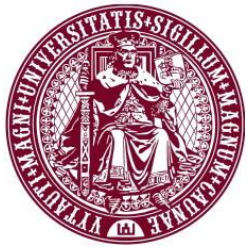

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Assessment of International Equity Investment Connectedness:

Portfolio Diversification with Respect to Institutional and Non-institutional Investors

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Master thesis in International Business and Finance

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FOREWORD

I would like to thank the Norwegian School of Economics and the Vytautas Magnus University for giving me the possibility to obtain a double master degree with special thanks to Assoc. Prof. Dr. Renata Legenzova. I also would like to thank my supervisors at Norwegian School of Economics Dr. Darya Yuferova and at Vytautas Magnus University Dr. Asta Gaigalienė for leading me through this time-consuming research. Finally, I thank all staff at Norwegian School of Economics and Vytautas Magnus University who helped me during the double master degree studies.

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ABSTRACT

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International equity flows increased approximately five times from 2001 to 2016. Therefore, stock market connectedness is increasing over time. It is necessary to assess international equity investment structure not only in general but also by disaggregating it by the type of investor as institutional and non-institutional investors have different characteristics and are important participants in financial markets. This thesis concentrates on international equity investment connectedness during growth and crisis periods with regard to institutional and non-institutional networks. Its structure is divided into three parts. The first part is dedicated to the literature review on differences between institutional and non-institutional investors, determinants of equity flows, methodologies used to assess stock market connectedness and contagion, its channels, structure of international equity investment network and its relevant measures. The second part covers the relevance, aim, logic of the research, steps, chosen evaluation methods, formulation of the research hypotheses and discussion of research limitations. The third part is devoted to the discussion of the results obtained analysing international equity investment connectedness with respect to institutional and non-institutional investors during growth and crisis periods.

It is found that institutional and non-institutional investors have different portfolio diversification practices. Institutional investors accounting for majority of equity flows form denser, more clustered, hierarchical and connected network. These differences persist even during crisis although both network are affected negatively. Even if there are significant differences between institutional and non-institutional networks during crisis, it does not induce relevant changes in the

structure of both networks. In addition, non-institutional investors are less vulnerable to financial crisis. However, both types of investors react negatively to increased stock market volatility during growth period. Besides stock market volatility, institutional investors, especially from central countries, diversify their portfolios in more countries when exchange rate volatility increases during growth period and contracts during crisis. Non-institutional investors, instead, do not consider exchange rate volatility as a significant risk factor. Finally, both types of investors invest more in countries with higher debt to GDP during growth period but withdraw their investments during crisis. This factor is the most relevant to non-institutional investors.

INTRODUCTION

The purpose of diversification is to get a higher profit with a lower risk. Hence, investors choose stocks in different sectors, currencies, countries that are in different stages of their economic life cycles. Due to globalisation processes and increased wealth of poor countries, total international equity investment flows increased from $5.2tn in 2001 to $24.6tn in 2016 (Coordinated Portfolio Investment Survey database [CPIS], 2018), which leads to more complex, less predictable financial networks with more sudden reactions to global events. According to Markowitz (1952), the best portfolios are constructed with low-correlated stocks. Since the global market risk is lower than that of separate countries, investments in different countries seem to be a good source of diversification. However, it is discussed that higher financial integration is also related to enhanced risk of financial contagion. The financial crisis of 2007-2009 demonstrates that international equity investment flows are much more correlated than it was pronounced. Therefore, it raised uncertainty about the gains of portfolio diversification in foreign markets and inspire the discussion about the connectedness between equity markets. Now financial markets are much more connected than during crisis, when total equity investments accounted for $9.9tn. Therefore, the issue of stock market connectedness now is even more important than before.

In addition, investments in foreign equity markets are growing with regards to both institutional and non-institutional investors who are different in essence. It is commonly not agreed on type of investors stabilising financial markets (Barrot, Kaniel and Sraer, 2016; Zeng, 2016; Choi, Kedar-Levy and Yoo, 2015; Han, Zheng, Li and Yin, 2015; Foucault, Sraer and Thesmar, 2011; Bohl, Brzeszczynski and Wilfling, 2009; Kaniel, Saar and Titman, 2008), however, institutional investors are the major market players (CPIS, 2017). Notwithstanding, non-institutional investors affect stock prices by increasing volatility in stock markets (Han et al., 2015; Foucault et al., 2011), changing direction of equity flows due to changes in risk aversion (Roque, Cortez, 2014) or destabilising equity markets by being too pessimistic or too optimistic about future prices of stocks (Fisher and Statman, 2000). Both institutional and non-institutional investors would choose assets not only with regards to their riskiness and returns but also for external factors such as country creditworthiness (Garg and Dua, 2014), market liquidity (Todea and Pleşoianu, 2013; Bekaert, Harvey, Lundblad and Siegel, 2011), political climate (Ahmed, 2017; Giofré, 2017; Erdogan, 2014) and others. Although average non-institutional investors underperform (Koestner, Loos, Meyer and Hackethal, 2017; Barrot et al., 2016; Calvet, Campbell and Sodini, 2009), nevertheless, they provide additional liquidity to financial market when institutional investors are restricted. Owing to differences between institutional and non-institutional investors, both international equity investment networks should be evaluated.

Taking into consideration that due to globalisation relations among international equity markets become more complex and less predictable, the network methodology is advantageous given that it assesses both direct and indirect financial links between equity markets within international equity investment network, its topology and detects links vulnerable to financial shocks in other markets. In regard to financial connectedness it is found that markets are linked to each other both directly and indirectly (Sh. Zhang, Wang, Liu and Wang, 2016; Chinazzi, Fagiolo, Reyes and Schiavo, 2013), there are central and peripheral financial markets (Chuluun, 2017; Schiavo, Reyes, Fagiolo, 2010) and the probability of contagion depends on the network structure (Chuluun, 2017; Acemoglu, Ozdaglar and Tazbaz-Salehi, 2015; Elliott, Golub and Jackson, 2014; Feroldi and Gaffeo, 2014; Chinazzi et al., 2013; Oatley, Winecoff Kindred, Pennock and Danzman, 2013). However, the studies do not analyse institutional and non-institutional investors separately. Therefore, the **problem** of the thesis is how institutional and non-institutional investors portfolio diversification decisions affect formation of international equity investment connectedness?

The object of the master thesis is an international equity investment connectedness. The research is designed to achieve **the aim** which is to evaluate the influence of institutional and non-institutional investors portfolio diversification decisions on formation of international equity investment connectedness. In relation with the aim of the thesis, **the main tasks** are accomplished:

1. To analyse and synthesize financial literature about differences between institutional and non-institutional investors and determinants of equity flows.
2. To overview methodologies used to assess the connectedness and contagion among international equity markets, contagion channels and their results.
3. To develop the methodological background for assessment of international equity investment connectedness with respect to institutional and non-institutional investors.
4. To analyse general differences in international equity investment connectedness with respect to institutional and non-institutional investors, differences within and between international equity investment networks during growth and crisis periods, stock market and country riskiness impact on international equity investment networks with regard to institutional and non-institutional investors during growth and crisis periods.
5. To discuss the results with findings of other researchers, implications and suggest possible research extensions.

Methods and sources: the qualitative analysis is conducted analysing and summarizing findings in the scientific literature. Sources for qualitative analysis are gathered from *Jstor, Science Direct, EBSCO Business Source Complete, Emerald Insight, Springer Link, Cambridge Journals Online, SSRN* and *International Monetary Fund (IMF)*. Assessing the influence of institutional and non-institutional investors portfolio diversification decisions on formation of international equity

investment connectedness, the quantitative analysis is based on formation of network matrices, calculation of aggregate and node specific indices, running OLS and random/fixed effects regressions and comparing the results for different networks. The data for quantitative analysis is gathered from *CPIS* provided by *IMF*, *World Bank* and *Thomson Reuters Eikon* database. The research is conducted using *Microsoft Office 2016,* packages for network analysis *Netminer and Gephi* and statistical analysis software *STATA*.

The **structure** of this thesis is divided into three parts. In the **first part** I conduct literature review which enables to formulate research hypothesis. In literature review I discuss about the differences between institutional and non-institutional investors from the point of view of participation in stock markets and investor characteristics. Then, I overview which factors, according previous literature, are significant investing abroad. Later, I analyse and compare methodologies used to assess stock market connectedness, contagion, its channels and their results. Finally, I present findings of previous literature on financial connectedness and contagion using network methodology, summarize the usage of network structure measures by other researchers. In the **second part** I explain the relevance, aim, logic of the research, steps, chosen evaluation methods, formulate the research hypotheses and discuss research limitations. The **third part** is devoted to the discussion of the results obtained analysing the influence of institutional and non-institutional investors portfolio diversification decisions on formation of international equity investment connectedness. Firstly, I present general tendencies of international equity investment connectedness with respect to institutional and non-institutional investors and compare them. Secondly, I analyse how the gap in international equity investment connectedness with regard to institutional and non-institutional investors differ during crisis and structural changes caused by crisis within international equity investment networks with respect to institutional and non-institutional investors (later institutional and non-institutional networks). Thirdly, I evaluate stock market and country risk impact on the structure of both networks during growth and crisis periods. Finally, I compare the results with findings of other researchers and discuss their possible implications.

Findings of the conducted research reveal that institutional and non-institutional investors form different international equity investment networks: institutional investors have larger, denser, more clustered and hierarchical network. Clusters are not only denser but also consist of different countries. In addition, institutional investors invest in more distant countries, for example, Africa, therefore, the results are in line with findings of Roque and Cortez (2014) that non-institutional investors are more linked to neighbour financial markets. In addition, I find that the United States, the United Kingdom, Italy and France are important intermediaries connecting separate clusters in both networks. Even though non-institutional investors obtain less partnerships and generate less

equity flows, they are also vulnerable to financial crisis given that separate clusters and communities in the network are connected through direct and indirect links from central countries. Hence, both networks have characteristics of hierarchical and flat networks. Therefore, the results of Feroldi and Gaffeo (2014) analysing total financial portfolio and Schiavo et al. (2010) analysing international equity investments that both types of investment networks are hierarchical and consist of G7 countries are close to my findings, nevertheless, central countries in institutional and non-institutional networks partially differ.

Financial crisis makes twofold impact on the gap between connectedness measures in institutional and non-institutional networks. The differences in relations, determined by the number of connections, increase, while differences in relations, determined by equity flows, decrease suggesting that flows in institutional network are distributed in a larger array of countries and vice versa in non-institutional network. However, crisis does not induce significant internal changes in any of networks. The changes occurring in institutional network are due to ordinary countries which get and invest less funds because institutional investors from central countries do not change their investment strategies. These findings are in line with results of Chinazzi et al. (2013) that central countries are less affected by crisis. Non-institutional investors, instead, maintain the volume of investments but invest in fewer countries. Therefore, these findings complement the findings of Hoffmann et al. (2013) and Roque and Cortez (2014) that non-institutional investors prefer more transparent financial markets during crisis.

I also find that both institutional and non-institutional investors from ordinary and central countries react negatively to market riskiness. In addition, institutional investors from central countries diversify their portfolios in more countries during growth period and in less countries during crisis when exchange rate volatility increases. Non-institutional investors are not affected by exchange rate volatility in general. Hence, the statement of Ang and Bekaert (2002) that international diversification has a positive value for international portfolios, if the currency exchange rate risk is hedged, is relevant only to institutional investors. Moreover, an increase in public debt to GDP during growth period is a positive sign for both investors, but during crisis countries which have less sound economics lose significant volume of investments from institutional investors and partnerships with non-institutional investors. Findings of Bekaert, Ehrmann, Fratzscher and Mehl (2014) that during crisis investors care more about macroeconomic factors than stock market riskiness are possible to confirm but during growth period investors, especially non-institutional, take into account the level of public debt to GDP. Finally, the research results reveal that institutional investors considering public debt to GDP induce substantial losses in ordinary countries and gains in central countries summing equity inflows during growth and crisis periods.

