THE IMPACT OF EXTERNAL MACRO FACTORS ON NPL OF THE BANKING SYSTEM

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1. INTRODUCTION

In economies with bank-dominated financial systems, periods of economic distress are associated with deterioration of borrowers' balance sheet and increase in non-performing loan ratio. The recent global financial crisis only reinforced such premise. Non-performing loan (NPL) ratio has increased across bank-based financial systems like EU member countries and peripheral economies.

The ratio of non-performing loans to outstanding loans is a common indicator of ex-post credit risk. Given that markets build on credit risk measures to form expectations, a credit risk indicator plays significant impact in the economy. An upward trend of the NPL ratio has at least two direct implications for the capacity of the banking system to finance the economy and for the macroeconomic equilibrium. On one side, higher NPL ratio bites on the capital adequacy ratio of lending banks leading to a diminished capacity to lend. On the other, the increasing NPL ratio can be an indicator of already highly indebted borrowers keeping the lenders at bay. The expectations of continuing weak aggregate demand and already highly indebted pool of borrowers may deteriorate the expected ability to pay of the average borrower. Therefore, even banks with sufficient capacity to lend may still refrain from lending.

A final point is that a bank not affected by capital adequacy ratio, may still limit the supply of loans due to the fear of buying existing loans of other banks that may become non-performing in the near future. When an obligation is not paid within a time frame of 90 days, that financial obligation is classified as non-performing[2]. Within this time frame a borrower already unable to pay is still a good borrower. The time lag provides an opportunity for the borrowing firm with sufficient collateral to engage in borrowing contracts in order to pay an existing loan or attempt a riskier strategy to save defaulting on the existing loan. Undoubtedly, it can easily be the case that both, low lender capital adequacy ratio and risk-shifting behaviour of over-indebted borrowers that stand behind low bank financing in an economy.

High NPL ratios are closely related to costly financial crises and are a critical indicator monitored by investors, supervising authorities and markets. The high

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[2] *The criteria may change in different economies.*

costs are related to the inter-linkages between the deterioration of the asset quality of financial intermediaries and the business cycle in the economy. The links allow for the propagation of small financial or macroeconomic shocks to exacerbate the boom-bust cycles of the economy (Bernanke, Gertler, & Gilchrist, 1999). While in a market-based economy, like US, bank loans are not the dominant form of firm financing, the feedback mechanism between firm's ability to pay its debts and the economy is similar. In both environments, bank-based or market-based economies, financial crises have high economic costs (Haugh, Ollivaud, & Turner, 2009).

The depth of the recent crisis raised the interest in the modelling of macroeconomic factors that matter for the dynamic behaviour of the non-performing loans. The literature on the approaches used to capture the dynamics of credit risk is rich, both at aggregate and individual bank level. Chan-Lau (2006) make a very useful review of the broader specter of approaches used to analyze the probability of default. He lists examples of models used by central banks or private financial institutions using various approaches. I focus here only on macroeconomic models which shed light on the interrelationship between credit risk and macroeconomic factors.

To a large extent the literature on the macroeconomy-based models that investigate determinants of NPL ratio has expanded in two directions. Early research promoted studies that evaluate the impact of the aggregate macroeconomic indicators in determining the NPL ratio at aggregate level. These studies attempt to capture the elasticity and response of NPL ratio subject to macroeconomic shocks.

Typical macroeconomic indicators like GDP, unemployment, interest rates, exchange rates, inflation and alternative types of asset prices are common factors in explaining NPLs. I refer to Rinaldi & Sanchis-Arellano (2006) and Makri et al. (2014) relevant to Euro area, to Nkusu (2011) for a study with 26 advanced economies from 1998 to 2009 and Castro (2013) for the impact of macroeconomic factors on NPL ratio in southern Euro area economies. Recent studies on emerging economies are Radivojevic & Jovovic (2017) for the period 2000-2011, or De Bock & Demyanets (2012) for a sample of data in 25 emerging countries, 1996-2010. With a more regional focus are studies investigating dynamics of NPL in the Eastern European economies. A World Bank (2008) report at the peak of the crisis suggests strong adverse effects from the global financial crisis in terms of the bank asset quality in these economies (for a non-exhaustive list see Jakubík & Reininger (2014), Klein (2013), Beckmann et al. (2012)). Jakubík & Reininger (2014) investigate macro determinants of economy-wide NPLs in a group of CESEE economies and find that GDP growth is the main driver of NPLs in those economies. Klein (2013) evaluates the determinants of non-performing loans in CESEE during 1998–2011.

