655,12	362988,95
3		75,61	360414,99	387837,10		85,09	433367,43	412701,26
4		80,81	400431,10	366251,29		80,10	394967,36	368287,47
5		81,91	408896,05	374716,24		82,23	411358,57	384678,68
6		81,73	407510,87	373331,07		86,48	444064,05	417384,15
7		86,8	446526,58	388135,26		89,51	467381,12	400568,08
8		86,51	444294,91	385903,59		88,86	462379,11	395566,07
9		85,28	434829,56	376438,25		90,32	473614,40	406801,36
10		88,02	455914,97	432028,20		90,15	472306,18	434021,87
11		86,38	443294,51	419407,74		74,60	352642,63	314358,33
12		64,96	278458,93	254572,16		86,88	447142,21	408857,90
1	2004	85,65	437676,86	419421,41	2005	87,37	450912,96	414996,96
2		78,49	382577,76	364322,31		86,83	446757,44	410841,44
3		84,46	428519,33	410263,88		90,54	475307,39	439391,40
4		82,37	412435,93	390689,05		85,27	434752,61	412136,28
5		84,80	431135,77	409388,88		88,79	461840,43	439224,11
6		86,39	443371,46	421624,57		89,16	464687,73	442071,41
7		91,08	479462,91	407984,89		90,34	473768,31	427497,14
8		91,89	485696,19	414218,16		93,42	497470,16	451198,99
9		94,57	506319,87	434841,85		93,49	498008,83	451737,67
10		98,00	532715,11	483823,92		92,70	491929,46	494928,60
11		78,76	384655,52	335764,33		78,88	385578,97	388578,10
12		89,77	469381,93	420490,74		82,95	416899,27	419898,40

Data with 68 observations (continued)

Month	Year	IP	Initial Estimation (W)	Monthly GDP (Z)	Year	IP	Initial Estimation (W)	Monthly GDP (Z)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	2006	81,65	406895,24	444931,57	2007	88,65	460763,07	480781,66
2		80,81	400431,10	438467,43		83,69	422593,87	442612,45
3		81,88	408665,18	446701,51		89,49	467227,21	487245,80
4		82,01	409665,59	427429,49		89,59	467996,76	470842,03
5		85,25	434598,70	452362,60		90,87	477846,87	480692,15
6		88,51	459685,72	477449,62		92,99	494161,13	497006,41
7		90,67	476307,79	458863,87		94,97	509398,03	495170,70
8		90,72	476692,56	459248,64		95,21	511244,93	497017,60
9		94,76	507782,00	490338,08		97,06	525481,43	511254,10
10		84,27	427057,20	426331,84		89,00	463456,47	459202,55
11		90,06	471613,60	470888,23		94,17	503241,71	498987,79
12		91,91	485850,09	485124,73		94,94	509167,17	504913,26
1	2008	93,83	500625,27	510585,52	2009	92,26	488543,49	519772,58
2		91,62	483618,43	493578,67		92,42	489774,75	521003,85
3		91,70	484234,06	494194,31		92,98	494084,18	525313,27
4		92,76	492391,19	502505,47		93,89	501087,00	527812,16
5		94,53	506012,06	516126,33		94,67	507089,41	533814,58
6		95,19	511091,02	521205,30		95,72	515169,59	541894,76
7		97,61	529713,90	535058,73		97,38	527943,96	555355,42
8		97,96	532407,29	537752,13		98,62	537486,26	564897,73
9		96,26	519325,11	524669,94		96,09	518016,89	545428,35
10		94,40	505011,65	515772,62		98,85	539256,20	546477,56
11		94,77	507858,95	518619,92		98,37	535562,41	542783,76
12		93,13	495238,49	505999,46		97,67	530175,63	537396,98
1	2010	96,59	521864,59	533420,81	2011	101,66	560880,29	581371,32
2		97,28	527174,42	538730,64		98,06	533176,83	553667,86
3		101,37	558648,63	570204,85		105,86	593200,99	613692,02
4		101,44	559187,30	562682,20		102,19	564958,86	583670,39
5		100,9	555031,78	558526,68		105,63	591431,05	610142,58
6		104,72	584428,23	587923,13		107,23	603743,70	622455,23
7		100,93	555262,65	613301,74		109,45	620827,50	657244,01
8		101,12	556724,77	614763,86		103,1	571961,68	608378,19
9		92,32	489005,21	547044,30		104,12	579810,99	616227,50
10		100,77	554031,38	576587,51		107,59	606514,04	641657,98
11		101,72	561342,02	583898,15		101,35	558494,72	593638,65
12		100,83	554493,11	577049,24		102,89	570345,64	605489,57

