The Dynamics of Non-Performing Loan in Indonesian Banking Industry: A Sensitivity Analysis using VECM Approach

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Setiawan Abadi [1], Noer Azam Achsani [2], Dwi Rachmina [3]

Abstract

This study aimed to analyze the dynamics of Non-Performing Loan (NPL) in Indonesian banking industry, both at the aggregate level and per economic sectors. We employ 6 macroeconomic variables influencing the NPL such as BI (Bank Indonesia) rate as proxy of interest rate, CPI, nominal exchange rate, import, M2 and the Industrial Production Index (IPX) on monthly basis from January 2003 to December 2013. We used Vector Error Correction Model (VECM) and take impulse response function (IRF) and variance decomposition to analyze the sensitivity and to determine which variables were dominant.

It was found a positive relationship between NPL, either in aggregate level and per economic sector with interest rate and M2, meanwhile CPI and nominal exchange rate variables shown dualism, which are some sectors shown positive and the others are negative relationship. Import variables had negative relationship with NPL, while IPX was not good enough to explain the NPL in most sectors, except manufacturing and social services sector. It was found that mining sector is highly sensitive to interest rate shocked, meanwhile Agriculture is quite sensitive not only with interest rate but also import variables. While Trading sector is sensitive due to exchange rate shocked. It was concluded that interest rate is the dominant variables that influence the NPL.

Keywords: NPL, VECM, economic sector, macroeconomic
JEL classification

1. Introduction

Dynamic of global economic fluctuation's condition today has given higher level of uncertainty on doing business. Intense of fluctuations that exist continuously and occurred in long term period will influence the economic sustainability (Prasetyantoko, 2008). Banking sector in Indonesia has been an important role as pillar in national economic growth. Banking sector have intermediation function that could either direct or indirectly support the real sector growth (Suta and Musa, 2003). Indonesian economic growth was in line with Indonesia Banking's loan and assets growth, which since 2001 they always shown positive growth. Hence, resilience of banking sector in Indonesia is very important due to macroeconomic changes and its role in economic development.

Sensitivity analysis that commonly known as stress test was conducted to complement the risk measurement system by estimating bank's potential losses in abnormal market (stress) conditions by using certain scenarios due to sensitivity of changes in the bank's performance and identify risk factors that influence a significant impact for bank's portfolio.

Bank's performance in Indonesia is generally influenced by internal and external factors. Internal factors came from such as management business decisions that reflected in its capital expenditure, internal policy, human resources allocation and others (Sastrosuwito and Yashusi, 2012). Meanwhile, external factors may come from such as regulation and macroeconomic factors either in domestic and international. The bank's performance is affected by various types of risks faced by banks.

Currently, Bank Indonesia (BI) regulation stated that there are eight (8) types of risk faced by banks in business operations such as credit risk, market, liquidity, operational, legal, reputation, strategic and compliance. Nevertheless, this study will focus on the Indonesian banking's sensitivity analysis that derived from credit risk. Credit risk has a meaning related to the possibility (probability) of a borrower (debtors) become default and unable to meet its obligations to creditors. Credit risk might be pointed out from several indicators, such as NPL (Non-Performing Loan) ratio, write off, loan loss reserves (allowance for impairment), restructured loan, etc, but the most commonly used indicator is the NPL ratio. We might conclude that the higher Banks' NPL have, the higher its credit risk faced by the Banks.

The purposes of this study were to analyze the sensitivity of Indonesian banking NPL's both in banking system aggregate level and per economic sector due to macroeconomic changes and to find out which macroeconomic variables were dominant to influence the NPL. We expect that this study can provide a comprehensive overview on the NPL sensitivity either in aggregate level or per economic sector that will reflected in the NPL's movement in the future.

This study is limited to the impact of credit risk due to macroeconomic changes that is reflected in the NPL either in aggregate level or per economic sector. Some macroeconomic variables that are chosen regarding some previous study were nominal exchange rate USD/IDR, BI (Bank Indonesia) rate as proxy of interest rate, Consumer Price Index (CPI), Industrial Production Index (IPX), broad money supply (M2) and imports.

2. Literature Review

Some previous study has been conducted to examine the relationship between NPL and macroeconomic variables. Various macroeconomic variables that been used in previous study were diverse, but several common variables such as exchange rate, CPI, interest rates are being used in previous study and each of these variables have a significant contribution to influenced the NPL ratio.

Study by Khemraj and Pasha (2009) in Guyana, conclude that several macroeconomic variables such as exchange rates, GDP growth and interest rates were the dominant factor that affecting the level of NPL. While the research conducted by Farhan *et al.* (2012), confirms that the level of NPLs in Pakistan are strongly influenced by macroeconomic changes, such as inflation (CPI) and the interest rate that have positive association with NPL ratio. The higher of the inflation and interest rates in Pakistan, they will increase the NPL ratio. Meanwhile, according to the study by Collins *et al.* (2011) and Gremi (2013), concluded that the interest rate has a strong positive relationship to the bank's NPL ratio. The higher the interest rate they have, the higher the NPLs level will be. These results indicate that if interest rates getting higher, many borrowers will not be able to fulfill its obligations to the bank.

According to Janvisloo *et al.* (2013), there is strong evidence that the loan quality in Malaysian Banking is sensitive to economic cycles. One of the results from this study showed a strong negative relationship between economic growth (GDP) and NPL levels. Meanwhile, based on research by Ahmad and Bashir (2013), one of the conclusions is founding negative relationship between the level of industrial production and NPLs level in Pakistan. This indicates that the lower of industrial production level in a country, the more NPLs of banks in the country will increase.

Based on previous researches, it shown some initial hypotheses that can describe the relationship between macroeconomic variables and NPL level. Some initial hypothesis of macroeconomic variables related to NPL ratios can be seen in Table 1.

Table 1. Initial hypothesis on relationship on macroeconomic to affect NPL

No	Macroeconomic variables	Initial hypothesis of macroeconomic relationship to NPL ratio
1	IPX	(-) Negative
2	CPI	(+) Positive
3	BI rate (Interest rate)	(+) Positive
4	Exchange rate (USD/IDR)	(+) Positive
5	M2	(+) Positive
6	Import	(-) Negative

3. Data and Methodology

All data either the NPL and macroeconomic variables (CPI, BI rate, exchange rate USD/IDR, IPX, M2 and imports) that been used in this study derived from the Indonesian Banking Statistics (SPI, Bank Indonesia) and BPS in monthly basis from January 2003 to December 2013. This study will be conducted using NPL level data in aggregate and per economic sector for Indonesian Commercial Banking. There are ten (10) economic sectors of loan in Indonesian Banking Statistics data (SPI) that will be indexed as seen in Table 2.

