THE ROLE OF META-ANALYSIS IN EXAMINING RESULTS OF EMPIRICAL STUDIES ABOUT FINANCIAL CONTGAGION

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Abstract

The paper gives some new insights on the subject of financial contagion using the methodology of meta-analysis. We show that traditional qualitative literature review is not the proper way to summarise empirical findings of financial contagion and we use meta-analytical tools instead. The results of the meta-analysis show that on average asset market correlations have increased during turbulent periods, but the increase is rather moderate. When correlation coefficients are adjusted for the presence of heteroskedasticity, the increase is considerably smaller but still statistically significant. The crises are different in their contagiousness but the level of development of destination country seems not to play significant role whether crises spread over or not.

Keywords: financial crisis, contagion, meta-analysis

JEL Classification: F36, B41, E61, E44

1. Introduction

Financial contagion has become increasingly popular research task in the recent decades. Several crisis in 1980's, 1990's and in the present century were transmitted rapidly to other countries that were sometimes quite different in their size and economic structure as compared to the country of origin and being even located on the other side of the globe. Borrowing the phrase from epidemiology this phenomenon has been called financial *contagion* in the economic literature. According to Rigobon (2002) the issue of *contagion* has been one of the most debated topics in international finance since the Asian crises. The events in last year with yet another financial crisis' 'snowball' rolling over the world show that developing an understanding of financial contagion is clearly indicated for policy makers to manage and avoid future spreading of crises.

Because of that increasing popularity the puzzle of financial contagion has been investigated a lot recently. However, drawing some final conclusions on financial contagion based on empirical evidence is problematic, because of the multidimensionality of the subject. There is still no consensus on neither the definition nor the testing methodology of financial contagion, additionally chosen

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crises, financial indices and destination countries of spreading of the crises may affect the results. All that leaves qualitative literature review as the research methodology with doubtful value and its' results undermined.

Research methodology that can better deal with this multidimenionality is meta-analysis. Meta-analysis enables us to control for all these study characteristics and come to one quantitative finding. Therefore the aim of the paper is to show that qualitative literature review is ill-designed to summarise recent empirical findings in the subject of financial contagion and to find more adequate results by using quantitative analysis in the form of meta-analysis instead.

The paper consists of four sections. In the next section the methodology of meta-analysis is introduced. The results of qualitative analysis of literature about financial contagiondata and the results of the meta-analysis implemented for examining financial contagion are presented in section three. Finally, a brief conclusion is given in section four.

2. The main features of meta-analysis

Meta-analysis is a research method to synthesise empirical research results from previous studies. De Dominicis *et al.* (2006) have given as the purpose of meta-analysis to review and quantitatively summarise the literature using statistical approach. This very general aim is in the heart of every meta-analysis but there are diffenent approaches and methodologies used in that label and the unique definition of meta-analysis is still not worked out.

The term meta-analysis was first coined by Gene Glass in 1976, although some procedures later known as meta-analytic (for example the concept of effect size) were already present in Karl Pearson's study in 1904. By Glass's definition "Meta-analysis refers to the statistical analysis of a large collection of results from individual studies for the purpose of integrating the findings. It connotes a rigorous alternative to the casual, narrative discussions of research studies which typify our attempt to make sense of the rapidly expanding research literature." (Glass 1976). By Schultze (2004) meta-analysis is a method for systematic literature reviews on a certain substantive question of interest, more specifically on his words: "meta-analysis is a systemetic process of quantitatively combining empirical reports to arrive at a summary and an evaluation of a research findings."

Basu (2003) defines meta-analysis as "synthesis of available literature about a topic. Ideally, synthesis of randomized trials to arrive at a single summary estimate is used." By James Neill's (2006) version "Meta-analysis is a statistical technique for amalgamating, summarising, and reviewing previous quantitative research." The most simple definition we have seen was given by Hunter and Schmidt (1990) who defined meta-analysis as "analysis of analyses".

Abstractly speaking, meta-analysis combines the results of several studies that address a set of related research hypotheses. Usually this is done by identification of

a common measure. This common measure is called effect size. Individual effect sizes are aggregated and after study characteristics are controlled the resulting overall results can be considered meta-effect sizes.

Many advantages meta-analysis has over traditional literature review have been pointed out, from which the most important are:

- quantitative estimation and statistical testing of overall effect sizes;
- generalization to the population of studies;
- finding moderator variables to explain heterogeneity in distribution.

The main difference between meta-analysis and traditional literature review is that meta-analysis uses the summary statistics from individual studies as the data points. By accumulating results accross studies, it is possible to get more accurate representation of the population relationship than any of the individual studies can provide.

The main steps of meta-analysis after all relevant studies are congregated, (which we follow in our paper), are the following:
1) calculating relevant individual effect size statistics and controlling for their independency;
2) compute the effect sizes weighted mean for which special weights have to be calculated;
3) determine the confidence interval and statistical significance of the effect size weighted mean;
4) homogeneity testing;
5) conclusions and interpretations.

For conducting the first step the appropriate individual effect size statistics have to be found. What is meant by individual effect size statistic is a quantitative finding from a single study. As those individual effect sizes may be quite different in their nature, different effect size statistics to code different forms of quantitative study findings are worked out. The various effect size statistics are based on the concept of standardization. It means that the effect size statistic has to produce a statistical standardization of the study findings such that the resulting numerical values are interpretable in a consistent fashion across all the variables and measures involved. In our case it means we have to define an effect size statistic capable of representing the quantitative findings of a financial contagion studies in a standardized form that permits meaningful numerical comparison and analysis across the studies. (see Lipsey and Wilson 2001). It is found that good effect size statistics consider both the magnitude and the direction of a relationship (statistical significance which is often in the centre of qualitative literature review is therefore not sufficient statistic). In addition, as brought out by Lipsey and Wilson (2001) the effect size statistics should be defined so that there is relatively little confounding with other issues (such as sample size).

The next step is to aggregate all these individual effect size statistics into one meta-effect size. So one has to derive an overall value from the meta-sample by pooling all the estimates and deriving an overall summary statistic. Usually for finding this overall summary statistic the weighted average of the individual effect sizes computed. That, of course, leads to the question how should the weights be determined. Hedges (1982, Hedges and Olkin 1985) has demonstrated, that the optimal weights are based on the standard error of the effect size. Because a larger standard error corresponds to a less precise effect size value, the actual weights are computed as the inverse of the squared standard error value - called the inverse variance weight in meta-analysis. The standard error formulation has been worked out for the most important types of the individual effect size statistics (including mean differences and correlation coefficients that are used in the present analysis). We discuss these formulations in more detail in the chapter three when computing the weights for our individual effect size statistics.

In the next step there is a question of the homogeneity of the effect size distribution. In other words, whether the various effect sizes that are averaged into a mean value all estimate the same population effect (see Hedges 1982, Rosenthal and Rubin 1982). If the distribution is homogeneous, the dispersion of the effect sizes around their mean is no greater than that expected from sampling error. In other words, in a homogeneous distribution an individual effect size differs from the population mean only by sampling error.

