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Referee report on the doctoral thesis

“The impact of acquisitions on participating firms’ efficiency within major European insurance markets”

by Thomas Krupa

submitted for the doctoral degree under social field of science, in Economics and Finance as the science discipline at University of Gdańsk

The subject of the review is the doctoral dissertation written by M.Sc. Thomas Krupa entitled “*The impact of acquisitions on participating firms’ efficiency within major European insurance markets*” and prepared under the supervision of dr hab. Leszek Czerwonka, prof. UG. The review was requested by dr hab. Przemysław Borkowski, prof. UG - Chairman of the Economics and Finance Discipline Council at University of Gdańsk (the letter of June 25, 2021), which refers to the resolution of the Faculty Council of June 24, 2021¹. The review is to be used in the procedure for granting M.Sc. Thomas Krupa doctoral degree.

The general goal of the thesis is to: is to “*gain a better understanding of whether and why acquisition events in the European insurance market increase efficiency*” (p.21). To obtain the general goal of the thesis author states thirteen objectives and twelve specific hypotheses

¹ The text of the thesis was obtained in the printed format on the 5th August 2021.

(p.22-23): six of them is related to the European life insurance sector and six to the European non-life insurance sector.

The general goal, specific objectives as well as hypotheses are formulated clearly in a way which is amenable for scientific investigation. They do focus on the specific topic and address an important and policy relevant problems.

The thesis is divided into six chapters accompanied by introduction and conclusion. The construction (structure, completeness and order of chapters) of the thesis is good. The reviewed dissertation has 523 pages (382 pages of the main text together with references), the rest constitute of: list of figures, list of tables, and Appendices. The formal and editorial side of the work does not raise any objections. The work is written very carefully; the illustrations are made skillfully. The language of the thesis is clear; with a few language typos. The thesis is long (if not too long?) – see my specific comments below.

In the introduction, author explains briefly background and scope of the research, together with motivation and presents research aims, objectives and hypothesis to be tested. The structure of the thesis is also presented here. This part introduces the reader very well into the further text. Author in an exhaustive manner justifies the choice of the subject, motivation, and determines the exact research methods and techniques.

In the first chapter, author presents the most important terms dedicated to the subject of the thesis, discusses the historical background of the M&A activities and describes the most important theories as well as methods used to estimate M&A (together with presentation of their advantages and disadvantages and the justification of the choice of the most suitable methods to be used in further empirical analysis).

In the second chapter author presents an overview of the methods utilized to performance assessment, concentrated on the nonparametric measures of efficiency (e.g. DEA, Malmquist index)². Specifically, author explains different DEA approaches presenting their advantages and disadvantages. The literature review of empirical studies considering the assessment of insurance sector in also conducted in this chapter.

² Author presents also parametric methods used in evaluation of efficiency and the comparison of advantages and disadvantages between parametric and non-parametric methods, see e.g. Table 2.1.

In the third chapter author describes the European insurance market (as a whole) and presents the description (together with basic statistical information and comparative analysis) of the insurance sector in seven European countries (France, Germany, Italy, Netherlands, Spain, Ireland and Switzerland) which later will undergo formal empirical analysis.

The fourth chapter is dedicated to the development of hypothesis and research methodology. The research design goes from the selection of variables and sample transformation, through first stage analysis: checking models requirements, NSBM approach, and statistical methods to the second stage analysis based on the OLS regression.

The empirical parts of the thesis with the usage of the described earlier methods are presented in the next two chapters. In the fifth chapter the efficiency analysis of acquires in life insurance sector is conducted while the analogous analysis for the firms from non-life insurance sector is performed in the sixth chapter. The analysis is divided into following stages: checking the NSBM model requirements, calculation of the efficiency scores and ratios, conducting the comparison of efficiency ratios between acquirer and non-acquirer units and finally regressing the (significant) changes in efficiency ratios on the potential determinants with the use of OLS as the estimation method.

The empirical analysis takes into account company level data (from BvD): the final sample consists of 124 life and 221 non-life insurance DMUs³. The company level data comes from Moody's Analytics Insurance Focus database of Bureau van Dijk (Bureau van Dijk, 2019) while information on the acquisition events are taken from a Thomson Reuters database (Thomson Reuters, 2019) and PricewaterhouseCoopers (2019).

