

Credit Risk Management and Measurement Econometric and Empirical Model in the Banking System

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Abstract - The scientific paper begins with research on the financial-credit stability of the banking system in Kosovo, in the Western Balkan countries, in the Eurozone and beyond, to analyze the importance and effect of indicators on the stability of the banking system. This research paper focuses on management, analysis and measurement of credit risks. Firstly, the performance of the banking system is analyzed in different periods (specifically during the last 10 years), making comparability with other countries. Then, the financial- credit risk indicators are analyzed through: empirical time series analysis, credit shock analysis, credit index analysis, descriptive analysis, factorial analysis, reliability analysis. Finally, in order to protect the banking system from the failure or decline of financial stability at all times and continually the quality of loans and other assets should be assessed. This paper will assist future researchers for further analysis in different countries.

Keywords: Banking System; Credit Risk; Stress-test analysis; Herfindahl-Hirscham Index (IHH); Econometric model

JEL Classification: C1; C12; G21; G23; G32; O57

1. Introduction

The external financial and economic environment is characterized by a growth rate accelerating the growth of economic activity. The Eurozone economy is moving more and more towards economic growth compared to previous periods. The growth of economic activity remains mainly concentrated in the production and services sector, especially in Germany, Italy, Spain, while France during the period under review was characterized by slower economic growth. Risk management today is practiced by many banks or entities, in order to curb the risk that may be faced in the

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near future. Whenever a bank or entity makes any decision relating to investments, it tends to find the number of financial risks such as high inflation, drop, volatility in capital markets, bankruptcy, credit risk etc. The process of risk management in banks is complex, so the banks must implement the use of a simple and sophisticated model, for analysis and risk assessment, which must include policies, procedures, rules and structure of the better managed. So, the bank needs to manage carefully, since an ineffective risk management can lead very quickly to the failure of the bank. If a bank perceives that is in financial weak position, depositors would withdraw their funds, other banks will not lend, on the other hand self-bank will not be able to sell debt securities in financial markets. All those will further aggravate its financial situation. The banking sector in the major eurozone countries with the exception of Greece, characterized by improvement of the main indicators of financial health, more specifically the level of capital of the banking sector expressed through the regulatory capital ratio to risk weighted assets improved in Germany, Spain, and the eurozone was also characterized by improved liquidity in the banking sector, especially in Germany and Italy, while countries such as Greece and Italy increased their non-performing loans. According to ECB data, the eurozone during 2015 compared to previous periods is characterized by an increase in lending activity, where the Netherlands had the highest growth, while Slovenia had the largest decline. The highest increase was in Montenegro, while the smallest was in Albania. Macedonia had the highest growth of lending activity compared to other periods, while the lowest growth was in Montenegro. Regarding the interest rates on loans in the Western Balkans countries have declined, while the lowest interest rates on loans are in Bosnia and Herzegovina. The main objective of this paper will be the measurement of credit risk in the banking system realized with the econometric model in the Kosovo banks and other countries. Kosovo as a country in transition should have well designed bank policies for the protection of credit risks. This indicates that one credit risk of good-planned, is one component of importance as determinant of bank stability and economic development of the country. Another objective for risk measurement is the identification and evaluation of various macroeconomic factors, and factors related to the structure of banks' assets and liabilities, affecting indicators of badly managed loans.

2. Methodology

The methodology includes: the focus of the paper, the purpose of the paper, the methodology used, the research question, and the hypotheses.

2.1. Focus of the Paper

This research paper focuses on management, analysis and measurement of risks, with particular emphasis on credit risk in the Kosovo banking system and beyond. Firstly, we have analyzed the performance of the banking system in different periods (specifically during the last 10 years), making comparability with other countries. Then, we have analyzed the financial-credit risk indicators through: empirical time series analysis, credit shock analysis, credit index analysis, descriptive analysis, factorial analysis, reliability analysis, and research related tests.

2.2. Purpose of the Paper

The purpose of this research is to evaluate and determine indicators for credit risk management and measurement in all variables or factors affecting the banking system.

2.3. Methodology of the paper

This research paper is realized through empirical analysis, as well as through questionnaires distributed to the banking sector (large banks and micro-banks). The questionnaire was conducted through the SL (Likert Scale) related to credit risk management and measurement, processing the data as mentioned above through econometric models such as: factorial analysis, reliability analysis, descriptive analysis etc. The main limitation of this research was the unwillingness of banks to provide information on the issue, where respondents mainly cited bank rules and laws given that the topic involved risk management. It is recommended to remove these in the future, in order to gain customer trust.

Research question

Was there a high concentration of credit exposures during the survey period according to credit shock analysis?

2.4. The hypothesis of scientific paper

Ho: There is a significant link between research methods (time series method and econometric and statistical methods), for managing and measuring credit risk.

H1: There is no significant link between research methods (time series method and econometric and statistical methods), for managing and measuring credit risk.

3. Review of the Literature

Our modern world depends on credit. Entire economies are driven by people's ability to "buy-now, pay-later". In fact, two hundred years ago it was a privilege to borrow money, but in industrialized societies today it is considered right. Credit insurance is a risky business, as borrowers vary in their ability and willingness to pay. In other cases, they may lose only a portion, or simply incur additional expenses to refund their money. (Anderson, 2007). In the decades before the 1970s, banking was a relatively common and well understood business. Banks were at the same time intermediaries between suppliers and users of funds and risk managers (and sometimes of recipients). (Banks, 1993). The banking industry has a long history and has had a significant impact on the economy and even on politics. (Gestel, T. V. & Baesens, B. 2009). Commercial banks play an important role in enhancing economic development and financial stability by financing the industry requirements in the country. (Vaish, 1997). We can deduct payments at the risk-free rate, using the neutral risk assessment in the lines of Jarrow and Turnbull (1995). (Wagner, 2008). Credit risk management is definitely one of the most important issues in the area of financial risk management. With the recent financial turmoil and regulatory changes introduced by Basel II, credit risk analysis and risk assessment in general have received even more attention from the financial and banking industry. (Gestel, T. V. & Baesens, B. 2009). Credit risk models are the tools that assist banks in defining, collecting, and managing risk across geographic lines and products. (Bandyopadhyay, 2016). And most importantly, valid credit risk models and proper use tests are the basic building blocks to achieving credit compliance. (Bandyopadhyay, 2016). Effective credit risk management is an essential component of a comprehensive risk management approach essential to the long-term success of any banking organization. (Bandyopadhyay, 2016). A default loan swap (CDS) is a bilateral and privately negotiated contract in which a hedge seller (insurer, risk taker) provides a hedge buyer (risk taker) for a well-specified credit event in an amount recognized for a specified period amount and for an asset (s) specified reference (portfolio). (Wagner, 2008). Banks also are facing more and more with credit risk on various financial instruments, where in addition to loans also include risk in: receipts, inter-bank transactions, trade financing, foreign exchange transactions, financial futures, exchanges, bonds, equity and options in extending pledges and guarantees, and settlement of transactions. (Bandyopadhyay, 2016, f. 29). Specialized information on financial products is collected by banks to improve investment decisions and to manage risk. (Gestel, T. V. & Baesens, B. 2009). Effective credit risk management is an essential component of a comprehensive approach to risk management, because lending is the core activity of the banking industry. (Bandyopadhyay, 2016). In this case we can say that in order to manage the speed of integration and expansion of the banking industry, regulations and laws are needed to protect clients who, through their deposits, facilitate bank turnover. (Madura,