Table 2. Macroeconomic Variables and NPL Index [4]

Index	NPL / macroeconomic	Initial	Unit	Transformation
[1]	Agriculture, hunting and agriculture facilities	AGRI	(%)	-
[2]	Mining	MIN	(%)	-
[3]	Manufacturing	MANU	(%)	-
[4]	Electricity, gas and water	ELEC	(%)	-
[5]	Construction	CONST	(%)	-
[6]	Trade, restaurant and hotel	TRADE	(%)	-
[7]	Transport, cargo storage and communication	OTO	(%)	-
[8]	Business services	SERVBUS	(%)	-
[9]	Social services	SERVSOC	(%)	-
[10]	Others	OTH	(%)	-
[11]	Aggregate (Total)	TOT	(%)	-
-	BI rate [5]	INT	(%)	-
-	CPI (2007 = 100)	IHK	Indices	-
-	IPX (2000 = 100)	IPX	Indices	-
-	M2	L_M2	Billion Rp	ln
-	Exchange rate (USD/IDR)	L_KURS	In unit Rp	ln
-	Import	L_IMP	Million USD	ln

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4) Since August 2011, the loan data format in SPI divided into 18 economic sectors in more detail format different with 10 economic sectors as previous period. Researcher is doing an internal mapping to the loan data before and after August 2011 in order to classify the economic sector following the 10 economic sectors format. This can be done because the new economic sectors format (18) is a breakdown from the previous economic sectors format (10).

5) BI rate was chosen as a proxy for interest rate that is used in this study. BI rate sourced from Bank Indonesia and the data is available from November 2005. For the period before November 2005, researcher use 1-month SBI (Sertifikat Bank Indonesia) rate as a proxy with the consideration that the 1-month SBI rate is the best estimator to get BI rate numbers. BI rate set by Bank Indonesia with the aim to be used as a reference rate to liquidity operations undertaken through SBI auction. The maximum gap between 1-month SBI rate and the BI rate from November 2005 to November 2007 (2 years data) is not significant (maximum 2bps).

We used the exchange rate of USD/IDR based on mid prices exchange rate of USD/IDR exchange rate obtained from BI. The model discussed in this section analyzes the sensitivity of NPL to macroeconomic conditions with the help of Vector Error Correction Model (VECM) techniques to find the relationship between NPLs level and macroeconomic variables both in aggregate and per economic sectors level.

VECM model that been used in this study were constructed to follow the general model as follows (Firdaus, 2012):

$$\Delta Y_{it} = \mu_{i0x} + \mu_{i1x}t + \Pi_{ix}Y_{i,t-1} + \sum_{j=1}^{k-1}\Gamma_{jx}\,\Delta Y_{i,t-j} + \varepsilon_{it} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(1)$$

Notes:

ΔY_{it} : vector form difference in endogenous variable size (n x 1), which are NPL i-th sector, and macroeconomic variables (IPX, CPI, BI *rate*, exchange rate, M2 and Import).

μ_{i0x} : intercept vector size (n x 1).

μ_{i1x} : coefficient regression vector from i-th sector model.

t : time trend.

Π_{ix} : α$_x$β', where β' contain long term cointegration equation.

$Y_{i,t-1}$: variable in level.

Γ_{jx} : coefficient matrix of cointegration.

$k - 1$: order of VECM.

ε_{it} : vector of error from i-th sector.

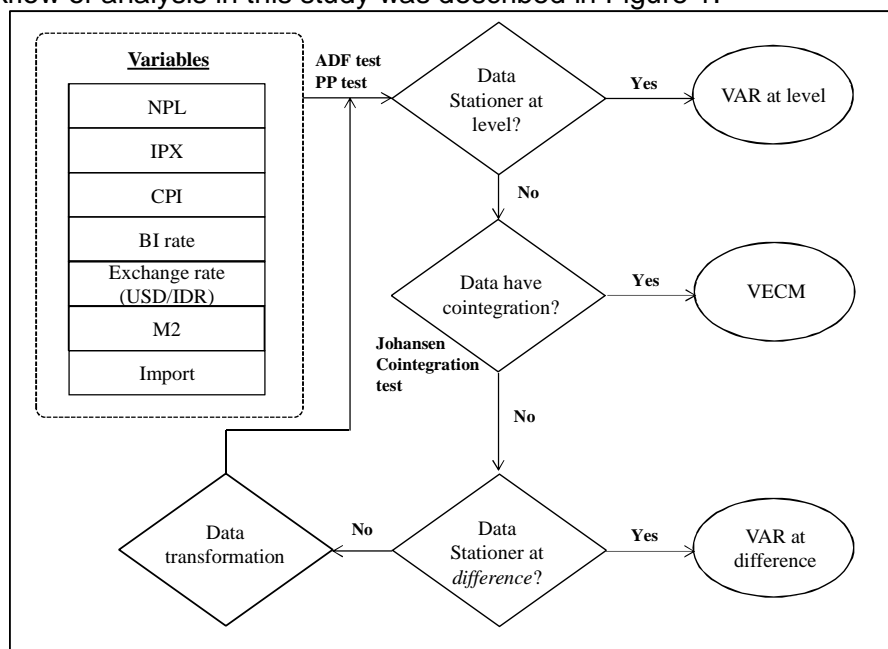The workflow of analysis in this study was described in Figure 1.

Figure 1. Workflow of Choosing Methodology

4. Indonesian Banking Description

Banking in Indonesia has been grown significantly for last decade, both in terms of assets and by loans disbursed. After the 1997-1998 economic crisis in Southeast Asia, including