The empirical analysis is followed by conclusion⁴. In this part author does not only summarize the main findings of the presented empirical studies together with verification of hypotheses, but also presents challenges, policy implication and scope for the future research.

Summing up my overall impression about the thesis is positive. The main strengths of the thesis are: a) author addresses an important and policy relevant research questions, b) the candidate provides deep literature review (total number of 527 references is used in the thesis) showing familiarity with, and understanding of, the relevant literature together with the

³ The original sample, before data cleaning include: 776 life and 1524 non-life insurance companies (p.200 and 202).

⁴ Each chapter ends with specific conclusions named: „Interim conclusion”.

ability of critical thinking c) author uses a quite large dataset and uses appropriate methodology d) the results and interpretations are presented in a clear way, e) the technical quality and language accuracy are high, f) author provides the access to the R-codes either at Github: <https://github.com/thomaskrupa/thesis>⁵ and as thesis's Appendix.

Based of the above arguments, I can state that the thesis fulfills requirements for doctoral dissertations stated in the specific law regulations and I recommend its admittance to the public defense. In particular, author has demonstrated general theoretical knowledge in the discipline of economics and finance, the scientific problem regarding the relationship between the acquisition and efficiency of participating firms from insurance market is original, the performed analysis indicates author's ability to conduct scientific work independently. In his research, the PhD candidate proved to possess appropriate skills related to conceptualization of scientific research (selecting interesting topic, formulating a defensible and researchable scientific problems); and then operationalization it (identifying the specific research procedures together with obtaining needed data). Author has used a diverse range of research methods and is capable to draw conclusions on the bases of the obtained results. The research conducted by the PhD student fills some research gap in the field of effectiveness assessment.

At the same time, I have some general and more specific comments and suggestions. They are enumerated below:

Major comments

- Author uses non-parametric methods in order to estimate efficiency of units from life and non-life insurance sectors (specifically, he uses network slack-based measure (NSBM)). In order to evaluate efficiency scores he presents the mix of inputs and outputs, in the case of life insurance sector there is only one output⁶. It is well known that methods he uses are especially dedicated to the multi inputs multi outputs production processes – when there is only one output is there a need to use non-parametric methods?

⁵ I would highly recommend author to sustain this good practice: providing open access to codes (and data if possible on the bases of confidentiality issues) for research purposes in his future studies e.g. during submitting scientific article.

⁶ Originally, there are two outputs defined for life insurance sector (se e.g. Table 5.1) however, profit is excluded from the set of outputs based on the analysis of relevance of the variables (p.222).

- In order to draw strong conclusions the analysis has to be confirmed in robustness checks, although author conduces one robustness check considering earned premium as alternative to incurred benefits plus additions to reserves (life) or incurred claims plus additions to reserves (non-life) sector, in my opinion this approach is too limited. The empirical analysis should be enlarged by some additional robustness checks e.g. changing the set of input/output variables, considering life and non-life sector together as recommended by some researchers, changing the calculation method e.g. calculation Malmquist indices as an alternative to efficiency scores or based analysis on the conditional efficiency measures (Bădin et al., 2012). Without such deeper sensitivity analysis and especially taken into account the limited number of observations (in the second stage analysis), drawing strong conclusions is not recommended.
- As far as I understand, the estimation of efficiency scores is conducted on the sample of units coming from different countries, it means that author assumes the same technology across different countries – is this assumption not too strong? In the second stage analysis country specific effects are neither taken into account.
- My main criticism related to the second stage analysis – the estimation of the effects of the potential determinants of the statistical changes in efficiency scores in acquiring versus non-acquiring units is based on OLS regression. However the number of observations is very limited e.g. 9 observation (Table 5.27), 10 observations Table 5.30, 7 observations – Table 5.31). This is the main limit of this study. Is it possible to draw any conclusions on the bases of OLS conducted on 7 observations, is it possible to verify hypotheses on the basis of 7 observations etc. In spite the fact that author underlines that in case of such limited number of observations results should be interpreted with caution (e.g. p. 260) – but then based on that results he verifies hypotheses and in the final interpretation refers to overall European insurance sector. Is such generalization justified? I also have some doubts considering OLS as the best procedure for the second stage analyses (see minor comments). I also do not fully understand why author didn't employ e.g. difference-in difference (DID) approach in which he could compare (based on the regression) treated (acquirers) with non-treated units (non-acquirers) in pre-treated period (before time of acquiring: t) to post-treated period. DID

method is straightforward and often used in policy analysis for establishing effect of the “treatment” or policy on the average outcome (see e.g. Wooldridge, 2012 p. 455–458).