Due to the vast literature and the variety of approaches employed, similar to Jakubík & Reininger (2014), this study relies on a macro-approach that uses macro variables as determinants of aggregate NPL ratio in the banking system. A more in-depth review of literature employing these latter approaches to

explain other indicators of bank asset quality (LLPs) or bank-specific and sector-specific asset quality indicators is provided by Foglia (2009) or Čihák (2007) and more recently by Dent et al. (2016). Bank-specific factors that capture bad management, cost efficiency, poor loan underwriting, screening and monitoring are critical for the NPL ratio of individual banks[3]. A combination of macro and bank-specific factors is a common practice aiming at better forecasting models at bank level following the work of Berger & DeYoung (1997).

There are few earlier studies of Bank of Albania that have analyzed the dynamics of NPL in Albania. Shijaku & Ceca (2009) take a macro perspective to examine the elasticity of the aggregate (transformed) NPL ratio to key macro variables like GDP, inflation rate, domestic interest rates, exchange rate and foreign interest rate in a stationary VAR with quarterly data for a relatively short period of time, 2001-2007. In Shijaku & Ceca (2011) the authors take a mixed micro-macro perspective to analyse individual banks' NPLs using macro indicators. They examine NPLs of a panel of banks for the period 2005-2009 at quarterly frequency. In addition, there are several other studies at the Bank of Albania that evaluate the impact of macroeconomic factors on the quality of bank assets in a broader framework (see Dushku and Kota (2013), Kalluci and Kodra (2010), Dushku and Vika (2011)). Unlike the earlier studies, the focus here is on external macroeconomic factors, particularly on foreign (international) business cycles. In the next section I describe the data used to this end.

2. DATA AND THE VAR METHODOLOGY

I define the NPL ratio for each subgroup of non-performing loan (NPL) according to (i) the currency in which the loan is denominated and (ii) the type of borrower. On this basis, the NPL ratio in a subcategory 'j' is the ratio of non-performing loans to the stock of loans within that particular subcategory 'j'.

$$nplR_t^j = \frac{npl_t^j}{Outstanding\_loans_t^j} \qquad \forall j = indLek,\ coLek,\ indFx,\ coFx,\ total \qquad (1)$$

Since the NPL ratio takes values between 0 and 1 it is a common practice to perform logit transformation of such that:

$$LnplR_t^j = ln\left(1/_{nplR_t^j} - 1\right) \qquad (2)$$

For the sake of later reference, note that $\{LnplR_t^j\}$ is inversely related to $\{nplR_t^j\}$, such that an increase in the latter shows up as a decline in the former. The 'j' superscript is defined by (i) *the currency of denomination, domestic or foreign, and (ii) the type of borrower*, individual household or (non)corporate sector. Based on these two criteria there are four NPL ratios, which following the logit transformation are defined as[4]:

[3] *See Williams (2004) EU banks data 1990-1998, Podpiera & Weill (2008) with Czech banks NPLs, Jiménez & Saurina (2006), Louzis et al. (2010) with Greek banks data, Dash & Gaurav (2010), Beckmann et al. (2012).*

[4] *This format of NPL ratio takes into account the write-offs that have taken place since 2015 as reported in the periodic Financial Stability Reports of Bank of Albania. I include the write-offs as they are not a reduction of NPL due to macroeconomic factors, but rather an ad-hoc procedure.*

(1) $LnplR_t^{indLek}$ *NPL ratio of individual households in domestic currency,*

(2) $LnplR_t^{coLek}$ *NPL ratio of corporate and non-corporate firms in domestic currency,*

(3) $LnplR_t^{indFx}$ *NPL ratio of individual households in foreign currency,*

(4) $LnplR_t^{coFx}$ *NPL ratio of corporate and non-corporate firms in foreign currency,*

Having defined the NPL indicator, the vector of variables is now:

$$Y_t^j = \{y_t^*, R_t, E_t, LnplR_t^j\} \qquad \forall j = indLek, coLek, indFx, coFx \qquad (3)$$

where y_t stands for a measure of international business cycle, R_t stands for a measure of opportunity cost of monetary funds, E_t is nominal exchange rate and $LnplR_t^j$ is the logit transformed NPL ratio in category 'j' as defined in equation (2).

From a review of literature, different measures can be obtained for each of the three macroeconomic variables $\{y_t^*, R_t, E_t\}$. While the arguments for the choice of variables can take quite some space, for practical reasons I have chosen the macroeconomic variables as shown in Chart 1.

Chart 1. Definition of macroeconomic variabiles in the VAR equations.

	Description
y_t^*	Log of the industrial production of Euro area (monthly change).
R_t	The interest rate of Lek deposits, as a proxy of the opportunity cost of funds, in cases when ratios of NPL to credit stock in domestic currency, $\{LnplR_t^{indLek}\}$ and $\{LnplR_t^{coLek}\}$, are specified in the vector Y_t^J (monthly change).
R_t^*	The spread between 12-month Euribor rate and interest rate of Lek deposits, a proxy of the opportunity cost of funds, when ratios of NPL to credit stock in foreign currency, $\{LnplR_t^{indFx}\}$ and $\{LnplR_t^{coFx}\}$ are specified in the vector Y_t^J (monthly change).
E_t	Log of nominal effective exchange rate (monthly change).