Indonesia, banking sector continue to grow rapidly, whereas since 2003 loan always reach 10% minimum growth (Figure 2).
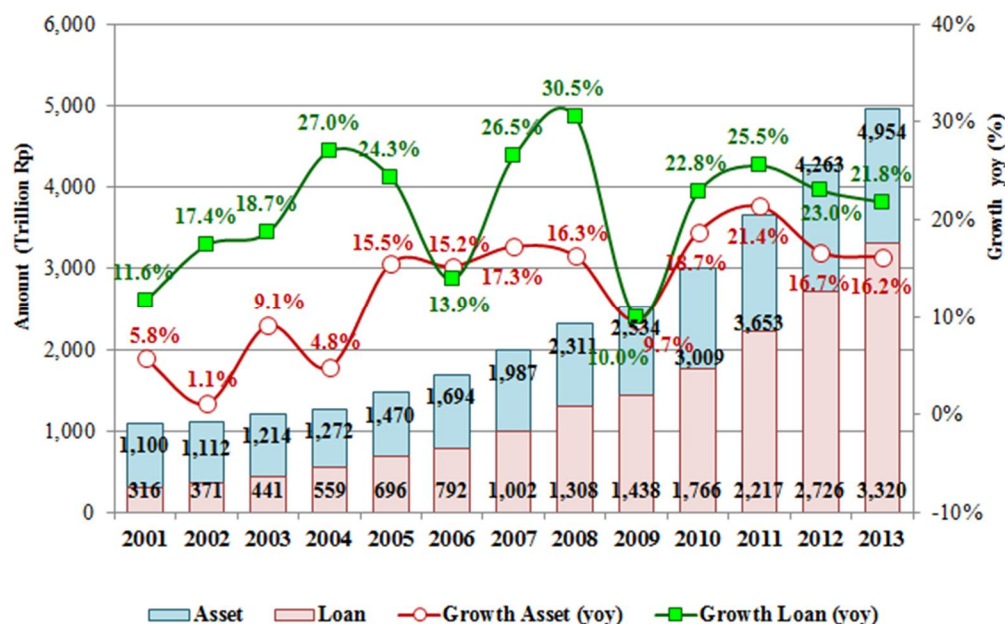

**Figure 2. Trend Asset and Loan Growth of Commercial Banking in Indonesia
Source: Indonesian Banking Statistics, Bank Indonesia (2003-2013)**

Loans deployment in Indonesia has been categorized through ten economic sectors based on Indonesian Banking Statistics (SPI). In 2003, loan to manufacturing sector was the largest portion (28.1%), but currently loan portion to this sector continued to decline (become 20.7% in 2008 and 17.5% in 2013). Meanwhile some economic sectors were growing quite significant, such as Mining, Trading and Others. Others sectors here including consumer loan, such as residential mortgage loans and car loans were growing very rapidly since 2005 until now (Table 3).

Table 3. Loan Composition per Economic Sector (Year 2003, 2008 and 2013)

in Billion Rupiah

Economic Sector	2003		2008		2013	
	Amount	[%]	Amount	[%]	Amount	[%]
[1] Agriculture	24,573	5.6	67,202	5.1	183,553	5.6
[2] Mining	5,122	1.2	32,215	2.5	126,826	3.9
[3] Manufacturing	123,810	28.1	271,187	20.7	577,880	17.5
[4] Electricity, gas and water	4,475	1.0	18,475	1.4	79,493	2.4
[5] Construction	12,543	2.8	58,753	4.5	116,090	3.5
[6] Trading	85,112	19.3	259,632	19.9	703,354	21.4
[7] Transportation	16,385	3.7	62,579	4.8	163,418	5.0
[8] Business servicess	44,953	10.2	152,302	11.6	344,336	10.5
[9] Social services	10,923	2.5	15,747	1.2	83,821	2.5
[10] Others	112,609	25.6	369,596	28.3	914,102	27.8
Aggregate (Total)	**440,505**		**1,307,688**		**3,292,874**	

Source: Indonesian Banking Statistics, Bank Indonesia (2003, 2008 and 2013)

Since 2003 to 2013, Indonesia had passed a mini crisis period in 2005 which is appears from the rising of NPLs in that period (Figure 3). This mini crisis at that time was triggered by high inflation, and rising of fuels price. But after 2007, NPL were gradually decreasing and remain stable until 2013. In fact, global crisis in US and Europe in 2008 to 2009 slightly impact to NPL for certain sectors such as Construction, Transportation, Business and Social Services. This indicates that the macroeconomic conditions or the current economic crisis may greatly affect the level of NPL.
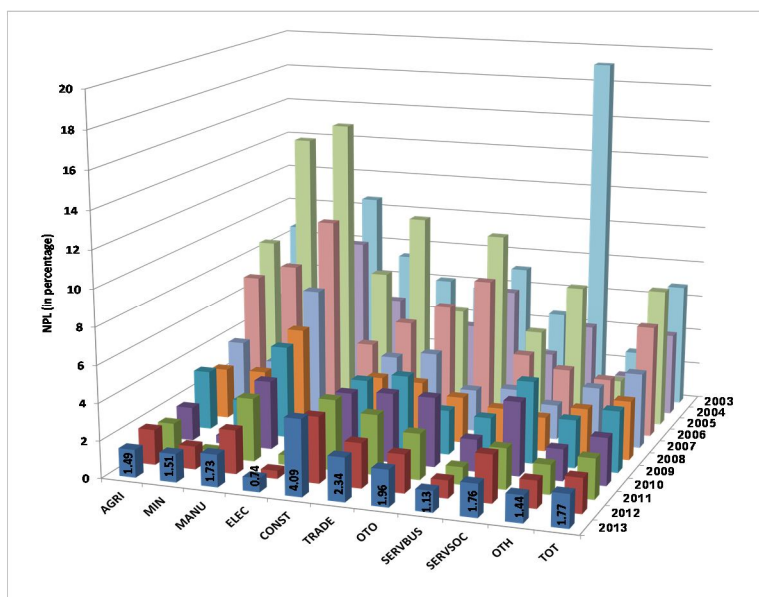

Figure 3. Series of NPL per Economic Sectors (2003 – 2013)
Source: Indonesian Banking Statistics, Bank Indonesia (2003-2013)

5. Results

In accordance with several steps to build VECM model, the first process is to ensure that all data that included in the model are stationary (Enders, 2004). Based on the Augemented Dickey Fuller (ADF) test and Phillip-Perron (PP) test, we found that all the data is stationary at 1st difference.

Table 4. ADF and PP Test of All Variables (NPL and Macroeconomic)

Variable	Data Level		Data *1st Diff.*	
	ADF	**PP**	**ADF**	**PP**
NPL_AGRI	0.1270	0.1372	**0.0000**	**0.0000**
NPL_MIN	0.2049	0.1141	**0.0000**	**0.0000**
NPL_MANU	0.7005	0.7263	**0.0000**	**0.0000**
NPL_ELEC	**0.0487**	0.0529	**0.0000**	**0.0000**
NPL_CONST	0.1481	0.0865	**0.0000**	**0.0000**
NPL_TRADE	0.5774	0.5762	**0.0000**	**0.0000**
NPL_OTO	0.5674	0.4839	**0.0000**	**0.0000**
NPL_SERVBUS	0.2622	0.3962	**0.0000**	**0.0000**
NPL_SERVSOC	0.1547	**0.0011**	**0.0000**	**0.0000**
NPL_OTH	0.7659	0.8077	**0.0000**	**0.0000**
NPL_TOT	0.7137	0.6658	**0.0000**	**0.0000**
INT	0.0797	0.0878	**0.0010**	**0.0013**
IPX	0.9993	0.4387	**0.0001**	**0.0001**
L_KURS	0.5522	0.5703	**0.0000**	**0.0000**
L_IMP	0.6384	0.6159	**0.0000**	**0.0000**
L_M2	0.9922	0.9998	**0.0355**	**0.0000**
IHK	0.9777	0.9800	**0.0000**	**0.0000**

Note:

*) The result shown stationary test for all data either in level and 1st difference data using ADF and PP test. Bold is significant value with 95% confidence level. NPL_ELEC at data level is stationary by ADF-test but not by PP-test, whereas NPL_SERVSOC is stationary by PP-test but not by ADF-test. For ensuring the stationary, author choose all data in 1st difference that comply with either ADF and PP test.

