

REVIEW

by Prof. DSc. Virginia Zhelyazkova

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of the dissertation of Anna Jatczak titled “Application of Mathematical Models in the Activities of Banks in Poland” for the award of the educational and scientific degree “Doctor” in Professional Field 3.8. Economics, Doctoral Programme “Finance and Insurance”

Scientific Supervisor: Prof. DSc. Igor Britchenko

1. General Description of the Submitted Materials

By Order No. 297 / 15.07.2026 of the Rector of the University of Insurance and Finance, Corresponding Member Prof. DSc. Boris Velchev, I have been appointed as a member of the scientific jury for the defence of the dissertation of Anna Jatczak entitled “Application of Mathematical Models in the Activities of Banks in Poland”.

The dissertation, its abstract, and the materials related to the doctoral candidate’s scientific output have been submitted for review. The dissertation has been prepared for the acquisition of the educational and scientific degree “Doctor” in Professional Field 3.8. Economics. The scientific supervisor is Prof. DSc. Igor Britchenko.

The submitted materials provide the necessary basis for assessing the content, methodology, results, and scientific and applied contributions of the dissertation research.

2. Brief Biographical Information about the Doctoral Candidate

Anna Małgorzata Jatczak was born in 1966 in Stalowa Wola, Poland. In 1990, she completed her higher education in mathematics at the Faculty of Mathematics and Physics of Maria Curie-Skłodowska University in Lublin, obtaining a Master’s degree in Mathematics with a specialization in applied mathematics. Her educational and professional background is directly related to mathematics and its practical applications, which corresponds to the thematic focus of the dissertation.

3. Relevance of the Topic and Appropriateness of the Objectives and Tasks Set

The dissertation is devoted to a topical and practically significant issue – the application of quantitative tools in the analysis and management of banking activities. The topic is of considerable importance in view of the dynamic changes in the interest rate environment, the acceleration of inflation during the period under review, and the need for banks to assess the impact of these processes on their profitability and operational efficiency.

The dissertation has a total length of 164 pages and is structured into an introduction, three sections, a conclusion, and a bibliography. The analysis focuses on the banking system of Poland, with SANBank and Bank Pekao S.A. examined in greater detail. The research period mainly covers the years after 2017.

The structure of the dissertation generally follows the logic of the topic addressed – from the presentation of the institutional environment and the main quantitative tools to their practical application.

4. Knowledge of the Research Problem

The theoretical and empirical material presented demonstrates knowledge of the main characteristics of the banking system in Poland, the financial mathematics tools used in banking practice, and the financial indicators employed to assess banking activities. At the same time, as noted below, the literature review could be enriched with contemporary studies on the measurement of bank efficiency.

5. Research Methodology

The main objective of the research is to present selected mathematical models and their practical application in the activities of banks operating in Poland. A main hypothesis has been formulated, according to which mathematical models play a decisive role in banking operations, as well as a working hypothesis that their use significantly increases bank efficiency.

This is also where my main methodological observation arises. In the dissertation, the concept of “mathematical models” is used too broadly. Not only simple and compound interest models, simulation calculations, and the DuPont decomposition model are presented as models, but also indicators such as ROA, ROE, ROS, net interest margin, and the cost-to-income ratio. The latter are primarily financial ratios and performance measures rather than independent mathematical models in the strict sense of the term.

Consequently, the empirical part of the dissertation is, in essence, closer to ratio and comparative analysis of the financial condition, profitability, and operational efficiency of banks than to the construction and empirical testing of mathematical models. This distinction should be made more precisely.

6. Characteristics and Assessment of the Dissertation

The first section presents the institutional and regulatory framework of the banking system in Poland, as well as a broad range of financial mathematics tools. The author demonstrates a good understanding of the functioning of the Polish banking system and of the practical significance of interest calculations.

The second section contains a financial analysis of the two selected banks. The use of indicators such as ROA, ROE, ROS, interest margin, and the cost-to-income ratio makes it possible to trace

the main trends in their financial development. A positive aspect is the effort to interpret the results in the context of inflation, interest rate policy, and changes in the banking environment.

At the same time, the comparison between a cooperative bank and a large joint-stock bank should be interpreted with due caution. The two institutions differ in terms of size, business model, customer structure, market scope, and risk profile. Therefore, the observed differences cannot be attributed solely to the use of particular mathematical tools. The different time periods for which the two banks are analysed also constitute a limitation.

The third section examines the practical application of interest models, the impact of WIBOR and inflation, and alternative approaches to accounting for inflation in loan servicing. This part has the clearest practical and applied orientation. Of particular interest are the simulations of the impact of the WIBOR tenor on repayment amounts and the comparison of two approaches to compensating for the depreciation of capital.

7. Contributions and Significance of the Research for Science and Practice

The contributions of the dissertation are predominantly scientific and applied. They can be summarised as follows:

- the main quantitative tools used in the analysis of banking activities have been systematised;
- a comparative analysis of the financial condition and efficiency of two banks with different scales and organisational profiles has been carried out;
- the impact of inflation and interest rates on the real value of loan and deposit capital has been examined;
- practical simulations of the impact of the selected WIBOR tenor on loan repayments have been developed;
- two approaches to accounting for inflation in mortgage loan repayment have been compared;
- practical conclusions have been formulated that can be used in bank planning and the pricing of loan and deposit products.

