ЭВОЛЮЦИЯ ЭФФЕКТА ФИНАНСОВОГО ЗАРАЖЕНИЯ В ЕВРОЗОНЕ В ПЕРИОД ДОЛГОВОГО КРИЗИСА

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АННОТАЦИЯ

В статье рассматривается изменение эффекта финансового заражения (ситуация, когда в периоды кризисов страны, экономически слабо связанные между собой в стабильные периоды, демонстрируют однонаправленное движение макропоказателей, поскольку кризис в одной из них провоцирует кризис в другой) в Еврозоне в период европейского долгового кризиса. За время кризиса институциональные связи на межбанковском уровне ослабли, а на государственно-банковском уровне несколько окрепли, что характеризует изменение природы финансового заражения. Риск дефолта отдельного банка стал менее опасен для финансовой системы, однако зависимость банков от устойчивости государства возросла. Сила изменений связи между риском государственного дефолта и изменением финансового заражения отличается по кластерам, сформированным по вероятности риска государственного дефолта. Регрессионное уравнение CDS создано специально для целей исследования, а именно получения остатков индивидуальных моделей банков. В работе используются два подхода к анализу финансового заражения, регрессионный и корреляционный анализ.

Ключевые слова: системный риск; финансовое заражение; европейский долговой кризис; модель CDS; регрессионный анализ; корреляционный анализ.

JEL: G01, G21, E61

EVOLUTION OF FINANCIAL CONTAGION IN THE CONTEXT OF THE EUROPEAN DEBT CRISIS

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ABSTRACT

This paper aims to study changes in the effect of financial contagion in the Eurozone during the European Debt Crisis. The results of the study show that the strength of institutional connections on the interbank level had decreased, while on the sovereign-bank level it had weakened; which could be explained by the change of the nature of the financial contagion with the flow of the crisis. Default risk of an individual bank had become less dangerous for the financial system; however, the dependence of banks on the sovereign stability had increased. An association of sovereign default risk and changes in the financial contagion varies among clusters, subject to the sovereign default risk probability. A regression equation of CDS spread was composed for the purpose of analysis of individual regression models' residuals. Two approaches of analysis were applied in the research: regression and correlation analysis.

Keywords: systemic risk; financial contagion; bank risk; European Debt Crisis; CDS modelling; residuals analysis; correlation analysis.

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Severe consequences of sovereign defaults during the European Debt Crisis have renewed concerns on the connectivity of countries in the global financial system. The crisis has shown that systemic risk is underestimated and requires careful reviewing, as systemic risk is not just a composition of individual types of risk, but a whole new level of risk. The main challenge associated with systemic risk regulation is that it cannot be directly attributed to a certain financial institution, because systemic risk arises from the interaction of direct risks (credit, liquidity, operational, etc.) and, thus, presents a higher form of risk, which evolves simultaneously with market developments.

The main mechanism of systemic risk transition is financial contagion. The derivative nature of contagion complicates its measurement and regulation, because relations to the underlying sources of risk cannot be directly tracked. It follows that contagion cannot be captured through a single model and it can be accessed only through the analysis of discrepancies between fundamental and real life results. Therefore, contagion may be approached as a distortion of normal conditions.

The subject of systemic risk is relevant for any country, because financial contagion is an inherent part of any financial system. The current Russian recession, caused by the structural vulnerability of the economy, has spread free through the financial system, causing a wide-scale closure of banks. Thus, it may be deduced, that measures of the Central Bank of Russia have direct influence on the banking sector through various channels of contagion.

Despite the significance of the contagion risk effect, our knowledge of its mechanism is still limited. A range of approaches have been developed in recent years; however, none of them can provide a single comprehensive answer to the question of contagion risk measurement. Thus, further research of its nature is required.

The limited information on the Russian banks and lack of market products, such as credit default swaps, constrains the research of the effect in Russia. In this regard, the most appropriate approach is an analogy. The study of the European Debt Crisis and its impact on the contagion effect could clarify consistencies of financial contagion.