- The study lacks taking care of endogeneity issues. Is there possible two-way relationship between efficiency (ratios) and independent variables of the second stage analysis? Additionally, author uses the term; “impact” describing the results of OLS estimations – is it not too strong? Do OLS estimates provide the proof about causality?
- The stated hypotheses are verified and the results are presented in conclusion (Table 6.39 and Table 6.40). Using purely scientific terminology: the hypothesis can be rejected or not, but not partly rejected or supported (Szreder, 2010). However, author writes about hypothesis’s support and describes it: lack, strong, moderate.
- The thesis is very extensive as far as number of pages is considered (all together 523 pages). In my opinion some parts are not needed or should be extremely limited. Some redundant information are included e.g. the names of removed variables from original database (footnote 159), information that data was pasted into 10 different excel files etc. – as a result it does not only make the thesis very inflated as far as number of pages is considered but also distract the reader from the main analysis. Additionally, if the R codes are available at GitHub there is no need to add them in Appendix. It is very valuable that author provides the R codes he was using, but as far as I understand he didn’t provide any extension or novelty to the method used (his analysis is based on the existed R packages) so there is no need to include such detail technical information. On the other hand, some important information need to be picked up from the text e.g. firstly, incurred benefits plus additions to reserves is described as the output variable in life insurance sector (p. 191) while in footnote we find information that in fact it will be treated as intermediate variable (footnote 144), the same refers to incurred claims plus additions to reserves in case of non-life insurance. The main focus of the thesis should be put on the performed analysis, not on its technical aspects such as coping excel files.

Minor comments

- Author arguments that because he uses efficiency ratio (not efficiency scores) a suitable method for the second stage regression is OLS. I’m not sure whether the arguments in favour of applying e.g. bootstrapping truncated regression (Simar and Wilson, 2007) or conditional

efficiency scores (Bădin et al., 2012) are limited only to the problem that efficiency scores are in range 0 - 1. In my opinion it is also related to the fact that efficiency scores are estimated in the first stage, so they are not observable variables but estimated (also with an error). I'm not sure whether OLS is the best procedure to solve this problem. Additionally, author could use the methods to estimate efficiency scores with errors and check their statistical significance (e.g. using bootstrap methods, see Simar and Wilson 1998, or Mastromarco et al., 2019).

- p. 216 typo: “An OLS regression is applied to calculate the effect from the dependent or endogenous variable to one or more independent, explanatory or exogenous variables” It should be other way round: the relationship goes from independent variable to dependent variable.
- As far as I understand outliers detection is performed after efficiency scores are calculated and on the basis of the values of efficiency score p. 230. Shouldn't it be conducted at an earlier stage, before efficiency scores are calculated – on the basis of inspection input and output variables?
- Is eq. (6) at p. 268 the same as eq. (12)?
- Is Table 5.2.9 acquiring after ex. (lower panel) the same as lower panel of 5.33? if yes then there is no need to provide two times the same information.
- Second stage regression: p.312, independent variables are taken between 2008 and 2014, how exactly they are calculated e.g. do they refer to the mean values of the variables for different years or values from a given specific year? At one place, author writes: “In the second stage, the main drivers for the efficiency change **after** an acquisition event were investigated by applying OLS.” (p.335), while e.g. hypothesis 3a and 3b refer to: “A higher level of leverage **before** the acquisition leads to (...)” (p.238 and 239, Tables 6.39 and 6.40)
- Efficiency ratios for acquiring units are calculated as the difference in efficiency scores in $t+2$ to $t-1$ (t – is the year of acquisition). Why $t+2$ and $t-1$ are chosen for ratio calculations? Shouldn't the analysis be confirmed with some other time periods before and after the year of acquisition? How the ratio is calculated for non-acquiring units (what is the t – for non-acquiring units)?