Data with 204 observations (continued)

Month	Year	IP	Initial Estimation (W)	Monthly GDP (Z)	Year	IP	Initial Estimation (W)	Monthly GDP (Z)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	2012	102,76	569345,24	611934,34	2013	113,91	655149,00	660314,35
2		105,63	591431,05	634020,15		112,31	642836,36	648001,70
3		102,46	567036,62	609625,71		112,58	644914,11	650079,46
4		103,38	574116,39	613917,60		114,12	656765,04	676681,50
5		108,31	612054,74	651855,95		115,78	669539,41	689455,87
6		109,79	623443,93	663245,15		113,34	650762,62	670679,22
7		111,41	635910,49	696428,73		115,28	665691,71	703328,49
8		100,78	554108,34	614626,57		113,37	650993,48	688630,17
9		109,61	622058,76	682577,00		116,36	674002,75	711639,43
10		118,17	687931,43	670369,34		118,05	687007,98	692411,31
11		114,13	656841,99	639279,91		116,2	672771,48	678174,81
12		114,12	656765,04	639202,95		117,36	681698,15	687101,48
1	2014	117,32	681390,33	689375,73	2015	123,33	727639,72	723207,32
2		116,6	675849,64	683835,04		119,67	699474,54	695042,14
3		116,8	677388,72	685374,12		125,46	744030,93	739598,54
4		117,25	680851,66	697378,87		127,11	756728,35	758900,02
5		120,16	703245,28	719772,50		123,03	725331,10	727502,76
6		120,22	703707,01	720234,23		126,26	750187,25	752358,92
7		117,05	679312,57	700459,29		122,21	719020,86	737789,76
8		120,13	703014,42	724161,14		127,01	755958,81	774727,70
9		127,74	761576,45	782723,17		130,31	781353,64	800122,54
10		124,37	735642,94	725827,33		132,07	794897,56	777069,33
11		121,73	715327,07	705511,46		129,77	777198,13	759369,90
12		124,94	740029,32	730213,71		126,84	754650,59	736822,37
1	2016	126,5	752034,15	743999,95				
2		128,5	767424,96	759390,76				
3		128,67	768733,18	760698,98				
4		127,28	758036,57	750482,80				
5		131,69	791973,30	784419,54				
6		136,3	827449,12	819895,36				
7		132,93	801515,61	811498,45				
8		134,72	815290,38	825273,23				
9		130,37	781815,37	791798,22				
10		132,15	795513,19	794320,22				
11		132,34	796975,32	795782,35				
12		132,3	796667,50	795474,53				

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IMPACT OF FINANCIAL INCLUSION ON FINANCIAL STABILITY BASED ON INCOME GROUP COUNTRIES

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ABSTRACT

Financial inclusion is one of strategies to increase inclusive growth in a lot of countries. However it may cause either stability or instability in the financial system and the impact can be different among income group countries. Potential instability in the financial system occurs when financial inclusion causes reduction in credit standard, inceasing risk of bank reputation, and uncoresponding regulation in microfinance. Therefore, this research aimed to measure financial inclusion and financial stability indexes between countries and analyze the impact of financial inclusion on financial stability in 19 countries based on income group from 2004-2014. Data were collected from World Bank, the International Monetary Fund (IMF) database, and other sources. The methods used Sarma index to calculate financial inclusion, Albulescu and Goyeau index to calculate financial stability, and Tobit model to analyze the impact of financial inclusion on financial stability. The results show higher income countries have higher financial inclusion and financial stability index than lower income countries. Financial inclusion only has positive significant effect to financial stability in high income countries. Lower and upper middle income countries have to increase availability of financial services to enhance financial inclusion. Moreover, lower and upper middle income countries have to increase financial development to enhance financial stability.