After ensuring that all data is stationary, it is necessary to determine the optimum lag that will be used in the VAR / VECM model as obtained the results in Table 5. Optimum lag that been choosen by Author to construct VAR/VECM model is using the minimum lag that had been recommended by Eviews, such as LR statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ). We used the minimum lag as the optimum lag in constructing the model with consideration of minimising missing information from those models.

Table 5. Optimum Lag of VECM Model per Economic Sector

VAR/VECM	Max[*)]	LR	FPE	AIC	SC	HQ	Opt
NPL_AGRI	4	4	4	4	1	2	1
NPL_MIN	4	4	2	2	1	2	1
NPL_MANU	4	4	2	2	1	2	1
NPL_ELEC	5	4	2	2	1	2	1
NPL_CONST	4	4	2	2	1	2	1
NPL_TRADE	4	4	2	2	1	2	1
NPL_OTO	7	4	2	2	1	2	1
NPL_SERVBUS	3	3	2	2	1	2	1
NPL_SERVSOC	4	4	2	2	1	2	1
NPL_OTH	6	4	2	2	1	2	1
NPL_TOT	5	4	2	2	1	2	1

*) Max. lag is the maximum lag obtained from the VAR / VECM model that striclty stable based on requirement of AR Root Test. The optimum lag (Opt) is the minimum lag from 5 recommendation lag tested in Eviews.

The next step in the process is to check whether there is any co-integration equation in the model or not by using Johansen co-integration test. Based on the results of Johanssen co-integration test (Table 6), we might see that all models at least have one cointegration equation, which means we have to use the VECM model.

Table 6. Johansen Cointegration Test Using Trace Statistics per Economic Sectors

Variables	H₀: R=0	R≤1	R≤2	R≤3	R≤4
	H₁: R≥1	R≥2	R≥3	R≥4	R≥5
NPL_AGRI	**145.830**	**86.917**	54.076	30.639	16.588
	[0.0003]	**[0.0082]**	[0.0917]	[0.567]	[0.7352]
NPL_MIN	**164.091**	**10.156**	64.627	38.239	20.143
	[0.0012]	**[0.0478]**	[0.2202]	[0.8309]	[0.9141]
NPL_MANU	**146.352**	98.151	67.433	39.483	20.762
	[0.0064]	[0.156]	[0.5734]	[0.8149]	[0.8466]
NPL_ELEC	**141.706**	96.765	54.871	31.778	11.984
	[0.0054]	[0.095]	[0.2827]	[0.5778]	[0.8335]
NPL_CONST	**139.318**	83.563	52.999	30.333	12.003
	[0.0004]	[0.0854]	[0.2483]	[0.6261]	[0.7922]
NPL_TRADE	**145.222**	91.830	64.091	37.765	20.759
	[0.0197]	[0.2958]	[0.7184]	[0.8754]	[0.9103]
NPL_OTO	**165.708**	112.600	71.316	44.415	22.301
	[0.0064]	[0.0751]	[0.225]	[0.6039]	[0.8904]
NPL_SERVBUS	**136.920**	86.041	52.576	30.250	12.687
	[0.0073]	[0.0875]	[0.3465]	[0.7574]	[0.8589]

NPL_SERVSOC	**150.907**	94.068	66.042	41.133	22.007
	[0.0013]	[0.0594]	[0.2034]	[0.6266]	[0.7927]
NPL_OTH	**143.357**	96.482	56.821	31.585	11.469
	[0.0252]	[0.2299]	[0.497]	[0.728]	[0.8971]
NPL_TOT	**147.355**	87.665	61.562	37.358	19.983
	[0.0179]	[0.2226]	[0.5558]	[0.8502]	[0.852]

*) The value of the trace statistics, [] is the p-value. Bold print is still acceptable limits with 95% confidence level.

Based on Granger causality test, the result shown that there is relationship between NPL and macroeconomic variables, such as interest rates in particular for Agriculture, Mining, Electricity, Business Services and Others sectors meanwhile IPX and import in particular for Agriculture.

Table 7. Granger Causality NPL and Macroeconomic Variables

Variable 1 \ Variable 2	INT	IPX	L_KURS	L_IMP	L_M2	IHK
NPL_AGRI	↔	←		↔		
NPL_MIN	↔	→	←			
NPL_MANU		↔	←		→	→
NPL_ELEC	↔			←		
NPL_CONST	←		←			
NPL_TRADE	→	←	←	→		
NPL_OTO	←	←		→	→	→
NPL_SERVBUS	↔	←	←	→	→	→
NPL_SERVSOC				→	→	→
NPL_OTH	↔	→		→		
NPL_TOT		←				

Notes:
→ : Variable 1 *granger cause* Variable 2, with 95% confidence level.
← : Variable 2 *granger cause* Variable 1, with 95% confidence level.
↔ : Variable 1 and 2 have mutually granger cause with 95% confidence level.

Based on VECM models, we were able to analyze the sensitivity of NPL with shocking (increase) 1 standard deviation of each macroeconomic variable to see the NPL movement using the Impulse Response Function (IRF) during the coming 30 months. Afterward, we use Forecast Error Variance Decomposition (FEVD) to analyze which macroeconomic variables that dominantly affect the NPLs.

Generally, NPLs in all economic sectors and in aggregate level give positive responses with interest rate (BI rate) and M2 shock except Electricity sector for M2 (Figure 4 and Appendix 1). This means that higher interest rate or M2 will affect the higher NPL level, which is in line with the initial hypothesis. The increased of BI rate, will make higher adjustment for loan interest rate. This condition have made the pressure of interest liability from the debtors side. And at last, it will impact the debtors performance and made higher probability that they become default. Otherwise, import variables had negative relationship impact with NPLs. Meanwhile, CPI and exchange rate

(Figure 5) shown dualism result, with some sectors shown positive and the others were negatives. IPX was not good enough to explain the direction of NPL in Indonesia because IPX only reflect the output indicator of manufacturing activity and not of all sector. Therefore, manufacturing sector was in line with IPX initial hypothesis.