- In many places author interprets results as the efficiency (scores), while in fact results relate to efficiency ratios e.g. in Table 5.6 (p. 229), the summary statistics refers to efficiency ratios not as indicated technical efficiency etc., “*size initially had a negative impact on efficiency*” (p. 260, 275).
- In the second stage analysis, author checks the non-linearity of leverage and size by estimating quadratic regression: “*First, evidence was found for a non-linear relationship between size and efficiency, namely that size initially had a negative impact on efficiency, but when it exceeded a certain value, the impact became positive.*” (p.275). It would be useful to see the actual value of the turning point (e.g. minimum) and check the distribution of actual data on the smile curve – in order to check where most of the points in the sample are actually concentrated to assure that the behavior of the curve does not stem from the imposed functional form.
- Why only DMUs which are available for all ten years are included in the analysis (balanced panel), especially that the analysis is based on the comparison of two periods (t+2) to (t-1)? Author writes: “*balanced panel data is used in this dissertation, which is consistent with Davutyan and Klumpes (2007). This thesis uses some criteria for the inclusion of data. All insurers (acquirers or non-acquirers) are required to have complete financial data over all ten*” (p.199), but in fact author does not explain why balanced panel is needed. As far as I understand the variables reported in all ten years are not utilized in analysis but only from years: t, t+2 and t-1. What would be the number of companies if unbalanced panel would be used?
- How deflation was conducted for variables referring to Swiss firms. I understand that variables are already expressed in common currency and author indicates using CPI deflator: “*All values were deflated to the year 2008 using the CPI*” (p.201). Does it mean that for variables for Swiss companies (expressed in EUR/USD), the “Swiss” CPI was used? In my opinion the variables (that needed to be deflated) should be first expressed in national currency, then deflated (e.g. in relation to 2008 with the use of country specific CPI) and then bringing to common currency (EUR/USD) on the basis of exchange rate from 2008 – see e.g. the procedure and terminology of OECD⁷ where a given variable is either expressed in

⁷ <https://stats.oecd.org/>

current prices in national currency (NCU), constant prices (from a given year) and NCU or in constant prices (from a given year) at constant exchange rates.

- Author conducts the analysis separately for life and non-life insurance sector, as indicated by author (e.g. see footnote 157) in some previous studies companies from life and non-life insurance were handled together – would it be possible to check the results when life and non-life insurance companies are pooled together?
- p.201, it is stated that during data inspection/transformation some companies were adapted (footnote 163 and 169) – what was the criteria used to adapt those companies?
- p.202: “*Additionally, test xxxx-xxxx columns were added that calculate the difference between the two check columns*”. What does xxxx-xxxx mean?
- It is not explain thoroughly why CRS is chosen for the first run during efficiency calculations (p.209)
- The acquisition sample is divided into companies with multiply and single acquisition event as author writes: *With the help of two samples, it is then possible to explain the effects of multiple acquisitions* (p.211) . I do not fully understand how efficiency ratios are calculated for companies with multiply acquisitions. Let’s consider that a given company X undergone acquisition two times: one in 2009 and another in 2013, so one efficiency ratio refers to the comparison of efficiency scores between 2008 to 2011 and another between 2012 and 2015 (t+2/t-1). Assume that both of the ratios turns out to be statistically significant. In the further analysis e.g. in the second step: are both efficiency ratios included (then in OLS we will have two different y-s and the same x-s – referring to the company X), or just one ratio is included: if one which one? The explanation at p. 204 starting with the sentence: “*An acquisition event would be marked with a one (...)*” it not fully clear for me, neither the explanation on p.228.
- p.222 “*The coefficient of profits (O2.2) were not all positive and significant*” – it refers to which column in table 5.4? The correlation between profits and inputs is high and statistically significant (Table. 5.3), in none of the columns in Table 5.4 there are results of not statistically significant coefficients of independent variables.

- p. 223: “All coefficients of the dependent variables are significant and positive (...)” - I understand that author refers here to the coefficients of independent variables and their statistical significance.
- p. 254 typo: “In addition, the median is 4.1 and higher in the acquirer before excl. than in the acquirer before excl. sample” should be higher in the acquirer before excl, than in the acquirer after excl. sample.
- From the form of the OLS equations e.g. p. 258 it is not clear what is the unit of analysis: if company, there should be subscript “*t*”, are the variables constant over time (there is no subscript “*t*”)?
- P.258 typo: explanation of yPTE – ratio of the pure technical efficiency ratios (ratio of ratio?).

The above mentioned comments do not change my overall high assessment of the merit of the thesis.

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