Keywords: financial inclusion index, financial stability index, Tobit model
JEL Classification: G21, G32, C23

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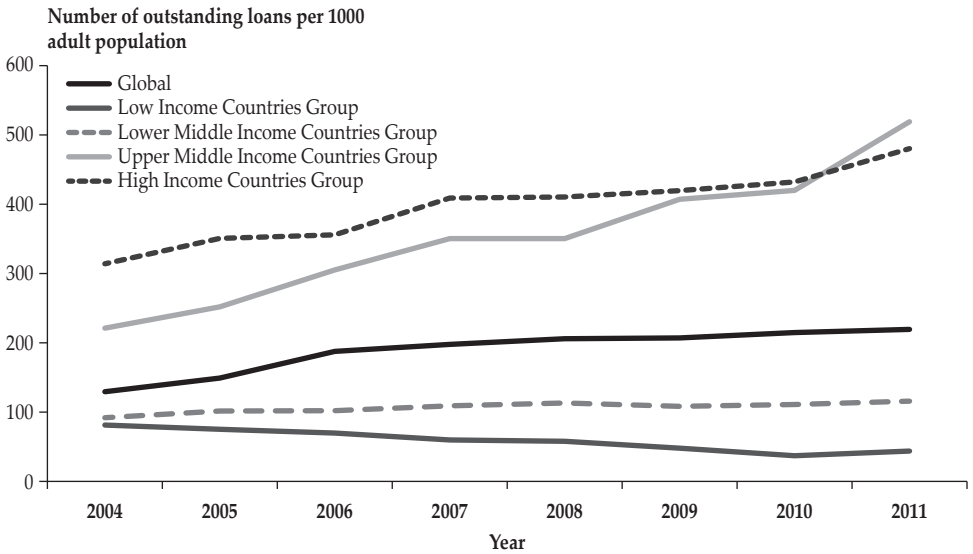
I. INTRODUCTION

Financial inclusion becomes an important program at national and international level because there are 2.6 billion people or more than 50% of world population not having access to credit, insurance, and savings (CGAP, 2013). Financial inclusion program is expected to increase inclusive growth in many countries. Increasing in financial inclusion enhances based deposit as source of credit. The credit can improve real sector peformance. These will reduce poverty, improve income distribution, and improve the stability of the financial system in order to achieve growth that is felt by the entire community (Khan, 2011).

Seriousness of the international communities in implementing the program of financial inclusion can be seen from increasing of formal financial services products. Figure 1 below shows an average increase of outstanding loans from 2004 to 2011. Upper middle income countries group has the highest average growth of outstanding loans. The percentage of outstanding loans growth in upper middle income countries group is 13.3%. Lower middle income countries group has negative growth of loans per 1,000 adult population. The growth rate of lower middle income countries group is negative 8.3%. Average world has positive credit accounts per 1,000 adult population growth rate amount of 8.1%.



Source: *World Bank* (2014)

Figure 1. Number of outstanding loans per 1000 adult population based on income level in 2004-2011

There are few studies about the impact of financial inclusion on financial stability with different result. Some studies about the impact of financial inclusion on financial stability which show the positive impact was conducted by Dienillah (2015), Morgan and Pontines (2014), Cull and Kunt (2007), and Huang and Ratnovski (2011). Meanwhile, some studies which show potential negative impact

of financial inclusion on financial stability undertaken by Dupas et al. (2012) and Khan (2011). Since there are different result of the impact of financial inclusion on financial stability, we need more research about this topic.

In the theory, high level of financial inclusion will be followed by strong financial system and people with lower income level should have a better impact of financial inclusion on financial stability than people with higher income (CGAP, 2013). This is because people with higher income have a faster response when the crisis happen than people with lower income. The response can be seen from the massive withdrawal of higher-income customers when a crisis occurs. But, from some studies and fact have not confirmed these theory so further research is needed.

Han and Melecky (2013) state that financial inclusion has a positive impact on financial stability in high income countries and upper middle income countries. This is because increasing in financial inclusion can improve deposits in commercial bank so it will make resilience of the funding base of deposits in banking sector when crisis occurs. In contrast to high-income countries group and upper middle income group, the lower middle income countries group has the potential instability in financial system due to financial inclusion (Khan, 2011).