I have chosen the industrial production of Euro area as an alternative indicator of foreign business cycles. Based on a study at the Bank of Albania, the synchronization of business cycles in Albania and Euro area is weak (Yzeiraj, 2012). It lends support to the view that Euro area output does not overlap with business cycles that arise due to domestic factors. In particular, the series used - euro area industrial production - captures the turning points of the recent global financial crisis and is available on monthly basis. I employ Vector Autoregressive (VAR) Models to analyze the response of NPL ratio following macroeconomic shocks. In a compact form the VAR equation is:

$$Y_t = X_t B + u_t \qquad (4)$$

where $X_t = \{Y_{t-1}, \ldots Y_{t-p}\}$ is a $T(x)p$ matrix of independent variables and deterministic terms, B is a $n(x)p$ matrix of coefficients and $u_t \sim N(0, \Sigma)$. The moving average representation of the VAR allows to identify the impulse response functions (IRF) of each variables subject to exogenous shocks.

$$Y_t = \sum_{i=0}^{\infty} \Theta_i \, u_{t-i} = \sum_{i=0}^{\infty} \Xi_i \varepsilon_{t-i} \qquad \Xi_i = \Theta_i A_0^{-1} \qquad (5)$$

The *(j,k)* element of Ξ_i in (5) is the impact of the kth structural shock on j^{th} variable at horizon i.

2.1 MODEL SPECIFICATION

I set up VAR equations for each subgroup of non-performing loan (NPL) ratio for each subcategory 'j'. The vector of variables Y_t^j shown in equation (3) can now be written as[5]:

$$Y_t^{indFx} = \{y_t^*, R_t^*, E_t, LnplR_t^{indFx}\} \qquad (3.1)$$

$$Y_t^{coFx} = \{y_t^*, R_t^*, E_t, LnplR_t^{coFx}\} \qquad (3.2)$$

$$Y_t^{indLek} = \{y_t^*, R_t, E_t, LnplR_t^{indLek}\} \qquad (3.3)$$

$$Y_t^{coLek} = \{y_t^*, R_t, E_t, LnplR_t^{coLek}\} \qquad (3.4)$$

The expected impulse response functions (IRFs), from a theoretical perspective and consistent with earlier studies in the introduction, are shown in Chart 2. Expected IRFs should show that, an increase in E_t (depreciation) and in R_t^* (higher cost of funds) should <u>lower</u> the $LnplR_t^{Fx}$ for both types of borrowers (that is <u>raise</u> the NPL ratio of the loan portfolio in foreign currency). Similarly a positive shock on the cost of funds in domestic currency (increase in R_t) should <u>lower</u> $LnplR_t^{Lek}$ for both borrowers (<u>raise</u> the NPL ratio of the loan portfolio in domestic currency). Finally, an upturn in international business cycles should lead to <u>higher</u> $LnplR_t^j$ variable (<u>lower</u> the NPL ratio) of any borrower in both currencies.

Chart 2. Expected signs of based on VAR impulse responses upon a shock in $\{y_t^*, R_t, E_t\}$.

(+) shock in	IR of $\{LnplR_t^{Lek}\}$	IR of $\{LnplR_t^{Fx}\}$	NPL ratio
(+) y_t^*	(+)	(+)	lower
(+) R_t	(-)	…	higher
(+) R_t^*	…	(-)	higher
(+) E_t	(-)	(-)	higher

(*) Note: From equation (2), the inverse relationship between the "$nplR_t^j$" and the logit transformed variable "$LnplR_t^j$" assumes that an increase in the latter, "$LnplR_t^j$", is a decline in the NPL ratio, or an improvement of asset quality of banks.

[5] *Alternative measures of the opportunity cost of monetary funds yield similar results, though not as good diagnostics. For NPL in domestic currency the variable R_t is replaced by the spread between 12 month TB yield and the deposit rates in Lek, as a proxy. The results for those alternative measures are not included in this article. For NPL in foreign currency the variable R_t^* is replaced by the spread between 12 month Euribor and one-month Euribor rate, as a proxy of the opportunity cost of funds. The results, not reported in this article, are very similar to the ones reported here.*

3. RESULTS

In appendix I show the impulse responses from the different VARs with the set of variables as defined in equations (3.1) to (3.4).

- NPL ratios of loan portfolios in foreign currency.