SYSTEMIC RISK AND FINANCIAL CONTAGION

Across financial literature, there exist a wide range of systemic risk definitions in which authors focus on some of the following features: sudden occurrence, disturbance of financial system functions, significant scale, probability of occurrence, evolving nature of the phenomenon, contagion, interconnectedness between financial system elements, insolvency of financial institutions, impact on the real economy and loss of confidence [1, 11].

Kaufman and Scott [7] provide the following definition:

"Systemic risk refers to the risk or probability of breakdowns in an entire system, as opposed to breakdowns in individual parts or components, and is evidenced by comovements (correlation) among most or all the parts".

Most definitions emphasize a feature of systemic risk which signifies that a certain unexpected event can potentially collapse the entire system. Triggers of the systemic risk may be seen as black swan events, which can be characterized as events beyond normal expectations, with a non-computable probability of occurrence and associated with corresponding psychological biases. It follows, that as these events cannot be predicted, financial institutions should build overall robustness against negative events, decreasing contagion.

The process of systemic risk functioning may be schematised in the following way:

It starts with a shock, which spreads through the channels of contagion affecting one or multiple institutions (*Figure 1*). When the shock affects a financial institution it deteriorates its financial viability. The partial failure or default of the financial institution becomes a source for the second round of shocks. Thus, the mechanism, which materialises systemic risk, is financial contagion.

Financial contagion refers to a situation in which instability in a specific market or institution is transmitted to one or several other markets or institutions [4]. This definition is based upon two underlying ideas: there should be a shock, which causes a spread of instability, and the transmission of the initial instability goes beyond what could be expected of a normal relationship. An inherent problem in the literature dedicated to contagion lies in the difficulty to identify empirically the presence of pure forms of contagion.

The target industry of the current research is the banking industry due to its high vulnerability to systemic shocks. In comparison to other industries, contagion in the banking industry occurs faster, spreads more broadly within the industry, result in a larger number of failures, result in larger losses and spreads beyond the banking industry, causing substantial damage to the financial system as a whole [7]. Contagion performs a pass-through function for a financial shock (*Figure 1*), and an example of contagion materialization is a domino effect [8]. The vulnerability and magnitude of the consequences of systemic shocks is one of the primary reasons for bank regulation in the first place, as the effect of contagion affects not only weak financial institutions, but the entire financial system. Consequently, it is easier to observe the effect of contagion in the banking industry rather than elsewhere.

MEASUREMENT AND MODELLING

The reason why contagion remains a problematic field of research lies in the nature of the phenomenon. Among the factors complicating the measurement of financial contagion, are such problems as simultaneous equations biases, omitted variable biases, conditional and unconditional heteroscedasticity, nonlinearity, non-normality and serial correlation [10].

Regardless of the complexity, the concept of contagion measurement may be approached similar to the task of hidden variable modelling [6]. A contagion measurement framework based on a latent factor structure allows the study of time and cross-sectional dimensions of analysis simultaneously. The latent factor framework provides a flexible way to quantify contagion (as it can utilize a wide range of approaches to contagion measurement, such as correlation analysis, VaR approach, probability models and

co-exceedance). In our case, an analysis of residuals is conducted [9].

$$Y_i = \alpha + \beta_i' * f + \varepsilon_i \qquad (1)$$

As contagion can be observed only as the effect of a latent variable on the model, it is necessary to choose a model which will be studied on the subject of this relation. Building a regression model, we assume that ε_i term of the model (1) is composed of random error and the effect of financial contagion.

$$CDS_{i,t} = Z''_{i,t} + \frac{Debt}{GDP_{j,t}} + iTraxx_t + VDAX_t \qquad (2)$$

$CDS_{i,t}$ — CDS of a Bank$_i$ at a time "t"
$Z''_{i,t}$ — Z'' score of a
$\frac{Debt}{GDP_{j,t}}$ — Debt-to-GDP ratio of the Count$_i$
$iTraxx_t$ — European CDS liquidity index
$VDAX_t$ — Index responsible for volatility
The resultant four-factor regression model (2) is expected to explain changes in the CDS spreads of banks, which is a proxy of default risk. The first factor, Z'' — score describes the default probability of a bank, based solely on the balance sheet items [3]. The second factor signifies government support as well as depicts sovereign solvency [5]. The third and fourth factors are responsible for volatility and levels of CDS market [2]. These factors describe the behaviour of CDS spreads, allowing us to focus on the error term of the model. If the error term of different banks correlates, we suppose that this indicates the presence of contagion.

