Stress-testing at the Bank of Albania: Methodological approaches and the quality of forecasting

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Abstract

The paper aims to present for the first time the methodology for building the stress-testing at the Bank of Albania, as well as to evaluate the quality of its forecasts. Through the forward-looking stress-testing analysis the financial system stability and capital adequacy in the banking sector are estimated for a period of up to two years. Regardless of the purpose of stress-testing to assess whether in the event of large losses the banking sector has the ability to absorb them and not to accurately predict the indicators of the banking sector, it is still important to assess whether the attitude toward risk is sufficiently conservative. The results suggest that the forecast of the capital adequacy ratio is quite close to its actual values. However, disintegrating these developments by the contribution that comes from the underestimation of the regulatory capital, in order to preserve the conservative trend of the exercise, has eased the underestimation of the risk-weighted assets, mainly reflecting the changes in the regulatory framework of the Bank of Albania. Following the results of the analysis, the paper proposes several ways to further improve the quality of forecasting. They relate mainly to the transition towards a dynamic stress test forecasting, the consolidation of the conservative trend for the forecasting of the regulatory capital and a preliminary assessment of the regulatory changes and their inclusion in the stress test.

Keywords: stress-testing, capital adequacy, quality of forecasting

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I. Introduction

The stress-testing exercise has obtained a special importance in assessing the risks to which the banking sector is exposed. The beginning of this exercise in the Bank of Albania is around 2005, in a simplified form of it, while the standardization and comprehensive inclusion of the main risks of the sector, was completed around 2010. The history of the stress-testing exercise in its actual form is relatively short. The International Monetary Fund refers to the stress-testing exercise in its FSAP analysis, starting from 2001. However, the global financial crisis showed that this new instrument of risk assessment failed to foresee their accumulation and the exposure or the real vulnerability of the banking sector. Haldane (2009) extensively discusses the reasons for the failure of stress-testing exercises, ranging from underestimation of the size of the applied shocks to problems in the assessment of the interlinkages between financial institutions. On the other hand, Jorion (2009) argues that, despite the large size of losses after the financial crisis, it should not imply that the risk assessment methodologies were wrong. Updating models with the newest approaches and recent data, adjusting the volatility or the correlations, helps build more accurate estimations of the stress-testing.

The purpose of this paper is to present for the first time the methodology for building the stress-testing at the Bank of Albania, as well as to evaluate the quality of its forecasts. Through the forward-looking stress-testing analysis the financial system stability and capital adequacy in the banking sector are estimated for a period of up to two years. Stress-testing focuses only on risks to the banks' capitalization based on macroeconomic scenarios, while risks associated with funding and liquidity are not part of these mechanisms.

The Bank of Albania has build two methodologies for stress-testing. Starting from 2010, the sustainability of the banking sector and individual banks in terms of severe but plausible economic shocks is estimated on quarterly basis through the top-down approach. In this approach, the Bank of Albania builds macroeconomic scenarios and assesses the risks of the banking sector based on the data of each bank's balance sheet. The results are presented to the Administrators and published in an aggregated way, drawing attention to the exposure of the banking sector and the individual banks to the risks analyzed. In the second approach, the

bottom-up approach, the Bank of Albania builds macroeconomic scenarios, while the commercial banks assess the exposure. This exercise is performed once a year, starting from 2012. In this case, the results draw attention to the improvement of the procedures of the exercise and to the risk exposure, presented directly to the participating banks.

This paper evaluates the forecasting quality for the methodology of the top-down approach. Regardless of the purpose of stress-testing to assess whether in the event of large losses the banking sector has the ability to absorb them and not to accurately predict the indicators of the banking sector, it is still important to assess whether the attitude toward risk is sufficiently conservative. The results of stress-testing concisely present the banking sector's vulnerability to adverse circumstances (Blaschke, 2001). Consequently, stress-testing does not assess the probability of the materialization of a certain scenario, but answers the question "How large could the loss be?" rather than "How probable is the loss?" (Blaschke, 2001). In this context, the stress-testing exercise is expected to be biased towards risk overestimation to provide a solvency buffer (cushion).

The results suggest that the forecast of the capital adequacy ratio is quite close to its actual values. However, disintegrating these developments by the contribution that comes from the underestimation of the regulatory capital, in order to preserve the conservative trend of the exercise, has eased the underestimation of the risk-weighted assets, mainly reflecting the changes in the regulatory framework of the Bank of Albania. The quality comparison of the time-extended stress-test forecasting reflects a better quality for the first year of the exercise, in line with the expectations.

The paper is structured as follows. The second section details the methodology of the stress-testing exercise at the Bank of Albania. Section 3 summarizes the steps of stress-test forecasting and the indicators used to estimate its quality. Section 4 presents the results for the forecasting errors of the capital adequacy ratio, regulatory capital and risk-weighted assets. Section 5 discusses the implications of the results and suggests some ways of improving the quality of the exercise. Lastly, the main findings are summarized.

II. The methodology of stress-testing at the Bank of Albania

The stress-testing exercise at the Bank of Albania took full shape starting from 2010. Previously, starting from 2005, the stress-testing mainly consisted in compiling some special sensitivity analysis.

The process of building macroeconomic scenarios is the first challenge in performing a stress-testing exercise. In general, the stress-test scenarios should be adverse, but plausible, and at the same time coherent, which means that the risk factors need to develop consistently. The consistency of the results for the stress-testing exercise is closely related to the consistency of the adverse scenarios. Constructing the right scenarios, in line with developments in the economic cycle, allows the analysis of the situations in real time and the construction of countercyclical policies for the banking sector. If the model does not include sufficiently "extreme" scenarios, thus “tail events” in the probability distribution, the final results do not represent the necessary risk and the relevant uncertainties.

Generally, stress to banks consists of a set of risks that can or cannot be statistically measurable. For this purpose, to assess and plan the impact of different scenarios to the banking sector, intermediate models have been built to evaluate the banks' exposure to different scenarios.