I. THEORETICAL ASPECTS OF FINANCIAL CONNECTEDNESS IN INTERNATIONAL EQUITY INVESTMENT NETWORK

This chapter is dedicated to the review and discussion in regard of financial literature. The relevance and differences between institutional and non-institutional investors are discussed in section 1.1. Section 1.2 summarizes factors determining international equity investment flows. Moreover, section 1.3 provides the conceptual clarity of financial connectedness, contagion and its channels (for vocabulary of terms see Appendix 1). Finally, network structure, its impact to financial connectedness and contagion, and its mostly used measures are summarized in section 1.4.

1.1 Differences between institutional and non-institutional investors

Although the scope of portfolio diversification is common for all types of investors, their behaviour and target countries could vary under the different macroeconomic conditions. Basically, investors can be distinguished into four groups: institutional, non-institutional, monetary authorities and non-profit organisations controlled by government. However, the contribution of monetary authorities and government-related units to total equity investment flows is less than 1% (Appendix 2). Hence, many authors analyse investments only with regard to institutional and non-institutional investors (Li, Rhee and Wang, 2017; Choi et al., 2015; Roque, Cortez, 2014).

There is no single definition of terms “institutional investor” and “non-institutional investor” because it varies based on the emphasized characteristic. However, an institutional investor is a legal entity (Çelik and Isaksson, 2014) and often is treated as an informed investor, while a non-institutional investor is regarded as a biased investor (Kaniel et al., 2008). They have different roles in the financial markets and possess specific characteristics (Table 1). Institutional investors are entities which invest funds on behalf of their investors and are regulated by monetary authorities. Non-institutional investors, who are physical people or other than professional investment companies, do not rise as many funds as institutional investors (Ivković, Sialm and Weisbenner, 2008), do not have specific knowledge about capital markets and do not have or not enough experience in investment (Stiglitz, 2003). The same results are found analysing purchase of stocks before and after bad mergers (Han and Chung, 2013), forecasts of stock returns (Choi and Sias, 2012) and ownership influence on bid-ask spreads (Schnatterly, Shaw and Jennings, 2008). Although non-institutional investors are relatively unskilled, their performance varies highly within the group. Bailey, Kumar and Ng (2008) come to the conclusion that wealthier and more experienced individual investors are more successful in foreign markets than others. Calvet, Campbell and Sodini (2009) suggest that the reason is investments in riskier assets. Koestner, Loos, Meyer and Hackethal (2017) agree with a positive correlation between experience and payoff –

having more practice, non-institutional investors make better investment decisions. Therefore, non-institutional investors compared to institutional investors are rather unskilled and lack of funds but the differentials decrease when non-institutional investors become more experienced.

Table 1
Differences between institutional and non-institutional investors

Feature	***Sub-feature***	**Institutional**	**Non-institutional**
Quality of subject	*Availabililty of funds*	Higher	Lower
	Financial literacy	Skilled	Relatively unskilled
Legal restrictions	*Use of intermediaries*	Do not use	Use
	Access to primary and secondary markets	Primary and secondary	Secondary
	Taxes	Lower	Higher
Engagement in stock market	*Stock preferences*	Dividend / growth	Growth / dividend
	Market stabilisation	Noise traders / contrarians	Contrarians / noise traders
	Share in a stock market	~82.5%	~17.5%
Investment bias	*Risk aversion*	Relatively less risk-averse	Relatively more risk-averse
	Overconfidence	Both can be overconfident	
	Equity home bias	Non-biased	Biased
	Herding	Relatively less	Herd
Investment abroad	*Market development*	-	Prefer developed markets
	Market transparency	Less transparent	More transparent
	Risk diversification	Higher	Lower
	Geographical distance	More distant markets	Closer markets
	Common stock exchange	-	Prefer
	Portfolio diversification	More diversified	Less diversified

Note: done by author based CPIS database (2017); Choi et al., (2015); Roque and Cortez (2014); Giofré (2013); Lai et al. (2013); Chiang et al. (2012); Jain (2007); Campbell (2006); Allen, Bernardo and Welch (2000).

Given that non-institutional investors are not professional investors, their participation in financial markets is restricted by law. Institutional investors are referred as financial specialists because they make investments using funds of other subjects. Non-institutional investors, instead, often consult with financial advisors before making investment decisions (Campbell, 2006), therefore, advised non-institutional investors perform better (Gaudecker, 2015). Kramer (2012) and Bhttacharya, Hackethal, Kaesler, Loos and Meyer (2012) arrive at different results – Bhttacharya et al. (2012) conclude that differences between investment performance of advised non-institutional investors and self-leading non-institutional investors are not significant. Kramer (2012) findings reveal significant differences between advised and non-advised non-institutional investors by explaining this phenomenon as a conflict of interests between non-institutional investors and financial advisors. However, portfolios of advised non-institutional investors are diversified better.

Another legal restriction occurs when institutional investors access primary and secondary markets because certain types of institutional investors, for example, investment banks, serve as underwriters in the primary market (Bonaventura, Giudici and Vismara, 2017), while non-institutional investors can participate only in the secondary markets. Non-institutional investors are determined not only by lower accessibility to financial markets but also by dividend tax

disadvantage (Kawano, 2014; Allen, Bernardo and Welch, 2000). Owing to tax advantage for institutional investors (Kawano, 2014), they prefer large-cap dividend-paying stocks, while non-institutional investors prefer small-cap growth stocks with high leverage (Bae, Min and Jung, 2011; Allen et al., 2000). Kawano (2014) concludes that the choices of non-institutional investors are influenced by dividend taxes – with a dividend tax reduction by 1% long-term profitability to non-institutional investors increases by 0.04%. Therefore, non-institutional investors choose more dividend stocks. However, non-institutional investors perform worse than institutional investors – on average, they underperform the market even before taxes (Barber and Odean, 2013). This result might be caused by many factors: illiteracy, scarce funds, transaction costs, investment biases and others.

Black (1986) suggests that noise trading is related to investment underperformance due to false thinking that noise contains information. Although average non-institutional investor incurs losses, in general, they provide liquidity to financial markets. According Foucault et al. (2011), along with liquidity provided by non-institutional investors, comes higher volatility destabilising the financial markets. Thus, non-institutional investors are important actors, although their equity market share accounts for approximately 17.5% (CPIS database, 2017). Recently, scientists highlight that both institutional and non-institutional investors could have a role of market stabilisation. Barrot et al. (2016) find that non-institutional investors offer additional liquidity during financial crisis when institutional investors are restricted. Institutional and non-institutional investors are different market agents because non-institutional investors underperform market (Barrot et al., 2016; Griffin, Harris and Topaloglu, 2003) selling assets before increase in their value, while institutional investors buy them (Griffin et al., 2003). Zeng (2016) analysing trading of institutional investors in the United States concludes that the relationship between overvalued stocks and institutional holdings is statistically significant. Analysing S&P 500 and WIG 20 Bohl et al. (2009) contribute with different findings – institutional investors have equity market stabilising roles in the United States and Poland. Han et al. (2015) analyse the role of foreign and local institutional investors in China and find that foreign institutional investors stabilise equity market, while local institutional investors increase stock market volatility. Therefore, origin of investor also matters.

Foreign investors form international equity investment networks. Their investment decisions are based not only on knowledge but also on preferences. Risk-aversion determines willingness to risk. Therefore, it strongly affects investment network because with higher risk-aversion certain countries and type of assets are avoided. For example, low return stocks are not attractive when the sentiments of investors are high (Baker and Wurgler, 2006). Luchtenberg and Seiler (2014) find that risk-aversion does not depend on the type of investor – it is, rather, a human

phenomenon: if the value of the stock increases, both institutional and non-institutional investors are risk averse; when the value of the stock decreases, both types of investors prefer to risk. However, non-institutional investors are more risk-averse (Basak and Pavlova, 2013), especially households which are risk averse in such a manner that portfolios become underdiversified (Gaudecker, 2015; Campbell, 2006; Barber and Odean, 2000).

Non-institutional investors perform worse owing to other behavioural biases. For example, according Barber and Odean (2013) and Ivković et al. (2008), the under-diversification can be caused by asymmetric information, overconfidence and familiarity bias. Other reason, why non-institutional investors invest in few stocks, in the sight of Ivković et al. (2008), is a small amount of money in hands. Overconfidence can occur for different reasons, for example, in belief that investor can invest better than average (Barber and Odean, 2013). Non-institutional investors are more overconfident than institutional investors (Liu, Chuang, Huang and Chen, 2016) due to lack of knowledge about financial instruments (Barber and Odean, 2013). In addition, the overconfidence varies depending on the market liquidity and volatility: in more liquid (more central in equity investment network) and less volatile markets both institutional and non-institutional investors are less overconfident.

Overconfidence is also associated with home bias. In Døskeland and Hvide (2011) terms, non-institutional investors fail not only to invest in close to their profession stocks but also in other local stocks. Seasholes and Zhu (2010) find that non-institutional investors perform worse when invest in local firms. However, not only non-institutional investors are home-biased. In the countries where uncertainty avoidance is high, institutional investors are home-biased (Choi, Fedenia, Skiba and Sokolyk, 2017). In addition, institutional investors from countries which are less tolerant to uncertainty and have higher cultural distance under-diversify their investment portfolios abroad (Anderson, Fedenia, Hirschey and Skiba, 2011).

Herding is related to the equity network formation and its changes in crisis periods. It is more pronounced among non-institutional investors, especially when an investor had a negative experience without herding (Merli and Roger, 2013). However, Basak and Makarov (2014) and Sias (2004) agree with the fact that even institutional investors before investing evaluate strategies of their competitors but arrive at different conclusions: according Basak and Makarov (2014), institutional investors choose strategies with different directions; according Sias (2004), institutional investors seek investments of other investors. Barber, Odean and Zhu (2009) come up with the same conclusions regarding non-institutional investors. However, Li et al. (2017) find that non-institutional investors are affected more by public information. The dispersion of investments is lower for non-institutional investors and is related to market movement. In addition, non-

institutional investors herd buying in growth periods, while selling only during crisis. Therefore, crisis is important forming institutional and non-institutional networks.

Non-institutional investors have less diversified portfolios than institutional due to their features such as biasness, lack of knowledge and funds. Institutional investors are less sensitive to transparency in foreign equity markets (Roque, Cortez, 2014; Giofré, 2013), existence of common stock exchange (Giofré, 2013), physical distance (Roque, Cortez, 2014) and market development (Roque, Cortez, 2014). As a result, institutional investors have more diversified investment portfolios and risk. In addition, institutional and non-institutional investors react differently to financial crisis: non-institutional investors choose equity investment in more developed countries which are more transparent, while institutional investors prefer investing in stocks allowing better portfolio diversification (Roque, Cortez, 2014). Hoffmann, Post and Pennings (2013) and Roque and Cortez (2014) find that non-institutional investors do not change their equity investment strategies with exception of common currency and investor protection which become irrelevant explanatory variables during crisis.

Based on their characteristics, investors fall into certain groups and, consequently, incur limitations forming personal preferences for portfolio diversification in foreign equity markets. Although institutional and non-institutional investors differ in their qualities, participation in equity markets and preferences for specific stocks and countries, an analysis of the paper is restricted to the differences arising from investments in foreign markets, summarized in the last section of Table 1. However, given that the global equity market is wide and various, there are many global, bilateral or country-specific factors affecting investment choices in other equity markets.

1.2 Factors determining international equity flows

When investors construct their portfolios, the primary concern is to diversify risk obtaining the highest possible returns. Nevertheless, the direction of investments is induced by many factors which can be grouped according to their origin. The thesis classifies foreign investment determinants to market risk, barriers and development (Table 2), information costs, familiarity and bilateral links (Table 3) and quality of legal and financial system (Table 4) factors.