While contagion is a time varying effect, measuring the mean effect may be not appropriate [12], so a more advance method is required. It follows that
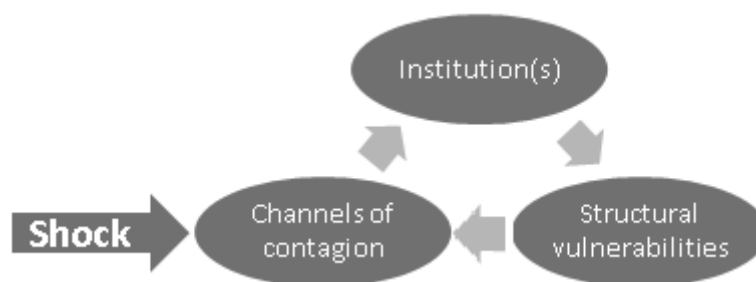

Figure 1. **Model of systemic risk**

analysis should focus not only on the panel data, but also on the structural relations of factors.

CONDITIONS OF THE MODEL

In order to compose a sample, a quartile panel data for 40 banks was collected. Eurozone countries were taken to avoid currency exchange bias, and only banks issuing CDS were included, due to the conditions of the model. Countries within the Eurozone were divided into three clusters by the probability of the sovereign default risk.

The decision on the time period of observations was dictated by the objectives of the research — the main recent trigger events of contagion were the recovery after the Financial Crisis 2008–2009 and the European Debt Crisis, which started at the end of 2009. Thus, the first observation is dated Q4 2007 and the last is Q3 2015; the most recent observation available.

EVOLUTION OF THE FINANCIAL CONTAGION EFFECT

Individual regression models of banks produce a table of residuals. Within each cluster, a coefficient of the moving correlation is calculated within a 15 month period, which allows for a matrix of correlation coefficients to be produced. In order to find the

average in the matrixes, values are transformed to be normally distributed (3); and after the average is found, the value is inversed (4) via Fisher's inversion to the correlation coefficient.

$$z := \frac{1}{2}\ln\left(\frac{1+r}{1-r}\right) \qquad (3)$$

$$r = \frac{\exp(2z)-1}{\exp(2z)+1} \qquad (4)$$

The resultant column of correlation coefficients describes the average strength of contagion in the different clusters. *Figure 2* shows the changes in the moving correlations.

It is of interest, that relations tend to be tighter in the safe cluster, and the weakest correlations are observed in the third cluster. During a crisis period variables tend to have a stronger positive correlation; however, it can be noticed that the risky cluster had the lowest correlation of the network with a downslope trend. This may be explained by the volatility of the financial system in general. While banks in Germany, Netherlands and Austria are solvent and respond to financial events in the same fashion, in risky countries, banks are at different levels of stability, which make them respond to financial events

