

Jurevičienė, Daiva; Rauličkis, Darius

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FORECASTING BANKS RETURN ON EQUITY USING LEADING ECONOMIC INDICATORS

Daiva JUREVIČIENĖ^{1*}, Darius RAULIČKIS²

¹*Economics Engineering Department Faculty of Business Management,
Vilnius Gediminas Technical University, Vilnius, Lithuania*

²*Faculty of Economics and Business, Mykolas Romeris University, Vilnius, Lithuania*

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Abstract. The research examines an approach to forecast return on equity using leading economic indicators for short periods in banks. ROE is one of the most important ratios for performance measurement. Its adequacy is necessary for competitiveness, attract funding in financial markets, accumulate reserve for future turbulences, secure compliance with supervisory requirements and maintain positive signals for the market. There is still a debate in the literature on factors of commercial banks' profitability forecasting, techniques, and most appropriate models to improve the correctness of predicting and acquiring more accurate signals for communication on targets. The problems are still relevant from both a theoretical perspective and practical implementation. This research aims to prove the necessity to include leading economic indicators for short term ROE forecasting. It conducts investigations for the relevant studies, using regression analysis, necessary tests, ascertains opportunities and limitations of using these indicators and develops a conceptual model and its assessment major Baltic banks. The results show verification of approach to forecast ROE using leading economic indicators for short periods. Such study complements signalling theory with a new approach, how to predict and acquire signal not only using economic indicators as a general group but sub-group them into coinciding, lagging and leading.

Keywords: return on equity, financial ratios, economic indicators, leading economic indicators, forecasting, banks.

JEL Classification: C53, G31, F47.

Introduction

Return on equity (ROE) is one of the most important ratios to measure the performance of banks. Its adequacy is necessary to survive in an increasingly competitive environment and attract capital in financial markets. Scholars and bankers agree that constant analysis and management of ROE is needed to secure adequate returns on investments for shareholders, comply with regulatory requirements, accumulate reserves for future turbulences in the economy and maintain the accuracy of signals sent to market. Management and supervisory authorities emphasise the need to periodically examine forecasting and effective management techniques to match the latest methods and economic trends. High competition, development of modern information technologies, globalization of services, and increasing demand to communicate results accurately accelerate these movements.

For profitability forecasting and management banks still heavily use techniques based on banks' sector-specific

and lagging ratios but do not integrate leading ratios. The demand for improvements of such techniques determines the relevance of related theoretical justifications and practical solutions. Verification of the effectiveness of leading economic indicators in forecasting ROE would let to decrease errors, set the more fundamental objective for ROE and enable to send more accurate signals to the market. Worth noting, in literature it is still debated on profitability factors, forecasting techniques, most appropriate models, theoretical clarifications and application in practice (Ali & Puah, 2018; Alharbi, 2017; Alalaya & Khattab, 2015; Beccalli et al., 2015; Chang et al., 2018; Ommeren, 2011; Horton et al., 2014; Kim et al., 2015; Quaedvlieg, 2019; Adhikari et al., 2019). Therefore, the problem of the study – how leading economic indicators can be applied in forecasting ROE of commercial banks to improve accuracy of forecasting and, by that, acquiring more accurate signals for communication on targets. The goal of the study – upon analysis and generalisation of relevant theory and methodology, to develop and empirically verify

*Corresponding author. E-mail: daiva.jureviciene@vgtu.lt

the model forecasting ROE of commercial banks improving the accuracy of forecasting and allowing acquire of more accurate signals for communication on targets. In the study, analysis and generalization of scientific literature were used to systemize theoretical concepts and statistical methods were used to analyse ROE and its factors – correlation and multiple regression analysis (allows to identify relationships among dependent and independent variables and analyse explanatory power of factors), generalized method of moments estimation (outweigh limitations of ordinary least squares parameter estimation in non-normally distributed sample), adjusted R^2 and RMSE ratios (measuring coefficient of determination and accuracy of the forecast). An ROE forecast model in banks using leading economic indicators used. It helps to identify the most significant ratios and factors supplementing existing literature with a new approach. Suggesting splitting economic indicators into more groups (outlining not only economic indicators but group them into coinciding, lagging and leading) and then examine factors choosing from those groups.

The first part covers systemised concepts of ROE and ratios valid to forecast it, investigation of strategic objectives management and signalling. In the second, there is a theoretical model to predict ROE using leading economic indicators and methods of its assessment. The third describes and presents the results of empirical research to validate the forecast of the ROE model using leading economic indicators.