2008) (Ochola, 2010). Banks play an important role in the economy and society as a whole. Their central role is to make community deposits and investments surplus useful, lending them to people for various investment purposes: enterprise growth, education, home, etc. (Gestel, T. V & Baesens, B. 2009).



Figure1. Role of Banks

The asset transformation function explains borrowers' demand for funds through lender deposits. (Anderson, 2007). At the same time, banks use savings deposits to secure long-term non-liquid investments. This is possible when the amount of deposits a bank holds is sufficiently stable. (Gestel, T. V. & Baesens, B. 2009). The bank's operations consist of business lines: banking investments, financial markets, banking and specialist activities. The scheme summarizes the main activities of the bank, depending on the bank and its organization. (Gestel, T. V. & Baesens, B. 2009). Our study contributes to several directions of current research. Firstly, we effectively apply "banking market risk" methods to solve a "credit risk" problem. As a result, we associate a growing literature on non-Gaussian volatility and dependency models with other literature on credit risk and portfolio loss. More broadly, regarding the indicators for management and measurement of credit risk within the banking system we use parameter models that vary over time for volatility and credit risk dependency, for example, by Engle and Kelly (European Central Bank, 2015). (Hager, 2008). At the same time, credit risk models and portfolio risk measures have been studied, for example, by Vasicek (1987), Lucas et al. (2001, 2003), Gordy (2000, 2003), Koopman, Lucas, and Schwaab (2011, 2012), and Giesecke et al. (2014). (Chen, R. & Yu, H. 2014). We argue that our analysis combined with shock analysis, time series analysis, credit index, econometric analysis, statistical analysis and all research-relevant tests will contribute to the good of the banking system regarding: risk measures loan portfolio (say, a year in advance or more years) that are available at a market risk frequency (such as daily, weekly, monthly, or annual) for the real-time risk measurement portfolio (Lucas, A & Schwaab, B & Zhang, Z. 2014). Then on the perspective of banks' financial stability, our research is based on theories and research of different authors from different countries, as, for example, (Acharya & Engle & Richardson, 2012), (Malz, 2012), (Suh, 2012), (Black, Correa, Huang, and Zhou 2012), and (Lucas et al. 2014). For this paper to have greater

relevance and accuracy for all the indicators studied in the case study, we felt the need to have knowledge of balancing an accurate banking structure and a covariance matrix of credit indicators. For such insights we have analyzed the research of (DECO), (Engle & Kelly, 2012). During the literature review, based on parameter models and oriented analysis in the study for credit risk we have seen the research of the Creal, (Koopman & Lucas, 2011,). Finally, based on the models used, we will give importance to this scientific paper, through models, analyzing in detail the aspect of credit risks.

4. Empirical Analysis in the Banking System

The empirical analysis is realized through financial stability reports for the period 2012-2017, but in some cases the period of analysis is based for ten years, respectively until 2019. This analysis is based on the structure of the banking sector making comparisons with Western Balkan countries and beyond. During the research are studied carefully all the financial items in the banking system with particular emphasis on credit risk. For detailed elaboration of credit risk measurement and management through time series, are used *Herfindahl-Hirscham Index (IHH) and Stress-test analysis*.

4.1. Activity and structure of the banking sector

The activity of the banking sector increased through the promotion of credit supply, facilitating and providing favorable and stable financing conditions. (Central Bank of the Republic of Kosovo, 2018). Increased activity by banks, especially new banks, affects the decrease of the concentration level in the banking market, where increased lending activity supported by the favorable position of the financial sector liquidity is the main factor in the overall asset growth in the financial system. (Central Bank of the Republic of Kosovo, 2015). Table1. Based on the Herfindahl-Hirscham Index (IHH), has a faster decline in loan concentration than in deposits in the big banks, as a result of fast growth of these items by the small banks. (Central Bank of the Republic of Kosovo, 2018). So, the big banks have scored smaller increases to award loans and for deposits compared to the smaller banks. (Central Bank of the Republic of Kosovo, 2016).

4.2. Assets

In 2017, the category that declined was that of cash and balance sheet with the CBK, as a consequence of the transfer of assets to the loan portfolio and applying negative interest rates (-0.40%) for banks' reserves above the mandatory level of 10% (Central Bank of the Republic of Kosovo, 2017). Table2.

4.3. Loans

Loans remain the most important category in the banking sector. Lending activity continued its upward trend in recent years as a result of improved credit supply through lower interest rates, improved credit portfolio quality, and the establishment of the Kosovo Fund for Credit Guarantees which provides collateral security for loans issued by banks for small and medium enterprises. (Central Bank of the Republic of Kosovo, 2018). Tables 3 4 5 6.

4.4. The Structure of Loans by Maturity

The structure of loans by maturity is almost similar to previous years. The increase is in line with banks' declarations for convenience in loans with longer maturity for financing of businesses and households. These loans are characterized by lower interest rates compared to the rates of short-term loans. Table 7.