Previous studies about the impact of financial inclusion on financial stability still use a proxy to represent the level of financial inclusion and a level of financial stability. Morgan and Pontines (2014) suggest to include other variables in describing financial inclusion and financial stability since financial inclusion is not only seen by financial products indicator such as SMEs outstanding loans but also seen by penetration and product access to formal financial institutions indicators (Sarma, 2008). The stability of the financial system is not only seen by Bank Z score because the financial system is not only influenced by the banking sector, but also influenced by the state of real economy, households, corporations, external factors, and so on. So it is necessary to build a more representative index describes the financial inclusion and stability of financial system. Therefore, the problem in this research are:

1. How is the performance of financial inclusion among countries based on income group countries in 2004-2014?
2. How is the performance of the financial system stability among nations based on income group countries in 2004-2014?
3. What is the impact of financial inclusion on the stability of the financial system based on income group countries in 2004-2014?

Based on the description above, the purpose of this research are to:

1. Calculate and describe index of financial inclusion among countries based on income group countries in 2004-2014.
2. Calculate and describe index of financial stability among countries based on income group countries in 2004-2014.
3. Analyze the impact of financial inclusion on financial stability based on income group between countries in 2004-2014.

II. THEORY

2. 1 Concept of Financial Inclusion

These are various definitions of financial inclusion from some researchers and institution:

Table 1.
Definitions of Financial Inclusion

No.	Authors	Year	Publication	Definition
1	Mandira Sarma	2012	Index of Financial Inclusion –a measure of Financial Sector Inclusiveness	Financial inclusion as a process that ensures the ease of access, availability and usage of the formal financial system for all members of an economy.
2	The Reserve Bank of India	2008	Financial Inclusion – from Obligation to Opportunity	Financial inclusion is the process of ensuring access to financial services and timely and adequate credit where needed by vulnerable groups such as weaker sections and low income groups at an affordable cost
3	Harun R Khan	2012	Issues & Challenges in Financial Inclusion:Policies, Partnerships, Processes & Products	Viable and sustainable business models with focus on accessible and affordable products and processes, synergistic partnerships with technology service providers for efficient handling of low value, large volume transactions and appropriate regulatory and risk management policies that ensure financial inclusion and financial stability move in tandem.

The level of financial inclusion can be measured by an Index of Financial Inclusion (IFI). Some researchers measure financial inclusion by calculating the proportion of adult or household populations who have access to formal financial services. IFI developed by Sarma (2008) are based on three dimensions, namely banking penetration, availability of banking services, and usability.

a. Banking Penetration
   Inclusive financial systems must be reachable or widely accessible among users. Banking penetration can be represented from the proportion of adult people that have an account at the bank. Indicator of banking penetration in this study uses the percentage of total accounts in formal financial institutions to total population over 15 years and the percentage of SMEs that have accounts in formal financial institutions.
b. Availability of financial services
   Inclusive financial systems must be available to all users. In the sarma study, availability indicator is represented by the number of outlets (branches, ATMs, etc.). In addition to Sarma (2012), Camara and Tuesta (2014), and Consultative Group to Assist the Poor (2012) also stated that the availability of financial services can be indicated by the number of branches in financial institutions or ATMs (Automatic Teller Machine).

c. Usability
   Despite having access to financial services, there is still a group of people not yet able to utilize the existence of financial services. Therefore, having an account is not enough to show a level of financial inclusion. Financial inclusion can be demonstrated in the use of financial services such as credits, deposits, payments, remittances, and transfers. Indicators used in Sarma (2012) are Outstanding loans from commercial banks (% to GDP) or Outstanding deposits with commercial banks (% to GDP), Meanwhile, usability indicators in Morgan and Pontines (2014) and Consultative Group to Assist the Poor (2012) is more specialized in the use of loans by small and medium enterprises (SMEs).

2. 2 Concept of Financial Stability

According to the publication of Asean Development Bank Institute (2014), there is no general agreement for the definition of financial stability but many institutions and researchers have tried to define it based on the experiences of some countries and previous studies. Bank Indonesia (2007) stated that Financial System Stability (SSK) is a stable financial system that capable of allocating resources and absorbing shocks that can prevent disruption to real sector activities and financial system. Then according to the European Central Bank (2012), financial system stability is a condition that the financial system can overcome shock and reduce barriers in the process of financial intermediation.