Beginning with the market riskiness, the optimal portfolio theory is introduced by Markowitz (1952) demonstrating that investment portfolio should be diversified choosing stocks from different industries, e.g. stocks which have lower return correlation/covariance (Table 2). In addition, besides equity returns, investors take account of dividend yields – non-institutional investors prefer growth stocks due to tax disadvantages (Kawano, 2014; Bae, Min and Jung, 2011). Given that the stock markets are determined by different level of riskiness, investors consider equity market and country specific risk factors. Such risks include stock market (Cai, Mobarek and Zhang,

2017) and exchange rate (Giofré, 2017) volatilities, market liquidity (Bekaert et al., 2011) and sovereign risk (Bekaert et al., 2014). Foucault et al. (2011) and Han et al. (2015) reveal that increase in stock market volatility is influenced by both institutional and non-institutional investors. Therefore, the relationship between stock market volatility and investing preferences should be bidirectional.

Table 2

Determinants of international equity investment flows: diversification, risk, returns and barriers

Class	Determinant	Source (year)
Risk diversification	Return Correlation	Karolyi et al. (2015); Roque and Cortez (2014); Garg and Dua (2014); Bekaert at al. (2009); Markowitz (1952)
Foreign market risk	Global risk	Cai et al. (2017); Bekaert et al. (2011)
	Stock market volatility	Cai et al. (2017)
	Exchange rate (volatility)	Cai et al. (2017); Giofré (2017); Kanas and Karkalakos (2017); Abid et al. (2014); Garg and Dua (2014); Gyntelberg et al. (2014); Bekaert (1995)
	Country risk	Bekaert et al. (2014)
	Market liquidity	Todea and Pleşoianu (2013); Bekaert et al. (2011); Bekaert (1995)
Returns	Equity returns	Stepanyan (2017); Al-Khouri (2015); Karolyi et al. (2015); Garg and Dua (2014); Roque and Cortez (2014)
	Dividend yield	Cai et al. (2017)
Foreign market size / development	GDP*	Muzur et al. (2015); Roque and Cortez (2014); Qian and Steiner (2014)
	GDP per capita	Giofré (2017); Karolyi et al. (2015); Erdogan (2014);
	GDP growth rate	Mobarek et al. (2016); Abid et al. (2014); Aggarwal et al. (2012); Bekaert (1995)
	Interest (real) rate differential, Inflation (volatility)	Stepanyan (2017); Cai et al. (2017); Mobarek et al. (2016); Mollah et al. (2016); Luchtenberg and Vu (2015); Abid et al. (2014); Erdogan (2014); Garg and Dua (2014); Bekaert (1995)
	Market capitalisation	Baumöhl et al. (2018); Mobarek et al. (2016); Luchtenberg and Vu (2015); Erdogan (2014); Roque and Cortez (2014); Qian and Steiner (2014); Kuvvet (2013); Todea and Pleşoianu (2013); Bekaert (1995)
	Market turnover	Cai et al. (2017); Karolyi et al. (2015)
	Unemployment rate	Bekaert et al. (2014)
Investment barriers	Capital controls	Giofré (2017); Karolyi et al. (2015); Erdogan (2014); Qian and Steiner (2014); Giofré (2014)
	Transaction costs / taxes	Karolyi et al. (2015); Todea and Pleşoianu (2013); Bekaert (1995)
	Equity market openness	Abid et al. (2014); Qian and Steiner (2014); Bekaert et al. (2011)

Note: * Bekaert et al. (2014) also find statistically significant government budget and current account factors. Luchtenberg and Vu (2015) – industrial production; Cai et al. (2017) – currency reserves.

Turning to exchange rate volatility, it is found to have a negative impact on investment diversification (Baumöhl et al., 2018), nevertheless, investments can be successful if it is hedged (Ang and Bekaert, 2002). Hedging of exchange rate volatility is irrelevant when the assets are from illiquid stock markets inasmuch as they enhance the riskiness of an asset due to low trading frequency. As a result, investors prefer more liquid equity markets (Bekaert et al., 2011; Bekaert, 1995). In addition, country risk is also a relevant factor because it comprises sovereign, political and other risks that enhance systemic risk. Bekaert et al. (2014) point out that sovereign risk should be

considered especially during crisis owing to changes in risk aversion of investors based on macroeconomic fundamentals. Moreover, Qian and Steiner (2014) find that higher central bank reserves have a positive influence on foreign equity investments because higher reserves reduce exchange rate risk and risk premium required by investors.

Nonetheless, financial soundness is not the only factor pertinent to foreign investors – the size (determined by GDP) of the country is also significant. Size, according to Muzur et al. (2015), is relevant as the bigger countries have more possibilities to invest abroad and attract foreign investments. In addition, Bekaert and Hoerova (2016) highlight that country size is correlated (positively in the United States and negatively in Germany) with a risk aversion. Therefore, country of equity holders also should be considered. GDP per capita, instead, is connected with a country's strength/development which is positively related to foreign investments (Giofré, 2017). Country development can be also expressed by its equity market capitalisation – when the capitalisation is low, illiquid market demotivates foreign investors to diversify their portfolios in the country (Erdogan, 2014; Bekaert et al., 2011). While low market capitalisation pushes foreign investors from equity markets indirectly, government policy through investment barriers such as high capital controls (Giofré, 2017), taxes (Karolyi et al., 2015) and low equity market openness (Bekaert et al., 2011) directly and negatively influence foreign equity inflows. However, due to globalisation, investment barriers diminish, for instance, Bekaert et al. (2011) reveal that such highly controllable sector as banking now is the most integrated in the world market.

Although the financial markets are becoming more integrated, the informational disparity persists (Table 3). Hence, there is a broad literature on factors which can be also called bilateral: common language (Giofré, 2017), religion (Hellmanzik and Schmitz, 2017), legal system (Giofré, 2017), common currency (Roque, Cortez, 2014) that lessens information costs, and cultural distance (Roque, Cortez, 2014) factors which reduce familiarity with other markets and increase information costs. More integrated markets or markets that were integrated in the past are more likely to have colonial links (Karolyi, Ng and Prasad, 2015), bilateral trade (Erdogan, 2014), FDI (Baumöhl, Kočenda, Lyócsa and Vżrost, 2018), migration (Hellmanzik and Schmitz, 2017) and, as a result, bilateral equity flows. Hence, countries that develop bidirectional trade are also engaged in bilateral foreign equity investments (Muzur, Suesse and Krivitsky, 2015; Qian, Steiner, 2014). Due to globalisation and increased financial market openness, equity flows are increasing in both developed and developing markets, still, giving the priority to the countries which had relations in the past regarding FDI flows, subsidiaries and partnerships. Karolyi et al. (2015) explain it by obtained information cost advantages that are higher for developed countries. In addition, foreign investments are determined not only by cultural proximity and familiarity but also by geographical distance which induces familiarly bias. According to Roque and Cortez (2014), non-institutional

investors prefer investments in culturally closer and less geographically distant countries. Even though geographical distance is reduced by technological advantages (Hellmanzik, Schmitz, 2016), the time zone differences in trading keep existing (Erdogan, 2014).

Table 3
Determinants of international equity investment flows: information costs and familiarity

Determinant	Source (year)
Common language	Giofré (2017); Hellmanzik and Schmitz (2017); Karolyi et al. (2015); Erdogan (2014); Giofré (2014); Roque and Cortez (2014); Aggarwal et al. (2012)
Common religion	Hellmanzik and Schmitz (2017); Mobarek et al. (2016); Roque and Cortez (2014); Aggarwal et al. (2012)
Common legal system origin	Giofré (2017); Hellmanzik and Schmitz (2017); Erdogan (2014); Giofré (2014); Aggarwal et al. (2012)
Cultural distance	Mobarek et al. (2016); Roque and Cortez (2014); Aggarwal et al. (2012)
Currency union	Giofré (2017); Erdogan (2014); Giofré (2014); Roque and Cortez (2014);
Colonial links	Giofré (2017); Hellmanzik and Schmitz (2017); Karolyi et al. (2015); Erdogan (2014); Giofré (2014)
Bilateral trade/net trade/exports/ imports/trade openness	Baumöhl et al. (2018); Cai et al. (2017); Mobarek et al. (2016); Muzur et al. (2015); Luchtenberg and Vu (2015); Karolyi et al. (2015); Erdogan (2014); Roque and Cortez (2014); Kuvvet (2013)
FDI	Baumöhl et al. (2018); Karolyi et al. (2015); Qian and Steiner (2014)
Bilateral migration	Hellmanzik and Schmitz (2017)
Geographical/virtual distance	Giofré (2017); Hellmanzik and Schmitz (2017); Karolyi et al. (2015); Erdogan (2014); Giofré (2014); Roque and Cortez (2014); Aggarwal et al. (2012)
Common border	Giofré (2017); Karolyi et al. (2015); Erdogan (2014); Giofré (2014)
Time zone	Hellmanzik and Schmitz (2017); Erdogan (2014)

Note: done by author.

The uncertainty of legal and political system highly affects risk-averse investors. For example, Roque and Cortez (2014) conclude that non-institutional investors prefer investing in more transparent countries. Transparency itself is related to stability and legal protection in the country (see Table 4). It is found that the standard of living and the level of corruption are inversely correlated (Lučić, Radišić and Dobromirov, 2016) and the efficiency of judicial, legal system, political stability, investor protection is higher and the expropriation risk is lower in more developed countries (Giofré, 2017, 2014). Wu, Li and Selover (2012) analyse how free flow of information and public trust affect international financial flows and arrive at the conclusion that countries with higher information availability to public also have higher public trust and investor protection. Accounting standards, which are related to the rule of law, should be taken into consideration due to difficulties that arise comparing performance of the companies which annual reports are based on different accounting standards (KPMG, 2015). Although accounting standards are not related to the level of development, other factors such as higher transparency, stability and investment protection determine advance of equity markets distinguishing high and low investment risk countries.

Table 4

Determinants of international equity investment flows: transparency, stability and legal protection

Determinant	Source (year)
Corruption	Giofré (2017); Jain et al. (2017); Mollah et al. (2016); Giofré (2014); Roque and Cortez (2014); Qian and Steiner (2014); Bekaert et al. (2011)
Judicial system efficiency	Giofré (2017); Jain et al. (2017); Giofré (2014);
Legal system	Giofré (2017); Erdogan (2014); Qian and Steiner (2014); Giofré (2014); Kuvvet (2013); Bekaert et al. (2011)
Investor protection	Bao and Lewellyn (2017); Stepanyan (2017); Roque and Cortez (2014); Kuvvet (2013); Aggarwal et al. (2012); Giannetti and Koskinen (2009); Bekaert (1995)
Expropriation risk	Giofré (2017); Stepanyan (2017); Giofré (2014); Kuvvet (2013)
Accounting standards	Giofré (2017); Giofré (2014); Bekaert (1995)
Information availability	Bekaert (1995)
Political stability	Giofré (2017); Bekaert et al. (2014); Erdogan (2014); Giofré (2014); Bekaert (1995)
Government effectiveness	Karolyi et al. (2015)
Rule of law/legal origin	Giofré (2017); Karolyi et al. (2015);Giofré (2014); Bekaert et al. (2011)

Note: done by author.

Analysing international equity investment flows, it is important to evaluate not only common foreign investment determinants such as currency, country, exchange rate risks, size of the country, diversification and return but also information costs and costs that arise due to the different cultures, languages, legal systems, physical distance and exposure to corruption, expropriation and political instability. Nevertheless, the research concentrates on the most commonly analysed stock market and country risk factors such as stock market volatility, exchange rate volatility and public debt to GDP. Institutional and non-institutional investors considering many factors, including risk factors, diversify their portfolios in foreign equity markets. As a consequence, they unintentionally form certain financial structures determined by certain connectedness characteristics which could become a source of direct or/and indirect financial contagion.

1.3 Concept and methodologies assessing international equity investment connectedness and contagion

Given that the financial contagion is a result of increased financial connectedness between equity markets, the methodologies used to assess both financial connectedness and contagion are similar. Nevertheless, there is a number of different methodologies unveiling alternate aspects of unilateral, bilateral and multilateral financial relationships, therefore, in the first part of this section the concept and methodologies used to assess the financial connectedness and contagion and results are discussed. As financial shocks can spread in different ways, the second part covers a review of financial literature which discusses about possible contagion channels.