Figure 4. IRF NPL per economic sector by BI rate 1 standard deviation shock
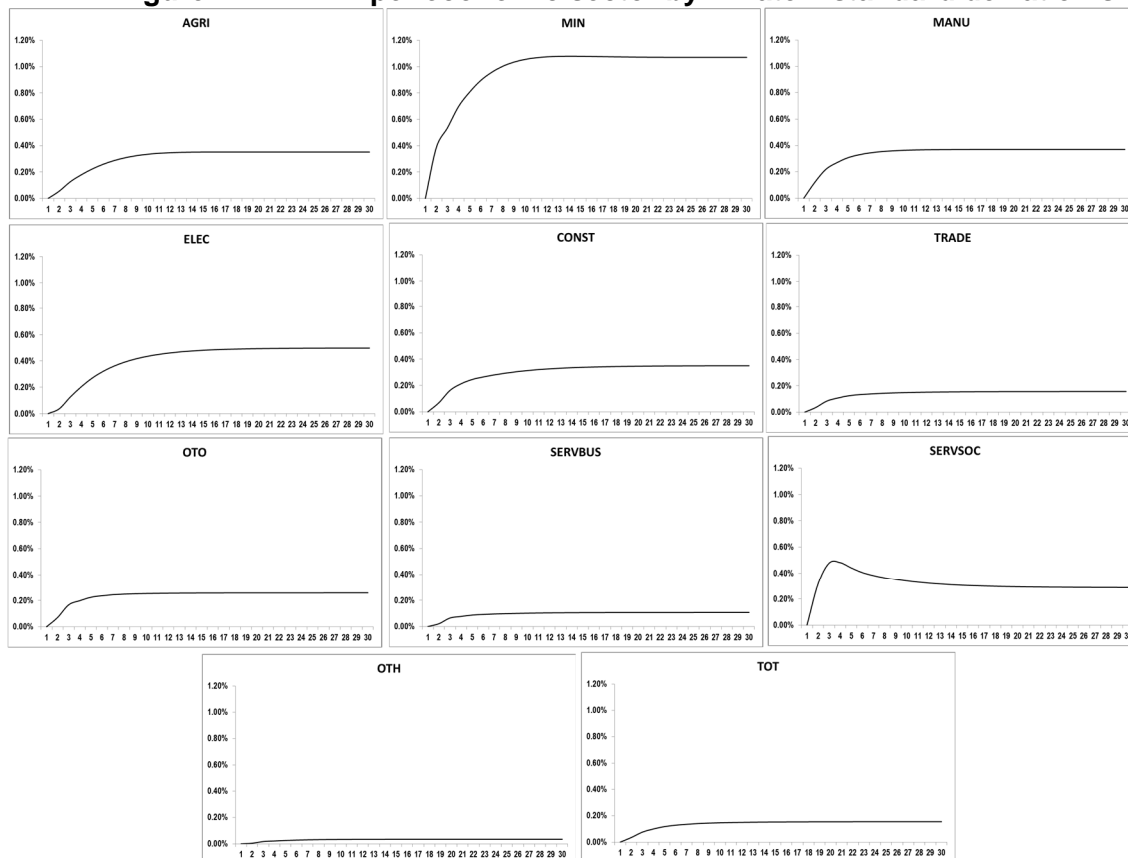
The reason of dualism result of CPI is because higher inflation can make debt servicing easier by reducing the real value of outstanding loans and also weaken borrowers' ability to service debt by reducing their real income (Castro, 2013). Meanwhile exchange rate is closely related to export and import activity. The impact of exchange rate shock could drive different direction for each sector.

Mining sector is most highly sensitive to interest rate shock. The possible reason for this is the characteristics of the loan in mining sectors itself, which usually have long term tenor and have fixed or contractual price for the mining that reflect debtors' cap of income. Social services sector is the most sensitive sector due to the value of imports and M2 shock. While Electricity is highly sensitive sector due to exchange rate shock. This happened because raw sources of electricity production in Indonesia mostly generated from oil and coal that close sensitive to exchange rate movement.

**Figure 5. IRF NPL per economic sector by nominal exchange rate (USD/IDR)
1 standard deviation shock**
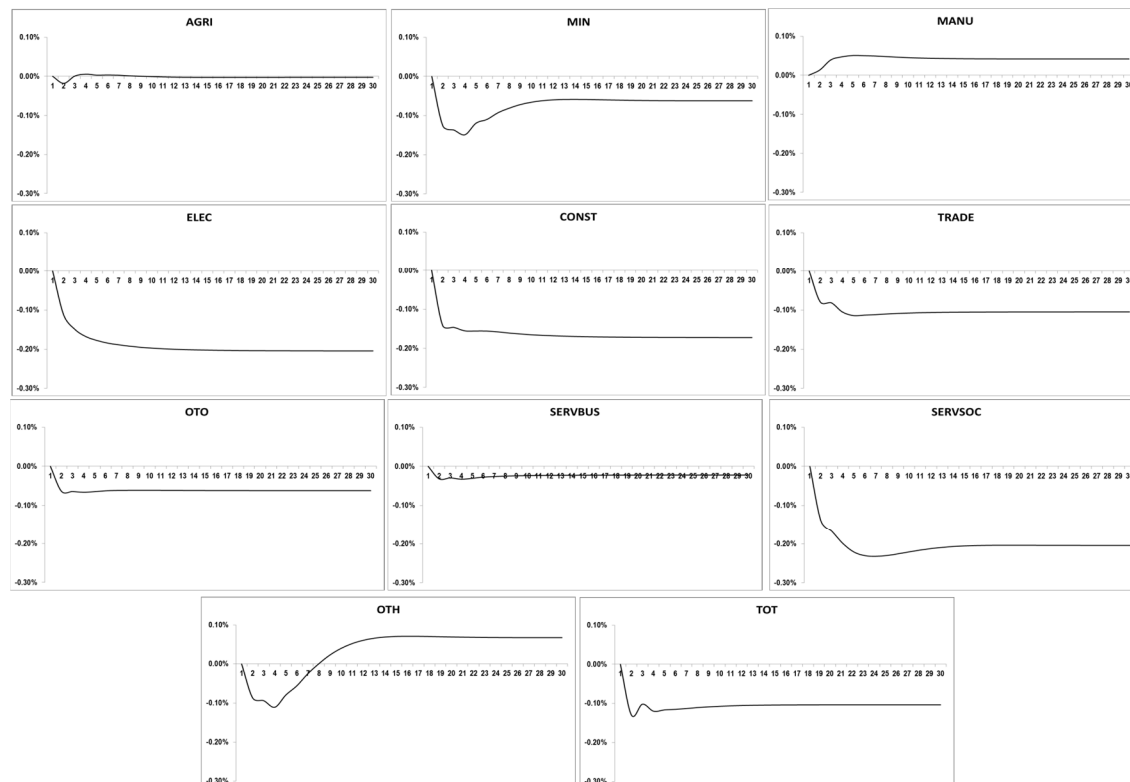
According to variance decomposition results of some economic sectors (NPL_TOT, NPL_AGRI, NPL_MIN and NPL_TRADE), we found that the interest rate is significantly contributed to the change in the NPL, which is the major is in mining sector. As for the NPL in the Trading sector, because of its scope is very broad, including export and import, then it must be very close related to the exchange rate and the value of imports (Figure 6).