1. Theoretical background

According to neoclassical economic theory profit maximization is the primary goal of any privately-owned entity enabling to compensate shareholders risk; helps employees and creditors to cover investment costs in the future (Knight, 1921; Schumpeter, 1934; Keynes, 2018 were the first analysing this topic). There is a clear distinction between profit and profitability (Qingbin, 2005). The measure of profit is the difference in income and costs (static, retrospective). Profitability indicates historical profit proportions and reflects future profit potential (dynamic, indicating) based on comparisons with other ratios, periods, peers, alternatives and macroeconomic information (Petria et al., 2015). Several different profitability ratios used. Often profitability compared with income, assets and capital of the entity. Such classification resulted in estimations that help multiple stakeholders to make better decisions (sales profitability is essential for salespeople as it shows the effectiveness of sales division). The second group (asset profitability) is significant for management to improve asset management. Finally, capital profitability is usually the primary indicator for shareholders and describes the success of an investment. This article focuses on capital profitability measured by ROE. According to Stockert, Kavan, and Gruber (2016), good ROE ratio can reflect high profitability (generating income, efficient cost compared to income or increase income-generating assets). It can

also reveal equity invested in a company (to maintain a high return on investments and effectively use of external funding leverage). Foremost critics of ROE ratio, according to ECB (2011), relating to its lower sensitivity to risks, company accounting details and financial standards. The same study also noted that ROE is an adequate measure of banks performance, useful for setting a strategic objective and for comparisons to peers.

Bank-specific ratios intensely used in all steps of ROE management (as strategic goal), sectorial and economic ratios are included in actions related to forecasting trends. In setting strategic goals longer-term forecasting horizon needed whereas shorter horizon forecasts required in the more familiar process analysis. Transformation process (changing clients' behaviour, increased supervisory requirements, changing technologies, etc.) of banks gives ground for periodical setting and reviewing strategic objectives, including ROE. The latter, according to Horton et al. (2014), can be divided: activity planning, setting strategic goals, periodical analysis and forecasting and following up of actual results compared to predictions. It requires various information (financial, sectorial and economic) and time investment. It is vital to forecast results accurately to establish a realistic baseline. Forward-looking short-term forecasting starts when strategic objectives, periodical assessment of results set. Short-term forecasting seeks to enable timely decisions and activities to improve outcomes (Quaedvlieg, 2019). The better bank can forecast strategic objective (as ROE), the more informed management can make timely decisions and enables management to communicate to shareholders or the public. Short-term forecasting is essential to avoid overoptimistic or pessimistic predictions, which may result in not optimal strategic objective, significant deviations in internal resource management and wrong expectations of shareholders and public (Adhikari et al., 2019).

One of the critical challenges of signaling theory is the complicated process to acquire accurate signals avoiding significant information asymmetries between management, shareholders and the public, which requires the ability to reflect a broad spectrum of information including internal, sectorial, economic (Spence, 2002). Later studies (Alharbi, 2017) divided companies into high-quality (able to signal accurate and sustainable signals) and low-quality (unable to indicate reliable and durable signs). Higher-quality companies also have better pre-requisites to improve profitability and raise value (García-Meca & García-Sánchez, 2017). Sufficient resolution of accurate signals problem in each institution determines signalling quality to the market – high quality (ability to mark accurate and reliable information) and low quality (inability to indicate accurate and reliable data). It is required to develop new methods and approaches, new conceptual models enabling to improve quality and accuracy of signal acquisition related to the expected ROE to resolve the abovementioned challenge in signaling theory (Figure 1).

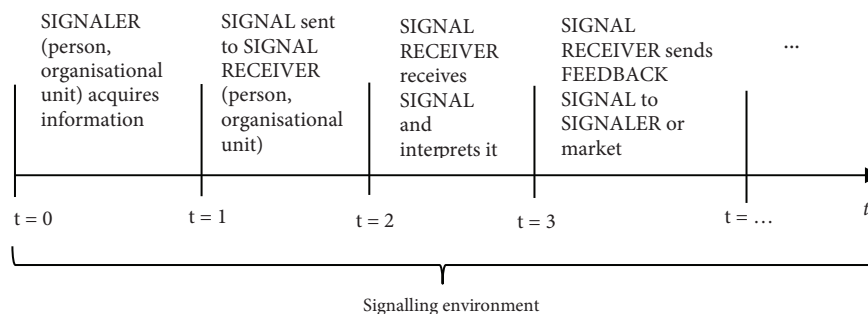


Figure 1. Representation of signalling theory in the timeline (source: Spence, 2002)

