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Review of Abhishek Anand PhD thesis “Procyclical effect of credit risk of banks – econometric analysis for EU financial system”

made under the scientific supervisor: prof. dr hab. Mateusz Pipień

I. Assessment of the significance of research problems and originality of the solution presented in the dissertation

The reviewed doctoral dissertation concerns the procyclicality in banking. Procyclicality refers to the mutually reinforcing feedback loops between the real economy and the financial system, which amplify fluctuations in business and financial cycles. The dissertation employed a nonstandard econometric framework, Seemingly Unrelated Regression Equations (SURE), to examine procyclicality in the banking sector for EU countries, focusing on three key areas: loan supply, loan loss provisions, and capital buffers.

The dissertation is both: theoretical and empirical. First, Author of this PhD thesis describes the literature on the subject. Second, Abhishek Anand in order to achieve the aim of the doctoral dissertation and verify research hypotheses, used quantitative methods based on the data for selected EU countries for the time period 2005-2020.

This dissertation was guided by the existing literature and identified research gaps, aiming to comprehensively analyses how these factors vary with economic cycles. Various models were developed, and the diverse results indicate the heterogeneity of procyclicality. The findings align with theoretical expectations and the critical literature review, where this heterogeneity was also observed.

I assess the dissertation presented for review positively, although it is not without weaknesses. The presence of quantitative research in the dissertation, largely determines its originality and positive evaluation.

Also, the results of the qualitative study in the dissertation determine its originality and proves that the Author is well prepared to conduct independent scientific research.

II. Formulating the objectives of the work and the originality of the research theses

Based on the existing literature and the research gaps, the main objective of the thesis was defined as: empirical analysis of the procyclicality in the banking sector and cross-country heterogeneity with Seemingly Unrelated Regression Equation (SURE) system for selected European Union countries.

With the main objective as stated above, the following detailed objectives were established:

- Presentation and discussion of main ideas of Procyclicality and conceptual relationship with the banking sector.
- Empirical verification of the procyclicality hypothesis of loan supply for the banking sector and its heterogeneity across the analysed EU countries.
- Empirical verification of the procyclicality hypothesis of loan loss provisions for the banking sector and its heterogeneity across the analysed EU countries.
- Empirical verification of the procyclicality hypothesis of capital buffers for the banking sector and its heterogeneity across the analysed EU countries.
- Application of the Seemingly Unrelated Regression Equations (SURE) methodology for procyclicality analysis The main goal of the doctoral dissertation is to examine the procyclicality of the banking sector across three dimensions: loan supply, loan loss provisions, and capital buffer.

The main goal of the doctoral dissertation is to examine the procyclicality of the banking sector across three dimensions: loan supply, loan loss provisions, and capital buffer.

There are four hypotheses of the dissertation derived from these goals:

H1: Loan supply of banks is procyclical.

H2: Banks hold lower loan loss provisions following higher economic growth.

H3: Capital requirements for banks, as mandated by banking regulators, create procyclical effects.

H4: The Seemingly Unrelated Regression Equations (SURE) model is an empirically important generalisation of the panel regression in procyclicality analysis.

The Seemingly Unrelated Regression Equations (SURE) model was used by the Author in case to verify the research hypotheses and for the analyses presented in this dissertation. The primary advantage of using the SURE model (and the Zellner (1962) estimator) in testing the procyclicality hypothesis is its ability to capture parameter variability across the objects analysed, such as different countries considered jointly. In contrast, panel regression methods, commonly used by many cited authors, assume that parameters remain constant across all entities.

It seems that the research hypotheses are correctly formulated. However, they seem to be too general, because the Author performs his research only on a research sample of EU countries. It seems that the hypotheses should be more clarified and the EU banking sector should be added.

The dissertation is theoretical and empirical in nature. It is structured in five chapters, with an introduction and conclusion. Chapter 1 provides the theoretical aspects of the business cycles that derived the concept of procyclicality. Chapter 2 presents the empirical model used for procyclicality testing. Chapters 3, 4 and 5 provide an empirical analysis of the procyclicality of credit supply, loan loss provisions and capital buffers for banks in EU countries. They explain the determinants of credit supply, loan loss provisions for banks and capital buffers for banks respectively including macroeconomic and bank-specific variables. They also provide empirical results with and without the SURE model.