4.5. Liabilities

The structure of liabilities in the banking sector continues to be dominated by deposits, which represent the main source of financing. This deposit support as a sustainable source of financing avoids exposure to foreign market movements. Table 8.

4.6. The Role and Importance of Risks in the Banking Sector

The exposure to risks in the banking sector remains realistically low given that credit risk and solvency risk have declined as a result of the decline in non-performing loans, rapid credit growth, banking capital growth through profit growth. Lending growth has affected the decrease of liquidity indicator but it is still at a satisfactory level. The rapid growth of loans and the increase of transferable deposits led to the slight decrease in the ratio of liquid assets to short-term liabilities. (Central Bank of the Republic of Kosovo, 2017). Table 9.

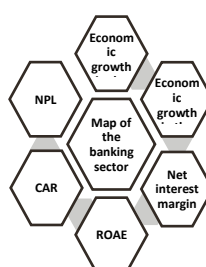


Figure 2. Map of the Banking Sector Risks

4.7. Credit Risk

One of the main risks that exposed the banking sector in Kosovo and beyond is the credit risk. Compared to countries in the region, Kosovo has the lowest level of non-performing loans. (Central Bank of the Republic of Kosovo, 2019). Tables 10 11 12.

4.8. Concentration of Credit Risk

An important factor in credit risk is the degree of concentration of credit exposures. Credit risk exposure is the ratio of total large exposures to the first-class equity. In the Kosovo banking system, the concentration of credit risk has declined, considering that the three major banks the ratio of credit risk exposure to the capital of the first class was diminished. Now, the level and quality of capital suggests consistency and high skills of the banking sector to cope with potential losses. During 2012-2019 the ratio of large credit exposures to the first-class equity is (2012=60.5%, 2013=91.0%, 2014=**124.0%**, 2015=81.2%, 2016=**51.0%**, 2017=70.9%, 2018=81.2%, 2019=**70.0%**). The banking sector has a favorable environment with low risks and sufficient capacity to withstand potential shocks. For the purpose of financial sector stability, the banking sector has created the stability index, which takes the values in the interval 0 and 1. Higher values represent a downward risk and vice versa. (Central Bank of the Republic of Kosovo, 2017). Table 13. Continuous increase of maturity mismatches on the side of mainly lending assets and increasing transferable deposits on the liability side, has slightly affected the growth of liquidity risk. This suggests that banks should in the future take care of adequate liquidity management. Also, one should not ignore the possibility that the continued growth of lending in the future will affect the capital because of the increased risk weighted assets. This suggests that there needs to be adequate measurement and management of credit risk. During the steady decline in interest rates on loans but to some extent be compensated from the effect of increasing the volume of lending, the bank's capital will be under the pressure of profitability. (Central Bank of the Republic of Kosovo, 2018). Table 14. Credit portfolio quality in Kosovo remains at the region's best level. Kosovo has for years stood at the lowest ratio of non-performing loans compared to the countries in the region.

4.8.1. Credit Risk Management and Measurement

To measure, manage and determine the same standard, terms and conditions for loan repayment within the banking system, it drafted a Credit Risk Regulation, which deals with loan repayments specifying clearly the terms and conditions of loan repayment. This regulation is expected to affect the increase in the level of repayments and improve the credit portfolio held by banks. (Central Bank of the Republic of Kosovo, 2018). Based on the pattern of expected losses over the coming years, changes must be made in the field of provision of the credit exposures. Implementation of IFRS 9: enables more advanced approaches to assessing credit risk, recognition of credit losses expected to result in earlier recognition of losses, as

well as increasing demand for provisions to cover possible losses. (Central Bank of the Republic of Kosovo, 2019). Therefore, to preserve lending activity and financial stability, banks need to be careful about the level of lending, household lending standards and enterprises.

4.9. Analysis of Stress Test for Measurement and Management of Credit Risk ¹

The banking sector, according to the analysis of credit portfolio shocks, is generally stable, profitable, with provisions for covering losses resulting from the growth of non-performing loans. In case interest rates will rise for loans and deposits taking into consideration their high participation in the balance sheet only one bank would suffer losses while the banking sector will be stable. However, there is a risk that in times of crisis the opportunity for reinvestment is diminished, while at the same time affecting the risk of over-borrowing of high interest borrowers. Tables 15 16 17.

5. Analysis of the Econometric Model for Credit Risk Measuring and Managing

Credit is money that is given to a creditor or borrower (also referred to as a debtor since he or she has an obligation). Credit risk refers to the risk that no contractual payment will be made (Chatterjee, 2015). The motivation to develop credit risk models stemmed from the need to conduct quantitative assessments of the amount of economic capital needed to support a bank's risk-taking activities. Minimum capital requirements have been internationally coordinated since the Basel Accord of 1998. According to Basel I, a bank's assets were allocated through a simple rule for multiple risk categories, each with a 'risk weight' ranging from 0% - 100%. The minimum capital was then set in proportion to the weighted amount of these assets.

$$\text{Minimum capital requirement} = i + \sum \text{risk weighted assets (1)}$$

While, Basel II had a much more detailed approach to risk weighting. According to Basel II, credit risk management techniques can be classified into:

- Standardized approach: this involves a simple categorization of debtors, regardless of their actual credit risk. It includes confidence in external credit ratings.
- Internal Rating Based Approach (IRB): here banks are allowed to use their own internal models 'to calculate capital requirement' as a credit risk regulator. Haldane et al (2007).

¹ Explanation: The Stress Test contains imagined macroeconomic and financial shock scenarios and does not represent a forecasting model to measure the banking sector's resistance to adverse shocks, given that such situations may occur or expected to happen in the future.

