Meta Analysis: For Synthesizing Research's Results In Social Sciences

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ABSTRACT Over the time, researches are increasing in numbers in different fields of social sciences. Sometimes these researches are overriding each other on a particular topic. It may happen that different researchers came out with different results on same topic or area of research. So it is not an intelligent approach to increase the number of studies without reaching to a proper conclusion. The researchers can overcome this problem by using a new tool of research "Meta Analysis". Meta analysis is a combined quantitative result of previous studies related to a particular topic. So Meta Analysis is a quantitative approach of literature review of previous studies. Narrative review of previous studies may create researcher's bias. By using Meta Analysis, summarized and unbiased result from previous studies can be calculated. Thus Meta Analysis is a technique to give brief quantitative result from available empirical literature in place of adding one more study in this literature. In this paper, Meta Analysis process and different steps are discussed. Different techniques and software available for Meta Analysis are also discussed.

1. INTRODUCTION

Scientific research is growing almost explosively as researchers in many fields are producing eminent numbers of empirical studies on the relationship between variables of interest. Furthermore findings are often contradictive and cause confusion among researchers who seek to draw conclusion from previous research. A method for the quantitative synthesis of research findings is Meta Analysis. (Alexander Kock, 2009). Although Meta Analysis was originally developed in the experimental sciences, it is currently also gaining ground in non-experimental sciences (Koetse, Florax & Groot,2005). Meta Analysis is important because it establishes whether scientific findings are consistent and can be generalized across populations (Cleophas & Zwinderman,2007). Meta Analysis offer a rigorous and transparent systematic framework for data synthesis that can be used for a wide range of research areas, study designs, and data types (Goodman, Boyce & Sax, 2013).

In 1907, Karl Pearson gathered data from over 10 studies pertaining to evidence on a vaccine against Typhoid. This work was considered the first Meta Analysis (Gordon, 2007). By the middle of the 20th century sheer volume of research reports forced researchers to consider how to develop and apply methods to synthesize the results produced. In 1971, Gene & Glass, coined the term "Meta Analysis" to refer to the statistical analysis of a large collection of analysis from individual studies for the purpose of integrating the findings (O'Rourke K.,2006).

Sometimes Meta Analysis is considered synonym to systematic review. Some systematic reviews may involve Meta Analysis, but not all. For instance some systematic reviews may qualitatively synthesize research findings in addition to or instead of conducting a Meta Analysis (Polanin & Smith, 2014). Some think that Meta Analysis is nothing than a new, quantitative method of conducting literature reviews. However Meta Analysis require major changes in our views of the individual empirical study, the nature of cumulative research knowledge and the reward structure in the research enterprise. It prevents from wasting of research sources (Schimdt, 1992).

Meta Analysis is a class of statistical methods for combining the results from a series of studies addressing the same research question. These methods can powerfully test hypothesis that cannot be answered clearly with one or few studies (Wampold, Ahn & Kim, 2000). Meta Analysis overcomes the danger of unsystematic or narrative reviews that has plenty of scope for basis (Davies & Crombie, 2001). Meta Analysis involves combining summary information from related but independent studies (Normand, 1999). Same way according to Aabo (2009), Meta Analysis is the quantitative analysis of findings from previous empirical studies.

Researchers have generated much data over the years. It is now time to apply Meta Analysis to draw conclusions that will stand the test of time (Wampold, Ahn & Kim, 2000). According to Cumming (2006) Meta Analysis is very valuable way to review literature. He argues that Meta Analysis should appear in the introductory statistics course. Walker et al. (2008) said that Meta Analysis is powerful but also controversial because several conditions are critical to a sound Meta Analysis and small violations of these conditions can lead to misleading results.

Earlier Meta Analysis was mostly used in Psychology and Medical sciences. But now days, it is used in all type of social sciences even in finance. For example Makhlouf (2013) studied remittances and Dutch diseases by Meta Analysis. Bineau (2000) used Meta Analysis to analyze Renminbi misalignment. Egert & Halpern (2005) used Meta analysis for equilibrium exchange rate in central and Eastern Europe, Coric & Pugh used for exchange rate volatility, Miller et al. used it for social research and policy making. Many researchers have used Meta Analysis in Foreign Direct Investment analysis and for Dividend Policy analysis also. In short, Meta Analysis is used in all fields of social sciences now days.

2. OBJECTIVES

The main objectives of writing this paper are as follows:

1. To discuss the importance of Meta Analysis in the field of social sciences.

2. To explain the procedure and steps for conducting Meta Analysis by synthesizing the previous studies' result.
3. To discuss the benefits and limitations of Meta Analysis.

3. META ANALYSIS PROCESS

Meta Analysis is also conducted similarly to other research processes. The main difference comes in statistical formulas to conduct Meta Analysis. Different researchers have explained different numbers of steps for Meta Analysis. For example Field (2005) has explained four steps process for Meta Analysis. Copper & Hedge (1994) explained five stages model; Shacher (2002) used ten steps process. So the main thing is to understand the Meta Analysis comprehensively rather than to confuse by the numbers of steps to divide the Meta Analysis process. Main steps for conducting Meta Analysis are discussed below.