Table 1

| As at 23/01/2016			1-Yr Default Probabiliky		
Cluster:	Country	Current	High	Avg	Chg
0	Finland	0.03	0.08	0.04	0.01
1	Estonia	0.05	0.28	0.06	0.03
1	Austria	0.15	0.35	0.17	0.04
1	Netherlands	0.15	0.22	0.13	0.1
1	Germany	0.16	0.44	0.21	0.05
1	Slovakia	0.17	0.48	0.2	0.11
2	Belgium	0.32	0.57	0.32	0.19
2	France	0.44	0.66	0.38	0.29
2	Spain	0.45	0.92	0.42	0.41
3	Ireland	0.61	10.04	1.78	0.6
3	Italy	1.86	2.42	1.46	1.32
3	Portugal	1.87	3.15	1.61	1.69
4	Greece	32.71	36.46	17.98	32.06
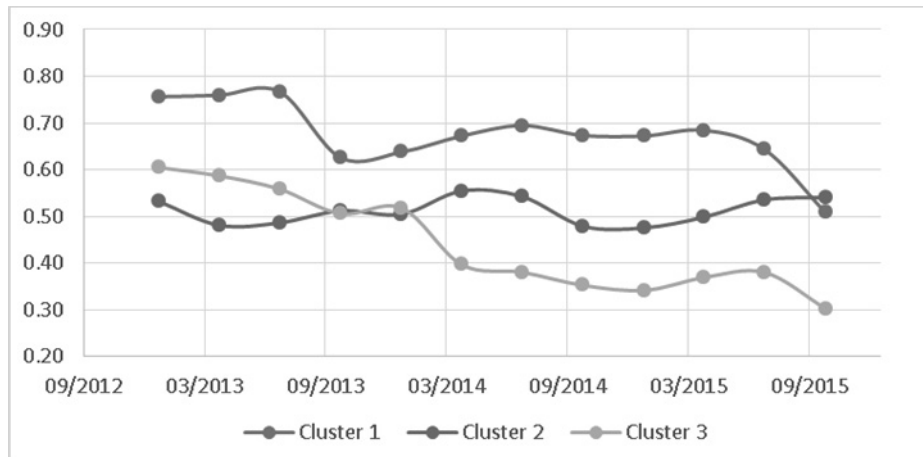
Figure 2. **Moving correlation of the residuals network**

in different ways. This may signify a lower level of interbank contagion.

The correlation analysis (*Figure 3*) may be more appropriate to study contagion, as it is free of the time-varying bias [12]. In frames of the current research, the main limitation at this stage is a small sample which may cause inconsistencies in observations. It is important to focus on changes in correlation coefficients of the three main variables; CDS, Z'' — score and Debt-to-GDP ratio during European Debt Crisis. In order to test, whether the observed values are statistically significant or not, a Student's T-test is conducted for each case.

If two approaches of analysis are combined, it can be concluded that, a country's default risk does affect the contagion of banks in the economy, operating in two different dimensions: interbank and sovereign-bank levels. This may be due to the active government

support of the banking sector during the European Debt crisis. An increase in the volume of liabilities between the government and banks has negatively affected sovereign-bank financial contagion. Another reason may lie in the fact that banks have withstood the crisis differently, and thus, were weakened unevenly. Consequently, in cluster 1 banks were relatively unaffected by the crisis, and their position remained sound; while in cluster 3 banks were damaged to various extents. A banking system, in which banks are already weakened to different extents, exhibits a lower interbank contagion, which may have caused the lower interbank correlation.

It can be observed, that in all three clusters the residuals follow the same trend (*Figure 4*). This may imply that the analysed system tended to drift towards higher values over time. It can be suggested, that either some latent factor affected the system differently
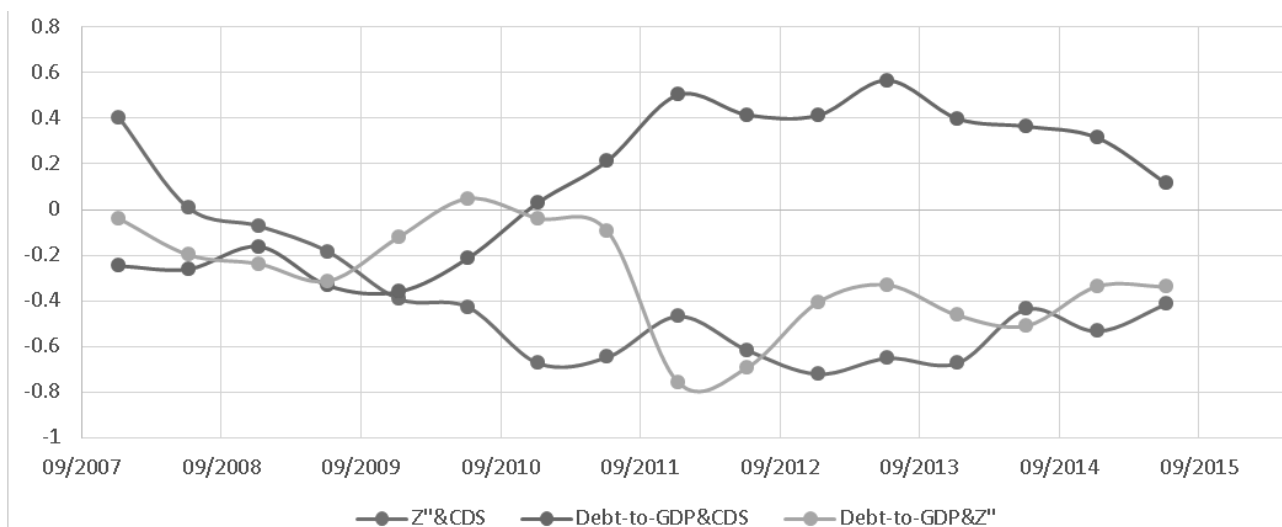