5.1. Econometric Model through Factor Analysis and Reliability Analysis

As stated in the research methodology, where in addition to the analysis of credit risk shocks according to time series in the banking system in Kosovo and the credit index, furthermore comparability with the Balkan countries and beyond. This research also includes analyzes through econometric and statistical models such as: Factorial analysis and reliability analysis for credit risk management and measurement in the banking system. The research was realized through SL questionnaires in the 20 banks for 55 variables to construct factor analysis and sub-factors analysis. The factorial analysis model for measuring and managing credit risk in the banking system is algebraically written. If p variables $X_1, X_2, X_3, \dots, X_p$, is measured in a sample of n subjects, then the variable i can be denoted as a linear combination of the factors $F_1, F_2, F_3, \dots, F_k$, $k < p$ (Cornish, 2007).

$$X_i = a_{i1}F_1 + a_{i2}F_2 + \dots + a_{ik}F_k + \mu_i \quad (2)$$

Where: a_{i1} - are the factor loadings or results for the credit risk, and μ_i is the fraction of variable X_i that cannot be explained by the factors or error term. Principal component analysis for measuring and managing credit risk in the banking system is mathematical form. From the original n -variables: $x_1, x_2, x_3, \dots, x_k$. We obtain k new variables: F_1, F_2, \dots, F_k

$$C_1 = a_{11}X_1 + a_{12}X_2 + \dots + a_{1k}X_k$$

$$C_2 = a_{21}X_1 + a_{22}X_2 + \dots + a_{2k}X_k$$

$$C_k = a_{k1}X_1 + a_{k2}X_2 + \dots + a_{kk}X_k$$

Where, F_1 - Indicates as much as possible the variance in the credit risk, F_2 - Indicates the remaining variance.

$$X_k \cdot 1 = \mu_k \cdot i + A_k \cdot m E_m \cdot 1 U_k \cdot i \quad (3)$$

Where,

X : The random vector variables

A : The factor load matrix of any constant matrix.

F : The random vector of common factors.

U : The random vector of a particular factor.

μ : mean vector.

$$E(X) = \mu = 0 \quad (4)$$

$$X_k \cdot 1 = A_k \cdot m F_m \cdot 1 U_k \cdot 1 \quad (5)$$

5.1.1. Factor 1- For which sectors do you expect a deterioration of credit quality or increased credit risk in the next 12 months?

Table 18. The Deterioration of Credit Quality in the Sector with test KMO

KMO and Bartlett's Test		Variables
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.699	Q1- Real estate loan
Bartlett's Test of Sphericity	115.579	Q2- Loans for small and medium-sized enterprises
Approx. Chi-Square		Q3- Home loan (residential mortgage)
df	36	Q4- Personal loans (consumer loans)
Sig.	.000	Q5- Corporate loans (product-service)
		Q6- Loans for agriculture
		Q7- Trade credit
		Q8- Project Financing Loan (investment)

From this table we have the following findings: KMO test- Data according to this test are suitable for factorial analysis because model acceptability value is greater than .050 < 0.699. Bartlett's Test - is important or significant .000. This means that the first factor, which includes 8 sub-factors, is important for the model given that there are high correlations between variables. Tables 19 20.

Table 21. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.821	.839	8

From this table we have the following findings: The first factor I (sectors that are expected to have a deterioration of credit quality or increased credit risk) has high reliability in the data reliability analysis model. Where, recommended in which factors the banking sector should have more carefully. The reliability value of the analysis is .821 > .500, or 81%. Whereas, to check the suitability of the model for calculating reliability for first factor with respect to the model gauges in this research are also included, Hotelling T2, F, Cronbach Square KI tests. Tables 22 23 24 25

5.1.2. Factor 2- For which sectors do you expect an improvement in the quality of loan payment repayment or less credit risk in the next 12 months?

Table 26. The deterioration of credit quality in the sector with test KMO

KMO and Bartlett's Test		Variables
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.733	Q1- Real estate loan
Bartlett's Test of Sphericity	113.183	Q2- Loans for small and medium-sized enterprises
Approx. Chi-Square	36	Q3- Home loan (residential mortgage)
df	.000	Q4- Personal loans (consumer loans)
Sig.		Q5- Corporate loans (product-service)
		Q6- Loans for agriculture
		Q7- Trade credit
		Q8- Project Financing Loan (investment)

From this table we have the following findings: KMO test- Data according to this test are suitable for factorial analysis because model acceptability value is greater than .500 < .733. Bartlett's Test - is important or significant .000. This means that the second factor, which includes 8 sub-factors, is important for the model given that there are high correlations between variables. Tables 27 28 29.

Table 30. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.908	.909	8

From this table we have the following findings: The second factor II (sectors that are expected to have an improvement in the quality of loan repayment or less credit risk in the next 12 months) has high reliability in the data reliability analysis model. Where, recommended in which factors the banking sector should have more carefully.

The reliability value of the analysis is .908 > .500, or 90%. Whereas, to check the suitability of the model for calculating reliability for second factor with respect to the model gauges in this research are also included, Hotelling T², F, Cronbach Square KI tests. Tables 31 32 33 34.

5.1.3. Factor 3- Measurement and management of credit risk reduction?

Table 35. The Deterioration of Credit Quality in the Sector with Test KMO

KMO and Bartlett's Test		Variables
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.709	Q1- Increased demand for payment of loans and credit transactions
Bartlett's Test of Sphericity	64.22	Q2- Restrictions of financing / granting of unsecured loans
Approx. Chi-Square	9	Q3- Restrictions on current and future capital levels
df	10	Q4- Regulatory pressure on risk (adoption of regulations, laws, etc.)
Sig.	.000	

From this table we have the following findings: KMO test- Data according to this test are suitable for factorial analysis because model acceptability value is greater than .500 < .709. Bartlett's Test - is important or significant .000. This means that the third factor, which includes 4 sub-factors, is important for the model given that there are high correlations between variables. Tables .6 37 38.

Table 39. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.886	.892	4

From this table we have the following findings: The third factor III (Measurement and management of credit risk reduction) has high reliability in the data reliability analysis model. Where, recommended in which factors the banking sector should have more carefully. The reliability value of the analysis is .886 > .500, or 88%. Whereas, to check the suitability of the model for calculating reliability for third factor with respect to the model gauges in this research are also included, Hotelling T2, F, Cronbach Square KI tests. Table 40 41 42 43.