The homogeneity test is based on the Q statistic - a statistical test that rejects the null hypothesis of homogeneity indicates that the variability of the effect sizes is larger than would be expected from sampling error and, therefore, we can't be sure that each effect size estimates a common population mean. If the Q statistic indicates that the distribution is heterogeneous, than there have to be differences among the effect sizes that have some source other than subject-level sampling error. These differences are usually associated with different study characteristics. The Q statistic is distributed as a chi-square with $k-1$ degrees of freedom where k is the number of effect sizes (Hedges and Olkin 1985). The formule for Q is:

$$(1) \qquad Q = \sum \left[w_i \left(ES_i - \overline{ES} \right)^2 \right]$$

where ES_i is the individual effect size for $i = 1$ to k (the number of effect sizes), $\overline{ES}$ is the weighted mean effect size over the k effect sizes, and w_i is the individual weight for ES_i. If Q exceeds the critical value for a chi-square with $k-1$ degrees of freedom, then the null hypothesis of homogeneity is rejected. A statistically significant Q, therefore, indicates a heteregeneous distribution.

Alternative approach to homogeneity testing, so called 75% rule, is given by Hunter and Schmidt (1990). They partition the observed effect size variability into two components - the portion attributable to subject-level sampling error and the portion

attributable to other between-study differences. According to their rule of thumb, the distribution is homogeneous if sampling error accounts for 75% or more of the observed variability.

All these steps, in that order, with following conclusions and interpretations are implemented in the chapter three, summarising the empirical results in the field of contagion of financial crises.

3. Meta-analysis for summarising empirical results of financial contagion

3.1. Qualitative summary of financial contagion empirical results

We have studied around 75 empirical analyses in the theme of financial contagion, results from which are summarised in Table 1 (see Appendix). Note that not all papers in the table actually test for the presence for financial contagion. So in some cases results in the third column of the table (whether evidence for contagion have been found or not) may be somewhat disputable (see different definitions of financial contagion).

As it can be seen from the table the results obtained on the field of financial contagion are quite hopelessly mixed. Counting *Yes*-es and *No*-s in the table we see that the results that indicate evidence on contagion are twice as frequent as those that suggest the opposite. However, many of the *Yes*-results are undermined by the later papers because of questionable testing methodology (not adjusting for the presence of heteroskedasticity). In many cases the chosen result in favor of *Yes*, *No* or *Mixed* is not clearcut. For example, in correlation coefficients based tests, there are mostly different results – some correlations have increased significantly during crises, some have not changed much and some have even decreased. So summing up the results for one *Yes* or *No* conclusion may not be the perfect way. There are almost no pairs of studies that are identical in all their definition of financial contagion, it's testing methodology and crises and samples under investigation. But all of them may influence the results of the analysis.

The results of the analysis confirm the opinion that empirical studies mainly provide heterogeneous results depending on applied definitions and methods and chosen crises, destination countries and financial indices. The evidence for both for confirming and contradicting financial contagion has been widely found in recent empirical analyses and we found no clue on which clear results is or should be dominating. We are aware that in many cases the results of empirical analyses may be biased and serious additional investments into examining possible consequences of financial crises are still necessary. We conclude that qualitative analysis of published research materials about previous financial crises does not give sufficient information to elaborate proper measures allowing to prevent serious consequences of financial crises. We propose that more adequate picture of financial contagion is possible to obtain by using a meta-analysis, which is exactly what we have done in the following section of the paper.

3.2. Data and technical details

For searching appropriate studies for meta-analysis we use ISI Web of Knowledge database for very recent studies and additionally the Contagion of Financial Crisis Website by World Bank Group for somewhat older ones. From the ISI Web of Knowledge database the studies corresponding to the keywords *financial contagion* are used. We define financial contagion as increase in cross-country correlations during "crisis times" relative to correlations during "tranquil times". Thus we follow the most common definition sometimes called shift-contagion that was first proposed by Forbes and Rigobon (1999) who stated that contagion is a significant increase in cross-market linkages after a shock. This notion of contagion excludes a constant high degree of comovement in a crisis period, in which case markets are just interdependent. Therefore only the studies that report both the pre- and post-crisis asset prices correlations (or their difference) between countries are included into the sample. Because of these restrictions we are left in our data set with 716 effect sizes (394 from these are independent) from 30 constructs (17 independent). If both short and long term post-crisis correlations are reported we use the short term data, as we can not use both because of the independency problems (about independency problems see further).

We follow the classical five steps, presented in chapter two, in our analysis, which for the sake of freshing the memory were the following:
1) calculating relevant individual effect sizes and controlling for their independency;
2) computing the weights and aggregating individual effect size statistics into one meta-effect;
3) determine the confidence interval and statistical significance of the effect size weighted mean;
4) homogeneity testing;
5) conclusions and interpretations.

For conducting the first step we have to find appropriate individual effect sizes. A single research finding on the field of financial contagion is a statistical representation of one empirical relationship between pre- and post-crisis correlation of asset prices. There are no rules given in the literature for which are the correct effect sizes for changes in correlation coefficients. For one thing, it is not intuitively clear whether we should deal the data as pre-post contrasts or association between variables. On the one hand, we have correlation coefficients and even if we are not interested in the correlation coefficients itselves but their changes over two points in time, it is not quite clear why these two approaches differ so much (in terms of the properties of effect sizes) that we could not use the same computational procedures. So, why not just take the effect sizes as correlations and live with that? On the other hand, we have data points for both before and after crises (which we can take as treatment) and we are interested in difference between them, the gain to be precise. Classical pre-post contrasts situation, is not it?

Whichever approach we choose from these two, it seems that the real difference comes into play while calculating the (weighted) mean effect sizes (step 2) and their

variances. For calculating individual effect sizes it seems really not to matter. The difference between post- and pre-crisis correlations is by far the most logical individual effect size for a given study (construct). Mathematically, our individual effect sizes are computed as:

(1) $$ES_i = r_{post_i} - r_{pre_i}$$

where ES_i is the individual effect size for study (construct) i and r_{pre_i} and r_{post_i} are pre- and post-crisis correlations respectively for study (construct) i.

Dealing our effect sizes as correlations we modify the effect sizes a bit, because of the problematic standard error formulation (these problems are more indepth discussed by Rosenthal 1994). Widely accepted method for doing that is transforming the correlations using Fischer's Z_r-transformation (see Hedges and Olkin 1985):

(2) $$ES_{Z_r} = 0.5 \ln\left(\frac{1+r}{1-r}\right)$$

where r is the correlation coefficient. The necessity for calculating standard errors (and therefore need for Fischer's Z_r-transformation) comes into play when calculating weighted mean effect sizes (see further (step 2 and 3)).