Based on studies that conducted by Hawkins and Klau (2000), Nelson and Perli (2005), Gray et al. (2007), and Cheang and Choy (2011), there are some sectors that can affect the stability of the financial system:

a. Real Economic Sector
   There are four variables of the real sector of the economy that can affect the stability of the financial system, namely GDP growth, government tax position, global oil price index, and domestic inflation.
b. Corporate Sector
   There are four variables of the corporate sector that can affect the stability of the financial system. These variables are the ratio of credit per equity, expenditure on interest, net foreign exchange exposure to equity ratio, and corporate failure.
c. Household Sector
   There are five variables of the household sector that can affect the stability of the financial system. These variables are household assets, household credit, household income, household consumption, as well as household credit services and principal payments.
d. External Sector
   There are six variables of the external sector that can affect the stability of the financial system. These variables are real exchange rate, current account, capital flows, global inflation, global GDP, and global economic climate.
e. Financial Sector
   There are seven variables of the financial sector that can affect the stability of the financial system. These variables are monetary aggregate (saving, transaction, total credit), money supply, ratio of domestic credit to GDP, interest rate

spread, bank profitability (ROA and ROE), real interest rate, banking sector risk (non-performing loan), capital adequacy, liquidity, credit rating of banks, Bank Z-Score, and banking concentration.

f. Financial Market Sector
There are five variables of the financial market sector that can affect the stability of the financial system. These variables are changes in stock index, distribution of corporate bonds, market capitalization, market liquidity, volatility, and housing prices.

2.3 Previous Studies

One of previous studies that analyzed the impact of financial inclusion on financial stability is Han and Melecky (2014). The result is high income countries and middle income countries should increase the access to deposit ratio. It may increase the resilience of the funding base of banking sector deposits at financial stress. The positive impact between financial inclusion and financial stability was also found in Adasme, Majnoni and Uribe (2006) about Chile. The result is an increase in loans by SMEs lowering risk from portfolio bank loans which means increasing the stability of the financial system.

Khan (2011) conducted research about middle income countries. His study stated that financial inclusion has either positive or negative impacts on financial system stability (Khan 2011). Positive impacts arise if financial inclusion can increase the diversification of banking assets and increase monetary policy transmission. While the negative impact is due to financial inclusion may decrease the credit standard. It may cause instability of mcrofinance institutions.

Furthermore, Dupas et al. (2012) with an experimental research in the western province of Kenya, which is a low-income country, has found out that increasing in availability of banking services did not lead to increasing in financial stability. This is because the increasing in financial inclusion is not followed by lower cost of borrowing money for the lower middle class, lack of trust, and not followed by improving the quality of services.

III. METHODOLOGY

3.1 Types and Sources of Data

The data used is secondary data which is an annual data with an unbalanced panel data structure. The panel data consist of a cross section data (five lower middle income countries, nine upper-middle income countries, and five high-income countries) and time series data from 2004 to 2014. The data were collected from various sources such as: World Bank, World Development Indicators (WDI), International Monetary Fund (IMF) database, and other sources. This research was conducted with software such as STATA and Microsoft Excel.

Table 2.
Information about Data, Unit, and Sources

Indicator	Unit	Source
Financial Stability Index		
Financial Development Index (FDI)		
Market Capitalization/GDP	(%)	IFS IMF
National Currency Credit/GPD	(%)	World Bank
Interest Rate Spread	(%)	World Bank
Bank Concentration	(%)	World Bank
Financial Vulnerability Index (FVI)		
Inflation, Consumer Prices	(%)	IFS IMF
General Balance, Deficit or Surplus/GDP	(%)	World Bank
Current Account/GDP	(%)	World Bank
Real Effective Exchange Rate (change)	(%)	World Bank
Non Governmental Credit/Total Credit	(%)	World Bank
Loan/Deposits	(%)	World Bank
Deposit/M2	(%)	World Bank
Financial Soundness Index (FSI)		
Bank Non-Performing Loans To Gross Loans	(%)	World Bank
Bank Capital To Total Assets	(%)	World Bank
Bank Return on Asset (ROA)	(%)	World Bank
Bank Z-Score	(%)	World Bank
World Economic Climate Index		
World Inflation, Consumer Prices	(%)	IFS IMF
World GDP growth	(%)	IFS IMF
Economic Climate Index	Index	CESifo
Financial Inclusion		
Penetration (Number of Bank Accounts per 1,000 adults)	Index	IMF
Availability (Number of Bank Branches per 100,000 adults)	Index	IMF
Usability (Outstanding Loans as Percent of GDP)	(%)	IMF
Usability (Outstanding Deposits as Percent of GDP)	(%)	World Bank
Other Factors		
Non-Performing Loan to Gross Deposit	(%)	World Bank
GDP per capita	USD / person	World Bank
Private credit by deposit money banks and other financial institutions to GDP	(%)	World Bank
Non-FDI capital flow to GDP	Index	World Bank
Financial Openness	Index	Chinn-Ito database
Liquid assets to deposits and short-term funding	(%)	World Bank