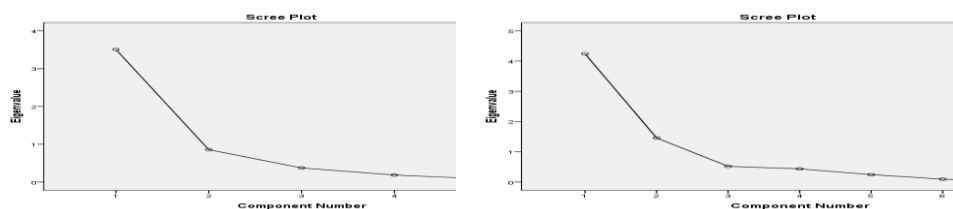


Figure 3. Factor 1&2

5.1.4. Factor 4- Loans that expect to decrease in volumes (on a net basis):**Table 44. The Deterioration of Credit Quality in the Sector with test KMO**

KMO and Bartlett's Test		Variables
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.782	Q1- Project Financing Loans (Investment)
Bartlett's Test of Sphericity	93.060	Q2- SMEs (Loans for Small and Medium Enterprises)
Approx. Chi-Square		Q3- Mortgage Loan (home loans)
df	21	Q4- Consumer loans
Sig.	.000	Q5- Corporate loans
		Q6- Other loans

From this table we have the following findings: KMO test- Data according to this test are suitable for factorial analysis because model acceptability value is greater than .500 $<$.782. Bartlett's Test - is important or significant .000. This means that the fourth factor, which includes 6 sub-factors, is important for the model given that there are high correlations between variables. Tables 45 46 47.

Table 48. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.883	.868	6

From this table we have the following findings: The fourth factor IV (Loans that expect to decrease in volumes (on a net basis)) has high reliability in the data reliability analysis model. Where, recommended in which factors the banking sector should have more carefully. The reliability value of the analysis is .883 $>$.500, or 88%. Whereas, to check the suitability of the model for calculating reliability for fourth factor with respect to the model gauges in this research are also included, Hoteling T2, F, Cronbach Square KI tests. Tables 49 50 51 52.

5.1.5. Factor 5- Which aspect is the instigator of credit risk growth and lower liquidity?

Table 52. The deterioration of credit quality in the sector with test KMO

KMO and Bartlett's Test		Variables
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.793	Q1- Market liquidity is not falling Q2- Reduction of market producers
Bartlett's Test of Sphericity Approx. Chi-Square	56.55 4	Q3- Central bank quantitative easing programs
df	15	Q4- Worsening market conditions
Sig.	.000	Q5- Effects of banking system regulation

From this table we have the following findings: KMO test- Data according to this test are suitable for factorial analysis because model acceptability value is greater than .500 < .793. Bartlett's Test - is important or significant .000. This means that the fourth factor, which includes 5 sub-factors, is important for the model given that there are high correlations between variables. Tables 53 54 55.

Table 56. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.890	.890	5

From this table we have the following findings: The fifth factor V (Which aspect is the instigator of credit risk growth and lower liquidity) has high reliability in the data reliability analysis model. Where, recommended in which factors the banking sector should have more carefully. The reliability value of the analysis is .890 > .500, or 89%. Whereas, to check the suitability of the model for calculating reliability for fifth factor with respect to the model gauges in this research are also included, Hotelling T2, F, Cronbach Square KI tests. Tables 57 58 59 60.

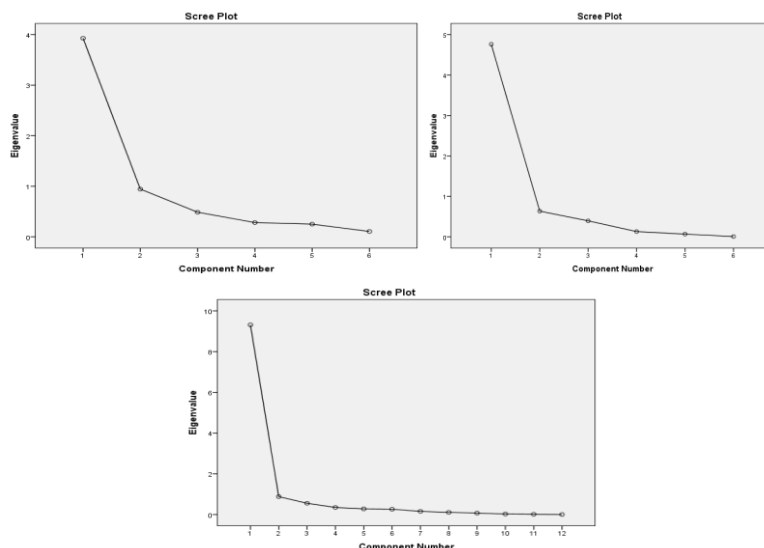


Figure 4. Factor 3, 4 & 5

5.1.6. Factor 6 - Expectations for short-term profits on credit risk in banks?

Table 61. The Deterioration of Credit Quality in the Sector with test KMO

KMO and Bartlett's Test		Variables
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.714	Q1 - Profit will be improved
Bartlett's Test of Sphericity	95.897	Q2 - Overall cost efficiency will improve
Approx. Chi-Square	15	Q3 - Total revenue will growth
df	.000	Q4 - Net interest margin will increase)
Sig.		Q5 - Provisions / impairments will increase

From this table we have the following findings: KMO test- Data according to this test are suitable for factorial analysis because model acceptability value is greater than .500 < .714. Bartlett's Test - is important or significant .000. This means that the sixth factor, which includes 5 sub-factors, is important for the model given that there are high correlations between variables. Tables 62 63 64.

Table 65. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.946	.946	5

From this table we have the following findings: The sixth factor VI (Expectations for short-term profits on credit risk in banks) has high reliability in the data reliability analysis model. Where, recommended in which factors the banking sector should have more carefully. The reliability value of the analysis is .946 > .500, or 94%.

Whereas, to check the suitability of the model for calculating reliability for sixth factor with respect to the model gauges in this research are also included, Hoteling T2, F, Cronbach Square KI tests. Tables 66 67 68 69.

5.1.7. Factor 7- Level of Identification, Measurement and Management of the Credit Risk

Table 70. The Deterioration of Credit Quality in the Sector with test KMO

KMO and Bartlett's Test		Variables
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.882	Q1-Credit insurance
Bartlett's Test of Sphericity	261.51	Q2-Cooperation / Agreements
Approx. Chi-Square	2	Q3-Reduction of extended credit
df	66	Q4 -Credit risk based on price
Sig.	.000	Q5-Deposit insurance
		Q6-Staff training
		Q7-Credit reference
		Q8-Staff rotation
		Q9-Staff recruitment based on competence
		Q10-Using software based on techniques
		Q11-Control

From this table we have the following findings: KMO test- Data according to this test are suitable for factorial analysis because model acceptability value is greater than .500 <.882. Bartlett's Test - is important or significant .000. This means that the seventh factor, which includes 11 sub-factors, is important for the model given that there are high correlations between variables. Tables 71 72 73.