The baseline scenario of stress-testing is built based on MEAM, the macroeconomic model of the Bank of Albania. The model generates projections mainly for the macroeconomic indicators such as economic growth and other indicators[2]. It gives the possibility to perform simulations and obtain quantitative effects of economic policies and shocks on economic variables.

The baseline scenario is based on the official forecast of the Bank of Albania for the economic growth, interest rates, credit expansion and developments in the exchange rate.

The adverse scenario is based on assumptions of lending deterioration, weakening of the domestic currency and interest rate growth. In order to analyze the banking sector’s stability to the stress-test scenarios, the shocks of the adverse scenarios maintain the same structure. Generally, the adverse scenarios in the stress-testing exercise are built based on two approaches:

[2] For more details refer to: Zoltan M. J., V. Kota and E. Dushku, 2007, “Macro econometric model of Albania: A follow up”, 7th Conference of the Bank of Albania, "Monetary policy strategies for small economies".

1. Reduction by 50% of the annual growth of lending used in the baseline scenario, 20% depreciation of the domestic currency and an interest rate increase by 2 standard deviations to the baseline scenario. Based on these shocks, MEAM estimates the economic growth for the adverse scenarios through the transmission channels.

Meanwhile, following the implementation of the IMF recommendations, the Bank of Albania builds an adverse scenario based on the cumulative decline of the GDP by 2 standard deviations (2-year cumulative) calculated as follows:

$$GDP^{baseline}_{year-year(+2)} = \left(\frac{GDP real^{baseline}_{year(+2)}}{GDP\ real_{year}}\right) - 1 \qquad (1)$$

while the economic growth after 2 years is estimated as follows:

$$g^{adverse}_{year-year(+2)} = g^{baseline}_{year-year(+2)-0.123} = \left(\frac{real\ GDP^{adverse}_{year(+2)}}{real\ GDP_{year}}\right) - 1 \qquad (2)$$

where $GDP^{baseline}$ is the Gross Domestic Product in the baseline scenario,

$GDP^{adeverse}$ is the Gross Domestic Product in the adverse scenario

g – is the growth rate of the GDP.

Credit risk

Credit risk represents the main exposure in the stress-testing exercise. This risk assesses the possibility that the banking sector borrowers do not repay their debt. In this case, banks are exposed to losses due to lack of inflows on their income on one hand, and increased spending on provisioning on the other hand (Blaschke, 2011).

The literature of credit risk assessment is focused on the assessment of losses stemming from credit risk and the relevant impact on capital. Credit risk generally includes expected losses, which must have been provisioned by banks, and unexpected losses, which should be recently provisioned. However, credit risk in the Albanian banking sector is assessed through the non-performing loans ratio, which summarizes the assessment on the share of delinquent loans over 90 days to total loans outstanding. The ratio of non-performing loans is regressed to the main macroeconomic factors that evaluate the sensitivity of banks' borrowers to macroeconomic risk

factors. This assessment is separately done for loans in ALL and foreign currency loans, including borrowers who are exposed to exchange rate fluctuations through indirect credit risk. The general form of the equations is as follows:

$$NPL\ ALL_t = \alpha_0 + \alpha_1 NPL\ ALL_t + \alpha_2 \Delta GDP_{t,t} + \alpha_3 i_t + \varepsilon_{t,t} \quad (3)$$

$$NPL_{FX_t} = \alpha_0 + \alpha_1 NPL_{FX_t} + \alpha_2 \Delta GDP_{t,t} + \alpha_3 i_t + \alpha_4 \Delta FX_{t,t} + \varepsilon_{t,t} \quad (4)$$

where NPL_ALL - is the non-performing loans ratio in ALL

GDP - is the Gross Domestic Product, percentage change

i - is the reference rate for lending, respectively the 12-months rate of Treasury Bills for ALL and *euribor* for foreign currency

FX - is the ALL/EUR exchange rate (percentage change) since the highest share of lending in foreign currency is in this currency.

Assuming a linear exposure to risks, the volatility of non-performing loans can be calculated as:

$$\sigma_{\left(\frac{NPL}{Assets}\right)} = \sqrt{\beta^2 \sigma_i^2 + \gamma^2 \sigma_{\ddot{p}}^2 + \cdots + 2\rho_{i,p}\sigma_i\sigma_p + \cdots} \quad (5)$$

According to this approach, a simultaneous integration of credit risk and market risks is performed.

The assessment of additional provisioning expenses is based on the structure of loan categories for each individual bank. Their impact is assessed in terms of capital adequacy as follows:

$$Capital\ Adequacy\ Ratio_{stress\ test} = \frac{Regulatory\ capital - additional\ provisioning\ expenses}{Risk\ weighted\ assets - additional\ provisioning\ expenses} \quad (6)$$

The interest rate and the exchange rate that determine the non-performing loans ratio are also determinants of market risk (interest rate risk and exchange rate risk are presented below).

Interest rate risk

The banking sector is exposed to interest rate risk if there is a mismatch between assets and liabilities that are sensitive to interest rates. The change in interest rate affects the interest income

and interest expenses, the net result of which is the main source of income for the banking sector in Albania. The assessment of interest rate risk can be done through two approaches:

The first approach, the re-pricing model, estimates the gap between assets and liabilities that are sensitive to interest rates. These assets/liabilities are allocated in several specific "baskets" according to their sensitivity to the interest rate and maturity. For each basket a gap between revenue flows in assets and the flow in liabilities is estimated. For any change in the interest rate ΔR_i, the re-pricing gap determines the change in net interest income for the basket $_i$ and the total portfolio:

$$\Delta\, Net\ interest\ income_i = Gap_i \times \Delta R_i \qquad (7)$$

The repricing model is simple and can be applied to aggregated data from banks' balance sheets. The main disadvantage is that this model does not include the impact of interest rate changes in the market value of the assets, basically using the value of assets/liabilities according to the balance sheet value and omitting profits/losses in capital.