The signalling theory can be applied in banks for the implementation of strategic objectives and reached by maintaining high-quality signals environment between management, shareholders, clients and public and requires significant investments in maintaining accurate as possible signal acquiring tools to reflect dynamic trends of internal, market and economy (Kim et al., 2015). However, scholars are still in the debate finding more accurate signal acquisition approaches (Forti & Schiozer, 2015). History of factors research of bank's profitability forecasting is closely related to the development of finance and accounting standards, data availability and assessment tools. Macroeconomic ratios were applied in assessments and improved ability to capture systemic factors despite increased interdependence of economies and financial markets. Internal and external factors can affect banks profitability. Profitability factors are usually divided into bank-specific, industry-specific and economic (Pasiouras & Kosmidou, 2007; Dietrich & Wanzenried, 2011). According to the OECD (2019), economic indicators can also be divided into lagging, coinciding and leading (Jurevičienė & Rauliškis, 2016).

Financial factors

Bank-specific factors used most widely in forecasting and budgeting. Following ECB (2011) they can be divided into income, effectiveness, risk and financial leverage. Profitability is usually determined by management's skills to generate excessive income or decrease costs through the development of the business model, managing risks and increasing leverage. The right balance between profitability and risk in the chosen business model is essential. Use of leverage should also be considered depending on the market situation and economic cycle, i.e. higher leverage determines higher profitability during the growth and lowers during the economic downturn. Such double edge result can be found due to leverage impact on capital structure and costs during the different phases.

Own funds. Theories are competing to explain the relationship between profitability and capital. Signalling theory describes that the higher equity ratio is (or equivalent), the better signal is transmitted to the market which then determines the higher company market value, decrease of funding costs and rise of profitability (Trujillo-Ponce, 2012). The theory of expected costs of bankruptcy

also supports a positive relationship between capital and profitability. I.e., the more risk is taken by the firm, the more capital it needs to hold to outweigh expected and unexpected losses but if not – might impact decrease of profitability in long-term (Nguyen, 2020). The theory of risk-profit partly contradicts the first ones. It describes that if the share of borrowed capital increases the risk and profitability increases too due to more effective use of own capital (own capital is defined as more expensive than borrowed) (Hoffmann, 2011; Sharma & Gounder, 2012). It implies a negative relationship between capital and profitability.

Funding structure. Banks use external funds which, together with own determines funding structure. Most popular are deposits, debt securities, loans, etc. Following Trujillo-Ponce (2012), deposits are the cheapest and most commonly used. The higher share of deposits is in funding structure; the better profitability might be expected and will determine the positive relationship with profitability ratios (Ali & Puah, 2018).

Funding price. Gruber et al. (2017) state that funding costs measured in basis points should be included as an independent variable. Banks earn a profit, not only generating a return on assets but also minimizing the costs of funding (Demandgüç-Kunt & Huizinga, 1998). Such ratio helps to avoid potential subjectivity of funding costs comparing different banks, business models and national specifics. I.e. decrease in funding costs increases profitability in the long term.

Credit risk. Credit risk is one of the highest risks in banking and one of the key ratios to forecast profitability. Asset quality ratios can be used, such as provisions divided by net interest income to represent credit risk (Ali & Puah, 2018; Dietrich & Wanzenried, 2011). The higher the credit risk, the higher the probability that it will cause related losses and decrease profitability.

Liquidity risk. Liquidity risk one most serious risks faced by banks. When banks hold the insufficient amount of high-quality liquid assets (HQLA), banks they are more vulnerable for sudden liquidity shocks, i.e. sizable and unexpected withdrawal of deposits. The ratio of HQLA and potential short-term obligations are the most common ratios used to define liquidity risk (Delechat et al., 2012). Regulators also assess banks liquidity (liquidity and liquidity coverage ratios). Under the theory of risk-profit,

the more HQLA bank holds, the higher the profit should be expected (decreased liquidity risk in long-term). Following Abdelaziz, Rim, and Helmi (2020), Pasiouras and Kosmidou (2007), Bordeleau and Graham (2010), a negative relationship expected between liquidity risk and profitability.

Business model. Models can be roughly differentiated by using the share of interests' income in the total income amount (Dietrich & Wanzenried, 2011). The smaller income share of profits and commissions would imply that the model is not traditional. Following Valverde and Fernández (2007), income from off-balance assets may also contribute to long-term profitability by providing partial diversification effects to total revenue. It is hard to define the expected impact on profitability.