Note that not all authors agree in the necessity of Fischer's Z_r-transformation for correlation coefficients as effect sizes. For example Hunter and Schmidt (1990) argue that the transformation gives results upward biased and standard correlations are more precise. However, some other authors claim that standard correlation effect sizes are downward biased and it is not clear which bias is greater and the main problem with standard correlations – problematic computation of standard errors and weights – remains

Later on, for interpreting the results we transform them back into standard correlation form using the inverse of the Z_r-transformation (Hedges and Olkin 1985):

(3) $$r = \frac{e^{2ES_{Z_r}} - 1}{e^{2ES_{Z_r}} + 1}$$

Moving forward to step 2 we need to aggregate all individual effect sizes into one meta-effect size. Before that weights for all individual effect size statistics have to be calculated. We use standard statistical software SPSS and some macros written by David Wilson, that are available via his home page for computational and statistical purposes.

We use standard error based inverse variance weights (re-read chapter two) for calculating correlation coefficients based effect size mean. The standard error formula for correlation based (after Fischer's z-transformation (see earlier)) effect size mean is the following:

(4) $$SE_{Z_r} = \frac{1}{\sqrt{n-3}}$$

and inverse variance weights therefore:

(5) $$w_{z_r} = n - 3$$

where n is the sample size of the individual effect size in both formulas.

However we do not have data necessary to calculate the effect size mean when treating individual effect sizes as treatment effects. More precisely, we lack information on correlations between pre- and post-treatment asset prices in individual studies. Therefore the sample size is used as weights instead.

The formula for calculating the weighted mean effect size is following:

(6) $$\bar{d} = \frac{\sum d_i w_i}{\sum w_i}$$

where d_i is the *i*-th individual effect size and w_i is weight (inverse variance weight in case of correlation coefficients and sample size for treatment effects) of the *i*-th effect size.

3.3. Results and discussion

As preliminary analysis we use all 716 effect sizes we have in the sample as independent data points. This approach is somewhat doubtful because there are some effect sizes within the studies that differ only by the chosen methods of measurement and therefore the independency assumption between different data points is violated. Later on we deal with that problem by choosing the appropriate weights to avoid overestimating the results of those duplicate effect sizes within the studies.

Using the abovementioned formulas (1)-(6) we get the estimate of the population effect size to be 0.054 if we treat the individual effect sizes as treatment effects (we call it Approach 1 in the following) and 0.065 if we treat the individual effect sizes as correlation coefficients (Approach 2 hereafter). Thus on average the asset prices correlations have indeed increased during the turbulent periods but on quite moderate extent. The standard errors are 0.0035 and 0.0036 respectively and the 95% confidence intervals well above zero in both cases.

By calculating Q statistic using abovementioned formula (7) we get it's value to be 3680.5 which is clearly over the critical value of 778 (degrees of freedom = sample size – 1; probability (p-value) = 0.05). So the dispersion of the effect sizes around their mean is greater than that expected from sampling error alone and therefore each effect size does not estimate a common population mean.

As stated above we have some independency problems in the data. There are cases for multiple effect sizes within the same studies. That violates the independency assumption and overestimates the weights of the studies with multiple effect sizes. The classical way to deal the situation is to choose only one effect size per study per construct. However, this approach does not use some information contained in the primary studies and we definitely do not want to lose the information of different correlation measurement methodologies as possible moderators. It is well known that heteroskedasticity adjusted correlation coefficients are lower than unadjusted ones and therefore the contagion seems to be more likely to occur in case of unadjusted correlation coefficients. Therefore rather than dropping some of the data points we diminish the weights of studies with multiple effect sizes per construct by dividing the sample size by the number of effect sizes per construct. (For discussion on multiple measurements within studies see also Rosenthal 1994)

Using this slightly modified sample (results are given in Table 1 below) we get the weighted average effect size to be 0.053 in approach 1 and 0.072 in approach 2 with standard errors 0.0047 and 0.0049 respectively. With 95%-confidence intervals easily above zero we can conclude that asset prices' correlations have increased during turbulent periods.

Table 1. Results of financial contagion meta-analysis

	SS	Mean ES as treatment effects			Mean ES as correlations		
		Mean ES	St. eror	Q stat.	Mean ES	St. error	Q stat.
All	716	0.053*	0.005	2782.0*	0.072*	0.005	5568.0*
U	159	0.168*	0.007	956.7*	0.208*	0.007	3432.2*
A	545	0.030*	0.007	668.0*	0.030*	0.007	716.1*
Tha97	86	0.132*	0.007	853.9*	0.173*	0.007	3367.1*
HK97	154	0.010*	0.009	295.6*	0.098*	0.009	323.0*
Rus98	46	-0.001	0.027	48.8	0.006	0.027	52.5
Bra99	33	-0.016	0.039	17.33	-0.014	0.039	15.4
Prewar	344	0.045	0.026	165.8*	0.059*	0.028*	197.3*
Mex94	372	0.141*	0.038	45.7	0.161*	0.045	39.0
US87	70	0.185*	0.062	5.8	0.181*	0.071	4.7
Ind04	68	-0.091*	0.028	122.0*	-0.116*	0.031	153.5*
Tur01	19	-0.194*	0.055	22.2	-0.209*	0.066	19.3
US01	82	0.014	0.055	22.4	0.019	0.066	17.8
Arg01	33	-0.374*	0.015	126.6*	-0.391*	0.015	156.6*
US02	33	0.126*	0.055	12.8	0.133*	0.066	10.3
Cze97	45	0.057	0.039	26.2*	0.058	0.041	26.3*
Emerg	33	0.054*	0.006	2254.3*	0.078*	0.006	5116.5*
Devel	14	0.052*	0.009	527.6*	0.051*	0.008	555.8*

ES – effect size
SS – sample size
U – cases with unadjusted (for heteroskedasticity) correlation coefficients
A – cases with adjusted (for heteroskedasticity) correlation coefficients
Tha – Thailand crisis, HK – Hong Kong crisis, Rus – Russian crisis, Bra – Brazilian crisis, Mex – Mexican crisis, US – United States of American crisis, Ind – Indian crisis, Tur – Turkish crisis, Arg – Argentinean crisis, Cze – Czech Republican crisis, Prewar – average of 6 pre II World War crises (Argentine crisis 1890, Baring crisis (UK) 1890, US banking crisis 1893, US stock market crash 1929, Sterling crisis (UK) 1931, devaluation of the dollar (US) 1933)
Emerg – cases with countries outside first 30 according to Human Development Index 2008
Devel – cases with first 30 countries according to Human Development Index 2008
Source: Author's calculations.