Impulse responses in Figure 1 and Figure 2 based on VAR estimations with the vectors Y_t^{indFx} and Y_t^{coFx}, from equations (3.1) and (3.2), indicate that

$LnplR_t^{infFx}$ and $LnplR_t^{coFx}$ ratios <u>decline</u> (<u>higher</u> NPL ratio) following a positive shock in nominal effective exchange rate (depreciation) for both type of borrowers in foreign currency, individual households and firms (the graphs in the bottom row of each figure),
$LnplR_t^{infFx}$ and $LnplR_t^{coFx}$ ratios show weak or no significant response to positive shocks in opportunity cost of funds (higher R_t^*), and
$LnplR_t^{infFx}$ and $LnplR_t^{coFx}$ ratios go up – indicating a decline of NPL - following a positive aggregate demand shock (y_t^*), or an upturn in foreign economic activity.

<< Figure 1 here >>

<< Figure 2 here >>

These IR functions are consistent with expected sign reactions of (transformed) NPL ratios in Chart 2. Note that the IR functions in the first row of each figure indicate a zero response of (y_t^*) following shocks in any of the variables, except own shocks. This results is due to the restrictions I have set in the VAR to impose exogeneity of aggregate demand variable (y_t^*) in the short and the long run. This restriction is motivated by the fact that Euro are industrial production is an exogenous source of business cycles in the domestic economy. It is therefore not affected by other domestic variables contemporaneously or at any lag[6].

Forecast error variance decompositions indicate that exchange rate explains around 9-10 % of NPL fluctuations over the 12-month horizon for both, the individual and the corporate loan portfolio, in foreign currency (Chart 3 and Chart 4). Foreign business cycle fluctuations explain a much smaller, or insignificant, fraction of NPL fluctuations in foreign currency. Around 80-90% of these fluctuations is explained by own exogenous shocks in NPL.

- NPL ratios of loan portfolios in domestic currency.

Impulse response for VARs with NPL ratios $LnplR_t^{indLek}$ and $LnplR_t^{coLek}$ in Figure 3 and Figure 4 of appendix indicate little response of NPL ratio to either macroeconomic variables. The low response of NPL ratios in domestic currency to macroeconomic variables is well captured by the low percentage of NPL ratio fluctuations explained by macro shocks. More than 90% of these

[6] *Getting rid of the restrictions does not change the conclusions drawn from IRFs and variance decompositions.*

fluctuations are explained by exogenous shocks in NPL ratios (Chart 5 and Chart 6 in appendix). Neither exchange rate nor opportunity cost explain a significant share of these fluctuations, while foreign business cycles capture up to 6 % of the total fluctuations observed in NPL ratio in domestic currency.

<< Figure 3 here >>

<< Figure 4 here >>

The results obtained from these basic tests are similar to those found on earlier works on credit risk like Shijaku & Ceca (2009), (2011). In Shijaku & Ceca (2009) the authors report that exchange rate and foreign interest rate have significant effect on credit risk measured by NPL ratio, while GDP growth shocks has a negligible effect. In Shijaku & Ceca (2011) and Dushku and Vika (2011), the authors confirm earlier results regarding the impact of exchange rate and interest rate. The possibility to investigate NPLs in domestic and foreign currency is explored in In Shijaku & Ceca (2011), but do not report evidence of a satisfactory economic and statistical model for the portfolio in foreign currency separately. In Kalluci and Kodra (2010) the authors find that nominal exchange rate, real effective *exchange rate* REER, 12 month yield and 3 month yield are all significant in explaining NPL. GDP is significant only in explaining the NPL of corporate firms[7]. Similarly Dushku and Kota (2013) find exchange rate and interest rate significant in explaining total NPL in single equation models. The high explanatory power of exchange rate is common among most studies mentioned.

4. CONCLUSIONS

The results from the econometric experiment are consistent with the theoretical predictions and with the findings from earlier studies in Albania. Yet the results are not very encouraging as a large share of NPL fluctuations is explained by exogenous own shocks.

The low power of macroeconomic factors to explain the NPL fluctuations could be due to different causes. I am listing the most relevant few arguments why impact of macro factors on NPL ratios turns low in the current framework.

- A key reason could be of a statistical nature. The NPL ratios are non-stationary variables. When using the monthly changes of the series we lose quite some information. A possible solution is the use vector error correction models.
- Absence of a reliable monthly series of business cycles or aggregate demand for the domestic economy may be one reason for the low

[7] *In Kalluci and Kodra (2010) the authors include a variety of indicators to explain the NPL of individual and corporate firm loans portfolios, like rental prices, export prices, M3, house prices and real effective exchange rate (REER) in addition to standard indicators GDP, opportunity cost and exchange rate. They find that exchange rate, REER, 12 month yield, 3 month yield are all significant in explaining NPL. GDP is significant only in explaining the NPL of corporate firms.*

response of NPL ratios to aggregate demand. Using the quarterly GDP series interpolated into a monthly series did not serve the purpose in this set up.