Operational effectiveness. There is a wide variety of ratios offered by academics to measure operational efficiency. Following Pasiouras and Kosmidou (2007), Dietrich and Wanzenried (2011), the cost to income ratio most often used. The essence of the ratio is instead straightforward – to indicate how much it costs to generate a particular income in percentage points. The indicator usually has a positive relationship with profitability, i.e. when cost efficiency increases the profitability rise.

Growth. Change in loans or assets used to measure banks success (Ali & Puah, 2018; Trujillo-Ponce, 2012). It represents the potential of profit to generate earnings in upcoming quarters. Another reason is economy of scale. When a bank is growing in the same type of assets, it becomes more cost-efficient to distribute fixed costs per asset unit. However, the effect is not linear, and sometimes it gives the opposite impact on profitability. When a bank becomes more complex (additional related costs) increase requirements from regulators, partners and customers (Regehr & Sengupta, 2016).

Effective tax rate. After-tax profitability ratios can be affected by the tax system in the particular country, sector or business model. The effective tax rate can be measured by the ratio of tax costs and earnings before taxes (EBT). Following Dietrich and Wanzenried (2011), such proportion could have a negative relationship with profitability.

Sectorial factors

Concentration. Industry concentration is measured by a Herfindahl–Hirschman index and calculated as the sum of the squares of all banks market shares in terms of total assets in percentage (Brezina et al., 2016). It indicates the banks potential competition in the sector and can determine profitability under theories of market power and efficient market structure (Alharbi, 2017). If HHI index equals to 10'000 it indicates that there is only one bank in the market, whereas when the index is approaching zero shows an increasing number of banks in the market. The market is highly concentrated if the index is above 0.18 and not concentrated if below 0.1. It is an expected positive relationship between HHI index and profitability.

Size. Though the growth of assets might capture some features of bank size, the separate variable should be defined to achieve the status of economies/diseconomies of scale. Literature suggests measuring it as the natural log of total assets (Alharbi, 2017; Hoffman, 2011). It is expected to find a positive relationship with banking profitability.

Coinciding and lagging economic factors

Numerous empirical evidence state coinciding and lagging indicators are valuable in economic and financial researches. They are useful to forecast long-term trends of the economy or its components (Dietrich & Wanzenried, 2011).

Economic growth. Use of real GDP growth is common due to its ability to forecast changes in the economic cycle and usually determines the demand for loans and other banks services (Alharbi, 2017; Dietrich & Wanzenried, 2011). The cyclical turmoil of the economy may cause a decrease in bank services demand and simultaneously may increase the credit risk. A positive relationship between real GDP growth and profitability can be expected. Worth noting, when GDP is studied in real terms (not nominal), inflation indicator should not be studied separately (García-Herrero et al., 2009).

Monetary policy. Dietrich and Wanzenried (2011) studied the relationship of interest rate term structure and banks profitability and concluded the significant correlation. Though interest rates are usually hedged in banks through derivatives, it is too costly to eliminate. Part of such risk is caused by one of the bank's main functions – a transformation of assets maturities, i.e. shorter-term funding banks transform it to longer-term assets. The ratio usually has a positive impact on profitability (Dietrich & Wanzenried, 2011). The steeper is interest rate term structure the more income receives bank from long-term loans if funded by deposits with lower interests. Three-month interbank rate (3-month EURIBOR), and the slope yield curve (the difference between the 10-year government bond yield and 3-month EURIBOR) is suggested as one of best measures of monetary policy (Borio et al., 2017).

Unemployment rate. The unemployment rate is one of the most significant macroeconomic variables to explain changes in profitability. The relationship is found through the demand for new loans and credit risk. Unemployment increase could harm through liquidity too (Horváth et al., 2014). Therefore, a negative relationship is expected.

Real estate prices. A significant part of banks business relies on services related to real estate. Bank profitability is also highly dependent on the development of real estate prices (Gaspar, 2015). Real estate prices affect banks through the decrease of risk mitigation techniques (in traditional banks, real estate remains a significant asset class, which used as collateral). Therefore, a positive relationship is expected.