The second approach, the gap model, includes the remaining maturity of assets and liabilities of the banking sector in the analysis. In this case, the weighted-average maturity of assets/liabilities is estimated as follows:

$$M^A = \sum_{i=1}^{n} w_i^A M_i^A \qquad M^L = \sum_{i=1}^{n} w_i^L M_i^L \qquad (8)$$

ku M^A is the weighted average maturity of assets.

M^L is the weighted average maturity of liabilities.

M_i^A is the maturity of an asset with a given maturity *i*.

M_i^L is the maturity of a liability with a given maturity *i*.

w_i^A is the share of the asset in the total portfolio.

w_i^L is the share of the liability in the total portfolio.

The banking sector's exposure to the interest rate risk depends on the size of the maturity gap mismatch.

$$Gap^{Maturities} = M^{A} - M^{L} \quad (9)$$

The first approach, the re-pricing model, where the gap between assets and liabilities sensitive to interest rate changes is built, has been used by the Bank of Albania until the end of 2013. Further on, the methodology has improved by using the assessment of the maturity gap.

Regarding the size of shock in terms of interest rate, a simpler approach in accordance with the methodology applied, is the parallel shift of the interest rate curve. This shock is applied to the interest rate in the base period and it does not include changes in volatility or correlation.

Exchange rate risk

The exchange rate risk is also important for the banking sector. This risk assesses the exposure of bank assets and liabilities to exchange rate fluctuations. The exchange rate risk may be direct, in accordance with the open foreign currency position of the banking sector, or indirect, in the event that the banking sector has provided loans to borrowers with income in domestic currency.

For the assessment of the direct risk, the shock means a higher depreciation of the domestic currency and an assessment of the corresponding impact in loss/profit on the long/short FX position.

$$\Delta \frac{loss}{profit} = Net\ open\ FX\ position * \Delta FX \quad (10)$$

The highest value between the total net open long FX position and the total net open short FX position represents the total net open FX position of the bank, or the bank's overall exposure to the exchange rate risk. Depending on the long or short position, the exchange rate depreciation can generate profit or loss for the banking sector.

The assessment of indirect exchange rate risk is included in the equation of non-performing loans in foreign currency and the corresponding impact on provisioning expenses.

Profitability, regulatory capital and risk weighted assets

The capital adequacy ratio is the comprehensive leading indicator of the stress-testing estimation. One of its determinants, the regulatory capital, is significantly affected by the performance of the

banking sector's financial result after relevant shocks. The financial result includes the impact that comes from net interest income through interest rate risk, losses or profit from exchange rate shocks in the net open FX position, change in provisioning expenses through credit risk and the applied haircuts in the securities portfolio through market risk.

$$financial\ result = f\left\{NII, \frac{loss}{profit} FX, provisioning\ expenses, haircut\right\} \quad (11)$$

Other profitability indicators such as commission income, administrative or other expenses are kept in line with the historical trend. The regulatory capital in the base period is corrected with the financial result of the forecasted periods, precisely at the end of the first year and at the end of the second year of the exercise. The adjustment with the financial result is performed in the same measure for both cases, profit and loss. For the exercise, it is also assumed that the banking sector will not distribute dividends.

$$Regulatory\ capital_{t+1} = Regulatory\ capital_{t} + Financial\ result_{t+1} \quad (12)$$

Regarding the performance of risk-weighted assets, their forecast is divided into two periods. For the 2010-2014 period, the banking sector was under Basel 1 approach, implying the need to assess only credit risk through forecasting the growth of outstanding loans. Starting from January 2015, the banking sector switched to the Basel 2 approach, and the capital requirements expanded not only for credit risk but also for market and operational risk. Regarding the operational and market risk, risk-weighted assets reflect the expert judgment on net income and the potential of asset quality deterioration.

At the end of the first year and of the second year of the exercise, the capital adequacy ratio is estimated for each bank and for the whole banking sector.

$$Capital\ adequacy\ ratio_{t-1} = \frac{Regulatory\ Capital_{t+1}}{Risk\ Weighted\ Assets_{t+1}} \quad (13)$$

Assessing the forecasting quality of stress-testing

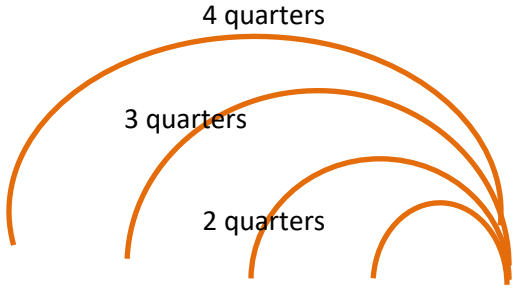
This section aims to assess the forecasting quality of the stress-testing exercise and its structure. The stress-test forecasting is not the same as the macroeconomic variables forecasting, mainly because it is based on scenarios with a low plausibility. Consequently, the comparison of the