3.2 Financial Inclusion Index

Calculation of Financial Inclusion index in this research uses a method developed by Sarma (2008). There are three dimensions in this calculation such as banking penetration (number of deposit accounts at commercial bank per 1,000 adult population), the availability of banking services (number of branches of commercial bank per 100,000 population) and usability (total of the proportion of loans and deposit to GDP). These are the steps of calculation:

1. Calculating the value of the indicator on each dimension that has been weighted.

$$d_i = w_i \frac{A_i - m_i}{M_i - m_i} \quad (1)$$

Where:
w_i = weight for dimension i, $0 \leq w_i \leq 1$; A_i = Current value of the variable i.
m_i = minimum value of the variable i; M_i = maximum value of the variable i.

2. Calculating the value of X_1 and X_2

$$X_1 = \frac{\sqrt{d_1^2 + d_2^2 + d_3^2}}{\sqrt{w_1^2 + w_2^2 + w_3^2}} \quad (2)$$

$$X_2 = 1 - \frac{\sqrt{(w_1 - d_1)^2 + (w_2 - d_2)^2 + (w_3 - d_3)^2}}{\sqrt{w_1^2 + w_2^2 + w_3^2}} \quad (3)$$

3. Calculating the value of the Financial Inclusion Index $= \frac{1}{2}[X_1 + X_2]$ (4)

Range of financial inclusion index is between 0 until 1. Country category based on financial inclusion index value is as follows:
Index <0.3 = Countries with low level of financial inclusion.
0.3 ≤ index <0.6 = Countries with moderate level of financial inclusion.
0.6 ≤ index = Countries with a good level of financial inclusion.

3.3 Financial System Stability Index

Calculation of financial stability index in this study uses a method developed by Albulescu and Goyeau (2010). There are 18 indicators in this calculation. These indicators represent some of the sub-indexes making up the index of financial stability. The constituent sub-indexes include the Financial Development Index, Financial Vulnerability Index, Financial Soundness Index, and the World Economic Climate Index. Steps of financial stability index calculation are as follow:

1. Normalizing each indicator value with the following formula:

$$I_{it}n = \frac{I_{it} - \text{Min } (I_i)}{Max(I_i) - Min(I_i)} \quad (5)$$

Where:
$I_{it}n$ = value of variable that has been normalized.
I_{it} = current value of i variable.
Min (I_i) = minimum value of i variable;
Max (I_i) = maximum value of i variable.

2. Calculating sub-indexes of financial stability index.

$$\overline{D}_t = \frac{\sum_{i=1}^{4} D_{it}}{4} \quad (6), \quad \overline{V}_t = \frac{\sum_{i=1}^{8} V_{it}}{7} \quad (7), \quad \overline{S}t = \frac{\sum_{i=1}^{5} S_{it}}{4} \quad (8), \quad \overline{W}t = \frac{\sum_{i=1}^{3} W_{it}}{3} \quad (9)$$

Where:
$\overline{D}_t$ = value of financial development index which is the average value of all the constituent indicators in t-period.
$\overline{V}_t$ = value of financial vulnerability index which is the average value all indicators constituent in t-period.
$\overline{S}_t$ = value of financial soundness index which is an average value of all indicators constituent in t-period.
$\overline{W}_t$ = value of world economy climate index which is an average value of all indicators constituent WECI in t-period.

3. Finally, the aggregate financial stability index is composed as follows:

$$\text{AFSI} = \frac{4\overline{D}_t}{18} + \frac{7\overline{V}_t}{18} + \frac{4\overline{S}_t}{18} + \frac{3\overline{W}_t}{18} \quad (10)$$

Financial system stability index has a value between 0 and 1. If the index value close to 0 means that the country has an unstable financial system, while if the value close to 1 means that the country has a stable financial system. But increasing in some indicators such as Bank Non-Performing Loans to Gross Loans, Inflation, Interest Rate Spread, World Inflation, and Non-Performing Loan to Gross Deposit will reduce value of sub-indexes.