Testing for homogeneity and calculating Q-statistics on that purposes reveals that the distribution is heterogeneous and therefore the individual effect sizes may not estimate the same population effect. Therefore we continue by searching moderators to explain the variabilities in effect sizes. As mentioned above, the correlation coefficients' calculating methodology is widely accepted as significant explaining variable for financial contagion. The logic being that when not adjusting for hetereskedastity, the post-crisis correlations are higher and therefore finding evidence for contagion more probable. For controlling the correlation coefficients measurement as potential moderator we divide our sample into two parts distinguishing heteroskedasticity adjusted (A) and unadjusted (U) correlation coefficients in turbulent periods. For the sample with unadjusted correlation coefficients we get the weighted mean effect size to be 0.168 using approach 1 and 0,208 in case of approach 2. For the sample with heteroskedastity adjusted correlation coefficients the respective values are 0.030 for both approaches 1 and 2. The difference is more than clear and we can conclude that the fact whether correlation coefficients are heteroskedastity adjusted or not significantly affects the results of financial contagion analyses. By dividing the overall Q into the within and between groups component, it is found that the between groups Q is highly significant which also indicates that the differences in correlation measurement (heteroskedastity adjusted or not) accounts for significant variability in effect sizes.

Still, there is some heterogeneity left in the distribution. Therefore we also control for other possible moderator variables. We are interested in, for example, if different crises have been different in the extent of contagiousness. For the Thailand 1997 crisis the treatment effects based (Approach 1) weighted mean effect size is 0.132 and 0.173 if effect sizes are treated as correlation coefficients (Approach 2). For the Hong Kong 1997 crisis the same values are 0.100 and 0.098; for the Mexican 1994 crisis 0.141 and 0.160; for the Russian 1998 crisis -0.001 and 0.006; for the Brazilian 1999 crisis -0.016 and -0.014 respectively. From these numbers it is clearly seen that the Mexican, the Thailand and the Hong Kong crisis are contagious while the Russian and the Brazilian crisis are not.

From other crises the US 1987 and the US 2002 crises are contagious; for the Argentinean crisis 2001, the Turkish crisis 2001 and the Indian crisis 2004 the opposite is true – asset prices correlations have decreased during turbulent periods;

pre-World War II crises on average are not contagious, as well as the Czech crisis 1997 and the US crisis 2001 with some but insignificant increase in average asset prices correlations. Again the given crisis as grouping variable accounts for significant variability in effect sizes, but there are still some heterogeneity left inside groups.

Using only data where correlation coefficients are adjusted for the presence of heteroskedasticity (not reported on the Table 1 below, but available on request) the results do not change much. The Mexican, the Thailand and the Hong Kong Kong crises are still contagious, although the weighted mean effect sizes are somewhat smaller. Also, Russian and Brazilian crises are not contagious with weighted mean effect sizes slightly negative. The only change is related with the US 1987 crisis, which is not contagious any more in the 95% confidence interval. However, with the weighted mean effect size clearly above zero (0.17) and only slightly below the unadjusted (U) case, the reason seems to be mainly because of small sample size.

We also investigate whether the level of development of the destination country makes it more or less susceptible for the spread of the crisis. The need for that differentiation is suggested for example by Hartmann *et al.* (2001) who find only very weak evidence of contagion on the sample of G5 countries and speculated that it may be different for emerging economies. We use Human Development Index (HDI) 2008 values for dividing countries as more or less developed ones. We call first 30 countries according to HDI as developed and all other countries as developing. Thus we have quite comparable sample sizes for both groups with 372 and 344 respectively. For the sample with less developed countries, the weighted mean effect size is 0.054 according to Aapproach 1 (effect sizes as treatment effects) and 0.077 according to Approach 2 (effect sizes as correlations). For the sample with more developed countries the corresponding values are 0.052 and 0.051 respectively. So according to the Approach 1 there is no difference in susceptibility for the spreading of crises between developed and developing countries, while according to the Approach 2 less developed countries are somewhat more susceptible for the carryover of the financial crises. The variability analysis reveals that the level of development of destination country does not account for significant variability in effect sizes. From that we may judge that herding behaviour seems to be more likely transmission force for financial crises than real and stable linkages. This finding is in line with Serwa (2005) who found that The Central and Eastern European stock markets are not more vulnerable to contagion than Western European markets. On the other hand the finding is in contradiction with Dungey and Tambakis (2003) who argue that developing countries are more affected by contagion than developed countries.

However, we also compare these two groups separately for adjusted (A) and unadjusted (U) cases (not reported in Table 2). The findings reveal that in the case U the less developed countries are indeed more susceptible to contagion of financial crises according to both approaches 1 and 2. Using Approach 1 the weighted mean effect sizes are 0.19 for developing and 0.12 for developed countries with not overlapping confidence intervals and in case of Approach 2 the differences are even

greater: 0.24 and 0.12 respectively. In the case A the according numbers are 0.04 for developing and 0.02 for developed countries (according to both approaches 1 and 2) but the differences are not significant at the 95% confidence level.

Summing up the results of the section we can conclude that on average asset market correlations have increased during turbulent periods, which gives some evidence to the support of financial contagion conception. Nevertheless, the increase is quite moderate and after controlling for heterogeneity in turbulent periods' correlations it's even smaller (although still statistically significant in 95% confidence level). Both the correlations' calculating methodology (heteroskedasticity adjusted or not) and the crisis under observation are significant moderators to explain heterogeneity in distribution. From the most important financial crises during past one and half decade the Mexican, the Thailand and the Hong Kong crisis are contagious while the Russian and the Brazilian crisis are not. The level of development of destination country on overall does not account for significant variability in effect sizes. Still, less developed countries are on average somewhat more susceptive to the financial crises contagion compared to the well developed countries.

4. Conclusion

Meta-analysis is a research method to synthesise empirical research results of several individual studies that address a shared research hypotheses. Meta-analysis is especially called for if the multidimensionality of the research topic makes traditional literature review as summarising analysis a doubtful and risky business. One of those topics is the contagion of financial crises.

Financial contagion is extremely complex and multidimensional phenomena with no uniquely accepted definition or testing methodology. Because of the rapid transmission of initial country-specific shocks to economies from which some were very different in both their size and structure compared to the country of origin, the 'financial contagion' puzzle has become one of the most newsworthy research task for economists during the last decades. The crises spreaded over the world like snowballs becoming bigger and bigger during the course and even countries with apparently sound fundamentals were not left unaffected. The events in last year with yet another 'snowball' rolling over the world show that developing an understanding in the subject of financial contagion is clearly indicated for policy makers to manage and avoid future spreading's of crises. The empirical results on the topic of financial contagion are mixed and in our view no unique conclusion can be made only based on the qualitative analysis of empirical literature. Thus, we propose that more profound and adequate picture of financial contagion is possible to obtain by using a meta-analysis.

The most important advantages meta-analysis has over traditional literature review are the following:

- quantitative estimation and statistical testing of overall effect sizes;
- generalization to the population of studies;

- finding moderator variables to explain heterogeneity in distribution.

The key element in meta-analysis is so-called effect size, which is a common measure from individual studies and permits meaningful numerical comparison and analysis across the studdies. Individual effect sizes are aggregated using special weights that determine the relative importance of each of them and after study characteristics are controlled for the resulting overall results can be considered meta-effect sizes.