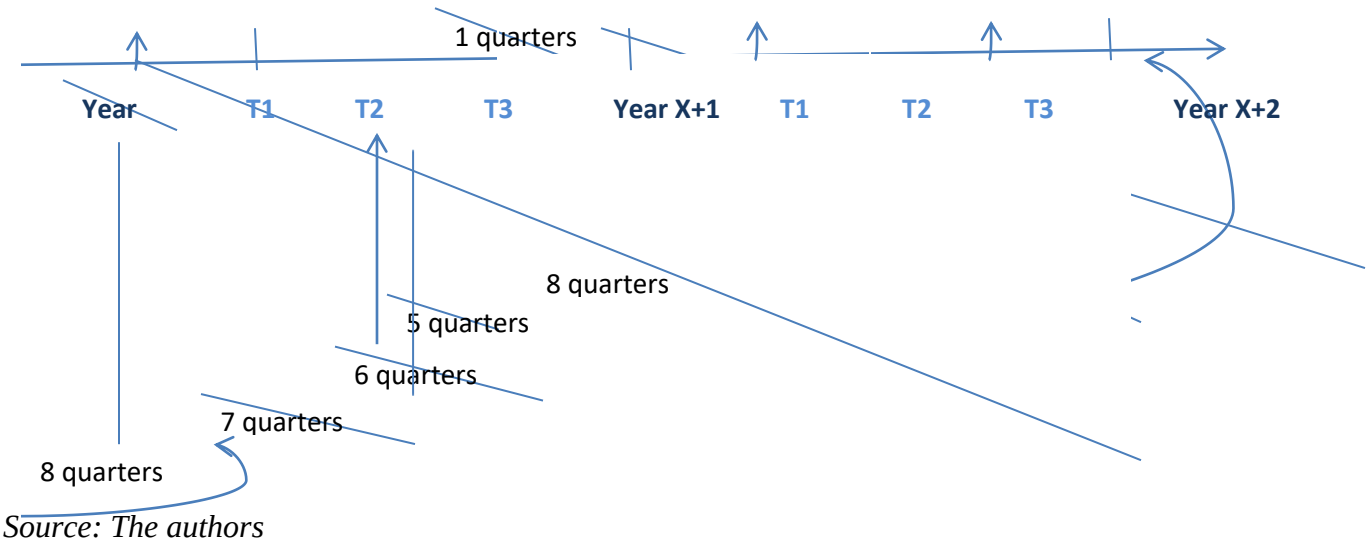
actual values with the forecasted values of the adverse scenario is not valid for its quality assessment. In the baseline scenario, the comparison of the stress-testing forecasted values with the actual values of the banking sector indicators is still difficult. The baseline scenario includes some static assumptions on the development of profitability indicators, capitalization or the interest rate effect. On the other hand, the actual data include a dynamic behavior of banks in search of profit, preliminary budgeting of their activity, a corrective behavior towards meeting their targets etc. However, the purpose of stress-testing is the assessement of the banking sector's stability even in the baseline scenario, which generally aims to maintain a buffer of a higher capital adequacy ratio than the actual one. For this purpose, considering the forecasted estimations in the baseline scenario, the forecasting errors that overestimate the risks are more acceptable than the forecasting errors that underestimate them.

The forecasting structure of stress-testing

Another aspect of stress-testing at the Bank of Albania is that exercise is static and not dynamic. Despite the quarterly frequency of the exercise, the forecasting horizon extends up to two years, thus up to 8 quarters, fixing the ending period at the end-year of the exercise. More explicitly, if it is December 2010, the forecasting exercise extends until December 2012, ie. 8 forecasted quarters. The next exercise will be conducted in March 2011, however, it extends again until the end of 2012, ie 7 forecasted quarters, and so on. The indicators of the banking activity will be estimated in each case for the end of the first year (December 2011) and the end of the second year (December 2012). A graphical illustration of the forecasting structure is presented below.

Chart 1. The structure of building the stress-testing exercise





Source: The authors

According to Gersl et. al (2010) the forecasting of the baseline scenario should assess slightly increasing risks compared with the actual performance of the banking sector indicators. In this case, it is important that the entire banking sector maintains a higher level of capitalization to face all the uncertainties related with losses assessed in the event of a weaker performance of the economy. Consequently, this means that the forecasting errors of stress-testing should be assessed differently from the forecasting errors of macroeconomic variables, for which the direction of the forecasting error is considered in the same way as "poor quality". In the case of stress-testing, the forecasting errors can also be biased toward overestimation of risks and underestimation of capital adequacy ratio, aiming that the banking sector is hedged against them.

To assess the quality of stress-testing at the Bank of Albania, we rely on quarterly data for the period of March 2010 - December 2015. The indicators for which the forecasting quality is assessed are the regulatory capital, the risk weighted assets and capital adequacy ratio. However, as the NPL ratio has a significant impact on the financial result of the banking sector and on the capital adequacy ratio, we also assess the forecasting quality of this assumption.

The assessment for each indicator of the stress-testing is compared with its actual performance according to the dynamics presented in Chart 1. This means that the forecasting errors are assessed according to the different periods of its estimations. More specifically, if we are at the beginning of the period, December 2010, the stress-testing exercise has forecasted the

performance of the banking sector indicators up to the end of 2011 and 2012, thus a forecasting 4 and 8 quarters. In the second period, March 2011, the stress test has forecasted the performance of the banking sector indicators again until the end of 2011 and the end of 2012, updating the financial situation of banks with the relevant period. However, in this case the forecast extends to 3 quarters (end of 2011) and 7 quarters (end of 2012). Moving along, the forecasted periods narrow further down to 2 quarters (end of the first year) and 6 quarters (end of the second year) for the exercise of June, etc. The following table presents precisely the estimation structure of the forecasted periods where the actual values are compared with the forecasted values of the stress-testing exercise.

Table 2. Forecasted periods based on quarters

The forecasted period	Q1, Year X		Q2, Year X		Q3, Year X		Q4, Year X	
	Year X+1	Year X+2	Year X+1	Year X+2	Year X+1	Year X+2	Year X+1	Year X+2
Forecasted quarters	3	7	2	6	1	5	4	8
Actual values	Q4, Year X+1	Q4, Year X+2	Q4, Year X+1	Q4, Year X+2	Q4, Year X+1	T4, Year X+2	Q4, Year X+1	Q4, Year X+2

Source: The authors

As of the above, the forecasted horizon is divided in accordance with the number of periods in advance on which the stress-testing exercise is built and varies from 1 quarter to 8 quarters, which represents the longest forecasting period. Compared to the end of the first year of stress-testing, the forecasting periods are considered as 4 quarters of forecasting, 3 quarters, 2 quarters and lastly, 1 quarter. Compared with forecasting up to the end of the second year of stress-testing, the forecasted period are estimated as 8 quarters, 7 quarters, 6 quarters and lastly, 5 quarters. As a result, the forecasting errors will also be evaluated for 1-8 quarterly periods of forecasting.