Table 74. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.972	.972	11

From this table we have the following findings: The sixth factor VI (Expectations for short-term profits on credit risk in banks) has high reliability in the data reliability analysis model. Where, recommended in which factors the banking sector should have more carefully. The reliability value of the analysis is .972 > .500, or 97%. Whereas, to check the suitability of the model for calculating reliability for seventh factor with respect to the model gauges in this research are also included, Hoteling T2, F, Cronbach Square KI tests. Tables 75 76 77 78.

6. Analysis of Results

6.1. Research Question

Question: Was there a high concentration of credit exposures during the survey period according to credit shock analysis?

6.2. The Hypothesis of Scientific Paper

Ho: There is significant link between research methods

(time series method and econometric and statistical methods), for managing and measuring credit risk?

H₁: There is no significant link between research methods (time series method and econometric and statistical methods), for managing and measuring credit risk?

In banking system of the Kosovo, the concentration of credit risk has declined, considering that the three major banks the ratio of credit risk exposure to the capital of the first class was diminished. Now, the level and quality of capital suggests consistency and high skills of the banking sector to cope with potential losses. During 2012-2019 the ratio of large credit exposures to the first-class equity is (2012=60.5%, 2013=91.0%, 2014=124.0%, 2015=81.2%, 2016=51.0%, 2017=70.9%, 2018=81.2%, 2019=70.0%). The banking sector has a favorable environment with low risks and sufficient capacity to withstand potential shocks.

The quality of the loan portfolio has continued to improve: as a result of the repayment of non-performing loans from bank balances, other economic and structural factors that have increased solvency and debt collection, the decision-making process for amending the Central Bank of Kosovo regulation, which set out specific deadlines within which banks should carry out the process of repaying from the balance of loans classified as "Loss".

The decrease in the number of non-performing loans is a good financial result of the enterprises contributing to increasing the solvency of their loans. Also, the activity of private bailiffs has facilitated and accelerated the loan repayment process, while the advancement of the structural reforms in the realization of collateral has led to an increase in the confidence of banks and consequently an increase in the volume of loans issued by banks. Credit portfolio quality in Kosovo remains at the region's best level.

Kosovo has for years stood at the lowest ratio of non-performing loans compared to the countries in the region such as: (Albania, Montenegro, Macedonia, Bosnia and Serbia). The banking sector, according to the analysis of credit portfolio shocks, is generally stable, profitable, with provisions for covering losses resulting from the growth of non-performing loans. In case interest rates will rise for loans and deposits taking into consideration their high participation in the balance sheet

only one bank would suffer losses while the banking sector will be stable. However, there is a risk that in times of crisis the opportunity for reinvestment is diminished, while at the same time affecting the risk of over-borrowing of high interest borrowers. The analysis of credit risk shocks did not include market risks given that banks have stated that loan interest rates are expected to decline slowly, while interest rates on other assets affected by central bank decisions and deposits held in European banks remain unchanged. Therefore, based on the above assumptions, interest rates on assets and liabilities will be unchanged. The results based on these assumptions suggest further improvement in the quality of the loan portfolio.

The ratio of nonperforming loans would drop to 0.3 percent from the current level of 2.5 percent. The banking sector's capital position will be strengthened as a result of credit growth, where the capital adequacy ratio (KPC) will rise to 17.9 percent from the current level of 16.8 percent. It is assumed the increase in the current year of economic growth of 0.5% which is slower than the previous year. Slowing economic growth is thought to have discouraging effects, causing useless capacity utilization, consequently widening the output gap. Slowing economic growth is also accompanied with contraction in credit growth, depreciation of the euro against other currencies, which is applied to the balance sheet gap more sensitive to interest rates (**$\Delta \text{Net interest income}_i = \text{Gap}_i \Delta \text{NI}_i$**).

It is assumed that the profit will suffer a shock, due to the slow growth of lending and the increase in the rate of failure of existing loans. The assumptions are reflected by calculating the profit for 2019, where for basis is taken net profit after tax, to which a concussion (reduction margin) of approximately 50% is then applied, deducting the income that will be realized if non-performing loans will not increase. The results of this analysis of credit shock analysis suggest that the banking sector does not have a high concentration of credit exposures, however, we can conclude that branches of foreign banks significantly affect the rate increase of the large credit exposures in the total banking sector. According to factor analysis, reliability analysis, descriptive analysis and all tests included in the 8 factors and their sub-factors, indicate the factors that should be taken into consideration in measuring and managing the credit risk in the banking sector. In this case, we can conclude that the factors which have a greater risk are accurately presented, or have less reliability, which need to be controlled and improved from the banking system.

Taking into consideration that both models are elaborated above in detail, and do not need to be repeated, we conclude that the H0 hypothesis is confirmed (There is an important link between the methods that help the banking sector to manage and measure credit risk).

7. Conclusion

Based on the Eurozone and Western Balkan countries, the focus of this paper will be on the State of Kosovo doing analysis between periods and through the banking sector questionnaire on credit risk management and measurement. Kosovo as a country in transition should have well designed bank policies for the protection of credit risks. This indicates that one credit risk of good-planned, is one component of importance as determinant of bank stability and economic development of the country. **Risk management today is practiced by many** organizations or entities, in order to curb the risk that may be faced in the near future.

The activity of the banking sector increased through the promotion of credit supply, facilitating and providing favorable and stable financing conditions. **Foreign owned banks continue to dominate**, out of 10 foreign owned banks 8 of them manage 90.4% of the assets and own 93.0% of the share capital. Germany and Austria dominate with % of assets. Kosovo has an increase in assets in 2017 (11.7%), while a decline in 2014 (9.5%). Compared to previous years, assets owned by foreign banks are decreasing. There is an increase in loans and a decrease in deposits. **Growth of loans was in** Albania, Bosnia, Serbia. The structure of new loans to enterprises includes: investment loans, non-investment loans and loans with favorable conditions. The structure of new loans to households includes: consumer loans, mortgage loans and loans with favorable conditions. In 2017, loan growth was evident in all sectors (3.5% -10%).

