EKONOMETRIA ECONOMETRICS 3(41) • 2013

ISSN 1507-3866

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POSSIBILITY OF USING META-ANALYSIS IN ECONOMETRICS

Abstract: The purpose of the article was to point out the possibilities of applying meta-analysis in economic science and particularly in econometrics. So far, in Poland meta-analyses were applied in behavioral sciences, medicine and some in economic studies and management, whereas this method has been used used elsewhere since the 1970s for solving a wide spectrum of problems in many fields of study. The present article shows meta-analysis as the method using statistical tools the most, from amongst all the methods of the literature review, and it shows the procedure of carrying it out step by step and its advantages and disadvantages.

Keywords: meta-analysis, methodology, econometrics.

1. Introduction

In the 1970s the new analytical method appeared. In 1976 Glass introduced the term meta-analysis as an analysis of analyses [Glass 1976], but up till now a single well-accepted definition or a single methodology of this method has not existed [Shelby, Vaske 2008]. Generally speaking meta-analysis is a statistical procedure of synthesize the quantitative results of many empirical studies [Glass 1976; Hedges 1987; Rosenthal 1978]. Differences in definition result from the controversy around such problems as [Shelby, Vaske 2008]: (1) is meta-analysis a total methodology or an analytic technique, (2) usage of effect sizes, (3) what is the unit of analysis, (4) finding differences between meta-analysis and comparative analysis.

For example according to Gliner, Morgan, and Harmon "meta-analysis is a research synthesis that uses a quantitative measure, effect size, to indicate the strength of relationship between the treatments and dependent measures of studies making up that synthesis" [2003]. However, in the paper, the definition given by Glass was accepted. According to him, meta-analysis is "the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings" [1976].

In the 1980s, meta-analysis was recommended to solve medical problems (nota bene: meta-analysis began with a medical problem [Rosenthal, DiMatteo 2001]) and social and behavioral research [Field 2001]. Nowadays all over the world this method

is used in many areas – for medical problems, technical, social and economic and many other ones. The number of published meta-analyses in social science is growing constantly [King, He 2005]. In the economic and management area, the first meta-analyses have just appeared in Poland [Gondek, Mazur 2010; Mazur 2011a; Mazur 2011b; Mazur 2012], but this method has not been applied widely yet.

The main aim of this paper is to present this method, show the advantages and disadvantages of it and indicate any possibilities of using it in econometrics.

2. Enter meta-analysis

First of all, meta-analysis should be placed among quantitative methods, but in fact it is one of the literature review methods (Figure 1) which are dichotomized as qualitative versus quantitative reviews.

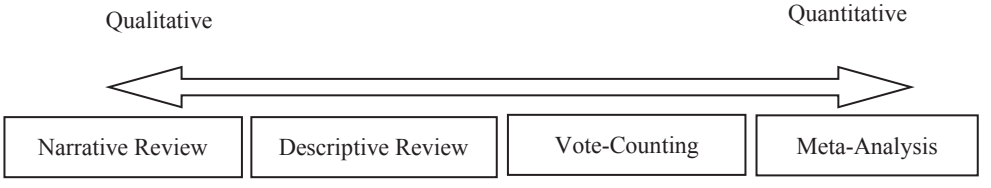

Figure 1. Review Methods on a Qualitative-Quantitative Continuum

Source: [Guzzo et al. 1987] after [King, He 2005].

Narrative review is the most qualitative method, because it presents verbal descriptions of studies focuses on theories, frameworks, factors, research results and it is of great heuristic value [King, He 2005]. This method is not appreciated in economic and management areas in Poland. Probably this is because of the lack of a standardized procedure for narrative review. The next one is descriptive review. Descriptive review uses some quantification, but only for checking the frequency of research in any area or how results in the area have been widened. Vote-counting is a more quantitative method than these two and it is useful for drawing qualitative inferences about a focal relationship by combining individual research outcomes [Pickard, Kitchenham, Jones 1998]. Some researchers treat vote-counting as a meta-analytic procedure (e.g. [Rosenthal 1978; Rosenthal 1991]), but this method does not use effect sizes, which is essential for a meta-analysis. Meta-analysis is the most quantitative method in all these literature review methods. It is conducted in four steps (Figure 2) and has a very strict statistic procedure.