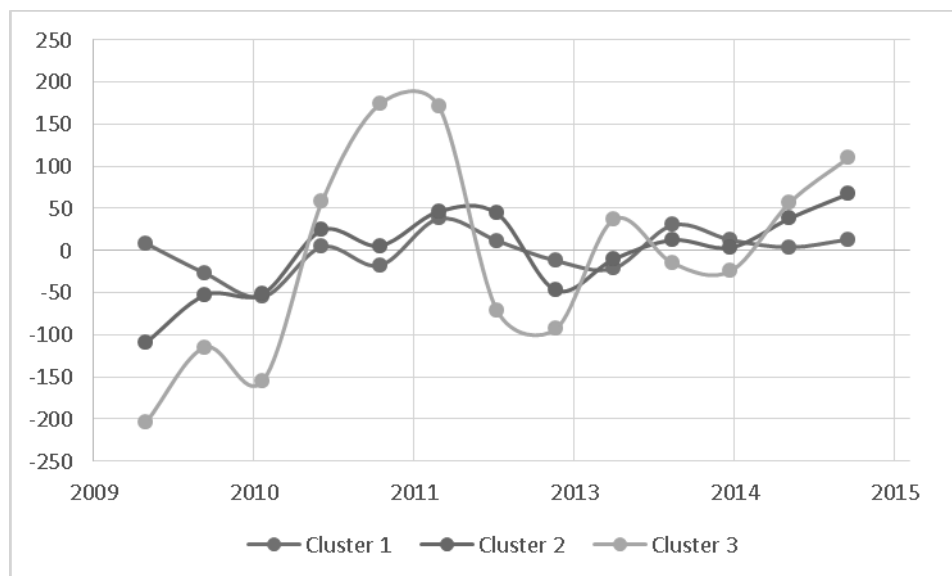*Figure 3.* **Correlation coefficients between CDS, Z'' and Debt-to-GDP**

Figure 4. **Average residuals of regression models**

over time or that new factors started to influence the model.

Table 2

	Cluster 1	**Cluster 2**	**Cluster 3**
Trend	14.73	49.45	77.06
%	100%	336%	523%

Clusters have positive trends, which are more than three and five times higher in the second and third clusters respectively (*Table 2*). Thus, it is fair to assume that an increase in the contagion effect could be associated with the sovereign default probability.

CONCLUSION

This paper studied changes of the contagion effect in the Eurozone during the European Debt Crisis. Summarising the discussion above, the following consistencies may be derived:

• The European Debt Crisis has increased the sovereign-bank contagion risk in the Eurozone. It follows that banks are now more dependent on sovereign actions than before, implying that sovereign exposures will have a higher impact on the financial stability of banks in the future.

• A decrease in interbank contagion signifies that in times of crises, the financial system becomes more resilient to individual defaults. Considering the growing sovereign-bank contagion in the Eurozone, this is a controversial side-effect.