Ratio: loans / deposits, they had the highest growth in 2017. The ratio of liquid assets to short-term liabilities, they had the highest growth in 2014. Indicators of capital adequacy they had the highest growth in 2015. The ratio of non-performing loans to total loans, they had the highest growth in 2014. Coverage of non-performing loans with provisions, they had the highest growth in 2016.

The ratio of the total value of large credit exposures to first class equity, they had the highest growth in 2014. Open positions in foreign currencies to the first level capital, they had the highest growth in 2014. The ratio of regulatory capital continues to stay above the minimum level compared to countries in the region, given that the result of the increase in first class capital is the support in accumulated profits over the years.

The decline in non-performing loans is a result of the improvement in the quality of the loan portfolio, as well as the rapid growth of the loan stock. In improving the quality of loans have affected: the application of strict standards and rules by the by most banks in issuing loans, licensing private bailiffs thus facilitating the implementation of loan contracts. **The banking sector has the highest credit risk on non-performing loans** from enterprise loans, within which energy, trade and manufacturing loans carry the highest NPL rates.

The reduction credit risk realized through the transfer of loans from the categories with lower quality towards the category of loans without delay. As of 2012, the lowest rate of non-performing loans was in 2016, while the highest rate of non-performing loans was in 2012. **Albania, Bosnia and Herzegovina, Serbia have the highest number of non-performing loans**, Macedonia and Montenegro have the lowest level of non-performing loans, while Kosovo has the lowest level of non-performing loans. **An important factor in credit risk is the degree of concentration of credit exposures.** Credit risk exposure is the ratio of total large exposures to the first-class equity. **In the banking system of Kosovo**, the concentration of credit risk has declined, considering that the three major banks the ratio of credit risk exposure to the capital of the first class was diminished. Now, the level and quality of capital suggests consistency and high skills of the banking sector to cope with potential losses. During 2012-2019 the ratio of large credit exposures to the first-class equity is (2012=60.5%, 2013=91.0%, 2014=124.0%, 2015=81.2%, 2016=51.0%, 2017=70.9%, 2018=81.2%, 2019=70.0%).

The banking sector has a favorable environment with low risks and sufficient capacity to withstand potential shocks: As a result of the decline of non-performing loans due to the improvement of credit portfolio quality and the process of repayment of loans lost by banks, the credit risk in the banking system was diminished. Also, the decline in the stock of non-performing loans has led to an increase in the coverage ratio with provisions.

The increase in credit exposures is a result of the increase in exposures of foreign banks which are subject to first-class equity restrictions of domestic banks. But the concentration of large credit exposures remains at a satisfactory level. The non-performing loans ratio (NPL) to total loans (%) there is an increase in 2014(8.3%) while a decline in 2019 (2.5). Coverage of non-performing loans with provisions (%) there is an increase in 2019(161.2) while a decline in 2014(114.4). Large credit exposures to first class equity (%) there is an increase in 2014(97.1) while a decline in 2015(67.3). The elaborations are discussed below. **Credit risk analysis for credit risk assesses the resilience to potential shocks** in the credit portfolio as well as the capital position in the banking sector, which may be caused by the unfavorable macroeconomic developments in the current year or within a one-year period.

The analysis is carried out through the application of three scenarios: baseline, moderate and severe. The baseline scenario is based on expected macroeconomic developments, where economic activity in the country is projected to have a positive annual growth, which is accompanied by double-digit lending growth and at the same time will affect the improvement of the credit portfolio. **Also, according to this analysis**, these developments are expected to further improve the performance of the banking sector in the aspect of capitalization.

The profit is supposed to be realized the same, according to reasoning that interest income on the loans may be increased by the effect of the increase in the value of the loan. But this effect may be limited by the continued pressures for decline in loan interest rates, whereas non-interest income is assumed not to continue to grow, given the limited scope for tariff and commission increases. On the other side, non-interest expenses are expected to decline due to the decrease in the need for additional provisions as a result of the improvement of the loan portfolio, but interest expenses may increase due to competition pressures for higher interest rates on deposits.

The first factor - (for which sectors do you expect a deterioration of credit quality or increased credit risk in the next 12 months). KMO and Bartlett tests are (.500 < 0.699), TVE (67.662%). Sub-factors: Q1, Q2, Q3, Q4, Q7 have the highest weight in the model which means they have risk, but credit risk can be managed and measured by such factors, while sub-factor Q8 has high risk. The reliability value of the analysis is .821 > .500, or 81%. P = .094 is statistically significant and the value of the non-collection characteristic P = .047 is statistically significant, in other words there are no differences between the measurements for the first factor. *It is recommended that during the granting of this loan for the financing of investment projects for a long time and large sums of money, risk management and measurement need to be done very carefully.*

The second factor- (for which sectors do you expect an improvement in the quality of loan payment re-payment or less credit risk in the next 12 months). KMO and Bartlett tests are (.500 < .733), TVE (72.568%). Sub-factors: Q1, Q2, Q3, Q4, have the highest weight in the model which means they have risk, but credit risk can be managed and measured by such factors, and it will also be an improvement in the quality of loan payments, while sub-factor Q8 has high risk. The reliability value of the analysis is .908 > .500, or 90%, P = .001 is statistically significant and the value of the non-collection characteristic P = .032 is statistically significant, in other words there are no differences between the measurements for the second factor. *It is recommended that during the granting of this loan for the financing of investment projects for a long time and large sums of money, risk management and measurement need to be done very carefully.*

The third factor - (Measurement and management of credit risk reduction). KMO and Bartlett tests are (.500 < .709), TVE (70.20%). Sub-factor: Q1 has the highest weight in the model which means there's risk reduction, but it must be supervised or managed, while sub-factor Q4 has higher risk. The reliability value of the analysis is .886 > .500, or 88%. P = .032 is statistically significant and the value of the non-collection characteristic P = .078 is statistically significant, in other words there are no differences between the measurements for the third factor. *It is*

recommended that if the banking system is compliant with regulations and laws, the credit risk can be easily measured and managed.