The dissertation employed a **nonstandard econometric framework**, Seemingly Unrelated Regression Equations (SURE), to examine procyclicality in the banking sector for EU countries, focusing on three key areas: loan supply, loan loss provisions, and capital buffers. This study was guided by the existing literature and identified research gaps, aiming to comprehensively analyse how these factors vary with economic cycles. Various models were developed, and the diverse results indicate the heterogeneity of procyclicality. The findings align with theoretical expectations and the critical literature review, where this heterogeneity was also observed. It is important to highlight why the European Union (EU) countries are particularly suitable for testing procyclicality and the related hypotheses using the SURE model. Selecting an appropriate sample for empirical analysis is crucial to ensure the results are both interpretable and applicable. For analysing the

procyclicality of bank credit supply, choosing a group of countries based on rational justification and sampling criteria is essential. The European Union, comprising 27 member countries that span much of the European continent, presents a unique case. In the dissertation was examined four scenarios: a novel approach that treats the group of countries as a single entity with correlated error terms (M1, Zellner estimator), and a more traditional approach where countries are analysed individually (M0, OLS estimator).

The empirical study presented in this dissertation based on EU banking sector data contributes to the literature. The results obtained from this model setup demonstrate the heterogeneity of the procyclicality hypothesis across EU countries.

III. Structure and content of the dissertation

The doctoral dissertation consists of 192 pages. The doctoral dissertation covers: an introduction, four chapters, conclusions, bibliography and abstracts.

The first chapter provides the theoretical aspects of the business cycles that derived the concept of procyclicality. The covered topics include origin and progress of the procyclicality concept. It also provides an extensive literature review of studies around the procyclicality and empirical works performed related to procyclicality in the banking sector.

Chapter 2 presents the empirical model used for procyclicality testing. It deals with the assumptions of Seemingly Unrelated Regression Equations (SURE) and methods of estimation. Later, it shows how the procyclicality hypothesis can be verified within this framework.

In terms of empirical analysis, three models were estimated and analysed in chapters 3, 4 and 5 to test the procyclicality hypothesis for selected EU countries: (1) FE Panel regression at aggregate level combining all countries, (2) M0 model with independent regressions for each country without considering the correlation of the error terms (3) M1 model with independent regressions for each country considering the correlation of the error terms (SURE specification).

Chapter 3 deals with procyclicality of loan supply for a sample of 15 EU countries. Empirical research indicates that loan growth is typically positive during economic booms and negative during recessions, affecting credit quality. Fixed-effect panel regression results initially showed less significant relationships between loan supply and macroeconomic variables, but System of Equations (SURE) models revealed substantial cross-country diversity.

Chapter 4 deals with procyclicality analysis of loan loss provisions (LLP) for a sample of 15 EU countries. Fixed-effect (FE) panel regression and the Seemingly Unrelated Regression (SURE) models were used to estimate the parameters. The SURE model indicated a positive relationship between loans and LLP in 13 countries and a predominantly negative relationship between profits and LLP. Deposits had mixed impacts on LLP across countries. The study highlights the importance of considering cross-country heterogeneity and financial linkages in analysing LLP determinants.

Chapter 5 addresses the procyclicality of capital buffers in 15 EU countries. Fixed-effect panel regression finds only lagged capital buffer and inflation significant. The SURE model highlights diverse, significant relationships across countries, showing stronger and more precise estimates than independent regressions.

To verify hypotheses, the Author employed a nonstandard econometric framework, Seemingly Unrelated Regression Equations (SURE), to examine procyclicality in the banking sector for EU countries, focusing on three key areas: loan supply, loan loss provisions, and capital buffers.