The main steps of meta-analysis, which is also followed in our paper, are the following:
1) calculating relevant individual effect size statistics and controlling for their independency;
2) compute the effect sizes weighted mean for which special weights have to be calculated;
3) determine the confidence interval and statistical significance of the effect size weighted mean;
4) homogeneity testing;
5) conclusions and interpretations.

The results of our meta-analysis indicate that on average asset market correlations have increased during turbulent periods, but the increase is rather moderate. Still, we find some evidence of financial contagion even after the turbulent periods' correlations are adjusted for the presence of heteroskedasticity. The results of our analysis show that the Mexican 1994, the Thailand 1997 and the Hong Kong 1997 crisis were contagious while the Russian 1998, the Brazilian 1999 and the Argentinean 2001 crisis were not. The level of development of the destination country seems not matter much for the financial crisis to spread over or not. Still, the meta-effect sizes are on average slightly higher in the case of less developed countries as compared to the well developed ones.

One of the main limitations of the paper is that our meta-analysis is restricted to correlation coefficients based analyses only. Studies using this methodology are the vast majority and it is not that simple to conduct comparable individual effect sizes necessary for the meta-analytic approach from the studies using other methodologies. Nonetheless this might be one of the subjects future research could focus on.

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Authors	Year	Contagion	Method	Sample	Market
Hartmann, Straetmans, de Vries	2001	Weak	extreme value analysis	G5 countries	Asset prices
Forbes, Rigobon	1999	No	Increase in correlation, adjusted	28 countries, 1987 US stock market crash, 1994 Mexican peso collapse, 1997 East Asian crisis	Stocks
Lomakin, Paiz	1999	No	Probit analysis	various countries	Bonds
Rigobon	1999	No (Yes less 10%)	Directly identified model; shift-contagion	Mexican, Asian, Russian crises	Stocks
Rigobon	2002	No	HS based identification method	Argentina, Mexico 1994-1999	Brady bonds
Craig, Dravid and Richardson	1995	No	CDR approach	US and Japanese stocks	Stocks
King, Wadhwani	1995	Yes	Correlation coefficient based tests	US, UK and Japan after 1987 US crash	Stocks, bonds
Lee, Kim	1993	Yes	Correlation coefficient based tests	12 major markets after US 1987 crash	Stocks
Calvo, Reinhart	1996	Yes	Correlation coefficient based tests	1994 Mexican peso crisis, Asian and Latin American emerging markets	bonds and equities
Baig and Goldfajn	1999	Mixed	Correlation coefficient based tests, adjusted	emerging markets during the 1997-98 East Asian crisis	Stocks, exchange rates, interest rates
Chou, Ng, Pi	1994	Yes	Var-covar transm mechanism (ARCH/GARCH)	1987 U.S. stock market crash	Stocks
Hamao, Masulis, Ng	1990	Yes	Var-covar transm mechanism (ARCH/GARCH)	1987 U.S. stock market crash	Stocks
Edwards	1998	No	Var-covar transm mechanism (ARCH/GARCH)	Mexican peso crisis, Mexico to Chile	Bonds
Edwards	1998	Yes	Var-covar transm mechanism (ARCH/GARCH)	Mexican peso crisis, Mexico to Argentina	Bonds
Longin and Solnik	1995	Yes	Co-integration based tests	seven OECD countries from 1960 to 1990	Stocks
Baig and Goldfajn	1999	Yes	Increase in correlation	1997-98 East Asian crisis	Sovereign spreads

Authors	Year	Contagion	Method	Sample	Market
Forbes	1999	Yes	Directly measure changes	Asian and Russian crises, individual companies around the world	Stocks
Eichengreen, Rose and Wyplosz	1996	Yes	Probit model	ERM countries in 1992-3	currencies
Kaminsky and Reinhart	1998	Yes	Probit model	Mexican 1995 and Asian 1997	Assets
Gravelle, Kichian, Morley	2003	No	Shift-contagion	4 emerging-market countries 1991-2001	Brady bonds
Gravelle, Kichian, Morley	2003	Yes	Shift-contagion	7 developed countries 1985-2001	Currencies
Kali, Reyes	2005	Yes	Network approach	Tequila Crisis Mexican 1994), the Asian Flu, and the Russian Virus	Stocks
Kali, Reyes	2005	No	Network approach	Venezuelan and Argentine crises	Stocks
Iwatsubo, Inagaki	2006	Yes	CDR approach	22 Asian firma and 7 indexes, Asian crises	Stocks
Didier, Mauro, Shmukler	2008	Yes	Theoretical analysis		
Sander, Kleimeier	2003	Yes	Increase in correl using Granger-causality methodology	Asian crisis, 1996-2000	Bonds
Arestis, Caporale, Cipollini, Spagnolo	2005	Yes/Mixed	Shift contagion	1997 Asian crisis; from Thailand, Indonesia, Korea, Malaysia to Japan, UK, Germany, France	Assets
Bordo, Murshid	2000	No/Weak	Correlation coefficient based tests	Different historical and current crises	Bonds, interest rates
Wolf	1996	Weak	Granger-causality	21 sectors of 24 developing countries, 1976-1995	Equity
Cerra, Saxena	2002	Yes	Probit model	Indonesian currency crisis	stocks, currency
Moussalli	2007	Yes	Directly measure changes	Asian, Russian, Brazilian crisis; Asian, East-European, Latin-American countries	Stocks, currencies
Woo, Carleton, Rosario	2000	Yes	Logit model	Asian crisis; 6 Asian countries 1990-1998	Currency
Woo	2000	Yes	Qualitative analysis	Asian crisis; from Thailand to 4 Asian countries	Bonds

Authors	Year	Contagion	Method	Sample	Market
Tornell	1999	No	Directly measure changes	Mexican 1995 and Asian 1997	Currency
Corsetti, Pesenti, Roubini	1998	No	Directly measure changes	Asian crisis; 24 developing countries	Currency
Kelejian, Tavlas, Hondroyiannis	2006	Yes	Directly measure changes	6 crisis; 25 developing countries	Currency
Corsetti, Pericoli, Scrabcia	2005	Yes	Increase in correlation, adjusted	Hong Kong stock market crisis 1997	Stocks
Favero, Giavazzi	1999	Yes	VAR model	7 European countries; ERM crisis, 1988-1992	Interest rates
Serwa	2005	Weak	Increase in correlation	7 crises, 1997-2002; 17 Western Europe and CEE countries	stocks
Serwa	2005	Yes	VAR model	Asian crisis 1997	capital markets
Serwa	2005	No	Markov switching framework	HSI and Nikkei 225; 1997 Asian crisis	stocks
Serwa	2005	Weak/No	transition matrices	US, UK , Japan, Germany	stocks
Forbes, Rigobon	2000	No	Shift-contagion	1990s	bonds, stocks
Hon, Strauss, Yong	2004	Yes	Increase in correlation, adjusted	2001 terrorist attack, 25 economies, OECD and Asia	stocks
Lee, Wu, Wang	2007	No	Increase in correlation, adjusted	earthquake in South-East Asia on Dec 26, 2004, 26 international stock indexes	stocks
Lee, Wu, Wang	2007	Yes	Increase in correlation, adjusted	earthquake in South-East Asia on Dec 26, 2004, 26 international exchange rates	exchange market
Wang, Thi	2006	Yes	Increase in dynamic conditional correlation coef	Asian crisis 1997, Thailand, China, Hong Kong, Taiwan	stocks
Kleimeier, Lenhert, Verschoor	2008	Yes	Increase in correlation	Asian crisis, Thailand + 14 countries	stocks
Candelon, Hecq, Verschoor	2005	No	serial correlation common feature	Mexican 1994, Asian 1997	stocks
Arestis, Caporale, Cipollini	2003	No/Weak	shift contagion, adjusted	Asian 1997; from 4 Asian countries to 5 developed countries	stocks