Forecasting errors

The analysis of forecasting errors focuses on evaluating the size of the error for each certain number of periods (periods in advance $_i$), as well as on analyzing the direction of the error. Regarding the size of the forecasting error, the literature presents several indicators that focus on comparing the forecasted values with the corresponding actual values as follows.

a. Forecasting errors

The average error (ME) helps to evaluate the deviation of the forecasted values to the actual ones by determining if there bias in forecasting. A positive value of the ME means overestimation and a negative value means underestimation. But the ME indicator can also be misleading. A value of zero could mean that the model has perfectly forecasted the actual value (less likely) or that the positive and negative values eliminate each other. In both cases, the ME indicator underestimates the error. The ME indicator is defined as:

$$ME = \frac{1}{n}\sum_{t=1}^{n}\left(F_t - A_t\right) \qquad (14)$$

where n is number of the forecasted periods, F is the forecasted period, A is the actual value and t refers to the period.

The average absolute error (MAE) assesses the extent of the forecasting errors. MAE is a way to address the underestimation errors by the ME indicator. Using absolute values of the errors, the average gives a better indication about the size of forecasting errors. The average absolute error (MAE) is determined as follows:

$$MAE = \frac{1}{n}\sum_{t=1}^{n}\left|F_t - A_t\right| \qquad (15)$$

The square root of the average error (RMSE) is an indicator that assumes that errors with a higher value are worse than the ones with a small value. The RMSE indicator eliminates the problem of positive/negative values by obtaining the square of the error. This result gives more importance to a bigger error, therefore the assessment of the forecasting errors is more conservative compared to the AAE indicator.

$$RMSE = \left(\frac{1}{n} \sum_{t=1}^{n} (F_t - A_t)^2 \right)^{1/2} \quad (16)$$

The indicators presented above are "series specific," meaning they provide an assessment of forecasting errors in units of each of the indicators. Meanwhile the two measures presented below enable the comparison between the forecasting quality of various indicators. This process is performed using the error rate regarding the actual values.

The average percentage error (MPE) is a relative measure of forecasting errors. It shows the weight of the forecasting error to the actual value of the indicator, but it also is a subject of "averaging" positive and negative values of the forecasting error (likewise the AE indicator).

$$MPE = \left(\sum_{t=1}^{n} \left(\frac{F_t - A_t}{A_t} \right) \times 100 \right) / n \quad (17)$$

The average absolute percentage error (MAPE) is a benchmark indicator that does not include the problem of averaging the positive and negative errors. This indicator provides the weight of the absolute error to the actual value and it is a simple way to communicate the forecasting quality.

$$MAPE = \left(\sum_{t=1}^{n} \left(\left| \frac{F_t - A_t}{A_t} \right| \right) \times 100 \right) / n \quad (18)$$

b. The contribution of assumptions on the forecasting errors

The forecasting errors can reflect two main factors. Firstly, the impact of the macroeconomic or financial assumptions and the credit quality is very important to the financial result. The assumed interest rates changes affect net interest income, credit quality, etc.; assumptions regarding the exchange rate impact the income statement in accordance with the net open FX position; the impact of the assumption on the performance of non-performing loans is reflected in the performance of provisioning expenses and the financial result. The second element that influences the forecasting error is related to the internal structure of stress-testing through the assumed inter-linkages for each indicator.

In order to separate the contribution of the assumptions from the one that comes from the stress-testing structure, the stress-testing exercise is re-estimated for the entire period under consideration by replacing the macroeconomic assumptions with their actual performance. The

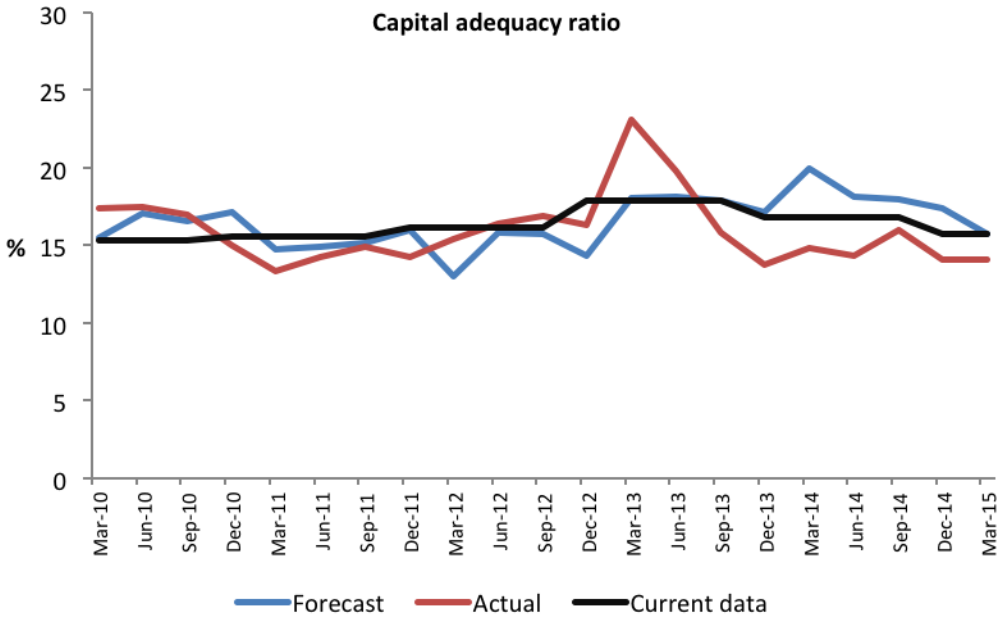
remainder of the forecasting error reflects the rigidity of its structure and the interlinkages within the banking sector indicators, the implicit risk aversion of the stress-testing and its tendency to underestimate the positive outcome.

III. The results

Comparing the actual performance with the stress-test forecasting

The main indicator of stress-testing is the Capital Adequacy Ratio. The actual values of this indicator are generally above the forecasted value up to the end of 2013. After this period, it is noted that the stress-testing exercise tends to overestimate the capital adequacy ratio until the end of 2015, where the difference between the two estimations is moderated. In the first part of the period under consideration, until 2013, only a small share of the forecasting error is due to errors in the stress-testing assumptions. However, after the second period, starting from the end of 2013, it is noted that the error correction in the underlying assumptions partially smoothes the difference from the actual values and aims at underestimating the Capital Adequacy Ratio.