In general, macroeconomic variable that being dominant influence the NPL by economic sectors is the BI rate (INT). However, for Electricity sector, the dominance of the IPX is significant, reaching 37.6% at t = 30. This is because IPX is an indicator of the rise or fall of industrial production which is very dependent on the electricity.

Figure 6. Variance decomposition of Aggregate NPL, NPL_Agri, NPL_Min and NPL_Trade
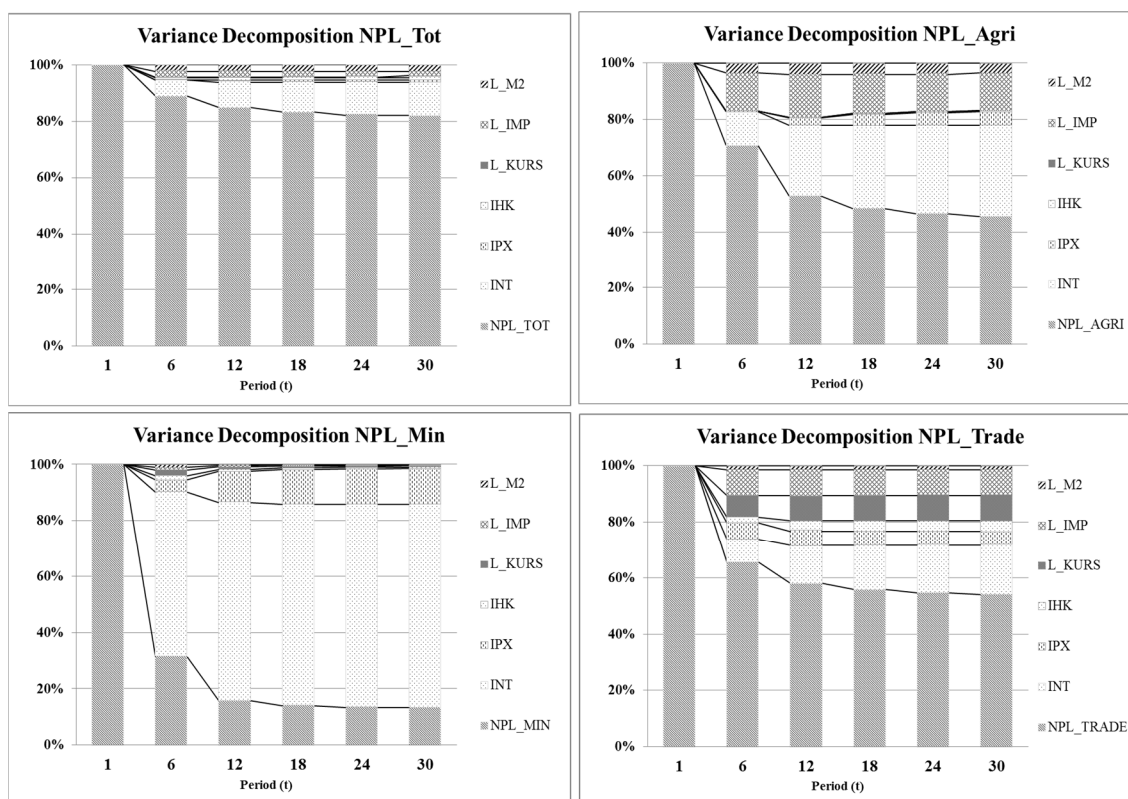
6. Conclusion

Based on results of this research, it can be concluded that the NPLs of banks have a causal relationship with macroeconomic variables. All economic sectors will positively response if there is a shock in the interest rate and broad money supply (M2). But in case of shocks to the imports, most of the sectors will negatively response even though there are some sectors that showed the other way. CPI and exchange rate might confirm the existence of dualism impact due to its shocked. This could be happened because several sectors experiencing a decreased or loss of income when the CPI or exchange rate increase or decrease. Meanwhile IPX variables cannot fully confirm the initial hypothesis and partly explained the NPL for Manufacturing and Social services sectors.

Interest rate is the most dominant variable in affecting the banking NPLs both in aggregate and per economic sector, which contributes in the Mining, Agriculture and Trading sectors and the other sector generally. While IPX is the dominant variable affecting the level of NPLs in the Electricity and Social services sectors.

Mining is highly sensitive sector due to interest rate shocks. While the Social services is the sector that sensitive due to CPI, imports and money supply (M2). Manufacturing is very sensitive due to exchange rates shock. In general, the results of this study have provided a brief overview on the direction of NPL either in the aggregate and as per economic sector in the future regarding the macroeconomic shocks.

Some suggestions from the author for the next study are further expanded the scope of the credit specifically, such as SME loans, consumer loans like residential mortgage, car loan or specific segments such as Credit Card. It is very well done considering the characteristics of the segmentation of such credit can be more specific and clarify the relationship between the level of

NPL with macroeconomic variables.

Things that can more be explore is by performing a comparison study between commercial banks and Sharia banking or banks with certain criteria such as the banks type as in the Indonesian Banking Statistics data (SPI) for example State Owned Banks, Foreign Banks, Regional Development Banks and others.

REFERENCES

Ahmad, F., Bashir, T. (2013). Explanatory Power of Macroeconomic Variables as Determinants of Non-Performing Loans: Evidence from Pakistan. World Applied Sciences Journal 22, 243-255.

Castro, V. (2013). Macroeconomic Determinants of the Credit Risk in the Banking System: The Case of the GIPSI. Economic Modelling 31, 672-683.

Collins, N. J., Kenneth, W. (2011). The Effect of Interest Rate Spread on The level of Non-Performing Asset: A Case Commercial Banks in Kenya. International Journal of Business and Public Management 1, 58-65.

Enders, W. (2004). Applied Econometric Time Series (2nd ed.). New York: Wiley.

Farhan, M., Ammara, S., Abrar, H. C., & Fareeha, K. (2012). Economic Determinants of Non-Performing Loans: Perception of Pakistani Bankers. European Journal of Business and Management 4 (9), 2012.