Leading economic factors

Following OECD (2019) forecast should include predictive factors. Use of leading economic indicators ground ability to forecast the economic behaviour in a particular economic cycle (Vašíček et al., 2017), sector trends (Nippala & Julin, 2012), etc. Fritzsche and Stephan (2002) state that there is no sole indicator capable of defining market trends. The inclusion of a critical economic indicator can make estimates more accurate. On the average lag between leading and coinciding economic indicator may be equal up to three months. Still, there are some shortcomings in the theoretical literature. These indicators are known to be useful tools for recording future changes; they are quite sensitive; no elaboration on, how they can be applied to commercial banks forecasting besides lagging and coinciding economic indicators.

Economic sentiment and confidence. Such indicators provide valuable evidence to review economic growth and profitability. Improve these ratios usually determines market participants optimism about the future, higher investments and expenditures. They are a composite of sectoral confidence indicators with different weights (Eurostat, 2019). Following ECB (2015), such ratios could capture positive trends within the economy, and higher demand for services increased purchasing power. It is expected a positive relationship.

Stock market. Stock market values as a leading indicator have quite a bit of evidence (Sayari & Shamki, 2016). Such indicator might signal further economic development in advance and may affect clients and assets values. Leading indicators may include the value of national and regional stock exchange, market capitalization. A positive sign of the relationship between these indicators and profitability is expected.

Surveys of industries. Governmental bureaus of statistics (Eurostat, 2019) produce studies usually every month or quarterly. Depending on sector/industry (services, industrial, retail, wholesale or construction) they focus on most important areas to define economic cycle (past performance, status and future expectations related to production, orders, inventories, pricing, permits, demand and employment). They determine potential growth of the economy, business conditions and private households (instance, industrial leading indicators may show a negative trend which is not yet represented in borrowers financial accounts but may expose banks to higher than expected credit losses).

The analysis of researches showed that scientists still being in the debate on the applicability of signalling theory, methods to acquire more accurate signals, profitability factors, forecasting techniques, most appropriate models, theoretical clarifications and application in practice. Quantitative forecasting methods help to improve the quality of management decisions, increase management knowledge on managed commercial banks objective. Further analysis of academic literature related to applicability

of bank-specific, sector and economic factors, it was noted that there are also leading economic indicators which can be useful as well for forecasting profitability. Though leading economic indicators are used in the economic analysis area, there were no theoretical clarifications, and empirical evidence were supporting their relevance in profitability forecasting.

2. Methodological provision

To develop the model for strategic objective management and forecasting of ROE using leading economic indicators methodological provisions presented. The research uses primary data from banks financial statements, departments of statistics of Baltic countries, European bureau of statistics, Organisation for Economic Co-operation and Development, Bloomberg platform and other for 2005–2018 years.

Regression models are most appropriate for ROE forecasting and let to analyse cause-effect relationships (Buchatskaya et al., 2015, Chambers et al., 1971; Ou et al., 2016); correlation useful to identify potential relationships (Čekanavičius & Murauskas, 2015). Time series analysis allows studying phenomena changes in the timeline, enables identification of socio-economic phenomena changes causes, its features, seasonal trends, etc. It is necessary to perform sample descriptive statistics analysis, use micro/micro editing and donor methods to fix data errors (De Waal et al., 2011), use correlation matrix to prevent and early identify multicollinearity (Park & Yoo, 2014). Profitability forecasting is subject to multiple regression which aims to form model with multiple independent variables, determine the relative significance of each variable and ability of the model to explain the dependent variable. Following theoretical findings mathematical model was formed for empirical analysis:

$$\Delta Y_{i,t+1} = \alpha + \sum_{j=1}^J \beta_j \Delta X_{i,t}^b + \sum_{l=1}^L \beta_l \Delta X_{i,t}^d + \sum_{k=1}^M \beta_m \Delta X_{i,t}^m + u_{it}, \quad (1)$$

where: $Y_{i,t+1}$ – dependent variable ROE for bank i at time t with $i = 1, \dots, N$ and $t = 1, \dots, T$. N – the number of cross-sectional observations, T – the sample period length; α – scalar which measures a constant term; β – vector of $k \times 1$ slope parameters that estimate the sign of the explanatory variables; $X_{i,t}^b$ – bank-specific explanatory variables divided into $1 \times k$ vectors; $X_{i,t}^d$ – industry-specific explanatory variables divided into $1 \times k$ vectors; $X_{i,t}^m$ – macroeconomic variables divided into $1 \times k$ vectors; u_{it} – a one-way error disturbance term is capturing – a bank-specific or fixed effect and a remainder or idiosyncratic effect that vary over time and between banks (v_{it}); $Y_{i,t}$ – a one-period lagged dependent variable of the bank at the time to reflects profitability persistence over time; ∂ – coefficient of the one-period lagged dependent variable measures the adjustment speed of banks' profitability to equilibrium. A value between 0 (high speed of adjustment and imply a

relatively competitive market structure) and 1 (slower mean reversion and, therefore, less competitive markets) indicates that profitability is persistent and will eventually return to the equilibrium level, but some degree of profit persistence exists.