The fourth factor - (Loans that expect to decrease in volume (on a net basis). KMO and Bartlett tests are (.500 <.782), TVE (81.38%). Sub-factor: Q1 has the highest weight in the model which means there is a decrease in the volume of investment loans, but it must be supervised or managed, while sub-factor Q6 there will be growth in other loans. The reliability value of the analysis is .883 > .500, or 88%. P = .005 is statistically significant and the value of the non-collection characteristic P = .063 is statistically significant, in other words there are no differences between the measurements for the fourth factor. *It is recommended to be careful in increasing the volume of other loans, as otherwise it will be difficult to measure and manage credit risk.*

The fifth factor - (Which aspect is the instigator of credit risk growth and lower liquidity). KMO and Bartlett tests are (.500 <.793). TVE (65.48%). Sub-factors: Q1 and Q2, have the highest weight in the model which means the market liquidity and reducing market producers is not falling, but it must be supervised or managed, while sub-factor Q5 (Effects of banking system regulation) there is a decline. P = .011 is statistically significant and the value of the non-collection characteristic P = .023 is statistically significant, in other words there are no differences between the measurements for the fifth factor. *It is recommended to be careful in increasing the banking regulation system, as otherwise it will be difficult to measure and manage credit risk.*

The sixth factor- (Expectations for short-term profits on bank credit risk). KMO and Bartlett tests are (.500 <.714), TVE (79.37%). Sub-factors: Q1, Q2, and Q3 have the highest weight in the model which means that profitability and cost efficiency will improve and total revenue will be increased. P = .098 is statistically significant and the value of the non-collection characteristic P = .096 is statistically significant, in other words there are no differences between the measurements for the sixth factor. *It is recommended to be careful in increasing the banking sector for these factors; otherwise it will be difficult to measure and manage credit risk, if they will not be kept under control.*

The seventh factor- (Level of identification, measurement and management of the credit risk). KMO and Bartlett tests are (.500 <.882). TVE (77.61%). Sub-factors: Q1, Q2, Q3, Q4, Q5, have the highest weight in the model which means that credit insurance, collaborations, agreements, reduction of extended credit, credit risk based on price, deposit insurance, all these factors have lower risk levels, can easily be identified and measured, and are expected to improve even further in the future. P = .008 is statistically significant and the value of the non-collection characteristic P = .016 is statistically significant, in other words there are not differences between the measurements for the sixth factor. The reliability value of the analysis is .972 > .500,

or 97%. *It is recommended to be careful in increasing the banking sector for these factors, otherwise it will be difficult to measure and manage credit risk, if they will not be kept under control.*

The seventh factor- (Level of identification, measurement and management of the credit risk). KMO and Barlet tests are (.500 <.882), TVE (77.61%). Sub-factors: Q1, Q2, Q3, Q4, Q5, have the highest weight in the model which means that credit insurance, collaborations, agreements, reduction of extended credit, credit risk based on price, deposit insurance, all these factors have lower risk levels, can easily be identified and measured, and are expected to improve even further in the future. $P = .008$ is statistically significant and the value of the non-collection characteristic $P = .016$ is statistically significant, in other words there are no differences between the measurements for the sixth factor. The reliability value of the analysis is $.972 > .500$, or 97%. *It is recommended to be careful in increasing the banking sector for these factors; otherwise it will be difficult to measure and manage credit risk, if they will not be kept under control.*

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Appendix with results of scientific paper (Tables with detailed explanations)

Table 1: <https://sway.office.com/glbwul2HFRuqh7Gg?ref=Link>.

Table 2: <https://sway.office.com/BvMSfuV5HGurn54d?ref=Link>.

Tables 3 & 4 & 5 & 6: <https://sway.office.com/PHWPZ5KLXZhf6NZf?ref=Link&loc=play>.

Table 7: <https://sway.office.com/3RnuhP7UkwMwRA0E?ref=Link>.

Table 8: <https://sway.office.com/ZtvBc48vQNB9GsMB?ref=Link>.

Table 9: <https://sway.office.com/ET0VwhWmXuG4RbKh?ref=Link>.

Tables 10; 11 & 12: <https://sway.office.com/kuQ8yTJQDRxobNEK?ref=Link>.

Table 13: <https://sway.office.com/H9Fyy3tvaQLtE9BR?ref=Link>.

Table 14: <https://sway.office.com/hQYI71LDzsad1pcp?ref=Link>.

Tables 15; 16 & 17: <https://sway.office.com/McIugaAUIUps2qqf?ref=Link>.

Tables 19 & 20: <https://sway.office.com/NohrAsvFOFjMc8tT?ref=Link>.

Tables 22; 23; 24 & 25: <https://sway.office.com/ohuvh6mEXskwXLiF?ref=Link>.

Tables 27; 28 & 29: <https://sway.office.com/2fSvvhVBMATI3tH?ref=Link>.

Tables 31; 32; 33 & 34: <https://sway.office.com/vmMPO4DHLuHoqCuL?ref=Link>.

Tables 36; 37 & 38: <https://sway.office.com/T4zPestbDVBISqcE?ref=Link>.

Tables 40; 41; 42 & 43: <https://sway.office.com/sv7bwGmyxvOq4zGh?ref=Link>.

Tables 45; 46 & 47: <https://sway.office.com/HswzJeAkCanjYGtm?ref=Link>.

Tables 49; 50; 51 & 52: <https://sway.office.com/P28ibTb0IKsdtMEp?ref=Link>.

Tables 53; 54 & 55: <https://sway.office.com/vHhcTDA22SbVVRyV?ref=Link>.

Tables 57; 58; 59 & 60: <https://sway.office.com/viu56uh8ZRidjXKk?ref=Link>.

Tables 62; 63 & 64: <https://sway.office.com/4pA9abgVPxaXv42z?ref=Link&loc=play>.

Tables 66; 67; 68 & 69: <https://sway.office.com/GMXyiYjrTw1hfdR8?ref=Link>.

Tables 71; 72 & 73: <https://sway.office.com/ptd350Hr3zGYMoGE?ref=Link>.

Tables 75; & 76; 77 & 78: <https://sway.office.com/iwALVls19zPjh4TV?ref=Link>.