The first step is to conceptualize the research problem. This includes the choice of the dependent and independent variables and the criteria of inclusion and exclusion of studies. In the step two, the suitable data should be collected from the chosen studies, but it is necessary to be careful about the date. Typically, the data is from

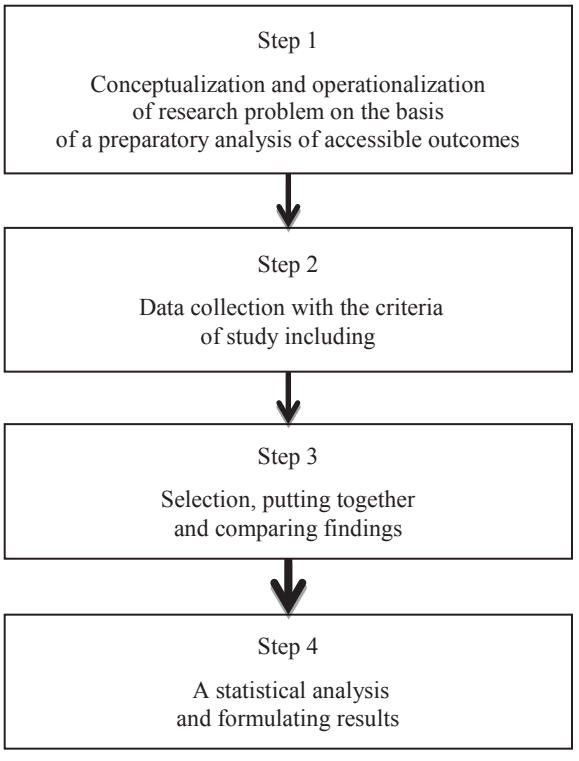

Figure 2. Meta-analysis procedure

Source: own elaboration on the basis [Mazur 2011b].

so-called d-family (based on standard deviation) or r-family (based on correlation). The studies come from an international scientific base, for example Springerlink, Wiley Online Library, JSTOR, Emerald, EBSCO, Proquest or Elsevier [Mazur 2011b]. Then the studies are coded. It is possible that data from the total dataset is inconsistent or inappropriate, which is why step three is needed. Selection, putting together and comparing findings critically is necessary. A statistical analysis and formulating results is the least step of the meta-analysis procedure. In this phase, the researcher makes statistical procedures for meta-analysis according to the steps shown in Figure 3 [Mazur 2011b; Shelby, Vaske 2008]:

1. Count effect sizes for each study independently.
2. Count weighted mean of effect sizes.
3. Determine the confidence interval for the mean.
4. Analyze homogeneity.

If the distribution of effect sizes is homogenous, then we know that the values are concentrated around the mean, and it is a base for giving results. But if the

distribution of effect sizes is heterogeneous, then we can use one of the three models: Random Effect Model, Fixed Effect Model and Mixed Effects Model, which are described in the body of the literature (e.g. [Raudenbusch 1994; Shadish, Haddock 1994; Lipsey, Wilson 2001; Hedges 1982; Hedges 1994; Hedges, Olkin 1985; Cooper, Hedges 1994]).

After statistical analysis the researcher can formulate results, but they depend on the meta-analyst's personal judgments, understanding of the research, and the