Chart 2. The comparison of the performance for the Capital Adequacy Ratio

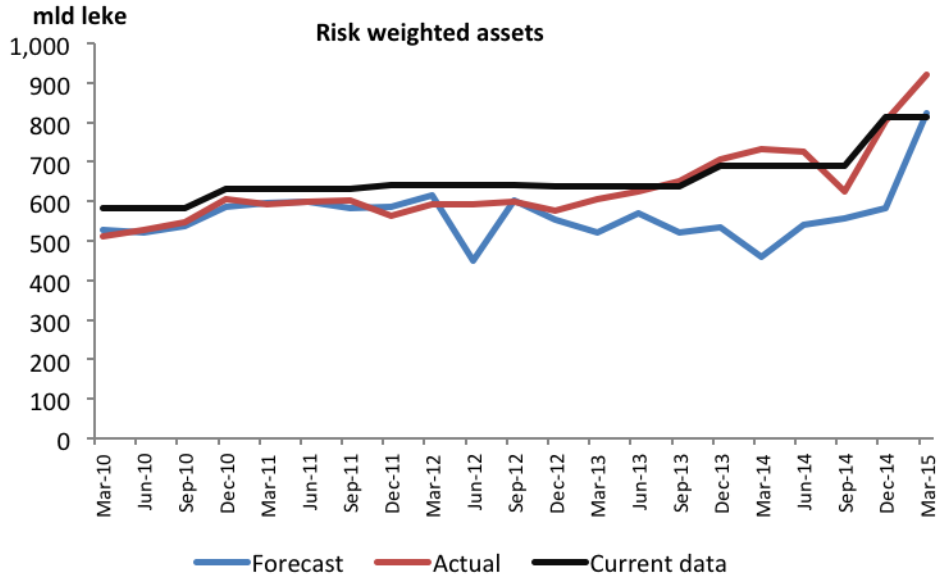


Source: Authors' estimations

The difference between the actual performance and the forecasted capital adequacy ratio reflect assessments for both the Risk Weighted Assets and the Regulatory Capital.

Considering the risk-weighted assets, the stress-testing exercise seems to have underestimated their performance persistently. This underestimation becomes even more significant after 2013, where the difference from the actual value is even more profound. The error correction for the assumptions of the stress-testing smoothes this difference significantly. For the period after 2013, the current assumptions values are quite close to the actual value of Risk Weighted Assets, implying that incorrect assumptions have had the main contribution for the underestimation of this indicator.

Chart 3. The comparison of performance for the Risk Weighted Assets



Source: Authors' estimations

Focusing further on this assessment, this development reflects two fundamental changes in the estimation of the risk-weighted assets, which are not part of the macroeconomic assumptions.

- Firstly, in May 2013, the Bank of Albania presented a package of countercyclical/ macroprudential measures which aimed at supporting and stimulating lending and reducing the credit risk. The package of measures included incentives to channel the

excess liquidity of the banking sector towards lending to the economy and supported the prompt restructuring of loans, prior to becoming non-performing loans. Measures related to stimulating lending aims:

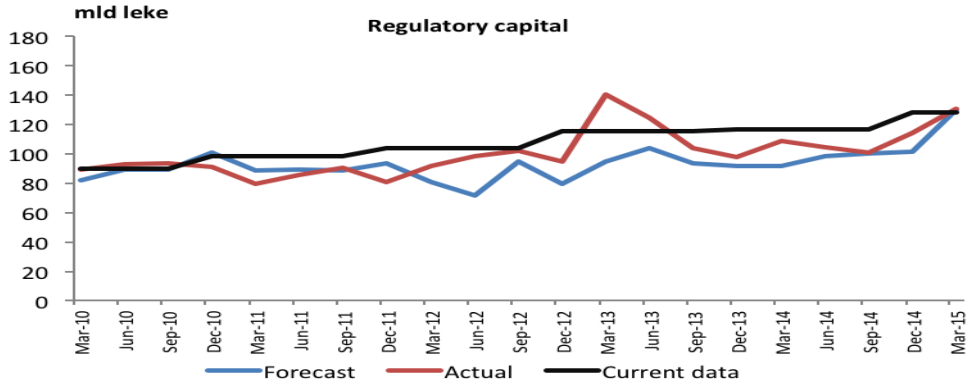
- i. zeroing coefficients for calculating the risk-weighted assets for credit growth within the range of 4-10% and
- ii. an increase to 100% of the risk coefficients for the additional net position of the investments abroad.

The package of countercyclical measures gave a direct impact on the performance of risk-weighted assets, mainly in terms of their growth for the additional net investment position to other countries, which have not been part of the stress-testing assumptions.

- Secondly, the risk-weighted assets increased after the implementation of the new regulation on capital adequacy in January 2015 under Basel 2. In addition to the credit risk, the Risk Weighted Assets include the market risk and the operational risk. In the condition where the exposure to these additional risks was unknown and there were no estimations, the stress-testing assumptions have not incorporated the new implemented regulation. As a result, for forecasted periods after 2015, the changes in regulation gave a significant impact in changes between actual and forecasted values.

The second element that determines the capital adequacy ratio is the regulatory capital. Unlike the risk-weighted assets estimation, the forecasted regulatory capital is generally underestimated for all the period under consideration. In this case, the main impact comes from the conservative trend of expectations for the increase of the financial result, which is the main contributor in the performance of the regulatory capital in the stress-testing exercise.