- The impact of bank-specific factors may be critical in driving the aggregate NPL ratio for the whole banking sector. The stock of private sector loans was very low at the beginning of the sample period and the market for loans has been dominated by a few banks initially. In the second half of the sample considered here a different set of banks are the dominant ones leading the lending market. The use of panel data may capture these bank-specific factors.

There could be many other factors which weigh at different degrees in different period of time. A more elaborate investigation of NPL ratios would require taking into account the above three factors.

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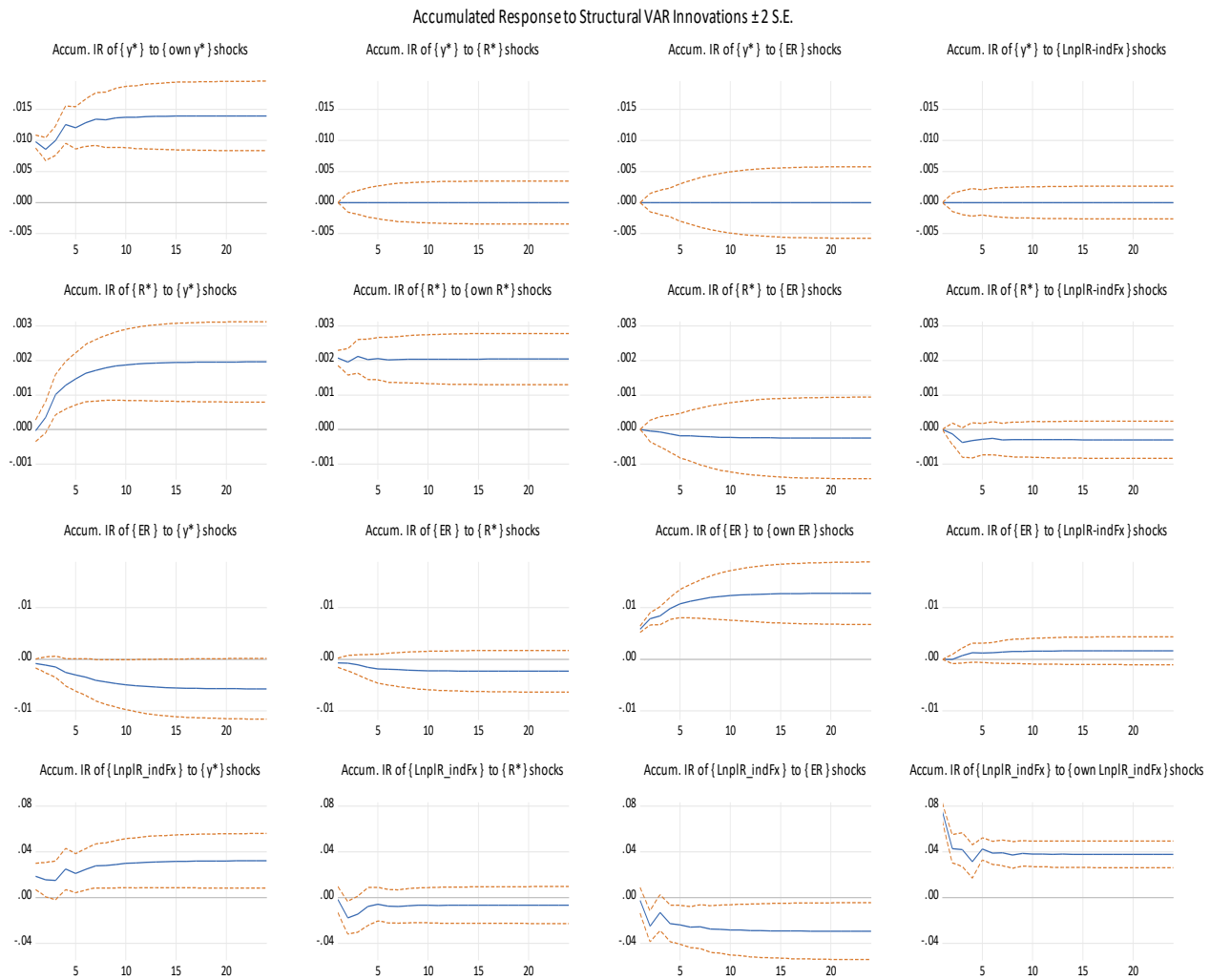
APPENDIX

Figure 1. IRFs from VAR in equation (3.1) with the vector of variables Y_t^{indFx}.