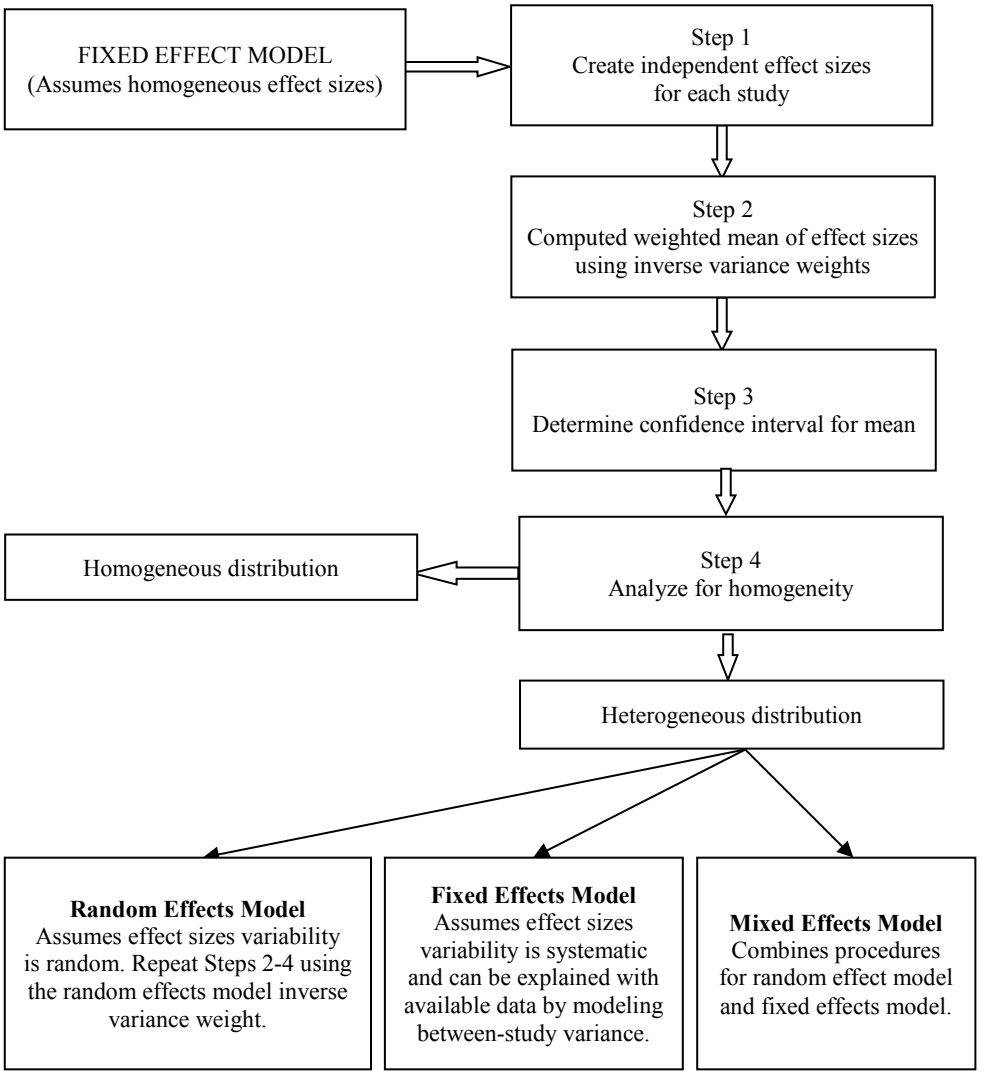

Figure 3. Analysis steps for meta-analysis

Source: [Shelby, Vaske 2008] adapted from [Lipsey, Wilson 2001].

purpose of the research [Shelby, Vaske 2008]. In the body of the literature there is a lot of advice showing how to avoid typical mistakes made in meta-analysis, especially how to reduce this personal judement.

3. The advantages and disadvantages of meta-analysis

Every method has its own limitations. The typical advantages and disadvantages of meta-analysis were assembled into Table 1.

Table 1. The advantages and disadvantages of meta-analysis

Advantages of meta-analysis	Disadvantages of meta-analysis
– it is less appraising than different than different literature review methods, – it takes into account results form an individual study and size of sampling, as well, – it uses result with no information who is the author of the study or the place of publishing, – it has got its own strict statistical procedure, – because of synthesis of result, the total size of sampling increases, – studies without significant result can be included into meta-analysis, – it can settle doubts between contradictory studies or also to deliver conclusions from examinations which did not bring explicit conclusion, – it performs both functions confirming relations in nature and the explanations in relation to the examined phenomena and processes, – it can be an inception for a research showing the wide spectrum of achievements and research trends; this advantage is especially useful if current results are ambiguous, – meta-analysis can offer insights, – it can indicate the statistical significance in the future. For that purpose studies should be gathered from a historical perspective, – it is unable to find differences and resemblances in outcomes methodology of leading studies, – this method can help to establish the borders of cumulated additional knowledge, especially if too many moderator variables are taken into account.	– many studies cannot be synthesized for example concerning the structure, conceptual models, studies of cases, examinations about speculative character and comment papers, statistical and mathematical models, interviews or quality studies, – if the researches uses the triangulation only a quantitative part can be included in meta-analysis with omitting quality part which can more contribute to conclusions drawn in the study, – increasing the sample size does not always mean that credibility and representative of achieved results increase, – it does not diversify studies on account of their quality, – studies with significant results are published more often than studies with "weaker" results and that is why they are more possible to be included into meta-analyses, – conducting this method it is possible that "apples and oranges" are included into the research and compared to each other, – 15 is the required minimum number of studies, – some econometric problems as unobserved heterogeneity, unexplainable or partially explainable heterogeneity, hetero-skedasticity, non-independence of estimates from primary studies can appear during conducting of meta-analysis, – meta-analysis does not answer what to do with the outlier problem, – sometimes it is very difficult to indicate unit of analysis in meta-analysis – the publication of results of meta-analysis requires giving to the author quite big editorial possibilities, because meta-analysis usually increases the length of the text.

Source: own elaboration on the basis [Bal, Button, Nijkamp 2002; Field 2001; Glass 1976; Mazur 2011b; King, He 2005; Nelson, Kennedy 2009; Rosenthal 1991; Shelby, Vaske 2008].