The doctoral dissertation is written in a synthetic way, which is correct and in line with the requirements for empirical PhD thesis, but sometimes the issues discussed in dissertation could be more clarified and explained. The structure of the dissertation with its theoretical content and the empirical study carried out allow us to clearly state that the objectives were implemented correctly. The general structure of the work is understandable and subordinated to the set goal, which proves the scientific maturity and the ability to pose and solve a research problem by Abhishek Anand. Unfortunately, there is no appendix in the dissertation presenting more detailed results of calculations.

The whole doctoral dissertation is illustrated with diagrams and tables. The way of conducting considerations is clear and understandable. However, the doctoral thesis is underdeveloped from the editorial side. There are no data sources under the tables in the dissertation, charts are not readable, etc. Tables are badly formatted, they are not uniform: sometimes too small, sometimes too large.

IV. Evaluation of the doctoral dissertation

In general, I assess the PhD thesis positively, although it is not devoid of some weaknesses.

The subject of research on the credit cycle is interesting and has been the subject of research for many years, but the topic is still relevant and the doctoral dissertation is original. The relation between the business cycle and the behavior of banks has been widely studied in the literature. In periods of economic growth, banks tend to increase lending by either reducing net interest margin or loosening credit screening criteria. This increase in lending can eventually lead to a decline in the quality of credit as riskier borrowers gain access to loans. Conversely, during economic downturns, the demand for loans and the level of deposits typically decrease, reducing available credit. Particularly, the concept of bank lending procyclicality has been discussed in the literature on macrofinancial linkages. Furthermore, the procyclical nature of bank lending is one of the basic arguments for regulating the financial sector and the regulatory framework may contribute to the procyclical nature of bank lending.

Finally, the topic raised in the doctoral dissertation is still relevant and important also in the context of the current geopolitical crisis. Whole the doctoral dissertation is prepared in very synthetic form, which is commendable.

In terms of editing, the work is correct in general is written carefully. Although there are minor stylistic mistakes. However, I have editorial remarks regarding the formatting of the entire doctoral dissertation. My editorial notes mainly concern the ways of formatting the PhD thesis (as I mentioned above), e.g. the lack of spaces after subsections, which sometimes causes the work to be illegible and the tables move to the next page. There is lack of uniformity in font selection in tables at the PhD thesis. Sometimes it is too much, other times it is too small. My comments also concern the presentation of the results in the form of charts, which could be larger, which would make them more transparent for the reader (e.g. pp. 54, 63). In my opinion, the readability of the charts would also increase if the data sources for the charts were placed below the chart and the titles at the top of the chart, as in the case of the tables presented in this paper. The Author of the work could increase the volume of subchapters, which would not cause a large increase in the volume of the work because the reviewed work is not very extensive. The first chapter is very extensive (about 40 pages), while the empirical chapters 3, 4 and 5 are very short (about 50 pages in total).

The empirical research presented in the PhD thesis is original. Theoretical methods and empirical parts are described comprehensively. However, due to the complexity of the work, there

are places where certain issues could be refined and clarified. There are some inaccuracies, both in the description of the donation problem and the description of the research method is not entirely clear. My critical remarks concerns both the theoretical and empirical parts.

In the theoretical part, the content of the first chapter is generally broad but somewhat unsatisfactory. Even though the first chapter is extensive and the problem of procyclicality is described in detail, the Author did not write anything about credit risk, and yet the title of the work is as follows: "Procyclical effect of credit risk of banks – econometric analysis for EU financial system". In my opinion, the doctoral dissertation should include definitions regarding credit risk in the banking industry. Also, the credit risk management plays a crucial role in ensuring the stability of financial institutions. The Author only emphasizes that non-performing loans ratio (NPL) is assumed to be a measure of credit risk in econometric models, which is of course true, but it is too short information for a doctoral dissertation.