Authors	Year	Contagion	Method	Sample	Market
Fazio	2007	Weak	Probit analysis	1990-1999, 14 emerging market economies	currency
Bayoumi, Fazio, Kumar	2007	Yes	correlations and distance relationships	15 countries, 1991-2001	stocks, exchange rates
Bayoumi, Fazio, Kumar	2003	Yes	correlations and distance relationships	16 countries, 1991-2001 (Tequila, Asian, Russia, Argentine)	stock
Alvarez-Plata, Schrooten	2003	No	correlations	7 Latin-American countries, 2001-02 Argentinean crisis	stocks, interest rates
Wang, Moore	2008	Yes	dynamic conditional correlation	4 CEE countries, 1994-2006	stocks
Kallberg, Pasquariello	2008	Yes	excess comovement, adj	82 US industry indexes, 1976-2001	stocks
Chiang, Jeon, Li	2007	Yes	dynamic conditional correlation	9 Asian countries, 1990-2003	stocks
McAleer, Nam	2005	Yes	increase in co-movement (FR)	6 Asian countries, Asian crisis 1997	exchange rates
Haile, Pozo	2008	Yes	panel probit model	37 advanced and emerging market economies, quarterly data 1960-1998	currency
Sola, Spagnolo, Spagnolo	2002	Yes	Markov switching framework	Asian crisis 1997; from Thailand to South-Korea	stocks
Sola, Spagnolo, Spagnolo	2002	No	Markov switching framework	Asian crisis 1997; from South-Korea to Brazil	stocks
Baur	2003	Yes	regression analysis	Asian crisis, 11 Asian markets	stocks
Alba, Bhattacharya, Claessens, Ghosh, Hernandez	1998	Unclear	Qualitative analysis	Asian crisis	stocks, exchange rates
Frankel, Schmukler	1996	Yes	Correlation coefficient based tests	Mexican 1994, to Asia and Latin-America	Country fund prices
Valdes	1997	Yes	Correlation coefficient based tests	Mexican 1994, from Mexico to Latin-America	secondary market debt prices and credit ratings
Agenor, Aizenman, Hoffmaister	1999	Yes	Correlation coefficient based tests	Mexican 1994, from Mexico to Argentina	Interest rates
Boyer, Gibson, Loretan	1999	No	Increase in correlation, adjusted	Gernany, Japan, USA; 1991-1998	Exchange rates

Authors	Year	Contagion	Method	Sample	Market
Loretan, English	2000	No	Increase in correlation, adjusted		3 pairs of asset returns
Gelos, Sahay	2001	No	Increase in correlation, adjusted	from the Czech Republic, Asia, and Russia to CEE	Stocks, exchange rates, sovereign spreads
De Gregorio, Valdes	1999	Not tested	conditional probability	1982 debt crisis, Mexican 1994, 1997 Asian	Exchange rates, credit ratings
Caramazza, Ricci, Salgado	2004	Yes	conditional probability	Mexican 1994, Asian 1997, Russian 1998; 41 countries	currency
Glick, Rose	1999	Not tested	conditional probability	5 crises and 161 countries	Currency
Park, Song	1998	Yes	conditional probability	Asian crisis, 8 Asian countries	Exchange rates, stocks, interests
Longin, Solnik	2001	Yes	GARCH framework	US, UK, France, Germany, Japan; 1959-1996	Stocks

META-ANALÜÜSI ROLL FINANTSKRIISIDE ÜLEKANDUMISE UURIMISEL

Andres Kuusk, Tiiu Paas
Tartu Ülikool

Finantskriiside ülekandumist riigist riiki on epidemioloogiast tulenevast terminoloogiast lähtudes hakatud majandusteadlaste seas nimetama nakkuslikkuseks (ka lumepalliefektiks). On täheldatud, et finantskriisid kandusid viimastel kümnenditel ootamatult kiiresti paljudesse maailma riikidesse ning sealhulgas nendesse riikidesse, mis olid tugevad nii makromajanduslike näitajate kui rakendatava finantspoliitika osas. Samuti ei pruukinud nn nakatatud riigid omada kriisi lähteriigiga sarnast majanduse struktuuri.

Finantskriiside kiirest levikust tulenevalt on ka mõistetav, et nende nakkuslikkus ehk kriiside nn lumepalliefekt on rahvusvahelises majanduskirjanduses kujunenud viimastel aastatel oluliseks uurimisteemaks. Olulise tõuke finantskriiside riikidevahelise ülekandumise tõsisemaks uurimiseks andis 1990-te aastate krahhide tagajärgede kiire levik üle paljude maailma riikide. Iseenesest mõistetavalt kaasnes kriiside ja krahhide kiire levikuga ka vastuse otsimine küsimustele, kas finantskriiside puhul saab rääkida nende nakkuslikkusest st ülekandumisest, selle põhjustest, ulatusest ja täpsematest seostest. 2008. aasta finantskriis koos sellele järgneva majandussurutisega on taas teravalt päevakorda tõstnud finantskriiside nakkuslikkuse (edaspidi *finantsnakkus*) uurimise vajaduse. Oluline on finantskriiside kiire ülekandumise õppetunde üldistada ning selgitada võimalusi ja välja töötada meetmeid finantskriiside lumepalliefekti pehmendamiseks.