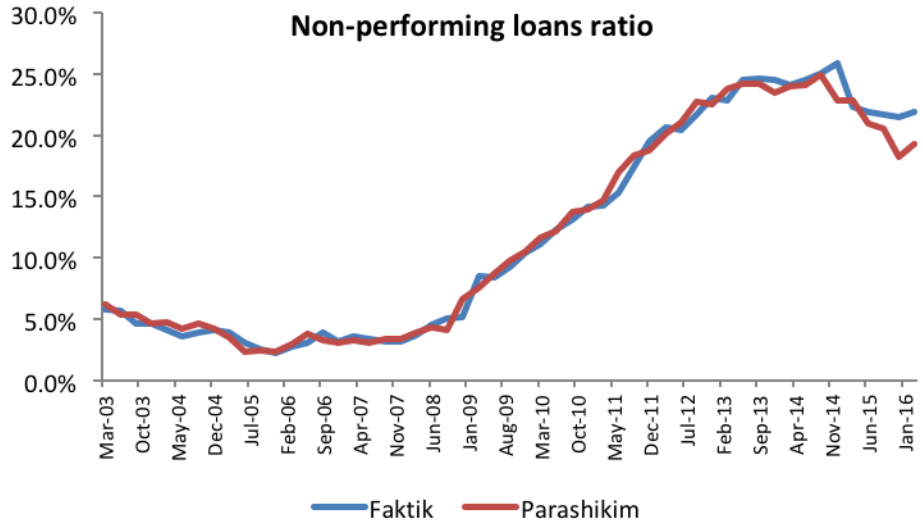
Chart 4. The comparison of the Regulatory Capital performance



Source: Authors' estimations

The disintegration of the errors contribution in estimating the capital adequacy ratio by the inaccurate forecasting of the risk-weighted assets, as well as the inaccurate forecasting of the regulatory capital, shows that these two elements have offset one another. The underestimation of the risk-weighted assets was offset by the underestimation of the regulatory capital, smoothing the forecasting error of the capital adequacy ratio.

Finally, the developments in non-performing loans are important for stress-testing, as the provisioning expenses are the main item that affects the financial result, particularly in the adverse scenarios. Generally, the comparison of actual and forecasted values show a qualitative forecasting for the non-performing loan ratio. There is an exception for the period after 2015, when the Bank of Albania required the write-off of non-performing loans which had been classified as lost for more than 3 years. In this period, the impact of the non-performing loans write-off is high, resulting in an underestimation of credit quality. This trend reflects a deterioration of the credit quality, which has smoothed the positive impact arising from non-performing loans write-off, as well as an overestimation of the outstanding loans that should have been written-off.

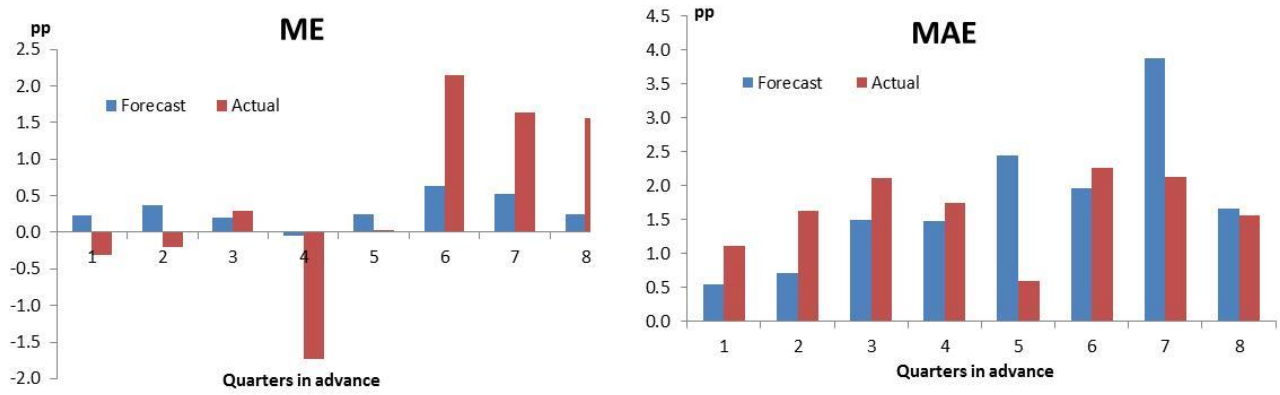


The forecasting errors according to the periods in advance

As explained in section two, the stress-testing exercise includes a variable period of forecasting, which extends up to 8 quarters in advance. The following section presents two main indicators of forecasting errors, for its main elements, while the rest of the forecasting errors is presented in the annex.

The absolute forecasting error (ME) of the capital adequacy ratio scores -0.1 percentage points for 4 quarters in advance and 0.2 percentage points for 8 quarters in advance. This means for example that stress-testing forecasts a capital adequacy ratio of respectively 15.9% and 16.2%, instead of the actual value of 16%. The size of the forecasting error increases for the second year of the forecasting, showing a trend of overestimation for the indicators, although the size is quite small. The corrected assumptions of risk-weighted assets have led to higher forecasting errors for the capital adequacy ratio (actual) due to lack of smoothing from the performance of regulatory capital.

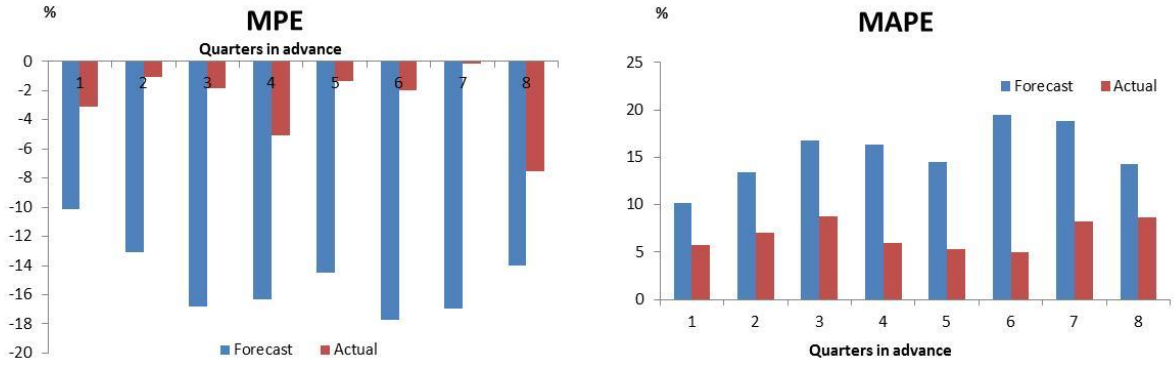
Chart 5. Forecasting errors, Capital Adequacy Ratio



Source: Authors' estimations

In relation to the forecasting errors for the risk-weighted assets, they show significant bias due to underestimation for the entire period. The corrected assumptions for risk-weighted assets through the re-estimated assumptions and the inclusion of two important changes in the regulations of the Bank of Albania, has significantly reduced the forecasting errors. The forecasting errors in the first and second year of the exercise do not change significantly, even though they show an increase during the end-year period, due to adjustments made by banks in their activities with the objective of reaching their targets.