Firdaus, M. (2011). Aplikasi Ekonometrika Untuk Data Panel dan Time Series Edisi Revisi. Bogor (ID): IPB Press.

Gremi, E. (2013). Macroeconomic Factors That Affect the Quality of Lending in Albania. Research Journal of Finance and Accounting 4(9).

Janvisloo, A. M., Junaina, M. (2013). Sensitivity of Non-Performing Loan to Macroeconomic Variables Malaysia Banking Sector: Panel Evidence. World Applied Sciences Journal 28(12), 2128-2135.

Khemraj, T., Pasha, S. (2009). The Determinants of Non-Performing Loans: An Econometric Case Study of Guyana. The Caribbean Centre for Banking and Finance Bi-annual Conference on Banking and Finance, St. Augustine, Trinidad.

Prasetyantoko, A. (2008). Bencana Finansial: Stabilitas Sebagai Barang Publik. Jakarta (ID): Gramedia.

Satrosuwito, S., Yasushi, S. (2012). The Determinants of Post-Crisis Indonesian Banking System Profitability. Economics and Finance Review 1(11), 48-57.

Suta, I. G. A., Soebowo, M. (2003). Membedah Krisis Perbankan. Jakarta (ID): Yayasan SAD Satria Bhakti.
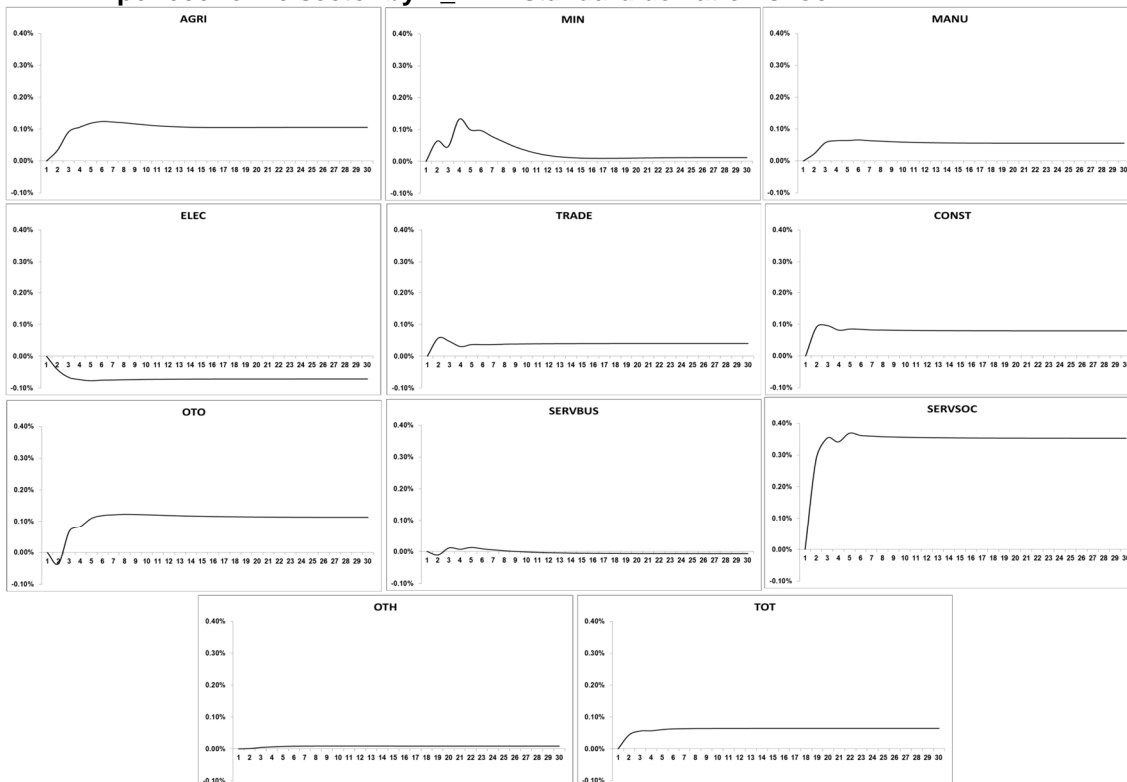
Appendix 1