The first chapter of the doctoral thesis, contains a subchapter 1.5.2 entitled: "Empirical work in procyclicality of credit risk", which covers about 5 pages. However, in my opinion this subchapter is has been written in too synthetic and does not consists current research on concerning credit risk. There is only basic information on credit risk measurement (p. 57) that it has three key components which also contribute to calculations of regulatory capital requirements by the bank (Probability of default (PD), Loss given default (LGD) and Exposure at default (EAD)). Also, figure 4 (p. 54) demonstrates the co-movement of credit risk (non-performing loans ratio) and economic activity (GDP growth) in the selected top EU countries (by banking assets) for the period 2008-2020 is not very clear and poorly described. Generally, figure 4 is not very readable, the presented charts are too small. In my opinion, more detailed presentation of this concept would be valuable. In the dissertation should be the subsection on credit risk and. Furthermore, the banking sector is exposed to a variety of other risks - including risk from cross-border activity.

The first chapter is fragmented and divided into too many subsections. It should be noted that there are many interesting schemes in it. The subchapter (1.6) concerning the research gap entitled "Summary indicating the research gaps in analyses of the procyclicality of the financial system" deserves praise in the doctoral dissertation.

Chapter two presenting the model of Seemingly Unrelated Regression Equations (SURE) for testing country heterogeneity of the banking sector's procyclicality. Chapter two seems to be exhaustive for a doctoral dissertation and is generally interesting. All formulas/patterns are

presented carefully and are correctly numbered. The second chapter is generally carefully presented and deserves praise.

However, while the research method is described in detail, the research sample which has been presented in the subchapters (2.3 and 2.4) is described too synthetically and it is not clear how exactly the data panel was constructed. Author stress that the data for all 27 EU countries have been considered initially for the time period 2005-2020, but due to SURE estimation assumption ($T > K$), the number of countries considered for final estimation are reduced to 15 based on their share in total EU banking assets. The data for bank specific variables are collected at bank level from Moody's Analytics BankFocus and then aggregated at country level. Data for macroeconomic variables, namely GDP growth rate, Inflation and Unemployment have been taken from the World Bank Development Indicators database. The data analyses and data preparations are performed using MS Excel. Further, the OLS and SURE estimations are done using Gauss software. It is not clear how exactly the data panel was constructed. Whether the data was merged with BankScope data, a previous version of the database. Also, it is not clear, why the Author did not use data at the bank level to study, since he drew data from the BankFocus database. Perhaps due to the SURE method used? But there is no clear information as to why it did not make an additional estimation at the level of banks.

Furthermore, in the subchapters 2.3 table 4 (p. 84) and table 5 (p. 85) present data after Brexit, but panel data cover the period 2005-2020. Table 4 presents banking size and credit supply contributions as a percentage of total EU banking size and credit supply by country for EU-27 members. Table 5 presents share of top 15 EU-countries by total assets. The tables present data on the selection of the sample to the SURE model. In my opinion, in the second chapter, it is lack a table presenting the entire research sample and basic statistics in the entire data panel, which should be presented e.g. in the appendix.

In the last three chapters: chapter three - Empirical importance of procyclicality of credit supply for banks in selected EU countries, chapter four - Empirical importance of procyclicality of loan loss provisions for banks in selected EU countries and chapter five - Procyclicality of Capital Buffer for banks in EU Countries, Author presents the empirical research and hypothesis verification.

My critical remarks for empirical part concerns both the description of the research sample (in chapter 2) and the presentation of the results. The description of the data sample, in my opinion,

is not fully understandable. However, the description of variables used in the three presented empirical models described in chapters 3, 4, 5 deserves praise. Descriptions of the variables used in the models are detailed and clearly presented and careful.

In the chapter three, Author mentions that used annual data forming the balanced panel for 15 EU countries, namely Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Poland, Portugal, Spain and Sweden covering the period from 2005 to 2020. The research sample contained 240 observations. Table 7 and table 8 present some descriptive statistics for the variables applied only for the study presented in chapter 3. The Author in table 9 presents the correlation between variables performs panel regression. However, the correlation between variables in the model is important but there is no information about the correlation function. It is not clear whether this is Pearson correlation, for the normal distribution or another. Table 9 is not described in detail. It would also be good to examine Spearman's correlation, instead the Pearson correlation if sample distributions are not normal. I have not found information about data tests, data distribution, whether the data in the study are normally distributed. The Pearson correlation coefficient is a correlation coefficient that measures linear correlation. Spearman's rank correlation coefficient for all pairs of variables in the list, is a nonparametric measure of rank correlation. In general, there is a lack of detailed descriptions under the tables. Table 15 (p. 109) is illegible. In my opinion, there should be one methodological chapter, for the entire study, described all the empirical chapters.