1.3.1 Methodologies used to assess financial connectedness and contagion

The concept of financial connectedness in equity markets is closely related to stock market liberalization and globalisation. Globalisation effect on financial markets and their efficiency are

twofold. One stream of literature argues that countries, which open equity markets to foreign investors, benefit from financial liberalisation because it induces foreign investment flows (Fuchs-Schündeln and Funke, 2003), market efficiency (Bekaert et al., 2011), economic and productivity growth (Gehringer, 2012). When equity markets are open to foreign investments, investors can exploit the possibility to diversify their portfolios in different financial markets with reduced cost of equity. Other stream of literature see globalisation as a possible source of non-diversifiable risk making equity markets prone to financial shocks in other countries. However, scientists argue whether global financial crisis of 2007-2009 was induced by increased global risk presenting different results. Indeed, alternative methodologies, often, generate controversial results. Nevertheless, different results do not indicate that one or other technique is unreliable – they are used to unveil different aspects of a problem. Methodologies used to assess financial connectedness and contagion are similar (Table 5).

Table 5

Methods used to analyse financial connectedness and integration

Method	Articles about connectedness	Articles about contagion
CAPM	**CAPM:** Chaudhary (2016); **ICAPM:** Abid et al. (2014); Guesmi and Nguyen (2014); Guesmi et al. (2014); Guesmi and Teulon (2014); Teulon et al. (2014); Berger and Pozzi (2013); Guesmi et al. (2013); Guesmi and Nguyen (2011); Bekaert (1995); Bekaert and Harvey (1995); **IAPM:** Carrieri et al. (2013)	**ICAPM:** Guesmi et al. (2013)
Factor	Nardo et al. (2017)	Bae and Zhang (2015); Bekaert et al. (2014); Baele and Inghelbrecht (2010); Bekaert et al. (2005)
Correlation, Wavelet	**Correlation:** Nardo et al. (2017); Lucey and Zhang (2010); Baele (2005); Solnik et al. (1996); **Wavelet:** Shah and Deo (2016); Graham et al. (2013); Rua and Nunes (2009)	Solnik et al. (1996)
Cointegration, VAR	**Cointegration:** Caporale et al. (2016); Lagoarde-Segot and Lucey (2007); Palac-McMiken (1997); **VAR:** Baele and Soriano (2010); Bekaert et al. (2002)	**VAR:** Cai et al. (2017); Forbes and Rigobon (2002); Royen (2002); **GVAR:** Beirne and Gieck (2014)
GARCH, DCC	**GARCH:** Berger and Pozzi (2013); Baele (2005); **ARCH-M:** Carrieri et al. (2007); **VAR-GARCH:** Dutta (2018); **DCC-GARCH:** Guesmi and Nguyen (2014); Guesmi and Teulon (2014); Guesmi, Moisseron and Teulon (2014); Guesmi et al. (2013); Guesmi and Nguyen (2011); **GDC-GARCH:** Abid et al. (2014); **ARFIMA-GARCH:** Lyocsa, Vyrost and Baumöhl (2017); **c-DCC-FIAPARCH:** Teulon et al. (2014); **DCC:** You and Daigler (2010); **VAR-DCC:** Al Rahahleh et al. (2017); **VECM-DCC:** Al Rahahleh et al. (2017)	**GARCH:** Baumöhl et al. (2018)*; Billio and Caporin (2010); Baele and Inghelbrecht (2009); **DCC-GARCH:** Guesmi et al. (2013); **ADCC-GARCH:** Mensi et al. (2017); **EGARCH:** Khallouli and Sandretto (2012); **DCC-MIDAS:** Mobarek et al. (2016)
Network	Chuluun (2017); Diebold and Yilmaz (2015); Sh. Zhang et al. (2016); Naitram (2014); Chinazzi et al. (2013); Diebold and Yilmaz (2013)	Diebold and Yilmaz (2015); Minoiu et al. (2015); Chinazzi et al. (2013)

Note: Baumöhl et al. (2018) use GARCH model and 9 its derivations.

Capital asset pricing model (CAPM) is a single factor model, which decomposes return on equity separating risk free rate and risk premium. This model assesses the asset riskiness evaluating

what risk premium should be given to investor investing in a certain market when government 10-year bonds are assumed to have risk free rate. CAPM can be calculated for segmented (separate markets), integrated (international CAPM which includes currency exchange risk) or partially integrated markets. However, integration of equity markets is a time-consuming process, hence, Bekaert and Harvey (1995) augment static CAPM model by allowing degree of integration to change over time. They find twofold results: such countries as Colombia, Jordan, Korea and Malaysia are integrated, while Chile, Greece, India, Mexico, Nigeria, Taiwan, Thailand and Zimbabwe are not. Nevertheless, these results should be interpreted with caution because Chile, Greece, Mexico, Korea and Zimbabwe failed in specification tests. Berger and Pozzi (2013) analyse equity time-varying market integration of the United States, Japan, Germany, France and the United Kingdom for period 1970-2011 and conclude that financial integration increased among all countries except Japan. Notwithstanding increasing integration in a long-term period, integration is not unidirectional – there are periods when country-specific shocks lead to disintegration. Guesmi, Moisseron and Teulon (2014) using ICAPM, find that MENA countries are regionally integrated. Demir and Coşkun Kaderli (2015) analyse which models are more suitable to assess the cost of equity in Turkey and arrive at the conclusion that local CAPM and other local measures that are not suitable, hence, models which evaluate market integration, such as world CAPM, are better indicators. The same results are found by Chaudhary (2016)[1], Abid, Kaabia and Guesmi (2014)[2], Guesmi and Nguyen (2014)[3], Guesmi and Teulon (2014)[4]. Analysing integration of not only regional but also of global equity markets, Guesmi and Nguyen (2011)[5] find that countries are integrated regionally but are quite segmented globally, especially emerging markets. As Bekaert and Harvey (1995) notice, model can provide biased results. Given that the CAPM is a one-factor model, lack of other important explanators can influence the reliability of results. This ICAPM drawback is offset by factor models. Bekaert, Harvey and Ng use two-factor (2005), while Bekaert et al. (2014) multi-factor models to estimate equity market contagion. This model is useful assessing determinants of equity flows. Because the model is time-variant, it can estimate bilateral connectedness and contagion. However, neither time-variant CAPM nor factor models do not consider multilateral relationships in complex financial network.

The simplest co-movement method is correlation between stock prices/returns. Drawbacks of the unconditional correlation, which is measured calculating Pearson correlation, are that it treats historical data equally, in consequence, the results are highly affected by outliers, thus, correlation between equity markets could be higher than actually it is (Nardo, Ndacyayisenga, Papanagiotou,

[1] Chaudary (2016) analyse India and the United States.
[2] Abid, Kaabia and Guesmi (2014) analyse Indonesia, Malaysia, Singapore, Sri Lanka and Thailand.
[3] Guesmi and Nguyen (2014) analyse Czech Republic, Greece, Poland and Romania.
[4] Guesmi and Teulon (2014) analyse Egypt, Israel, Jordan and Turkey.
[5] Guesmi and Nguyen (2011) analyse Southeastern Europe, Latin America, Asia and Middle East.

Rossi and Ossola, 2017). Forbes and Rigobon (2002) argue that conditional heteroskedasticity can be adjusted. They propose an augmentation, however, it is sensitive to small samples and periods when higher endogeneity is expected. To analyse whether cultural distance affects financial integration, Lucey and Zhang (2010)[6] use both conditional and unconditional correlations. Unconditional correlations show higher interdependence than conditional correlations, nevertheless, the results, still, are quite similar. For periods 1961-1994 (Solnik, Boucrelle and Le Fur, 1996) and 2000-2015 (Nardo et al., 2017)[7] the results are similar – during crisis the correlation is higher. An alternative to correlation methodology is a wavelet methodology. Its peculiarity is an analysis of time series data decomposing it in frequency and time. Graham, Kiviaho, Nikkinen and Omran (2013) study interdependency of MENA countries and the United States. The results support the findings of Guesmi and Nguyen (2011) that countries are integrated regionally but not globally. Rua and Nunes (2009) find that the co-movement of major developed stock markets highly depends on the trading frequency suggesting that lower frequency increases co-movement. Co-movement methods do not evaluate market riskiness in a form of risk premium. These methods are more relevant analysing integration/connectedness trends using high frequency data. However, this methodology is not suitable to measure indirect connectedness.

Cointegration technique, proposed by Engle and Granger (1987), test whether there is a relationship between stock markets considering long-term equilibrium between the time-series which are not stationary. Palac-McMiken (1997) observe that all ASEAN markets, except Indonesia, have common long-term trend. London, Frankfurt and Paris stock exchanges are also found to be cointegrated (Kasibhatla, Stewart, Sen and Malindretos, 2006). Caporale, Gil-Alana and Orlando (2016) conclude that S&P 500 and Euro Stoxx 50 indices have unit roots, however, after the financial crisis the European Union and the United States had a different path of recovery. Although cointegration technique is suitable assessing long-term relationships between stock markets, its drawback is restriction of analysis to one dependent and independent variable. Vector autoregression (VAR) model, instead, can assess multiple time series correlations but it does not have corrected errors (Engle and Granger, 1987), do not fit in non-linear models and not evaluate conditional heteroskedasticity (Stock and Watson, 2001). On the other hand, it captures temporal changes better than CAPM method because it is an autoregressive model. Cai et al. (2017) use this model to evaluate financial contagion in "wake-up" hypothesis where investors reassess market risk based on its fundamentals. Authors confirm this hypothesis showing that contagion can be transferred to other markets without having any financial linkages.

[6] For their analysis Lucey and Zhang (2010) use daily stock market indices of 23 emerging countries.
[7] Nardo et al. (2017) analyse 22 European countries.

Non-linearity problem is solved using generalised autoregressive conditional heteroskedasticity (GARCH) models. However, Lamoureux and Lastrapes (1990) test GARCH model analysing stock returns and conclude that GARCH model does not capture infrequent and highly irregular events causing persistence in structural shifts in unconditional variance. GARCH method is popular assessing volatility spillovers across financial markets because it considers fat tails and cluster volatility (Bollerslev, 1986). General model assumes that the residuals are normally distributed while its modifications incorporate different assumptions, for example, in EGARCH model residuals are exponentially distributed (Audrino and Trojani, 2006). GARCH model and its modifications are widely used in CAPM tests (Guesmi, Nguyen, 2014; Guesmi, Teulon, 2014; Guesmi, Moisseron and Teulon, 2014; Carrieri, Chaieb and Errunza, 2013). Al Rahahleh, Bhatti and Adeinat (2017) using DCC-GARCH model find that equity flows between the United States and Hong Kong and the United States and Australia are bilateral. Strong unilateral correlation is found between the United Kingdom and Taiwan (UK → Taiwan) and between Taiwan and the United States (Taiwan → US). Baumöhl et al. (2018) in their analysis use GARCH and 9 its derivations. They come up with a conclusion that the highest connectedness in equity markets was in 2008 and now it is decreasing. In addition, the highest volatility spillovers come from the most liquid markets which are also the most vulnerable to volatility spillovers from other markets. Although GARCH methodology captures volatility spillovers adjusted for heteroskedasticity, it does not evaluate multidimensional links of equity investment network.

Network methodology also has disadvantages. It is a non-parametric statistical method, therefore, analysis is based on descriptive statistics, for example, mean and standard deviation. In order to conduct statistical analysis, this method should be combined with other methods, for instance, Ordinary Least Squares (OLS) which obtain simple regressions. However, it helps to have a picture of a whole financial system and its components: central countries and peripheries, clusters and neighbours. This method is especially relevant analysing contagion spreads across the financial network and helps to detect the weak links: Sh. Zhang et al. (2016) and Chinazzi et al. (2013) implementing network methodology find that the average volume of investment significantly decreased in 2008. In addition, Chuluun (2017) comes to the results that countries which are highly integrated are also highly exposed to volatility spillovers, however, Chinazzi et al. (2013) argue that financial crisis firstly arises but also dissipates in central countries, therefore, countries in periphery are more vulnerable to negative financial shocks.