I would not consider the use of established indicators such as ROA, ROE, ROS, and the cost-to-income ratio to constitute an independent scientific contribution. Rather, the contribution lies in their systematic application to the specific banks and in the interpretation of the results obtained under conditions of a changing inflationary and interest rate environment.

8. Assessment of the Publications Related to the Dissertation

The dissertation abstract lists three single-authored scientific articles by Anna Jateczak published in *VUZF Review* in 2021 and 2022, which are thematically related to the dissertation research: on simple interest as a mathematical model in banking, on compound interest, and on the instruments of ratio analysis in assessing the economic and financial condition of a bank. A co-authored mathematics textbook published in 2016 is also listed. The three articles reflect substantial thematic areas developed in the dissertation and demonstrate the doctoral candidate's consistent interest in the application of mathematical tools in banking.

9. Assessment of Compliance with the Minimum National Requirements

The submitted scientific output related to the topic of the dissertation provides grounds for concluding that the minimum national requirements for the acquisition of the educational and scientific degree "Doctor" in Professional Field 3.8. Economics have been fulfilled.

10. Personal Contribution of the Doctoral Candidate

On the basis of the submitted dissertation and its abstract, it may be concluded that the research, the analyses performed, the simulation calculations, and the conclusions formulated are the result of the doctoral candidate's own work. Within the materials submitted for review, there are no grounds to question the independent nature of the dissertation or to conclude that plagiarism is present.

11. Dissertation Abstract

The dissertation abstract presents the objective, the specific tasks, the subject and scope of the research, the methods used, the structure of the dissertation, the main results, and the stated contributions. In terms of content, although very concise, it reflects the main points and results of the dissertation and makes it possible to follow the logic and scope of the research conducted.

12. Critical Remarks and Recommendations

Alongside the positive aspects, the following more substantial remarks may be formulated:

A clearer distinction should be made between a mathematical model, a formula, a method of analysis, and a financial indicator. Financial ratios should not automatically be presented as mathematical models.

The concept of "efficiency" is, in some places, equated with profitability. ROA and ROE measure profitability, while the cost-to-income ratio measures cost efficiency, but these indicators do not exhaust the multidimensional concept of bank efficiency. A distinction between profitability, operational efficiency, cost efficiency, technical efficiency, and risk-adjusted efficiency would be desirable.

The hypotheses formulated are too general and, to some extent, self-evident. The proposition that banks use mathematical calculations does not require independent empirical verification. A more

significant question would be which specific models, and under what conditions, improve the quality of decisions and measurable outcomes.

Ratio and comparative analysis reveal the dynamics of financial results but do not, in themselves, demonstrate a causal effect of the use of mathematical models on efficiency. Such a conclusion would require an examination of causal relationships through an econometric model or another appropriate quantitative method.

The sample of two banks limits the possibilities for generalising the results to the entire banking sector in Poland. This limitation should be explicitly acknowledged.

The literature review should be enriched with contemporary publications on the measurement of bank efficiency, including studies using DEA, SFA, Malmquist indices, and risk-adjusted profitability measures. A significant part of the literature used consists of publications from earlier years.

It would be advisable to expand the dissertation abstract in accordance with good academic traditions so that it reflects more fully the main aspects of the scientific research conducted in the dissertation. The Bulgarian translation of the abstract requires editing in order to eliminate inaccuracies and overly literal translations.

The remarks outlined above do not diminish the value of the work carried out but delineate the boundaries within which the results and claims of originality should be interpreted.

13. Personal Impressions

I have no personal impressions of the doctoral candidate beyond the materials submitted as part of the procedure.

14. Recommendations for the Future Use of the Dissertation Contributions and Results

The results of the research could be further developed by expanding the sample of banks, harmonising the periods analysed, and incorporating a broader range of methods for assessing bank efficiency. The practical simulations related to interest rates, WIBOR, and inflation provide a basis for subsequent research with a broader comparative and econometric scope.

CONCLUSION

The dissertation of Anna Jatczak constitutes a completed and independent study with a clearly defined practical and applied orientation. The author demonstrates knowledge of the Polish banking system, the main tools of financial mathematics, and the possibilities for analysing banking activities through financial indicators and simulation calculations.

Notwithstanding the terminological and methodological limitations identified above, the dissertation contains results of practical significance for the assessment of bank profitability and for the analysis of the impact of inflation and interest rates on lending and deposit activities. My

critical remarks are directed primarily at the need for a more precise definition of the tools used and for greater restraint in formulating the conclusions, rather than calling into question the overall value of the dissertation.

In view of the above, I give a positive assessment of the dissertation and propose that the esteemed scientific jury award Anna Jatczak the educational and scientific degree “Doctor” in Professional Field 3.8. Economics, Doctoral Programme “Finance and Insurance” at the University of Insurance and Finance.

The dissertation contains scientific and applied as well as applied results that meet the requirements for the acquisition of the educational and scientific degree “Doctor”. The submitted dissertation demonstrates that Anna Jatczak possesses the necessary theoretical knowledge and skills to conduct independent research in Professional Field 3.8. Economics.

4 September 2026

Sofia

Reviewer:

/Prof. DSc. Virginia Zhelyazkova/