Chapter four is generally well described. I have similar remarks to chapter four as to the third chapter. Also, the Author in table 19 presents the correlation between variables performs panel regression, but does not detailed information about using type of correlation. Table 25 (p. 131) is illegible.

Chapter fifth concerns the procyclicality of capital buffers in 15 EU. The research sample included 15 countries and the panel contained only 150 observations in the research sample. Also, like in the chapters three and four, the result tables are not described in enough detail.

The Author in the dissertation summarized his research in the conclusion, but there is no synthesis of the results in the context of the verification of hypotheses. The Author formulated four hypotheses in his doctoral thesis but there is no table/additional information concerning comparing the results of the models with the research hypotheses. I also have doubts about the way of verifying

research hypotheses, which are only discussed in more detail in the summary. It would be worth describing and justifying this paragraph in more detail explanation of the results of the model.

The estimation method used in the doctoral thesis should also be better described. Furthermore, the paper lacks a comprehensive description of the research sample used in the study. In general, the paper lacks a synthetic summary of the results obtained in relation to the presented hypotheses.

There is not the robustness of findings of the baseline model. In the dissertation, Author did not perform a resistance test of the results obtained, the additional estimations of the so-called robustness check of the results, therefore the conclusions of the study should be approached with great caution.

The employed a nonstandard econometric framework, Seemingly Unrelated Regression Equations (SURE), to examine procyclicality in the banking sector for EU countries and a very careful definition and description of the variables used in the study deserve praise in the doctoral thesis.

Overall, I evaluate the quantitative research positively. I consider them comprehensive and original. An interesting approach of using SURE model contributes to the literature on the subject. This study was guided by the existing literature and identified research gaps, aiming to comprehensively analyse how these factors vary with economic cycles. Various models were developed, and the diverse results indicate the heterogeneity of procyclicality. The findings align with theoretical expectations and the critical literature review, where this heterogeneity was also observed.

V. Evaluation of the selection and use of literature

The bibliography contains appropriate literature items, that is a good proof of knowledge of the literature on the subject. The cited literature is broad and includes articles and monographs as well as reports sourced from the Internet. The selection of literature is adequate to the subject of research presented in the dissertation by the Author, embedded in the international literature on the subject. However, there could have been more citations of the latest publication of the subject. Which would make the research in the doctorate more topical. Finally, the cited literature demonstrates a strong understanding of the studied issues and includes a substantial amount of the latest research on the subject. It is commendable that the Author of the doctoral dissertation refers to works that are considered to be the basis in the analyzed research area.

VI. Conclusion

The reviewed dissertation shows that Abhishek Anand is well prepared to conduct scientific research, which is confirmed by the empirical research presented in this dissertation. The dissertation has reduced the existing cognitive gap in the literature.

The findings contribute to academic knowledge, provide practical implications for regulators and bank managers, concerning procyclical effect of credit risk of banks. Research on procyclicality is very important from the point of view of macroprudential policy. The concept of bank lending procyclicality has been widely discussed in the literature on macrofinancial linkages and financial market imperfections related to the asymmetry of information.

The evaluation carried out allows us to conclude that the doctoral dissertation of Abhishek Anand in the light of applicable law, meets the requirements for doctoral dissertations. To achieve the aim of the doctoral thesis and verify the research hypotheses, Abhishek Anand used quantitative methods used in the social sciences.

I hereby state that the reviewed doctoral dissertation meets the conditions set out in the Law on Higher Education and Science and I request that Abhishek Anand be admitted to the next stages of the doctoral procedure. I recommend that Abhishek Anand should be admitted to the public defense of the doctoral dissertation.

Matgorate Pawłowski