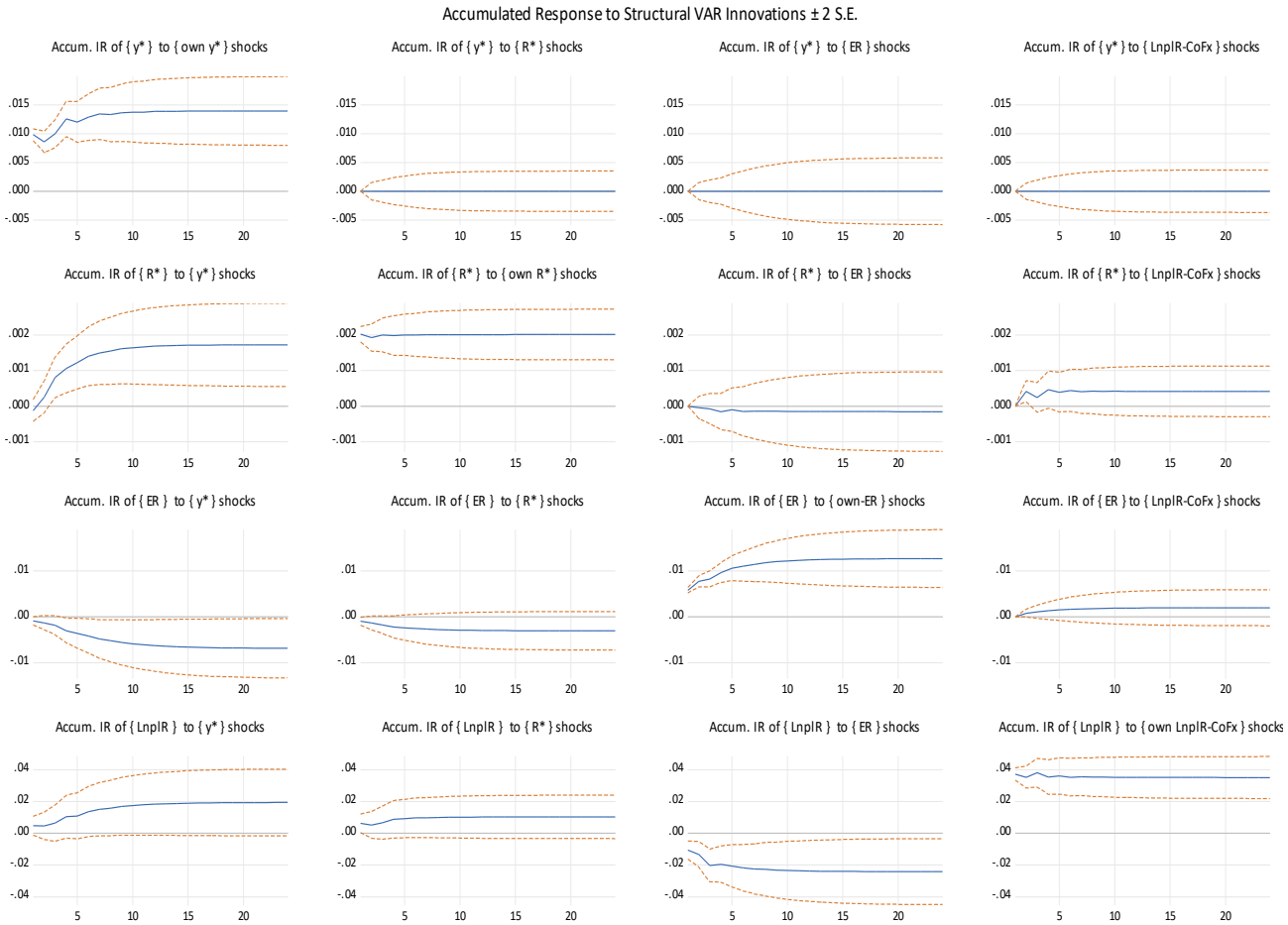


(*) Note: From equation (2), the inverse relationship between the "$nplR_t^j$*" and the logit transformed variable "*$LnplR_t^j$*" assumes that an increase in the latter, "*$LnplR_t^j$*", is a decline in the former variable, NPL ratio, or an improvement of asset quality of banking system.*

Chart 3. Forecast Error Variance Decomposition of $\{LnplR_t^{indFx}\}$

Period	S.E.	y* shock	R* shock	*ER* shock	$LnplR^{indFx}$ (own) shock
1	0.07764	6	0	0.1	94
4	0.09135	5	4	8.9	82
8	0.09238	6	4	8.8	82
12	0.09241	6	4	8.8	82

Figure 2. IRFs from VAR in equation (3.2) with the vector of variables Y_t^{coFx}.