Methodologies, which assess connectedness of equity markets during growth periods, can also consider crisis impact on the level of connectedness. The reason of crisis, in other words, contagion, can be measured assessing its potential channels.

1.3.2 Financial contagion channels

When foreign investors diversify their portfolios in foreign equity markets, consequently, those equity markets become interconnected. However, higher financial connectedness leads to higher financial stability only until a certain level (Acemoglu et al., 2015). In addition, the risk of financial contagion depends not only on the level of financial connectedness but also on the type of links among financial markets. Therefore, there are many channels that can affect investment in different markets.

First group of researchers argues that bank deposits are spread globally and a massive withdrawal of deposits creates liquidity shocks which are transferred to other financial systems. Allen and Gale (2000) limit their analysis to spread of contagion through banking sector assuming that investors have complete market information and there is no relation with currency markets. They model prevalence of contagion based on the completeness of the market: incomplete international banking market with low degree of connectedness, incomplete international banking market but with high degree of connectedness and a complete market where all markets are connected. Modelling results show that complete and incomplete markets with low degree of connectedness are not contagious, while incomplete market with high degree of connectedness is susceptible to propagation of liquidity shocks. Empirical analysis done by Bekaert et al. (2014) using a factor model suggest that banking sector had no important role transferring global financial crisis of 2007-2009. In addition, different sectors were not affected homogeneously. Mollah, Quoreshi and Zafirov (2016) using adjusted conditional correlations, proposed by Forbes and Rigobon (2002), find that banking sector was the most important channel of increased correlation between equity markets. This is justified by high interconnectedness between financial sectors (Belke and Dubova, 2018). Implications of Dungey and Gajurel (2015) are similar: banking sector is prone to volatility spillovers, in general, but it is found to be exposed to both systematic and idiosyncratic risks in crisis period. According an author, idiosyncratic risk can be an expression of a herd behaviour.

Herding can activate different contagion channels, therefore, contagion comes into action when risk-averse investors become even more risk averse shifting their preferences towards safer assets (Bekaert et al., 2014; Guidolin and Pedio, 2017), more liquid assets (Guidolin and Pedio, 2017) or increased risk premium (Guidolin and Pedio, 2017; Schumacher and Żochowski, 2017). Bekaert et al. (2014) using VIX and TED spreads find that their variation increases in crisis period, however, they explain it as a measure of an econometric problem, hence, it does not reflect herding. Other authors find mixed results (Guidolin and Pedio, 2017; Lee, 2017; Longstaff, 2010).

Analysing an Asian Crisis, Baig and Goldfajan (1999) find substantial results: when market news and economic fundamentals are controlled, shocks in other markets are transferred

instantaneously. Bekaert et al. (2014) in their paper call this phenomenon "wake-up hypothesis" which is confirmed during financial crisis of 2007-2009. Macroeconomic factors determining strength of a certain country are more influential factors than financial links during crisis because investors reassess the riskiness of the country based on its fundamentals although that country has no financial relations with other countries (Baumöhl et al., 2018; Ahmed, Coulibaly and Zlate, 2017; Bekaert et al., 2014). Such macroeconomic factors are political stability, sovereign ratings, current account, unemployment rate, government budget (Bekaert et al., 2014), GDP growth, religion (Mobarek, Muradoglu, Mollah and Hou, 2016), market size (Baumöhl et al., 2018; Cai et al., 2017; Mobarek et al., 2016), net/bilateral trade/trade openness (Baumöhl et al., 2018; Cai et al., 2017; Mobarek et al., 2016; Luchtenberg and Vu, 2015), inflation rates (Mobarek et al., 2016; Luchtenberg and Vu, 2015), interest rates (Cai et al., 2017; Luchtenberg and Vu, 2015), exchange rate volatility (Cai et al., 2017) and stock market volatility (Cai et al., 2017). Bekaert et al. (2014) analyse information asymmetry as one of possible contagion channels. It is found irrelevant but authors argue that different opinions can have impact on stock market contagion just the model does not fit to this variable or variable should be measured in a different manner.

The discussion about global risk impact on financial markets remains open. Both Allen and Gale (2000) and Acemoglu et al. (2015) claim that markets with higher connectedness are more vulnerable to financial crisis. In addition, based on Baumöhl et al. (2018) findings, type of financial linkage is also important because indirect links are stronger than direct. Chuluun (2017) concludes that central in the financial network countries are also the mostly correlated. Findings of Chinazzi et al. (2013) show that the pattern of network changes during crisis but countries in the centre and periphery of the network remain the same. However, Cai et al. (2017) and Bekaert et al. (2014) reject hypothesis that countries, which are highly integrated in financial or trade network are the most affected by crisis. Knowing that financial networks have a hierarchical structure, not only central countries should be considered, owing that findings of Chinazzi et al. (2013) reveal that countries in periphery are more vulnerable to crisis. Hence, an important question would be whether other countries, which are not directly linked to central countries, are influenced by enhanced global risk during crisis.

All methodologies have their advantages and disadvantages. They can give additional information analysing the same problem from different perspectives. Factor models are useful determining which factors are relevant to investors both during growth period and crisis, however, network methodology is the most suitable analysing differences between institutional and non-institutional networks taking into account their structure: density, centralization, clustering and first-degree relationships.

1.4 International equity investment network and its structure

Structural changes in financial networks due to globalisation and financial crisis of 2007-2009 fuelled discussions about a global financial network as an integral unit which consists of highly connected financial markets, its vulnerability to market internal shocks and their spread across other financial markets. Network methodology is getting more attention in finance field due to its capability to assess the connectedness of overall financial market. The concept "network" itself is defined as a system of units that are interconnected (Guidotti, Gardoni and Chen, 2017), however, it changes with a type of the network (Gaigalienė, 2014). Equity investment network is a sort of network where financial units such as countries, firms or people are interconnected by some type of the financial links, for example, foreign direct investment or foreign portfolio investment. The gains from portfolio diversification in foreign markets depend on the co-movement of network stock markets (Chuluun, 2017). The circulation, dispersion and speed of capital flows increased through financial liberalization due to the innovations in communications, technology and financial instruments (Gaigalienė, 2014). Hence, the financial markets are becoming more connected forming certain community structures which patterns are more altering (Y. Zhang, Cao, He and W. Zhang, 2017). Researchers, who analysed foreign investment portfolios, emphasized mainly four factors which determine network structure: the number of financial partners, volume of investment, tendency to cluster and roles of countries and regions (Table 6).

The most general aspect of network is its completeness. When a network is composed only of investing countries, the network is found to be highly connected (Schiavo et al., 2010). Countries with higher number of financial partners are more vulnerable to shocks and sentiments in other countries (Chuluun, 2017) because they are financially more integrated. Y. Zhang et al. (2017) state that the degree of globalisation is affecting the structure of the network – when the distance between countries becomes shorter, they can easier reach each other. However, relations between countries in financial network are heterogeneous (Lydeka and Gaigalienė, 2013). Volume of investment is expressed by connections with other countries evaluating the total sum of equity flows. Hence, it affects the activeness of the network (Sh. Zhang et al., 2016) and exposure to financial shocks (Chinazzi et al., 2013; Tabak, Serra and Cajueiro, 2010). Clusters in a financial network also have their roles – countries, which share the same investment ideas, group into clusters creating tight connections within a group but do not share the same investment properties outside the cluster. Sh. Zhang et al. (2016) analysing international trade and investment network find that international investment network is more clustered than international trade network. In addition, countries form financial clusters with alike countries (Dimitrios and Vasileos, 2015) having stronger connections with geographically closer countries (Sh. Zhang et al., 2016).

Table 6

Characteristics of network structure

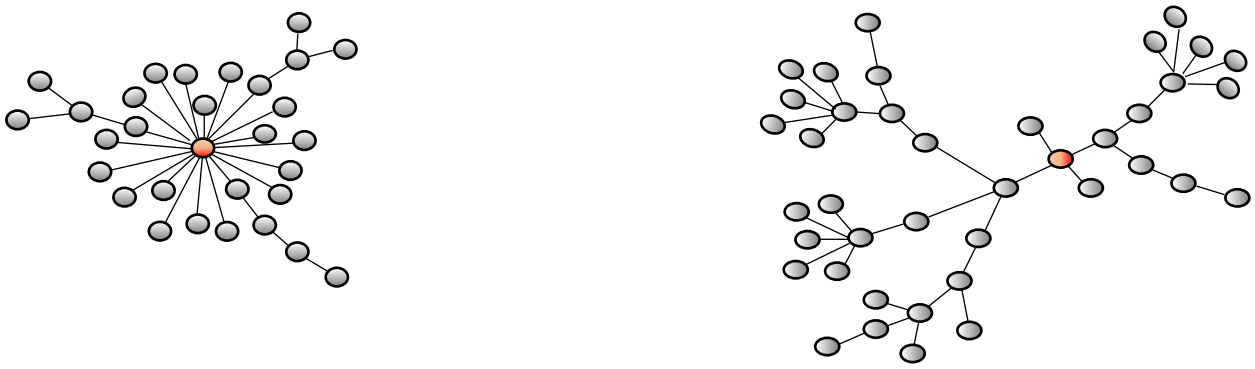
Characteristic (measure)		Source
Network completeness (density)		Y. Zhang et al. (2017); Chuluun (2017); Sh. Zhang et al. (2016); Gaigalienė (2014); Lydeka and Gaigalienė (2013); Schiavo et al. (2010)
Number of financial partners (node degree)		Y. Zhang et al. (2017); Chuluun (2017); Sh. Zhang et al. (2016); Feroldi and Gaffeo (2014); Gaigalienė (2014); Chinazzi et al. (2013); Schiavo et al. (2010)
Volume of investment (node strength)		Y. Zhang et al. (2017); Sh. Zhang et al. (2016); Chinazzi et al. (2013); Lydeka and Gaigalienė (2013); Schiavo et al. (2010)
Connection and exposure of the neighbour countries		Chinazzi et al. (2013); Lydeka and Gaigalienė (2013); Schiavo et al. (2010)
Degree of globalisation		Y. Zhang et al. (2017); Sh. Zhang et al. (2016)
Heterogeneity / disparity		Lydeka and Gaigalienė (2013); Tabak et al. (2010)
Clustering		Y. Zhang et al. (2017); Sh. Zhang et al. (2016); Dimitrios and Vasileos (2015); Feroldi and Gaffeo (2014); Naitram (2014); Chinazzi et al. (2013); Lydeka and Gaigalienė (2013); Schiavo et al. (2010) Tabak et al. (2010)
Geographical distance		Sh. Zhang et al. (2016)
Rank in the network		Y. Zhang et al. (2017); Sh. Zhang et al. (2016); Feroldi and Gaffeo (2014); Naitram (2014); Chinazzi et al. (2013); Schiavo et al. (2010)
Centrality	Richest members	Chinazzi et al. (2013)
	Intermediary (betweenness)	Y. Zhang et al. (2017); Dimitrios and Vasileos (2015); Schiavo et al. (2010)
	Neighbour* (eigenvector, pagerank)	Chuluun (2017); Sh. Zhang et al. (2016); Dimitrios and Vasileos (2015)
	Closeness	Dimitrios and Vasileos (2015); Lydeka and Gaigalienė (2013); Tabak et al. (2010)
	Eccentricity	Tabak et al. (2010)
Community structure		Sh. Zhang et al. (2016); Feroldi and Gaffeo (2014)
Rank within community		Sh. Zhang et al. (2016)

Note: Chuluun (2017); Dimitrios and Vasileos (2015) use eigenvector centrality, while Sh. Zhang et al. (2016) use PageRank centrality measure. Measures in brackets are presented when titles of characteristic/measure do not coincide.