3.4 Analysis The Impact of Financial Inclusion on Financial Stability

In analyzing the impact of financial inclusion on financial stability in Asia, the equation used is composed as follows:

$$AFSI_{it} = b_1 + b_2 IFI_{it} + b_3 CGDP_{it} + b_7 OPNS_{it} + e_{it} \quad (11)$$

Where :
$AFSI_{it}$: Index of Financial Stability for country i year t (index).
IFI_{it} : Financial Inclusion Index for country i year t (Index).
$CGDP_{it}$: The ratio of private credit from bank deposits and other financial institutions of GDP for country i year t (%).
$OPNS_{it}$: Financial openness index (financial openness) for country i year to t (Index).
e_{it} : Error for country i year t.

IV. RESULT AND ANALYSIS

4.1. Financial Inclusion Based on Income Group Countries

Table 3 shows the average Financial Inclusion Index (IFI) based on the Income Group Countries consisting of lower middle income countries, upper middle, and high income countries. The financial inclusion index consists of three dimensions that represent access to banking sector (d_1), financial services availability (d_2), and usability (d_3).

Table 3.
Financial Inclusion Index by Income Level Group of Countries

Group	Average			
	d_1	d_2	d_3	IFI
LMIC	0.1128915	0.045201	0.20532	0.130108
UMIC	0.242146	0.191096	0.260257	0.242013
HIC	0.5990889	0.414563	0.490407	0.496548

Where:
LMIC : Lower Middle Income Countries.
UMIC : Upper Middle Income Countries.
HIC : High Income Countries.
d_1 : dimension of access to banking sector with normalized data.
d_2 : dimension of financial services availability with normalized data.
d_3 : dimension of financial services usability with normalized data.
IFI : Index of Financial Inclusion.

Table 3 shows that high income countries group has the highest average index of financial inclusion. The financial inclusion index is valued at 0.49 where the value is more than 0.3, which means high income countries group is the group of countries with moderate financial inclusion (Sarma, 2008). High income countries group has the highest average index of financial inclusion since high income countries group has high value of banking penetration dimension represented by the number of deposit accounts at commercial bank per 1,000 adult population, availability of financial services dimensions represented by a number of commercial bank branches per 100,000 population adults, and product usability of formal financial institutions dimensions represented by the proportion of outstanding loans and deposit to GDP.

Upper-middle income countries has an average value of financial inclusion index at 0.24. The index value is less than 0.3 so classified in the group of countries with poor financial inclusion (Sarma, 2008). Dimension that contribute the greatest value on the financial inclusion index in upper middle income countries group is dimension of financial services usability. It is represented by the relatively high proportion of outstanding loans and deposit to GDP compared to other dimensions. The obstacles in the implementation of financial inclusive in Upper-middle income countries group is lack of financial services illustrated by low number of branches provided by commercial banks.

Lower middle income countries group has the lowest average value of financial inclusion index at 0.13. The index value is less than 0.3 so classified in the group of countries with poor financial inclusion (Sarma, 2008). All dimension of financial inclusion in the group of middle income countries is the lowest compared to other groups. Moreover, the lowest dimension in lower middle income group of countries is availability of financial services illustrated by the low number of branches provided by commercial banks.

4.2. Financial Stability Based on Income Group Countries

Table 4 shows the results of calculation for the average financial stability index based on Income Group Countries. Financial system stability index is composed of four sub-indexes representing the development of financial sector, the vulnerability of financial sector, the soundness of financial sector, and world economic climate. From the calculation results obtained as follows:

Table 4.
Financial System Stability Index Based on Income Group Countries

Group	Average				
	FDI	**FVI**	**FSI**	**WECI**	**AFSI**
LMIC	0.2986871	0.392638	0.597476	0.652325	0.46056
UMIC	0.398602	0.496787	0.582886	0.638334	0.517693
HIC	0.5982915	0.547644	0.531516	0.671236	0.575914

Where:
FDI : Financial Development Index; FVI: Financial Vulnerability Index
FSI : Financial Soundness Index; WECI: World Economic Climate Index.
AFSI : Aggregate Financial Stability Index

Table 4 shows that the group of countries having the highest value of an average financial stability index is high income countries group. The high index of financial stability in high-income group of countries due to the relatively high constituent sub-indexes such as the Financial Development Index and Financial Vulnerability Index. The high index of financial development is illustrated by the high average value of capital in the financial markets, high value of domestic credit, low interest rate spreads, and high concentration of banking sector. Then, the high index of financial vulnerability is illustrated by the low rate of inflation and high real effective exchange rate.