Some comments to Table 1 are necessary. First, according to Field, 15 is the required minimum number of studies [Field 2001], but in fact there are many meta-analyses conducted correctly, where the number of used studies is lower (e. g. [Pierskalla et al. 2004]). Second, this method does not diversify studies on account of their quality. Thus, a risk of including findings from so-called "poorly-methods" exists, and this can cause distorting results. On the other hand, the impartiality of this method is its advantage, which was the intention of the authors of meta-analysis. Third, in spite of that, meta-analysis is a formalised method of synthesis of results based on the literature review and for this reason the results obtained from this method are treated as reliable and credible, because meta-analysis should lead to explicit and the only possible outcomes irrespective of the author, but because of methodological mistakes made by the authors of meta-analyses, they can lead to ambiguous or contradictory results and conclusions. Admittedly, this defect does not persist immanently in the method but in research, nonetheless it should be mentioned. Fourth, this method is treated as unusable in putting hypotheses or research questions, but in fact it is very useful to this purpose [Mazur 2011b].

4. Meta-analysis in econometrics

So far, in Poland meta-analysis has been unpopular in economic studies and management, and in such disciplines as econometrics. But there are many possibilities of using it successfully:

- meta-analysis can be very useful in looking for variables for an econometric model (e. g. [Glass 1976; De Linde Leonard et al. 2013; Mur, Angulo 2009; Schipper 1999] after [Bal, Button, Nijkamp 2002]). On the basis of the available studies it is possible to indicate exogenous variables, which are the most often chosen by researchers to describe the endogenous variable. A huge number of studies is carried out (a) for finding the relationship between variables and the force of this relationship, and this is why researchers count the correlation coefficient (*r*-family type effect size) and/or (b) for describing the strength of the differences between two variables (*d*-family type effect size) and it is useful to find this effects sizes across all studies. Moreover, it is easy to convert *d* to *r* and *r* to d according to the formulas [Rosenthal, DiMatteo 2001]:

$$r = \sqrt{\frac{d^2}{d^2 + 4}} \text{ and } d = \frac{2r}{\sqrt{1 - r^2}},$$

- if the studies are arranged chronologically, it is possible to state if the strength of the relationship between variables increases, and similarly in cases of finding differences between two variables. Such information is very useful in econometrics,

- a meta-regression analysis is useful in econometrics (e.g. [Doucouliagos, Laroche 2003; Schipper 1999] after [Bal, Button, Nijkamp 2002; Ugur 2013]),
- the next reason for using meta-analysis in econometrics is finding analogies between objects (e.g. [Doucouliagos, Ulubasoglu 2008]), which is important especially with usage of analogy methods,
- meta-analysis facilitates grouping similar objects which is useful in comparative examinations,
- this method is unable to find differences and similarities in results of studies and their methodologies,
- by analyzing studies included in meta-analysis, a researcher can find the differences in study processes and in this way it is possible to discover knowledge placed in black boxes [Bal, Button, Nijkamp 2002],
- for forming hypothesis; especially if the correlation between variables is still low, it has been increasing in further studies,
- it is for research design and measurement.

This list of possibilities of usage meta – analysis shows that this method can play an important role in economic science and in econometrics, as well. Many possible types of usage are implied as the advantages of the method.

5. Conclusion

A wide range of possibilities of using the meta-analysis method is presented above. The list of areas of usage it is not complete, of course. Still, new studies will come. In spite of the many limitations of using meta-analysis, this method is very attractive nowadays. We live in times of huge numbers of studies conducted all over the world and most of them are available because of the digitalization process. Thus, methods for synthesizing have become more popular and they are being developed by researchers. This paper should encourage Polish researchers to use it.

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MOŻLIWOŚĆ STOSOWANIA METAANALIZY W EKONOMETRII

Streszczenie: Celem artykułu było ukazanie możliwości stosowania metaanalizy w naukach ekonomicznych, a szczególnie w ekonometrii. Dotychczas w Polsce prowadzone były meta-analizy w naukach behawioralnych, medycynie i nieliczne w naukach ekonomicznych i zarządzaniu, podczas gdy metoda metaanalizy jest powszechnie wykorzystywana od lat siedemdziesiątych w świecie do rozwiązywania szerokiego spektrum zagadnień z bardzo wielu dyscyplin naukowych. Niniejszy artykuł przedstawia metaanalizę jako metodę najszerzej wykorzystującą narzędzia statystyczne w porównaniu z innymi metodami przeglądu literatury, ukazuje procedurę jej przeprowadzenia oraz zalety i wady.

Słowa kluczowe: metaanaliza, metodyka, ekonometria.