1. DEFINE OBJECTIVE

First of all, the objective of the study should be clearly defined. The variables and their scope used for analysis should also be clearly defined. Problem or question to be investigated should specified, it helps in selecting studies (Cooper & Hedge, 1994). If objective is clear, then it provide guidance in selecting related previous studies and rejecting those studies which are not equal according to different parameters such as nature and type of variables used, research environment in which studies conducted, precision etc.

2. SEARCH & SELECT STUDIES

After defining the objective of research, next step is to collect previous empirical studies related to our research topic. For finding the relating studies extensively literature survey is done especially for empirical literature. As explained by Field (2005) all possible sources for literature should searched such as online and print journals, conference proceedings, unpublished research work, reference section of other research papers, consult with specialists etc. After collecting the related literature, studies should be selected for Meta Analysis. All studies which are collected may not be suitable for Meta Analysis. Studies can be selected on the basis of variables used, method used for Meta Analysis, accuracy and precision of study etc. After selecting the studies important data and information should extracted from studies and should be coded on a different sheet. More than one person can conduct this independently.

3. SELECT EFFECT SIZE

After extracting important data from selected studies, next step is to select an effect size to conduct Meta Analysis. Effect size represents the units of analysis in a Meta Analysis and is produced by previous studies (Alexander Kock, 2002). The effect size statistic produces a statistical standardization of the study findings. In this way, numerical values will be interpretable in a consistent way across all the variables and measures involved (Moser & Schmidt, 2011). Articles may not report effect sizes or may report them in different statistic, so first job is to get effect size for each paper that represent the same effect and are expressed in the same way (Field, 2005). Different formulas are available to convert the one research statistic in another so that all selected studies present the same effect size. For knowing these different methods in detail readers are recommended to see Larrry C. Lyons (1998) at www.lyonsmorris.com. Researchers can use different effect sizes such as mean difference, risk ratio, odd ratio, correlation, standardized regression coefficient etc. In social sciences, coefficient of correlation is generally used for effect size. As explained by Aloe (2009) and Aloe & Thompson (2013) that when result in original studies is given by multiple regression then partial and semi partial correlation can be used as effect size. For understanding different effect sizes readers can read Aloe & Thompson (2013), Rae S. Kim (2011), Field (2005), Cooper & Harris (1994), Moser & Schimdt (2011), T. D. Pigott (2012), Alexander Kock (2009), DeCoster J. (2009).

4. SELECTING EFFECT MODEL

In Meta Analysis researcher has to select either fixed effect model or random effect model. These two models are different in assumptions and methods used for Meta Analysis. Under the random effect model we allow that the true effect size could vary from study to study. In fixed effect model because of one true effect size, smaller studies can be ignored because same information of true effect size can be found from big studies. So the more weight is given to big studies. In random effect model because studies are taken from different populations, we cannot ignore small studies. So there is no much difference in weights for small and big studies. Because random effect model take two types of errors within and between study error and fixed effect model only take within or sampling error, confidence interval and variance is large for random effect model (Borenstein et al., 2009).

5. SELECT ANALYSIS METHOD

Different methods are available for conducting Meta analysis. As explained by Moser & Schimdt (2011) that three main statistical approaches to Meta Analysis are Hedges and Olkin, Rosenthal & Rubin, Hunter & Schimdt. Different methods can be seen in Field (2005), Shacher (2002), Cleophas & Zwinderman (2007), Hedges (1982). These different methods use the different approaches to synthesis the individual studies' result.

6. PRESENTATION OF RESULT

After calculating the Meta Analysis result, it can be present by a table showing effect size, its standard error, confidence interval, studies' weight. To present the result graphically, forest plot can be used. In forest plot, effect size for each study and combined result, confidence interval and studies' weight can be shown. To check the selection bias, funnel plot can be used. If studies are laying symmetrically both side of effect size line, then there is no selection error and studies look like as funnel. If studies do not make funnel, then selection bias can be calculated by different methods. It can be used to see whether studies selected for Meta Analysis are having more weights in favor or against (Borenstein et al., 2005). After that result should be explained qualitatively in simple language.

5. MERITS & DEMERITS OF META ANALYSIS

Main merit of Meta Analysis is that it increases the analysis power because result is based on many studies and not on single study analysis. Second, it helps in solving the controversies on any specific topic. Third, it overcomes the biased narrative literature reviews.

First demerit of Meta Analysis is that it is based on previous studies, from which some studies may not be properly conducted. So, outcome is based on "Garbage in, Garbage out" principle. Second, studies are conducted in different environments and conditions, their combined result may not be representative. It may create problem of merging "Apple & Orange". Third, there is chance of selection

bias due to "File Drawer Problem". Small studies may be published only when they show significant result. S
o if such studies are selected for Meta Analysis, then they will certainly increase the chance of getting significant result from Meta Analysis.

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