Either lower middle income countries group or upper middle income countries group has lower value of financial stability index than high-income countries group because group of lower middle income countries and upper middle income have low value of financial development index. The low index of financial development is illustrated by low value of the capital in the financial markets and the low domestic credit value thus inhibiting stability of financial system.

4.3. Impact of Financial Inclusion of the Financial System Stability Based on Income Group Countries

This is the result of regression using Tobit model to answer the impact of financial inclusion and other factors on financial stability based on income group countries:

Table 5.
Impact of Financial Inclusion and
other Factors on Financial Stability Based on Income Group Countries

	LMIC	UMIC	HIC
	AFSI	AFSI	AFSI
IFI	0.3777	0.4568*	0.5142* *
CGDP	0.1965*	0.0239*	0.0673
OPNS	0.0004	0.0022	-0.0127*
Cons	0.4123***	0.4911***	0.5403***

*** : Significant level of 1%, ** : Significant level of 5%, * : Significant level of 10%.

Table 5 shows that financial inclusion has a positive impact on the stability of the financial system in lower middle income countries group, but the effect is not significant. In upper middle and high income countries group, financial inclusion has a positive and significant impact with a significant level at 5% and 10%, which means increasing in financial inclusion in terms of access, availability, and usability of financial services will improve the stability of financial system. This is due to increasing in financial inclusion illustrates the strengthening of real sector. In addition, increasing in financial inclusion will be followed by a strengthening of the base deposit that can be used to improve the process of intermediation (Khan, 2011).

Other variables that significantly affect financial stability are the ratio of private credit from bank deposits and other financial institutions of GDP and financial openness. The ratio of private credit from bank deposits and other financial institutions of GDP has a significant positive influence on stability of financial system over the group of lower and upper middle income countries with a significance level at 10%, it means increasing in the ratio of private credit from bank deposits and other financial institutions to GDP will improve the stability of financial system. This is because increasing in private credit will lead to growth in the real sector and growth in financial sector that will strengthen the stability of financial system (Sahay et al., 2015).

Financial openness has a significant negative impact on stability of financial system in high-income countries at the level of 10%. It means increasing in financial openness will reduce the stability of financial system due to high level of financial openness will increase the vulnerability to capital outflows from

short-term capital when shocks occur. Capital outflow will be followed by volatile capital (depreciation of capital in the stock market) and the depreciation of the currency will eventually enhance instability in financial system (Estrada, Park, and Ramayandi, 2015).

V. CONCLUSION

5.1. Conclusions

Group of countries with higher income level has a better level of average access, availability, and usability of financial services so that it has higher value of financial inclusion index than lower income group. Group of countries with higher income level also has higher value of financial stability index than lower income group. The high average index of financial stability in group of countries with higher income due to many factors such as having high value of capital in the financial markets, having high concentrations of banking sector, having low level of inflation, and so on.

Financial inclusion has a positive impact but not significant to the stability of financial system in the group of lower income countries, but has a significant positive impact on the stability of financial system in upper middle income and high-income countries group. This is because increasing in financial inclusion illustrates the strengthening of the real sector in high-income countries group. In addition, the increase in financial inclusion will be followed by a strengthening of the base deposit that can be used to improve the process of banking intermediation (Khan, 2011).

5.2. Recommendations

1. For the government and the financial sector in lower middle income countries should encourage sub-index of financial development by encouraging capital flow in financial markets and enhancing domestic credit.
2. For the financial services authority and banking sector in upper middle and high income countries, to encourage financial stability can push financial inclusion by increasing bank capital to assets and reducing volatility of banking return on assets.
3. For further research, it's better to add low-income countries group if it has not problem of data availability.
4. One of lack of this research is only use data from 2004-2014, so it could not capture economic crisis in 1998-1999.

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