Generalized method of moments suggested using to outweigh limitations of ordinary least squares parameter estimation model (Dietrich & Wanzenried 2011). Evaluation of regression parameters, Durbin-Watson test to identify autocorrelation (Durbin & Watson, 1950), adjusted R^2 as a coefficient of determination suggest assessing the quality of data and evaluating model results. Models' significance verification have to apply to out of sample validation. Homogenous groups of banks were formed. Forecasting results were investigated, analysed ROE, the relevance of different factor groups (financial, sectorial, lagging, coinciding and leading economic indicators) to such models and their relationship with ROE. Empirical research made and hypotheses examined using root-mean-square error (RMSE) approach (Shcherbakov et al., 2014; Hyndman & Athanasopoulos, 2014). Lastly, opportunities and limitations identified using leading economic indicators in forecasting ROE in banks.

3. Empirical study

Sixty-four econometric models for three states and eight banks formed according to the summary of the empirical studies to examine ROE forecasting using leading economic indicators for short periods. Evaluation of forecasting models' accuracy completed comparing models using leading economic indicators vs not applying them for the period 2015.03.31–2011.09.30, models using leading economic indicators vs not using them for the period 2011.12.31–2018.06.30. Other data used for out of sample validation.

Predicting the ROE one quarter (Table 1) log differences were explained better in 94% cases (6% similar), forecasting accuracy was 50–75% cases better (19–25% similar, 0–31% worse) when leading economic indicators are included. Results prove that it is essential to involve leading economic indicators. Then, ROE forecasting executed two quarters ahead.

Log differences were explained better in 88% cases (6% same, 6% worse); forecasting accuracy was 63–75% cases better (0–25% similar, 0–37% worse) when leading economic indicators are included as factors. Worth noting,

Table 1. A summary of the results of the one-quarter and two-quarters of ROE efficiency study (source: authors calculations)