Kuigi finantskriiside ülekandumise uurimisele on viimastel aastakümnetel pööratud olulist tähelepanu, on lähenemised finantsnakkuse mõistele, aga ka finantsnakkuse uurimisel kasutatavad metoodikad ning uuringute tulemused väga heterogeensed. Käesoleva uurimise eesmärgiks on välja selgitada, kas finantskriiside ülekandumist käsitlevate empiiriliste uuringute tulemusi kajastava erialakirjanduse kvalitatiivse analüüsi alusel tehtavad järeldused on kooskõlas nende empiiriliste uuringute põhjal läbiviidava meta-analüüsi tulemustega. Otsime vastust küsimusele, kas arvestades finantsnakkust käsitlevate mõistete, empiiriliste uuringute metoodikate ja tulemuste suurt heterogeensust on meta-analüüsi metoodikale tuginevalt võimalik saada kinnitust finantsnakkuse olemasolule. Eraldi tähelepanu all on siinjuures finantskriiside ülekandumisega seonduvad küsimused Kesk- ja Ida-Euroopa üleminekuriikide näitel. Eesmärgi saavutamiseks on läbi viidud kvalitatiivne kirjanduse ülevaade senistest olulisematest empiirilistest tulemustest ning seda on täiendatud kvantitatiivse analüüsiga meta-analüüsi raamistikku ja metodoloogiat kasutades. Autoritele teadaolevalt ei ole finantsnakkuslikkuse uurimiseks meta-analüüsi seni veel kuigi ulatuslikult kasutatud.

Oluline on rõhutada, et vaatamata intensiivsele uurimisele ja empiiriliste analüüside rohkusele, pole majandusteadlasete seas seni saavutatud üksmeelt finantsnakkuse täpse definitsiooni ega ka levimiskanalite kohta. Üksmeel on põhiliselt selles osas, et

tarvilik tingimus finantsnakkuse kui nähtuse esinemiseks on finantskriiside ja krahhide ülekandumine kriisi lähteriigist teistesse riikidesse. Erimeelsused tekivad aga selle tingimuse piisavuse suhtes. Osa uurijaid loeb kriiside ülekandumist piisavaks tingimuseks finantsnakkuse olemasolu kinnitamiseks. Teise suuna esindajad väidavad, et finantsnakkuse avaldumise testimiseks on vaja kontrollida ka riikide fundamentaalnäitajate (majanduse suurus ja struktuur, rakendatav poliitika jms) omavahelist korrelatsiooni. Kolmandate arvates leiab finantsnakkuse olemasolu kinnitust vaid siis, kui nakkuse levimise kanalid on pärast kriisi ilmnemist (võrreldes nö rahuliku ajaga) oluliselt tugevnenud.

Ka finantsnakkuse levimise kanalite osas ei ole majandusteadlased üksmeelsed. Kõige üldisemalt on kriiside ülekandumise kanaleid jagatud fundamentaalseteks ehk stabiilseteks ja investorite käitumisest tulenevateks ebastabiilseteks ühenduskanaliteks. Olulisimateks fundamentaalseteks ühenduskanaliteks loetakse: 1) finantskanalid (*financial linkages*) – riigid on omavahel seotud läbi rahvusvahelise finantssüsteemi; 2) reaalkanalid (*real linkages*) – riigid on seotud läbi rahvusvahelise kaubanduse, kas olles kaubanduspartnerid või konkureerides samal välisturul; 3) poliitilised kanalid (*political links*) – riikidevahelised poliitilised suhted.

Viimasel kümnendil alates R. Rigoboni (1999, 2002) töödest on levima hakanud ka seisukoht, et kriiside ülekandumisel fundamentaalsete levimiskanalite kaudu ei ole tegemist finantsnakkusega vaid lihtsalt vastastikuse sõltuvusega (*interdependence*). See omakorda seab kahtluse alla kõige laiema ehk nn tingimusteta finantsnakkuse definitsiooni. Siinjuures on oluline märkida, et käesoleval sajandil käsitletaksegi finantsnakkusena reeglina selle nähtuse kitsamaid avaldumisvorme.

Paljud autorid on jõudnud seisukohale, et fundamentaalsed ühenduslülid ei suuda täielikult selgitada riikidevahelisi seoseid ning muutusi nendes seostes. Tähelepanu tuleb pöörata ka investorite käitumisega seotud irratsionaalsetele aspektidele, eriti nn *herding*-kontseptsioonile ehk karjakäitumisele. *Herding*-kontseptsiooni südameks on informatsiooni asümmeetrilisus, mis põhjustab informatsiooni hankimise kulukuse tõttu väheminformeeritud investorite poolse (eeldatavalt) paremini informeeritud agentide tegevuse järgimise ja matkimise. Nii võib kogu turg liikuda kiiresti ja ühekorraga ajutiselt ühes suunas. Kui eeldatavalt informeeritud investorid juhtusid näiteks mingist riigist raha välja tõmbama mujal tekkinud kriisist tulenevate probleemide tõttu investeerimisportfellis, siis võivad tõsised finantsprobleemid tekkida ka väga heade fundamentaalnäitajatega riikidel.

Nagu juba eespool mainitud on finantsnakkuse avaldumist viimastel kümnenditel empiiriliselt väga palju analüüsitud. Seejuures on saadud ka väga erinevaid tulemusi, mis on ka mõistetav arvestades käsitletava uuritava probleemideringi mitmedimensionaalsust. Läbiviidud empiirilised uuringud erinevad lisaks finantsnakkuse mõiste erinevale tõlgendamisele ka kasutatava analüüsimetoodika, vaadeldavate kriiside, valimisse kuuluvate sihtriikide ja mitmete muude üksikasjade osas. Heaks näiteks on siinkohal Serwa (2005) uurimus, kes kasutas nelja erinevat testimismetoodikat ja nelja erinevat valimit ning sai ka oluliselt erinevad uurimistulemused.

Tulemuste üldistamiseks on käesolevas uurimuses käsitletud võimalikku finants-nakkust käsitleva empiirilise analüüsi tulemusi ca 75 juhu kohta (vt lisa). Liigitades saadud tulemusi *Jah* ja *Ei* tulemusteks ning neid loendades saab teha järelduse, et finantsnakkuse esinemist toetavaid tulemusi (*Jah*-tulemus) on ligi kaks korda rohkem kui mittetoetavaid (*Ei*-tulemustes). Suur osa *Jah*-tulemustest on aga saavutatud korrelatsioonikoefitsientide muutusel põhinevate testidega, kus tulemusi pole heteroskedastiivsuse esinemise suhtes kontrollitud ega kohandatud. Viimase kümnendi uurimused on aga selgelt näidanud sellise kohandamise vajalikkust. Selliseid tulemusi mitte arvestades on *Jah*- ning *Ei*-tulemused ligikaudu tasakaalus. Mitmete uuringute puhul ei ole ühtne järeldus *Jah* või *Ei* kasuks päriselt õigustatud, kuna ühe uuringu raames võib esineda nii finantsnakkust toetavaid kui ka mittetoetavaid tulemusi.

Peamiseks probleemiks konkreetsete üldistavate järelduste tegemisel on aga siiski juba mainitud uurimisprobleemi mitmedimensionaalsus. Uuringusse kaasatud kolmveerandsaja empiirilise analüüsi seas on vaid üksikud, mis kasutavad sama definitsiooni mõiste avamiseks, sama testimismetoodikat, samu kriise ning kriiside ülekandumise sihtriike. Selline heterogeensus uurimistöödes mõjutab ka tulemusi. Seega erialakirjanduse kvalitatiivsele analüüsile lisaks on oluline kasutada ka meta-analüüsi st kvantitatiivset analüüsimetoodikat, et saada täiendavat infot varasemate empiiriliste uuringute tulemuste üldistamiseks.