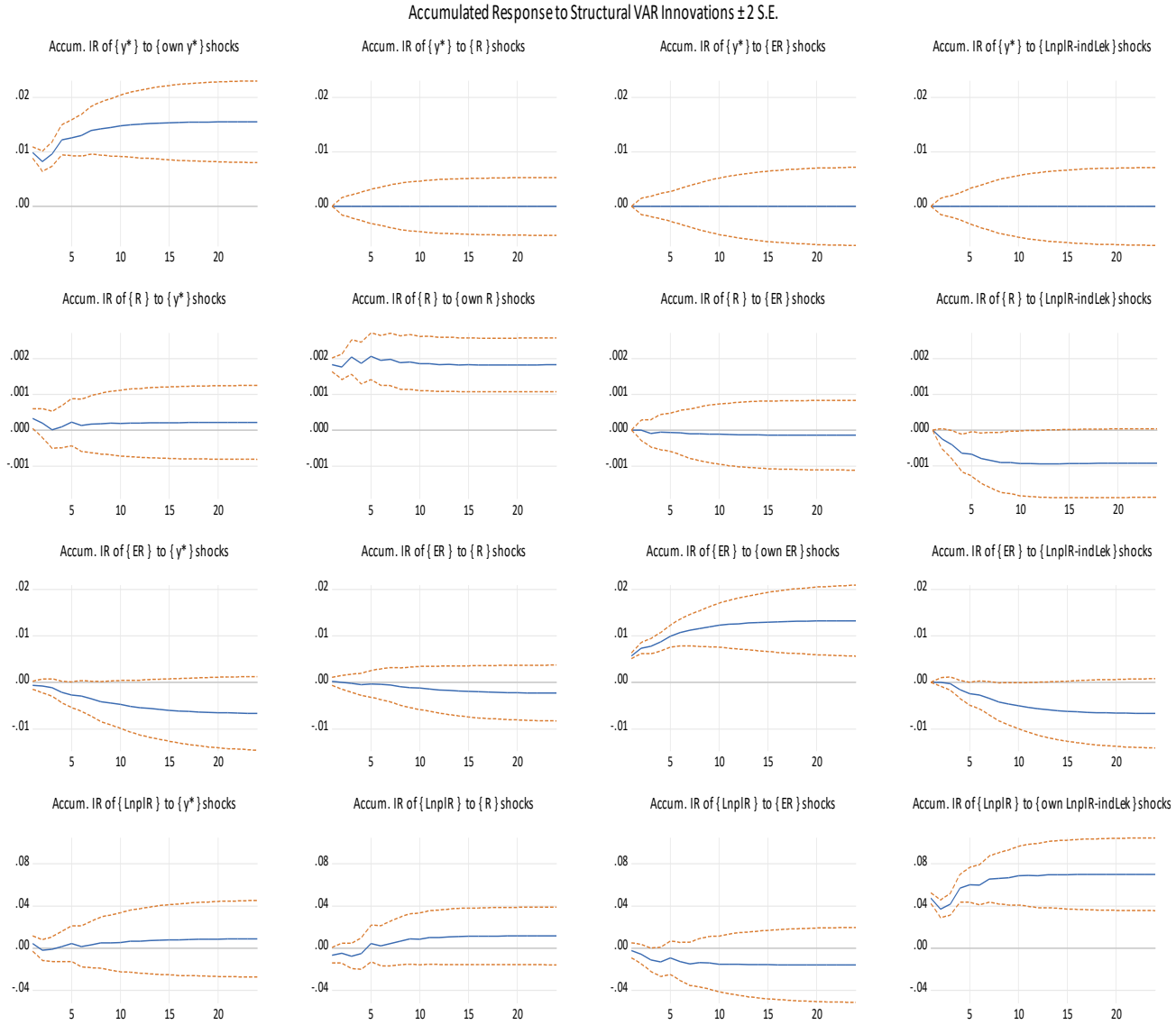


(*) Note: From equation (2), the inverse relationship between the "$nplR_t^j$*" and the logit transformed variable "*$LnplR_t^j$*" assumes that an increase in the latter, "*$LnplR_t^j$*", is a decline in the former variable, NPL ratio, or an improvement of asset quality of banking system.*

Chart 4. Forecast Error Variance Decomposition of $\{LnplR_t^{coFx}\}$.

Period	S.E.	y* shock	R* shock	*ER* shock	$LnplR^{CoFx}$ (own) shock
1	0.03958	1	3	7.1	89
4	0.04086	3	3	10.1	85
8	0.04105	3	3	10.2	84
12	0.04108	3	3	10.2	84

Figure 3. IRFs from VAR in equation (3.1) with the vector of variables Y_t^{indLek}.