| | Model | Period | Model effectiveness FW1 (E, F) | | | Model effectiveness FW2 (E, F) | | | Model effectiveness FW1 (E, F, L) | | | Model effectiveness FW2 (E, F, L) | | |
|--|-------|-----------|--------------------------------|--------------------|--------------------|--------------------------------|--------------------|--------------------|-----------------------------------|--------------------|--------------------|-----------------------------------|--------------------|--------------------|
| | | | Adj. R^2 | RMSE in the sample | RMSE out of sample | Adj. R^2 | RMSE in the sample | RMSE out of sample | Adj. R^2 | RMSE in the sample | RMSE out of sample | Adj. R^2 | RMSE in the sample | RMSE out of sample |
| LT | 1 | 05Q1–11Q3 | 0.61 | 0.04 | 0.21 | 0.77 | 0.03 | 0.23 | 0.71 | 0.03 | 0.18 | 0.91 | 0.01 | 0.28 |
| | 2 | 11Q4–17Q4 | 0.72 | 0.04 | 0.66 | 0.78 | 0.03 | 0.12 | 0.83 | 0.03 | 0.62 | 0.85 | 0.03 | 0.17 |
| | 3 | 05Q1–11Q3 | 0.56 | 0.27 | 0.80 | 0.25 | 0.42 | 0.34 | 0.98 | 0.06 | 0.07 | 0.89 | 0.07 | 0.09 |
| | 4 | 11Q4–17Q4 | 0.57 | 0.02 | 0.05 | 0.68 | 0.01 | 0.09 | 0.78 | 0.01 | 0.23 | 0.91 | 0.01 | 0.08 |
| | 5 | 05Q1–11Q3 | 0.78 | 0.04 | 0.32 | 0.69 | 0.05 | 0.10 | 0.78 | 0.04 | 0.32 | 0.82 | 0.04 | 0.17 |
| | 6 | 11Q4–17Q4 | 0.35 | 0.10 | 0.59 | 0.52 | 0.08 | 0.06 | 0.40 | 0.09 | 0.70 | 0.64 | 0.08 | 0.83 |
| LV | 7 | 05Q1–11Q3 | 0.40 | 0.24 | 0.69 | 0.38 | 0.27 | 0.11 | 0.95 | 0.07 | 0.12 | 0.92 | 0.09 | 0.10 |
| | 8 | 11Q4–17Q4 | 0.79 | 0.00 | 0.02 | 0.35 | 0.28 | 0.02 | 0.85 | 0.00 | 0.02 | 0.34 | 0.16 | 0.07 |
| | 9 | 05Q1–11Q3 | 0.70 | 0.16 | 0.22 | 0.49 | 0.21 | 0.19 | 0.92 | 0.08 | 0.19 | 0.96 | 0.06 | 0.11 |
| | 10 | 11Q4–17Q4 | 0.23 | 0.05 | 0.11 | 0.43 | 0.06 | 0.11 | 0.56 | 0.04 | 0.10 | 0.48 | 0.04 | 0.09 |
| | 11 | 05Q1–11Q3 | 0.94 | 0.01 | 0.08 | 0.55 | 0.04 | 0.09 | 0.96 | 0.01 | 0.08 | 0.62 | 0.03 | 0.05 |
| | 12 | 11Q4–17Q4 | 0.25 | 0.08 | 0.26 | 0.27 | 0.08 | 0.10 | 0.45 | 0.07 | 0.32 | 0.50 | 0.06 | 0.23 |
| EE | 13 | 05Q1–11Q3 | 0.63 | 0.16 | 0.91 | 0.78 | 0.13 | 0.22 | 0.70 | 0.15 | 0.17 | 0.80 | 0.12 | 0.21 |
| | 14 | 11Q4–17Q4 | 0.66 | 0.21 | 2.00 | 0.65 | 0.22 | 0.87 | 0.69 | 0.20 | 2.09 | 0.78 | 0.16 | 0.74 |
| | 15 | 05Q1–11Q3 | 0.28 | 0.22 | 0.14 | 0.38 | 0.21 | 0.57 | 0.98 | 0.04 | 0.05 | 0.97 | 0.05 | 0.03 |
| | 16 | 11Q4–17Q4 | 0.46 | 0.04 | 0.09 | 0.43 | 0.04 | 0.32 | 0.53 | 0.04 | 0.12 | 0.43 | 0.04 | 0.30 |
| Improved effectiveness of explanatory power / forecasting: | | | | | | | | | 94% | 75% | 50% | 88% | 75% | 63% |
| Similar effectiveness of explanatory power / forecasting: | | | | | | | | | 6% | 25% | 19% | 6% | 25% | 0% |
| Worsened effectiveness of explanatory power / forecasting: | | | | | | | | | 0% | 0% | 31% | 6% | 0% | 37% |

Notations: FW1 – model forecasting 1 quarter ahead; FW2 – two quarters ahead; F,E – model incorporating financial and economic indicators; F,E,L – model incorporating financial, economic and leading economic indicators; RMSE – root-mean-square error; LT – Lithuania; LV – Latvia; EE – Estonia.

the ROE forecasting models using leading economic indicators provide the same explanatory power and forecasting accuracy in one and two quarters ahead.

Effectiveness of all ROE forecasting models using leading economic indicators was also broken down by country and a commercial bank active in Baltic states (see Figure 2). Such view verifies that inclusion of leading economic indicators in combination with bank-specific, sector-specific, lagging and coinciding economic indicators for forecasting ROE improve forecasting accuracy and explanatory power differently. Though, in all Baltic countries' accuracy (lower RMSE) as well as explanatory power ($\text{adj } R^2$) improved significantly, from commercial banks' perspective the most significant benefit of accuracy improvement is seen in Swedbank and SEB (more notable in market size commercial banks). It suggests that though all commercial bank can benefit using leading economic indicators, the most significant effect could be seen in bigger in market size commercial banks.

It is necessary to use all identified factor groups (including leading economic indicators group) and most relevant actual factors: financial ratios, coinciding and lagging economic indicators, general leading economic indicators, trade-leading economic indicators, industrial leading economic indicators, services leading economic indicators, construction leading economic indicators.