Meta-analüüsi jaoks vajaliku andmestiku kogumiseks on kaasatud uuringud Maailmapanga *Financial Crisis Website* leheküljelt ning *ISI Web of Knowledge* andmebaasist vastavalt märksõnadele *financial contagion*. Valimisse on kaasatud ainult need uuringud, milles finants-nakkuslikkus on defineeritud statistiliselt olulise erinevusena kriisieelse ja kriisijärgse finantsvahendite hindade korrelatsiooni vahel ning kus nii kriisieelne kui -järgne korrelatsioon (või nende vahe) on selgelt välja toodud. Sel viisil on saadud 30 uuringut ja 716 individuaaltulemust. Neist sõltumatud on 17 uuringut ja 394 individuaaltulemust. Juhul, kui raporteeritud on nii lühiajalise kui pikaajalise perioodi kriisijärgne korrelatsioon, on sõltumatuse probleemi tõttu uuringusse kaasatud vaid lühiajalist perioodi iseloomustav tulemus.

Iga konstruktsiooni korral on leitud kaks metatulemust: ühel juhul on korrelatsiooni-koefitsientide muutu käsitletud kui mõjuefekti (*kontseptsioon 1*) ja teisel juhul kui korrelatsiooni (*kontseptsioon 2*). Kumb lähenemine on õigem? Meta-analüüsi käsitlevas kirjanduses pole seda teemat käsitletud ning autorite arvates pole ka intuitiivselt selge, millise neist valima peaks. Seetõttu ongi paralleelselt toodud tulemused mõlema kontseptsiooni korral.

Kontseptsiooni 1 kasutades on keskmiseks kaalutud korrelatsioonikoefitsientide muuduks 0,053 standardhälbega 0,0047 ja *kontseptsiooni 2* kohaselt 0,072 standardhälbega 0,0049. Mõlemal juhul jäävad 95% usalduspiirid selgelt üle nulli ning võib järeldada, et keskmiselt on kriisiperioodidel korrelatsioonid tugevnenud. Kontrollides jaotuse homogeensust Q-statistiku abil selgub aga, et jaotus on heterogeenne ning seega ei pruugi kõik individuaaltulemused esindada ühte ja sama üldkogumit. Seetõttu on vajalik jätkata analüüsi otsimaks võimalikke varieeruvust

põhjustavaid moderaatoreid. Esmalt on võimaliku moderaatorina kontrollitud heteroskedastiivsuse suhtes kohandamist kriisijärgsete korrelatsioonide arvutamisel. Selleks on valim jagatud kaheks vastavalt sellele, kas heteroskedastiivsuse suhtes kohandamist on teostatud (juht A) või mitte (juht U). Selgub, et kaalutud keskmine korrelatsioonide muut on juhul A tunduvalt väiksem, olles 0,030 nii *kontseptsiooni 1* kui *2* korral. Juhu U korral on vastavad tulemused 0,168 ja 0,208. Saab järeldada, et tegu on olulise moderaator-muutujaga, mida kinnitab ka gruppide vahelise Q-statistiku statistiline olulisus.

Kuna Q-statistiku väärtuse põhjal võib arvata, et jaotuses on endiselt veel järel teatud määral heterogeensust, siis on moderaator-muutujana kontrollitud ka erinevaid kriise. Selgub, et viimaste kümnendite suurematest kriisidest Tai 1997, Mehhiko 1994 ja Hong Kongi 1997 kriis olid selgelt rohkem nakkuslikud kui Vene 1998, Brasiilia 1999 ja Argentiina 2001 kriisid. Samuti olid nakkuslikud USA 1987. ja 2002. aasta kriisid, mitte aga Türgi 2001, India 2004, Tšehhi 1997 ega USA 2001 kriisid.

Võimaliku moderaatorina on kontrollitud ka sihtriigi arengutaset jagades valimi arenenud ja vähemarenenud riikideks vastavalt 2008. aasta inimarengu indeksile. Arenenud riikidena on siinkohal defineeritud nimetatud indeksi järgi 30 esimest riiki, mis on valitud eesmärgiga hoida valimi mahud mõlemas grupis umbkaudu võrdsed (vastavalt 372 ja 344). Sihtriigi arengutase võimaliku moderaatorina statistilist kinnitust ei leidnud. Seega saame teha järelduse, et riigi hea arengutase ei paku küllaldast kaitset kriiside nakkusliku leviku eest.

Kesk- ja Ida-Euroopa üleminekumajanduste uurimiseks on valimis 89 individuaaltulemust kaheksa kriisi ja nelja riigi (Tšehhi Vabariik, Eesti, Poola, Ungari) kohta. Mõlema kontseptsiooni (individuaaltulemused kui korrelatsioonid ja kui mõjuefektid) rakendamise korral on metatulemuseks 0,02; mis kogu valimi tulemustega – vastavalt 0,05 (*kontseptsioon 1*) ja 0,07 (*kontseptsioon 2*) – võrreldes on mõnevõrra väiksem. Siit tulenevalt saame teha järelduse, et Kesk- ja Ida-Euroopa üleminekumajandused on finantsnakkusele keskmiselt vähem vastuvõtlikud kui kogu valim tervikuna. Sarnasele tulemusele on varem jõudnud ka Serwa ja Bohl (2005) ja Serwa (2005). Ka neil ei õnnestunud leida tõendeid selle kohta, et Kesk- ja Ida-Euroopa riigid oleksid *finantsnakkuse* poolt kergemini haavatavad kui lääneriigid. Veelgi selgemalt tuleb see tulemus esile, kui valimisse kaasata vaid uuringud, kus korrelatsioonikoefitsiendid on heteroskedastiivsuse suhtes kontrollitud. Mõlema kontseptsiooni korral on meta-efekt nüüd negatiivne, näidates isegi korrelatsioonide vähenemist kriisiperioodidel. Üheks selgituseks oodatust väiksemale finantsnakkuse vastuvõtlikkusele Kesk- ja Ida-Euroopa riikides võib tuua suhteliselt väiksema spekulatiivsel eesmärgil tehtud investeeringute osakaalu ning väiksema tõenäosuse mullide tekkeks teiste arengumaadega võrreldes. Uurimistulemused näitavad ka seda, et kõige tugevamini on Kesk-ja Ida-Euroopa üleminekuriikidesse üle kandunud kriisid, mis on alguse saanud USA-st.

Käesoleva uurimuse üheks olulisemaks piiranguks on meta-analüüsi läbiviimisel piirdumine vaid korrelatsioonikoefitsientidel põhinevate uuringutega. Muid

mõõtmismetoodikaid kasutatavate uuringute kaasamist komplitseerivad raskused ühtselt interpreteeritavate individuaaltulemuste leidmiseks uuringute erinevate testimismetoodikate korral.