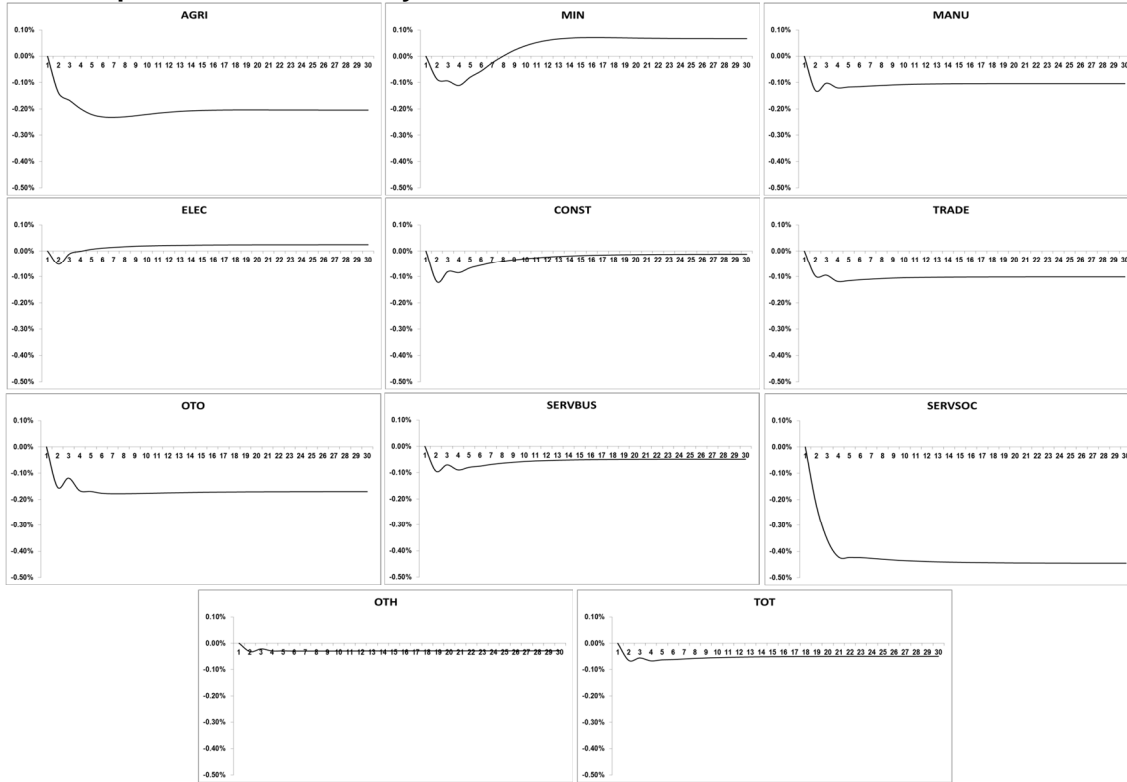**IRF NPL per economic sector by IPX 1 standard deviation shock**
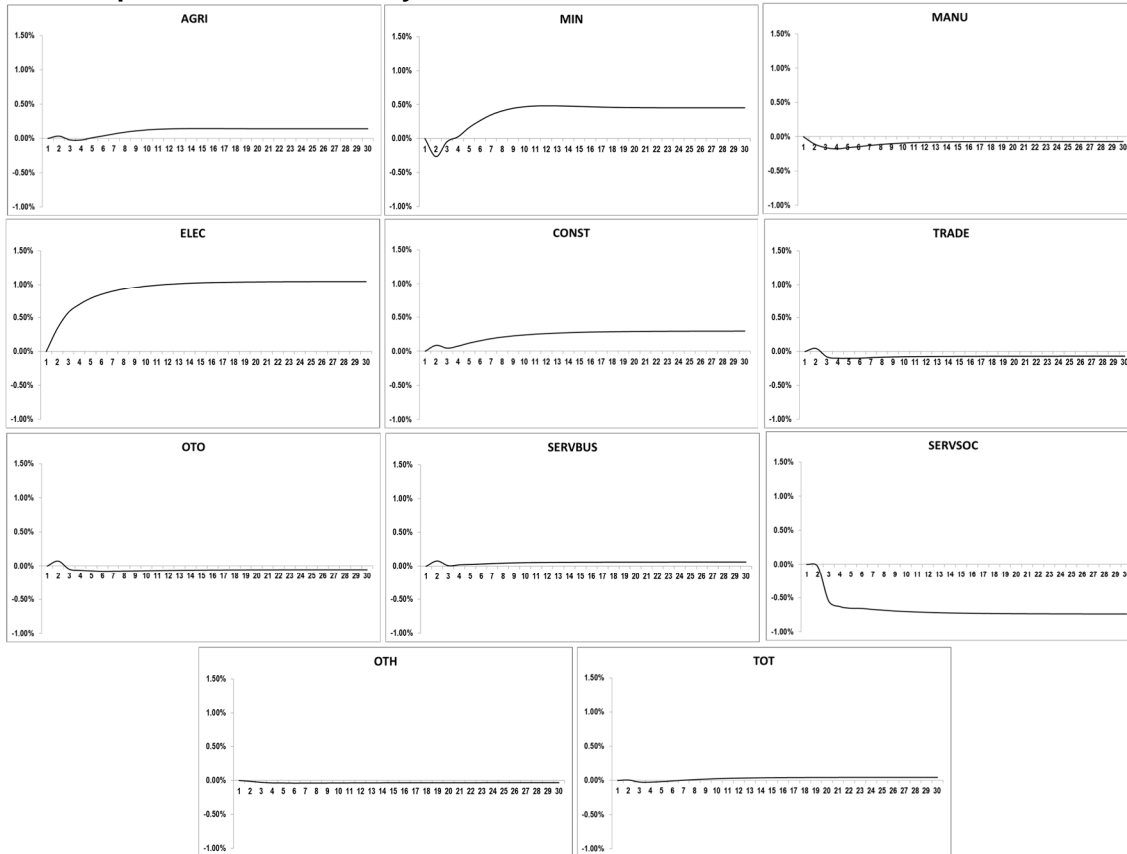
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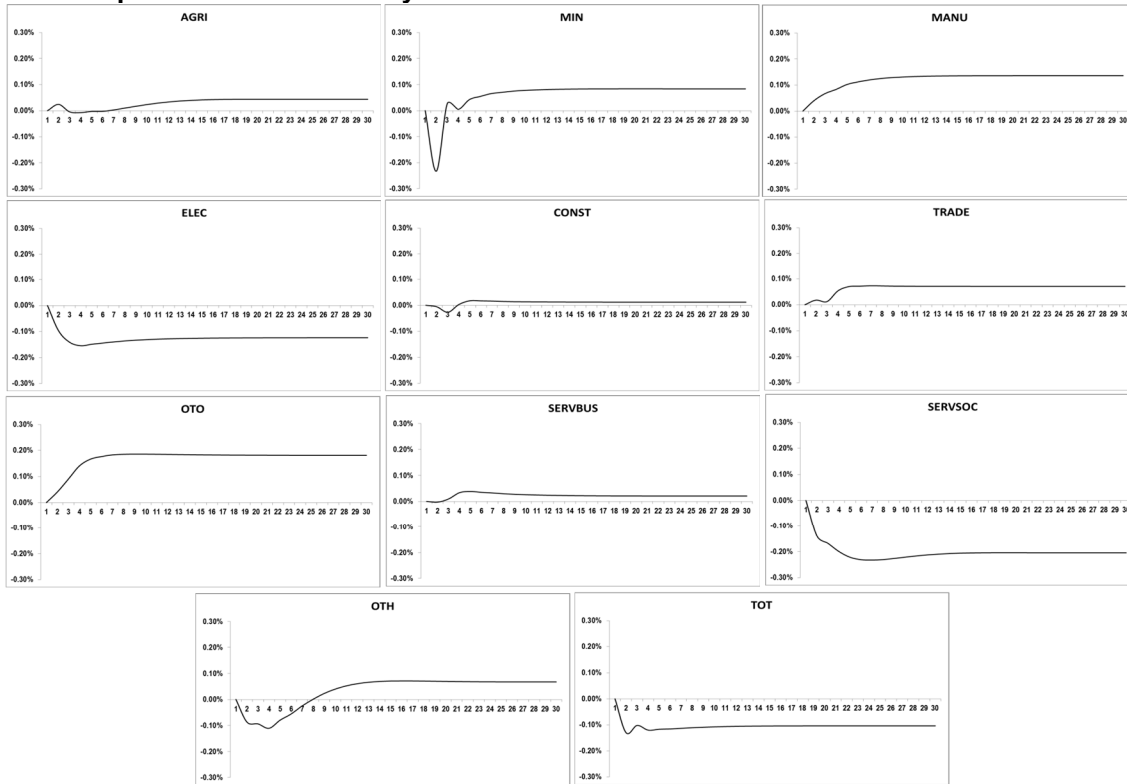
IRF NPL per economic sector by L_M2 1 standard deviation shock

IRF NPL per economic sector by L_IMP 1 standard deviation shock

Appendix 2
Variance decomposition per economic sector