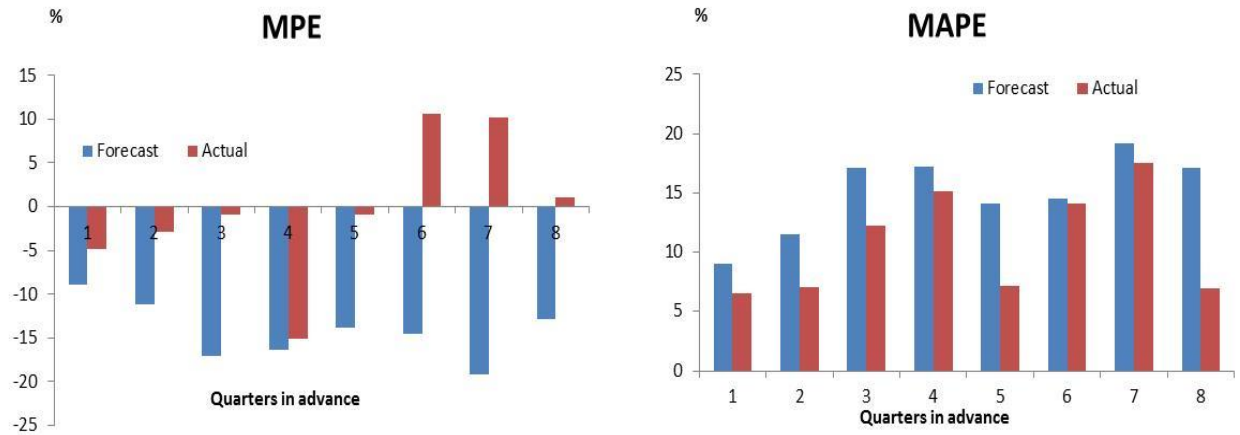
Chart 6. Forecasting errors, Risk Weighted Assets



Source: Author's estimations

The forecasting errors of the regulatory capital reflect the trend of their underestimation. The re-estimated assumptions with their actual performance has slightly smoothed these errors. In relative terms (MAPE), the regulatory capital is underestimated by 15% at the end of the first year of the exercise and by 13% at the end of the second year of exercise.

Chart 7. Forecasting errors, Regulatory Capital



Source: The author

The main impact on this forecasting comes from the structure of the stress-testing exercise. The static and not dynamic nature of the exercise means that items of the income statement that contribute to the financial result and directly to the regulatory capital are annualized for each quarter. After the annualization process, the assumptions on the relevant shocks are applied, mainly the impact of interest rate changes, the exchange rate fluctuations and the non-performing loans ratio. As a result, the structure and the formation of the financial result in the baseline scenario does not depend much from shocks and assumptions, but mainly from the annualization process.

Despite that the assessment process of the stress-testing quality generally shows that this exercise is relatively qualitative, with a good forecast of the capital adequacy ratio, it is still necessary to improve it further. The results show that the static nature of the exercise restricts the dynamic estimation of the banking sector activity and the lower difference with its actual values. Also, the static nature of the exercise does not maintain a uniform forecast horizon, which would enable a more consistent assessment of its quality. Therefore, the first recommendation of this paper is related to the need to switch to a dynamic stress-test forecasting. For this purpose, the financial result of each quarter would serve as the base period, which varies depending on the financial result for the next quarter and the relevant assumptions. Secondly, stress-testing seems to have maintained a conservative trend on forecasting the regulatory capital. However, a further consolidation of this trend for the baseline scenario would mean that the change in this indicator

reflects the financial loss but not the positive financial result. The second recommendation is precisely the restriction of changes in the regulatory capital only for the financial losses. Thirdly, it is noted that the lack of information on the expected impact of the regulatory changes of the Bank of Albania on the Risk Weighted Assets has had a significant impact on the stress-testing results. It is necessary that such changes also include a preliminary estimation of their impact, with an eligible marginal error, to correctly assess the risk exposure of the banking sector. Finally, the assessment of the stress-testing forecasting quality is important and should be carried out on frequent basis for its continuous improvement.

IV. Conclusions

The purpose of this paper is to present for the first time the methodology of building the stress-testing at the Bank of Albania, as well as to evaluate the quality of its forecasts. The Bank of Albania uses the stress-testing exercise on regular basis in order to assess the stability of the banking sector against extreme shocks. For this purpose, evaluating the forecasting quality is important for the assessment of further improvements. The results show that the forecasting quality for the main indicator of stress-testing, the capital adequacy ratio, is qualitative. The absolute error of forecasting (ME) for the capital adequacy ratio scores -0.1 percentage points for 4 quarters in advance and 0.2 percentage points for 8 quarters in advance. However, these results are influenced by two main elements: the persistent conservative trend to changes in the regulatory capital, which has smoothed the underestimating trend of the Risk Weighted Assets. In relation to the latter ones, the regulatory changes of the Bank of Albania have given the main impact in the underestimation of the banking sector risks. Following these results, the paper proposes several ways to further improve the quality of forecasting. They relate mainly to the transition towards a dynamic stress test forecasting, the consolidation of the conservative trend for the forecasting of the regulatory capital and a preliminary assessment of the regulatory changes and their inclusion in the stress test.

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