Consistencies observed in the example of the three clusters may be extended to the Russian economy's situation. The developing banking sector is expected to be highly depended on the actions of the Central Bank, and the current Russian crisis has strengthened this relationship. The Russian reality may be related to the third cluster of the research, as the sovereign stability has direct impact on the banking sector. Some factors of bank default in Russia differ from ones observed in the Eurozone, thus the model constructed in this study is not applicable to the Russian banking system. Nevertheless, lessons from the Eurozone should be taken into account for the purpose of Russian contagion risk measurement.

Globalization has both positive and negative consequences in terms of financial contagion, and the challenge for regulators is to find the optimal balance of trade-offs most effective in stimulating economic growth. The effect of financial contagion, caused by the growing interconnectedness of financial institutions, is an inherent part of this challenge.

REFERENCES

1. Acharya V., Pedersen L., Philippon T. & Richardson M. (2010). Measuring Systemic Risk.
2. Äijö J. (2008). Implied volatility term structure linkages between VDAX, VSMI and VSTOXX volatility indices. Global Finance Journal, No. 18 (3), pp. 290–302.

3. Altman E.I., Danovi A. & Falini A. (2013). Z-score models' application to Italian companies subject to extraordinary administration. Journal of Applied Finance, No. 23 (1).

4. Constâncio V. (2012). Contagion and the European debt crisis. Financial Stability Review, Banque De France, No. 16, pp. 110–111.

5. De Bruyckere V., Gerhardt M., Schepens G., & Vander Vennet R. (2013). Bank/sovereign risk spillovers in the European debt crisis. Journal Of Banking & Finance, No. 37 (12), pp. 4793–4809.

6. Dungey, M., Fry, R., González-Hermosillo B. & Martin, V. (2005). Empirical modelling of contagion: a review of methodologies. Quantitative Finance, No. 5 (1), pp. 9–24.

7. Kaufman, G., & Scott, K. (2003). What Is Systemic Risk, and Do Bank Regulators Retard or Contribute to It? The Independent Review, No. VIII (3), pp. 371–391.

8. Markwat T., Kole E. & van Dijk D. (2009). Contagion as a domino effect in global stock markets. Journal Of Banking & Finance, No. 33 (11), pp. 1996–2012.

9. Pritsker M. (2001). The Channels for Financial Contagion. International Financial Contagion, pp. 67–95.

10. Rigobon R. (2002). Contagion: How to Measure It?. In S. Edwards & J. Frankel, Preventing Currency Crises in Emerging Markets (1st ed.). National Bureau of Economic Research: University of Chicago Press.

11. Smaga P. (2014). The Concept of Systemic Risk. SRC Special Paper No. 5.

12. Suh S. (2015). Measuring sovereign risk contagion in the Eurozone. International Review of Economics & Finance, No. 35, pp. 45–65.

«Обучение в Европе: новые возможности»

В рамках реализации проекта «Повышение привлекательности европейского высшего образования» на основе договора с Ассоциацией академического сотрудничества (Бельгия) 14 марта 2016 г. в Финансовом университете прошел первый информационный семинар «Обучение в Европе: новые возможности».

Представитель Британского Совета в России И. Попова рассказала собравшимся о специфике обучения и стипендиальных программах в Великобритании. Возможностям обучения в голландских вузах посвятила свое выступление представитель нидерландского центра по интернационализации образования Nuffic Neso в России Е. Агафонова. Подробно об участии в программах студенческой мобильности в рамках партнерства с зарубежными университетами рассказала зам. директора Центра международного сотрудничества Финуниверситета М. Иванникова.

После презентаций выступающие не только ответили на многочисленные вопросы студентов об обучении за рубежом, но и поделились личном опытом учебы в зарубежных университетах. Интерес со стороны студентов к европейским образовательным программам свидетельствует об их желании двигаться вперед и пробовать свои силы на новом поприще. Надеемся, что этот семинар и последующие встречи помогут студентам реализовать свои амбициозные планы и потенциал.