Although financial networks are rather clustered, they are also centralised (Sh. Zhang et al., 2016) – there are countries which make the highest impact on all other network countries (Chuluun, 2017; Dimitrios and Vasileos, 2015), are close to the centre of the network (Tabak et al., 2010) are important intermediaries (Y. Zhang et al., 2017; Dimitrios and Vasileos, 2015), share investment ideas with similar countries (Dimitrios and Vasileos, 2015; Tabak et al., 2010), especially between highly investing countries (Chinazzi et al., 2013). Sh. Zhang et al. (2016) also find that international investment network is structured from basically two communities (one includes Northern American countries and another almost all countries in Europe, Asia, Oceania, Africa) but the number and rank of countries in communities change over time. When the scope of the researchers is to find out which countries are leading, they rank countries by certain characteristics, for example, the volume of investments (Sh. Zhang et al., 2016).

Investors diversifying their portfolios abroad could form different financial networks depending how intense and various their investments are. Financial networks are formed by bilateral links between creditors and debtors representing different countries. Depending on how closely countries are related, they could be linked directly or indirectly (Chuluun, 2017). According

Oatley et al. (2013), direct links are gained when there are no intermediaries. The role of intermediaries for indirect links is crucial because they make financial system more liquid lowering the transaction costs. Based on these relations two types of network structures can be formed: hierarchical and flat (Fig. 1).



Hierarchical Flat

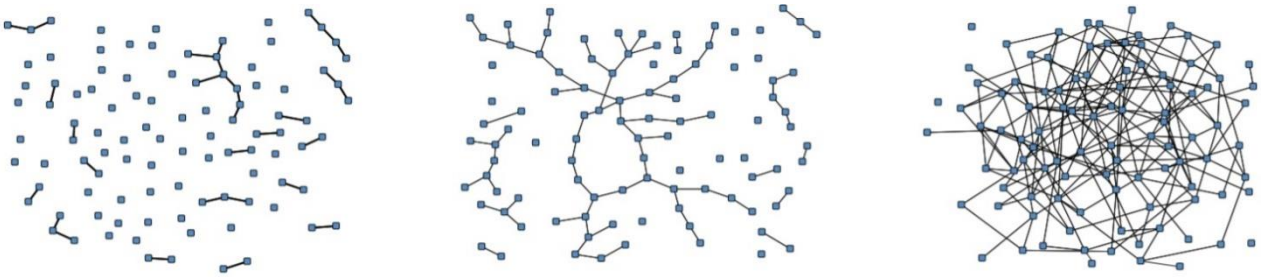
Figure 1. Types of network structure

Note: done by author based on Oatley et al. (2013).

In a hierarchical network, there is one country-hub which serve as an intermediary and most of the countries are directly connected to the hub but rarely connected directly among themselves. In a flat network, in contrast, countries are more connected among themselves. Hence, countries do not depend on one central country, therefore, the distinction between centre and periphery is not extreme. Vulnerability to financial shocks depends on the type of network structure (Oatley et al., 2013). If the crisis arises in peripheral countries of hierarchical network, other countries are highly resilient, however, if a crisis affects the central country, other countries will be also affected. Feroldi and Gaffeo (2014) find that financial network has a hierarchical structure with few developed central countries. These countries coincide with G7 countries and few others, such as Luxembourg, Ireland, the Netherlands and Cayman Islands. According Feroldi and Gaffeo (2014), this type of network stabilizes the financial system but it is also prone to uncommon financial shocks. In a flat network the probability that the local crisis will spread globally depends on how many links country has with other countries and how strong links are between them. When the number of countries and links increase, the spread of financial crisis in other countries will also increase. Given that countries in a flat network could belong to communities, the initial financial crisis can initiate secondary crises in countries which belong to the same community and the local financial crisis can spread globally whether the financial markets are highly interdependent.

As it was mentioned, denser financial network leads to higher financial stability only until a certain level. When the threshold is reached, the network becomes vulnerable to shocks and

financial system becomes unstable (Acemoglu et al., 2015). Figure 2 presents the level of diversification in financial networks. The lowest diversification occurs when countries in the financial network are almost not connected and the possibility of contagion is very low. When the level of diversification is medium, countries are connected at least with few other countries. However, according, Elliott et al. (2014) and Allen and Gale (2000), increased diversification enhances the possibility of financial contagion. Therefore, high connectedness is not only tight first order connections but also second, third and higher-level connections which can have important consequences during both growth period and crisis.



Low diversification Medium High diversification

Figure 2. Level of diversification in financial networks

Source: Elliott et al. (2014).

Institutional and non-institutional investors differ in their qualities, restrictions and preferences. Their preferences and, as a consequence, investments in foreign equity markets are induced by different factors which express market or country risk, information costs, familiarity and quality of legal and financial system, therefore, diversified portfolios create financial structures which are determined by certain connectedness characteristics that can be a source of financial contagion. Because contagion can arise in different forms due to international equity investment network complexity, the best methodology, which assess multilateral financial links, network structure including hierarchy, community and tendency to cluster, is the network methodology.

II. METHODOLOGY FOR ASSESSMENT OF INTERNATIONAL EQUITY INVESTMENT CONNECTEDNESS WITH RESPECT TO INSTITUTIONAL AND NON-INSTITUTIONAL INVESTORS

In this chapter the relevance of the research, its logic, research data and sample, steps of analysis, hypotheses and limitations of the study are discussed. Section 2.1 is dedicated to relevance and aim of the research. Section 2.2 covers logic of the research which is divided in sub-sections: 2.2.1 presents research data and sample, 2.2.2 reveals how equity investment network is identified and 2.2.3 clarifies which statistics are employed to conduct analysis. Finally, section 2.3 contains formulation of hypotheses and discussion on research limitations.

2.1 Relevance and aim of the research

As it was discussed in the first part, both institutional and individual investors are important financial market players. Their preferences based investments form links among countries and with increasing volume and investment distribution, the pattern of equity investment network is changing. As investment network became complex, it is not enough to analyse bilateral investment flows because countries belonging to financial network are related and can be affected indirectly (Chuluun, 2017). Given that financial network is not homogeneous and clustered, only ingoing or outgoing flows do not reveal the true relationships among countries.

Although total equity flows are increasing over time (based on CPIS database, $5.2tn in 2001, $9.9tn in 2008 and $24.6tn in 2016), half of these financial transactions are made among 10 countries which partially differ with respect to ingoing and outgoing equity flows (Table 7). Cayman Islands and Bermuda, compared to other countries, attract lots of investments due to their favourable legal environment. China, instead, is divided in areas which are different by their financial activities: Hong Kong invests in other countries, while China Mainland receives foreign investments. Baldwin (2016) suggests that investments in goods sector in the future will move to services sector enhancing investments in developing countries. Given all top developed countries, the United States is the only one having a negative investment balance which fluctuates from -$0.47tn to -$2.84tn. Investment balance of Germany is close to zero but negative, therefore, Germany invests more than receives. Japan is different from other countries because its aggregated investment flows were positive from 2001 to 2013 but since 2014 they are balanced. Such developed countries as the United Kingdom, France and Luxembourg have more ingoing than outgoing equity flows, however, much less than Cayman Islands. In contrast, less attractive developed countries are Italy, Netherlands and Canada. All other countries improve their positions in equity markets given that their share in total equity outflows increased from 18% in 2001 to 29%

in 2016. Total equity flows have a positive trend with short-term fluctuations (decrease in 2008 with return in pre-crisis level in 2013 (Appendix 3)). This implies that equity investment network is becoming not only denser but also more complex.

Table 7

Ingoing and outgoing equity flows of top 10 countries, trillion dollars

Panel A: Ingoing equity flows															
	US	***GB***	***LU***	***JP***	***FR***	***DE***	***CH***	***KY***	***NL***	***IE***	***BM***	***CA***	***CN***	***IT***	***Else***
2001	**1.03**	0.71	0.38	0.33	0.39	0.27	0.20	-	0.29	-	0.16	-	-	**0.12**	1.31
2002	**0.92**	0.66	0.46	0.31	0.29	0.20	0.20	**0.12**	0.24	-	0.13	-	-	-	1.29
2003	**1.32**	0.90	0.63	0.50	0.42	0.33	0.28	0.19	0.32	-	**0.17**	-	-	-	1.95
2004	**1.52**	1.05	0.82	0.67	0.53	0.43	0.32	0.28	0.38	-	**0.25**	-	-	-	0.25
2005	**1.73**	1.22	0.92	0.98	0.61	0.51	0.41	0.35	0.36	-	**0.30**	-	-	-	3.25
2006	**2.21**	1.55	1.34	1.11	0.87	0.69	0.56	0.51	0.46	**0.39**	-	-	-	-	4.59
2007	**2.41**	1.68	1.72	1.07	0.96	0.99	0.61	0.75	-	-	0.48	**0.46**	-	-	6.08
2008	**1.52**	0.93	1.11	0.65	0.58	0.53	0.42	0.43	-	-	0.25	**0.24**	-	-	3.21
2009	**2.03**	1.33	1.44	0.70	0.75	0.67	0.57	0.64	-	-	-	**0.40**	0.41	-	4.83
2010	**2.37**	1.49	1.55	0.82	0.72	0.72	0.57	0.70	-	**0.45**	-	0.54	-	-	5.67
2011	**2.37**	1.46	1.43	0.71	0.63	0.59	0.54	0.99	-	0.49	-	**0.48**	-	-	4.76
2012	**2.76**	1.69	166	0.80	0.76	0.75	0.62	1.09	-	0.65	-	-	**0.51**	-	5.71
2013	**3.57**	2.08	2.02	1.15	1.01	0.96	0.84	1.31	-	0.91	-	**0.53**	-	-	6.39
2014	**4.09**	1.97	2.18	1.19	0.98	0.90	0.82	1.78	-	1.12	-	-	**0.61**	-	6.73
2015	**4.38**	1.81	2.19	1.29	0.97	0.92	0.81	2.00	-	1.24	-	-	**0.56**	-	6.32
2016	**5.02**	1.84	2.38	1.39	1.05	1.00	0.81	2.16	**0.61**	1.26	-	-	-	-	7.03
Panel B: Outgoing equity flows															
	US	***GB***	***LU***	***JP***	***FR***	***DE***	***CH***	-	***NL***	***IE***	-	***CA***	***HK***	***IT***	***Else***
2001	**1.61**	0.56	0.32	0.23	**0.20**	0.38	0.24	-	0.24	-	-	0.23	-	0.24	0.95
2002	**1.39**	0.49	0.30	0.21	**0.20**	0.33	0.22	-	0.22	-	-	0.20	-	0.25	1.00
2003	**2.08**	0.66	0.49	**0.27**	0.34	0.44	0.29	-	0.35	-	-	0.28	-	0.33	1.48
2004	**2.56**	0.88	0.64	0.36	0.44	0.52	0.34	-	0.45	-	-	**0.32**	-	0.38	1.90
2005	**3.32**	1.08	0.81	0.41	0.52	0.53	-	-	0.48	0.38	-	**0.38**	-	0.42	2.31
2006	**4.33**	1.37	1.15	0.51	0.74	0.88	-	-	0.56	0.57	-	**0.50**	-	0.53	3.13
2007	**5.25**	1.51	1.41	0.57	0.83	0.95	-	-	0.67	0.65	-	0.61	-	**0.58**	4.17
2008	**2.75**	0.82	0.75	0.39	0.45	0.59	0.32	-	0.43	0.43	-	0.36	-	**0.31**	2.63
2009	**4.00**	1.08	1.07	0.59	0.60	0.71	-	-	0.59	0.54	-	**0.48**	0.50	-	3.60
2010	**4.65**	1.18	1.23	0.68	0.68	0.74	-	-	0.65	0.61	-	**0.58**	0.58	-	4.04
2011	**4.50**	1.05	1.07	0.67	0.51	0.65	-	-	0.61	0.56	-	0.58	**0.48**	-	3.77
2012	**5.31**	1.22	1.23	0.69	0.64	0.75	-	-	0.72	0.66	-	0.70	**0.61**	-	4.49
2013	**6.47**	1.55	1.56	0.71	0.83	0.92	-	-	0.86	0.82	-	0.86	**0.69**	-	5.50
2014	**6.73**	1.75	1.72	1.19	0.77	0.94	-	-	0.87	0.90	-	0.95	**0.74**	-	5.80
2015	**6.76**	1.67	1.81	1.28	0.72	0.95	-	-	0.80	-	-	0.94	0.79	**0.70**	6.07
2016	**7.01**	1.69	1.79	1.39	**0.74**	1.01	-	-	0.84	0.97	-	1.01	0.88	-	7.22

Note: analysis is done in million USD dollars but summary statistics are presented in trillion USD dollars. Data is gathered from CPIS database (2017).