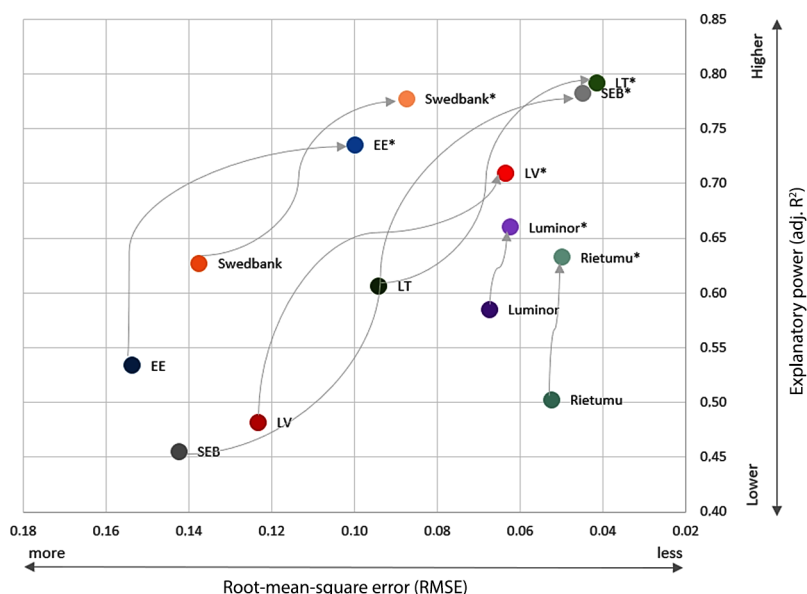
Leading economic indicators are significant factors in all forecasting cases. The results confirm that leading economic indicators should be included in the process of modelling forecast ROE. Furthermore, the results verify that the inclusion of leading economic indicators in combination with bank-specific and other economic indicators improves the accuracy of ROE forecast in shorter periods (one or two quarters ahead).

Conclusions

The theoretical significance is defined in two parts related to complementing signalling theory and ROE forecasting models. Upon analysis and generalisation of different approaches to forecasting ROE in banks using leading economic indicators, the concept was developed and validated in the Baltic bank sector. Such approach complements signalling theory and other existing academic literature with a new approach, how to forecast and acquire signal not only using economic indicators as a general group, but sub-group them into coinciding, lagging and leading. An ROE forecast model in banks using leading economic indicators is used. It helps to identify the most significant ratios and factors supplementing existing literature with a new approach. Suggests to split economic indicators into more groups (outlining not only economic indicators but group them into coinciding, lagging and leading) and then examine factors choosing from those groups.

64 econometric models were formed, and the effectiveness of all ROE forecasting models using leading economic indicators was examined in two periods. Results verified that inclusion of leading economic indicators in combination with bank-specific, sector-specific, lagging and coinciding economic indicators for forecasting ROE improve forecasting accuracy. It complements signalling theory with a new approach (how more accurate signal can be acquired) and supplements forecasting ROE literature with a new view (to group economic indicators into more groups, not only as economic indicators but into lagging, coinciding and leading economic indicators) and to form models choosing indicators from those groups.

It is suggested to apply this model in other regions. However, it should be adjusted according to local specifics.



Notations: Countries (LT – Lithuania, LV – Latvia, EE – Estonia), * – means models including leasing economic indicators, without the sign – not including leading economic indicators)

Figure 2. A visual breakdown of study results by country and commercial bank (source: authors' visualisation of results)

Despite the more subjective nature of qualitative ratios, one of the studies could focus on qualitative factors related to ROE. As a government, private institutions, including banks, data are not structured, standardised and publicly available, we suggest finding a relevant model of data exchange to improve data.

Given the limited period of the study, guidelines for future researches were identified. First, to apply the model in other regions than investigated, the model should be adjusted according to local specifics (different regulatory standards, market and products). Secondly, despite the more subjective nature of qualitative ratios, one of the suggested researches could focus on qualitative factors related to ROE. Third, noted that quantitative ratios data of government and private institutions, including commercial banks, are not structured, standardised and publicly available. Therefore, we suggested doing research finding relevant data exchange and management model to improve data accessibility for scientists as well as practitioners. Also, private and public sector companies' ratios may change due to new regulatory, tax, accounting and similar requirements and as a consequence, models have to be periodically verified. In the research relevance to use leading economic indicators for ROE forecasting and signalling is studied. Leading economic indicators reflect the newest trends. The short-term forecasting has the most significant value to signal and help for timely decision making by internal and external signal receivers (sends the fastest and most frequent signal on targets in comparison to long term targets). This research focuses on short term forecasting and does not study long term forecasting option. For long term forecasting of ROE, a separate study would be needed. Finally, when determining a sample for empirical research, data of non-performing commercial banks were not reflected – due to lack of standardisation of such data would result in to not complete time series. If decided include the data to forecasting, it is recommended a separate and more targeted (about bankrupted and non-performing commercial banks or more narrow scope) research.

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