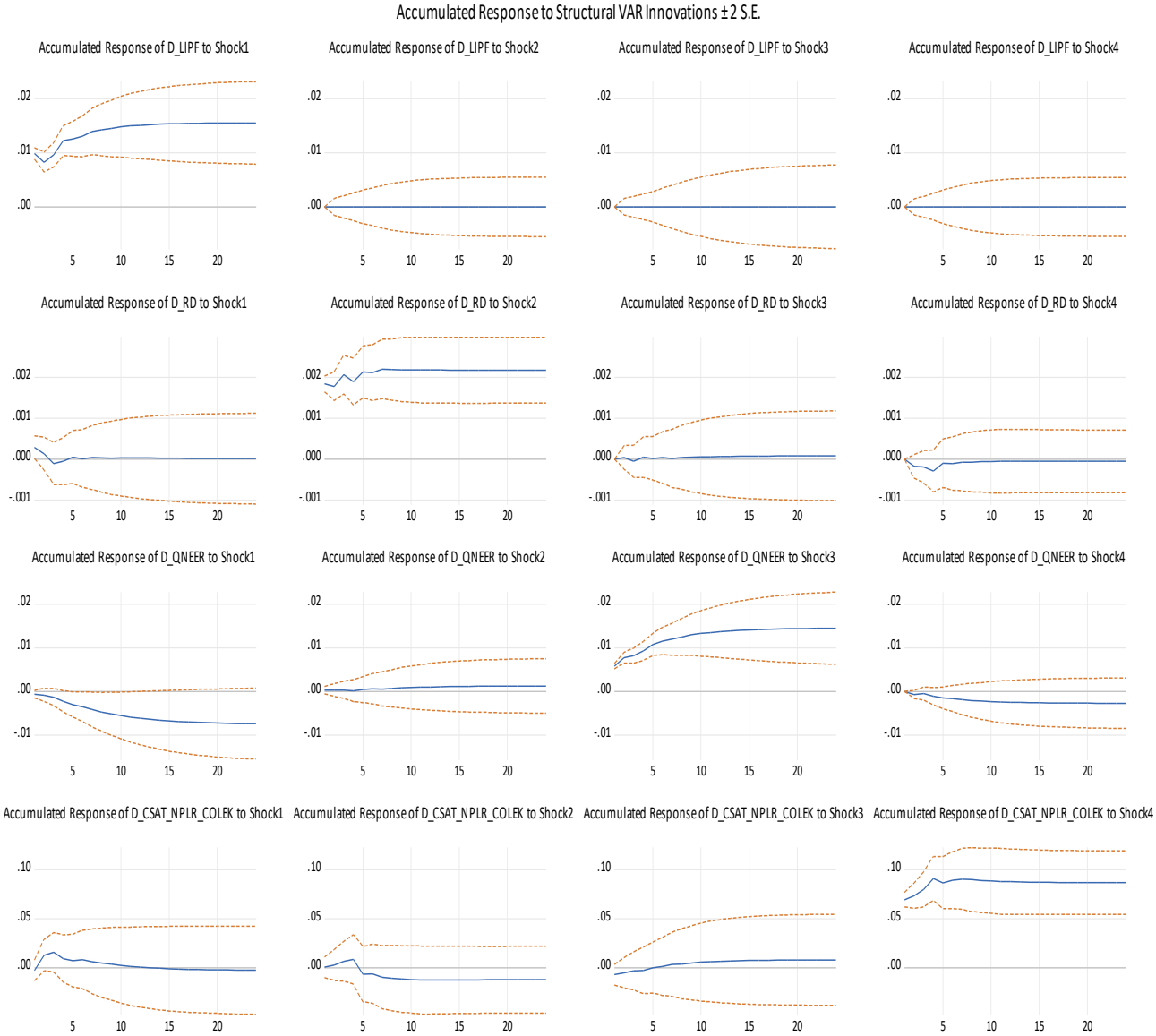


(*) Note: From equation (2), the inverse relationship between the "$nplR_t^j$" and the logit transformed variable "$LnplR_t^j$" assumes that an increase in the latter, "$LnplR_t^j$", is a decline in the former variable, NPL ratio, or an improvement of asset quality of banking system.

Chart 5. Forecast Error Variance Decomposition of $\{LnplR_t^{indLek}\}$

Period	S.E.	y* shock	R* shock	*ER* shock	$LnplR^{indLek}$ (own) shock
1	0.04814	1	2	0	97
4	0.05272	2	2	2	94
8	0.05463	3	6	3	89
12	0.05474	3	6	3	88

Figure 4. IRFs from VAR in equation (3.2) with the vector of variables Y_t^{coLek}.



(*) Note: From equation (2), the inverse relationship between the "$nplR_t^j$" and the logit transformed variable "$LnplR_t^j$" assumes that an increase in the latter, "$LnplR_t^j$", is a decline in the former variable, NPL ratio, or an improvement of asset quality of banking system.

Chart 6. Forecast Error Variance Decomposition of $\{LnplR_t^{coLek}\}$

Period	S.E.	y* shock	R* shock	*ER* shock	$LnplR^{CoLek}$ (own) shock
1	0.06984	0	0	1	99
4	0.07337	6	0	1	93
8	0.07533	5	5	1	89
12	0.07539	6	5	1	89