Equity flows should be disaggregated not only by ingoing and outgoing flows but also by the type of investor. Government and central bank investments are excluded since they are not an object of analysis and are not relevant (Appendix 2): government and central bank investments of five largest investing countries excluding the United States were less than 1%. Institutional investors, instead, generate the highest equity flows (Table 8). Considering only institutional and non-institutional investors, the latter invest from five to eight times less than former, even though, this relation does not have any clear trend.

Table 8

Share of institutional and non-institutional investors in total international equity investment market, 2001-2016

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Institutional	88.4%	84.1%	86.4%	87.4%	88.2%	87.7%	82.3%	83.0%
Non-institutional	11.6%	15.9%	13.6%	12.6%	11.8%	12.3%	17.7%	17.0%
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Institutional	82.5%	82.4%	81.9%	79.0%	82.2%	85.3%	84.8%	85.4%
Non-institutional	17.5%	17.6%	18.1%	21.0%	17.8%	14.7%	15.2%	14.6%

Note: in the share of institutional and non-institutional investors is calculated excluding share of government and monetary authorities.

Notwithstanding non-institutional investors contribute to the whole equity investment flows much less than institutional investors, they differ in their strategies and behaviour during the growth period and crisis. There is no common agreement on which type of investors form the market, however, many authors (Choi et al., 2015; Huang, 2015; Liao, Chou and Chiu, 2013) suggest that institutional and non-institutional investors act as contrarians. Their international equity investment choices are graphically presented in Figure 3 (for abbreviations see Appendix 4).

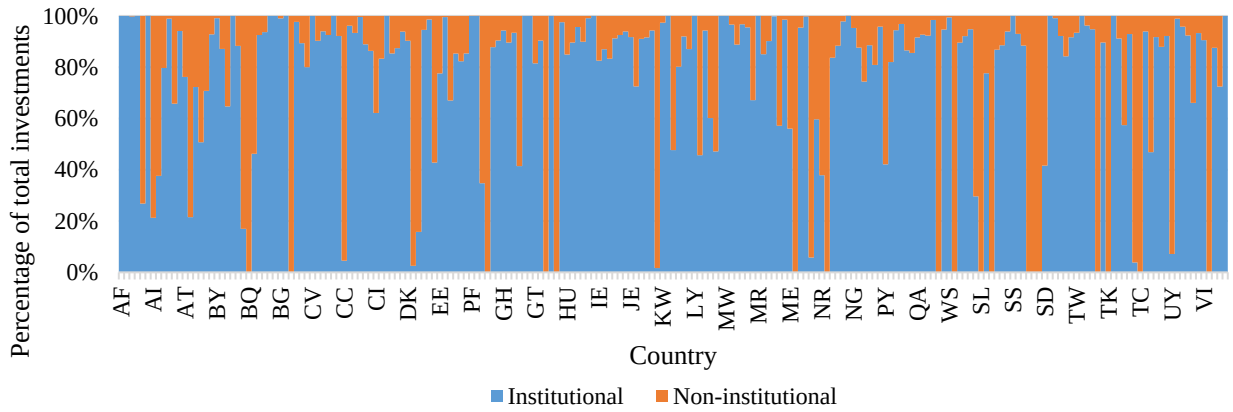


Figure 3. Share of institutional and non-institutional investors in total incoming equity flows separate to world countries in 2016

Note: figure denotes total incoming equity flows to world countries in 2016 expressed in percentage points. Area in red shows investments of non-institutional investors and blue one – of institutional investors. 0% (100%) occurs when all investments are made by non-institutional investors (institutional investors). For example, only non-institutional investors invested in such developing countries as Bonaire, Gambia, Haiti, Nepal, Saint Maarten and others. Institutional investors invested in Afghanistan, Albania, Angola, Benin, China Macao, Cuba, Ethiopia, Iraq, Kyrgyzstan, Libya, Niger, etc. Majority of flows in developed countries are generated by institutional investors. For example, France (85%), Germany (90%), Italy (91%), Japan (94%), Norway (88%), the United Kingdom (88%), the United States (92%).

Institutional investors account for 80-95% market share in developed countries (Figure 3 and Table 6), nevertheless, institutional and non-institutional investors invest in rather different developing countries (see Figure 3, where red or blue area are 0% or 100%), for instance, only institutional investors invest in Afghanistan, Angola and China Macao, while only non-institutional investors invest in Gambia, Haiti and Nepal. Besides equity holder and issuing countries do not coincide, not all equity holder countries have the same proportion of institutional and non-institutional investors (see Appendix 5), for example, in Mexico only institutional investors invest in foreign markets, while in Ukraine only non-institutional investors. Hence, analysis should

comprise all international equity investment network countries evaluating the direction of flows and type of investor.

Although the total ingoing and outgoing equity flows are equal, the distribution, however, is different. In addition, institutional investors account for 85% of all equity market but non-institutional investors are important because they invest in different developing countries and their share in holder countries varies. Therefore, the aim of the research is to evaluate the influence of institutional and non-institutional investors portfolio diversification decision on formation of international equity investment connectedness. The chosen methodology is presented in another section.

2.2 Logic of the research

Given that the aim of the research is to evaluate the influence of institutional and non-institutional investors portfolio diversification decision on formation of international equity investment connectedness, an analysis is divided into three stages: structure identification of the networks; analysis of their structure parameters; and statistical analysis of general differences between networks and factors which could make an influence on their structure (Figure 4).

In the first stage, nodes and links are defined since they are two main components of the network. Because the equity investment network is analysed in macro level, the number of nodes represent sample of the network countries which could differ with regard to institutional and non-institutional investors. The next step is to identify the type of financial relationship between countries (international equity investment) for both institutional and non-institutional investors. Another step is to identify the type of financial network. Table 5 shows that international equity investment links have both value and direction, therefore, it is natural to analyse international equity investment network as a valued directional network. **In the second stage**, the right indicators for the network analysis are chosen and calculated for networks discussed in the first stage. These indicators are common for both institutional and non-institutional investors willing to compare two different international equity investment networks. **In the third stage**, the first step is to analyse the general differences in international equity investment connectedness with respect to institutional and non-institutional investors. The second step is to evaluate whether the gap between international equity investment connectedness with respect to institutional and non-institutional investors differs during crisis. The third step is to analyse how international equity investment connectedness with regard to institutional and non-institutional investors changes internally during crisis. Finally, the impact of stock market and country riskiness on international equity investment connectedness with respect to institutional and non-institutional investors during growth and crisis periods is analysed.

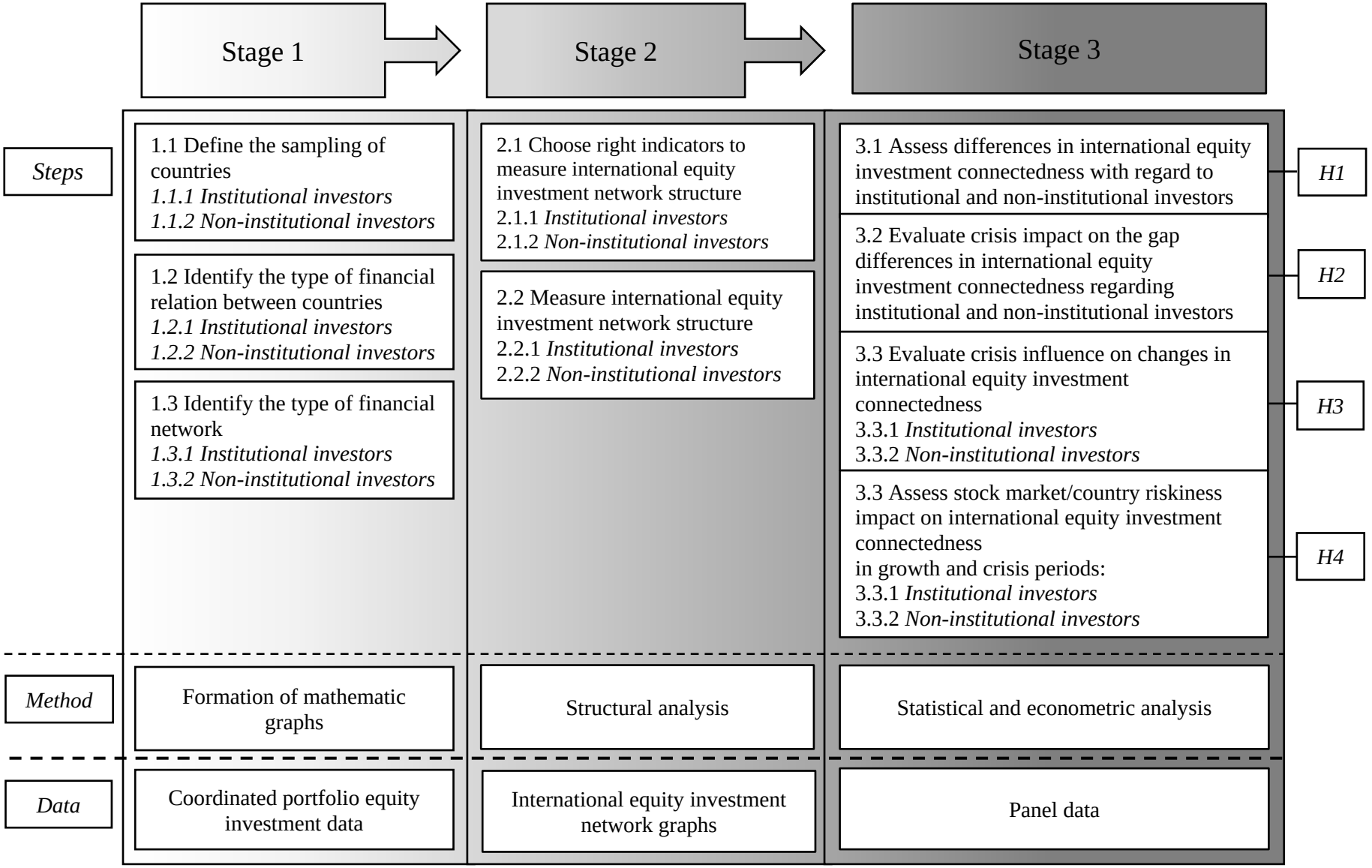


Figure 4. Scheme of the research logic

2.2.1 Research data and sample

The data relevant to the research is distinguished into two groups: the first group is data needed to calculate measures for institutional and non-institutional networks; the second group contains indices determining riskiness of the equity market/country and are used in the last part of analysis. Research data and its characteristics are provided in Table 9.

Table 9
Research variables measurement information

			Measurement			
Group	**Variable**	**Ratio**	**Currency**	**Period**	**Countries****	**Source**
1	Network links	Bilateral equity investment flows	USD	2001-2016	Up to 195	International Monetary Fund CPIS
2	Country risk	Public debt to GDP	USD*	2001-2015	Up to 186	International Monetary Fund HPDD
	Market risk	1-year equity price volatility	USD*	2001-2015	Up to 82	World Bank
		Currency exchange rate volatility	USD/local*	2001-2016	Up to 225	Thomson Reuters Eikon

Note: Public debt to GDP and bilateral equity investment flows are yearly data. 1-year equity price volatility, 1/2/3/6-months, 1-year and 23-days currency exchange volatilities are annualized. Finally, only one exchange rate volatility is chosen fitting best in regressions. *these measures are indices. Primary data is expressed in the currency, which is provided in the table. Only bilateral equity investment flows are expressed in USD dollars. However, network measures which are calculated in step 2, are also indices. ** Analysis covers countries and their autonomous parts.

Bilateral equity investment flows are gathered from International Monetary Fund (IMF), Coordinated portfolio investment survey (CPIS) database. Flows, which are disaggregated by type of investor, are used in the analysis. Even if central bank and government are among reported type of investors (see Appendix 6), only institutional and non-institutional investors are chosen based on Roque and Cortez (2014) suggested logic: group of institutional investors includes deposit-taking corporations, except central bank, and other financial corporations; non-institutional investors consist of all nonfinancial investors.

CPIS database offers semi-annual and annual data, however, annual data is more relevant in this research given that the availability of historical data is from 2001 to 2016. Sample contains countries and their autonomous parts which presence changes each year whereas: 1) the number of equity issuing countries changes over time (see Appendix 7); 2) in certain countries and years the data is confidential or partially confidential, e.g. the United Kingdom. Countries which have chosen to keep majority of data confidential are excluded[8]. Final matrices are adjusted to the number of available investors and equity holders, e.g., matrix for institutional investors in 2006 is 161*161, while for non-institutional investors is 157*157 (see Table 10).

[8] Which equity investment reports are included in analysis is determined by amount of non-provided data. If data is not provided for more than half countries, in which country i invests, report is not included in analysis because it misrepresents the real position of country i in the whole network.

Table 10

Number of issuer and holder countries with respect to institutional and non-institutional investors in period 2001-2016

Panel A: Number of holder countries								
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Institutional investors	37	40	42	47	48	49	50	49
Non-institutional investors	28	38	39	44	45	47	48	47
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Institutional investors	51	53	58	59	62	67	68	66
Non-institutional investors	50	51	56	57	58	64	65	63
Panel B: Number of issuer countries								
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Institutional investors	136	136	133	133	154	161	176	174
Non-institutional investors	124	132	123	145	147	157	161	151
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Institutional investors	174	183	178	191	193	191	195	192
Non-institutional investors	156	157	166	162	168	181	188	187

Note: institutional and non-institutional networks are not symmetrical. Reporting countries are a minority comparing with a total network.

Different equity market/country risk measures (equity price, exchange rate volatility and public debt to GDP) are chosen to evaluate different aspects of equity market riskiness: equity price volatility expresses stock market stability; exchange rate volatility is used to measure how investments in countries, where the official currency is not USD dollar, are influenced by volatility of currency exchange rates; public debt to GDP represents financial soundness of each country. Equity price volatility data is provided by World Bank, exchange rate volatility – by Thomson Reuters Eikon database, and public debt to GDP – by IMF Historical public debt database. Network structure parameters are calculated by network modelling and analysis programs Netminer and Gephi. Statistical analysis is conducted by statistical analysis package STATA. Having research data that is needed, type of equity network can be identified.

2.2.2 Identification of equity network

Based on the results of other researchers (Gaigalienė, 2014; Chinazzi et al., 2013; etc.), international equity investment network can be defined as a network which has either the value or direction. Therefore, weighted-directed graphs represent the nodes connected by weighted-directed links. Both nodes and links between those nodes are the main two components of network. The first step of network identification is the node identification. In this research node represents each country of international equity investment network. Link is defined as an equity flow from the holder country (institutional and non-institutional investors) to the issuer country. Thus, here, international equity investment network is defined as $Network = \{N, A, W\}$, a set of three elements: N – nodes where $N = [1, 2, \dots, n]$, A – links, and W – values of links. Feroldi and Gaffeo (2014) suggest denoting network as a graph consisting of two elements: N – set of nodes and g_{ij} – adjacency matrix (symmetrical matrix consisting of $n * n$ nodes) where i and j are nodes and $g_{ij} \in$

{0,1}. In this paper, the node is a country and the adjacency matrix is a matrix of all equity inflows and outflows (see Table 10).

The second step is a link identification. Given that the link must have an origin country, where it begins, and the target country, where the investments are held, the link direction is denoted as $i \rightarrow j$ where i is origin country and j is target country. In addition, an assumption that the equity graph has a direction ($g_{ij} \neq g_{ji}$) is also confirmed by the fact that:

1) The issuing (debtors) and holding (creditors) countries partially differ.
2) The number of issuing and holding countries differ.

Since it is assumed that the graph has direction, the same country can be either an origin or a destination country forming links $i \rightarrow j$ and $j \rightarrow i$. If there is a link, it gets value of 1, 0 otherwise. As a result, the links of all nodes get values of 0 or 1. Owing to valued graph, relationship strength between nodes can be measured, hence, $g_{ij} \geq 0$ where values are not binary.

The third step is to give weights to links valued by 1. This depends on the link specificity. The value of each link is weighted by amount of issued equity which is held in another country. Gaigalienė (2014) states that the choice of methodology, used to attribute weighed values to links, is important because results will depend on the chosen methodology. One of the methods in undirected graphs is to sum real values of $i \rightarrow j$ and $j \rightarrow i$ (Gaigalienė, 2014) or calculate an arithmetic average of equity flows from country i to country j and from country j to country i (Sh. Zhang et al., 2016; Schiavo et al., 2010). Chinazzi et al. (2013) uses real value of security which is issued in one country and held in another. Chuluun (2017) measures both undirected and directed links. In the first case, the link weight is calculated as $\frac{Holding_{ij}+Holding_{ji}}{Total\_Holdings_i+Total\_Holdings_j}$, in the second case, as $\frac{Holding_{ij}}{Total\_Holdings_i}$. Reyes, Schiavo and Fagiolo (2008) use weight $\frac{a_{ij}}{GDP_i}$ where a_{ij} is link adjusted by GDP of origin country. Given that here the direction is important, $Holding\_Real\_Value_{ij}$ and $Holding\_Real\_Value_{ji}$, e.g. value of flows of $Node_{in}$ and $Node_{out}$, which are provided by IMF, are analysed separately.

Fourth step is identification of network. Gaigalienė (2014) suggests that network can be constructed using two different methodologies: graphical or mathematical. Graphical method is relevant when sample is rather small. Mathematical method is more suitable when the number of nodes and links is high. Because the network in this research includes all world countries and their autonomous regions, a mathematical method is more suitable. In this step valued matrix $g_{ij} \geq 0$ is formed. If weighted link $w_{ij} > 0$, the link between node i and node j exists; if $w_{ij} = 0$, there is no link. Binary adjacency matrix $g_{ij} \in \{0,1\}$ with $n * n$ nodes is created by Netminer and Gephi programs. Whether link $a_{ij} = 1$, the link between node i and node j is existent, otherwise, link gets

0 value. Each matrix to be formed, is formed as in Table 11 for each year and type of investor separately. In addition, the diagonal cells do not have values because of bilateral international equity investment flows (internal investments are not included).

Table 11
Valued graph matrix

Issuer / Holder	Country A	Country B	Country C	Country D	Country E
Country A	0	Value	Value	Value	Value
Country B	Value	0	Value	Value	Value
Country C	Value	Value	0	Value	Value
Country D	Value	Value	Value	0	Value
Country E	Value	Value	Value	Value	0

Note: equity outflows are in matrix rows, while equity inflows are in matrix columns.

Taking into consideration valued network matrix, the international equity investment network is defined as $Net = \{N, A, W\}$. Since the network has two dimensions, the set of graphs is defined by equation (1):

$$Net_{set} = \{Net_{k,t}\} \quad (1),$$

where sub-index k denotes sector of holder (institutional or non-institutional investors) and t expresses years from 2001 to 2016. Having a set of graphs, relevant network statistics can be already calculated. Hence, the next step is to choose relevant network statistics.

2.2.3 Calculation of network statistics

There are many types of network statistics, however, not all of them are relevant for this research. Chinazzi et al. (2013) and Fagiolo and Mastrorillo (2012) propose general (aggregate) and node specific statistics which are applied in the thesis. Aggregate statistics give a general view about equity investment network. To be more specific, they are used to calculate descriptive statistics and to show international equity investment connectedness trends. It is important to get general understanding about equity investment networks because node specific indicators are more detailed measuring different degree relationships between nodes.

The first statistic to calculate is network density. It measures a real number of all possible links, thus, it expresses the network completeness. When values are gathered in different years – network density determines the development of the network; when it is compared between networks – network density simply shows which network is larger. It is estimated by formula (2):

$$Network\ density = \frac{m}{N(N-1)} \quad (2),$$

where *m* is denoted as the number of edges present in the network, N – the number of nodes. Node specific measures can be calculated either for first-degree or second-degree connectivity. Starting analysis with first-degree connectivity, node degree is the first and basic indicator to estimate (Opsahl, Agneessens and Skvoretz, 2010). Node degree measures network density at a node level

and is specified by the node position in the link – if it is issuing (in) or holder (out) country. In addition, inflows and outflows of the node in directed network should be analysed separately. Since each type of investor is analysed in macro level, countries represent different equity market participants. When country *i* receives investment flows, hence, it obtains a certain number of financial partners who invest in that country. This measure is called node in-degree. In other words, *node in-degree* defines the number of debtors that country *i* has (formula (3)):

$$ND_i^{in} = \sum_{j \in N_i^{in}} e_{ji} \quad (3),$$

where ND_i^{in} is a node degree of ingoing equity flows for a specific node *i*, e_{ji} is a link starting in country *j* and ending in country *i*. N_i^{in} is the number neighbours of a country *i* determined by ingoing equity flows. Higher degree shows that a certain country is more attractive than others and, based on the results, country can be attributed to a certain group (central, transitional or peripheral). This statistic should differ in institutional and non-institutional networks because, as it was seen in Figure 3, issuing countries partially differ. *Node out-degree* measures a crediting side of the financial link showing in how many countries a country *i* is willing to invest (formula (4)):

$$ND_i^{out} = \sum_{j \in N_i^{out}} e_{ij} \quad (4),$$

where ND_i^{out} is a node degree of outgoing equity flows for specific node *i*, e_{ij} is a link starting in country *i* and ending in country j. N_i^{out} is the number of neighbours of country *i* determined by equity outflows. Node out-degree gives an insight, which countries are the main investors in international equity investment network. Although a node out-degree presents potential leaders, transitional and peripheral countries, the number of links does not reveal anything about investment flows. From this point of view, node strength is supplemental. It shows the total node involvement to the whole network, e.g. an amount of equity investment that is made from and to a country. Similar to node degree, node strength is composed of the sum of inflows and outflows to the specific node. *Node in-strength* defines an amount of credit that a country *i* receives from all other countries (formula (5)):

$$NS_i^{in} = \sum_{j \in N_i^{in}} w_{ji} \ (5),$$

where NS_i^{in} is a node strength of ingoing equity flows for specific node *i*, w_{ji} is a weighted link starting in country j and ending in country *i*. Node in-degree and in-strength together show which countries are the most attractive to foreign investors. For example, a country *i* can have few links but a large amount of investments. In such a case, a country *i* would be dependent only on few investors in some way close to country *i*. If node in-degree and in-strength are one of the highest, country *i* is central in the network because majority of investors are interested in country *i*. Node out-strength could be interpreted in the same manner. *Node out-strength* defines an amount of credit that country *i* provides to all other countries (formula (6)):

$$NS_i^{out} = \sum_{j \in N_i^{out}} w_{ij} \quad (6),$$

where NS_i^{out} is a node strength of outgoing equity flows for specific node *i*, w_{ij} is a weighted link which starts in country *i* and ends in country *j*. If node out-strength is one of the highest, country is an intensive investor. Clustering coefficient gives additional information about neighbours of country *i* showing the probability that neighbours of country *i* are also neighbours among themselves (cluster needs at least three nodes). The coefficient has an interval [0,1] with a value 0 when clusters get shape of star (investors investing in country *i* are not correlated among themselves) and 1 when cluster gets a shape of clique (all investors in the cluster are related). In other cases, clusters are incomplete. Clustering coefficient formula (7) is based on Watts and Strogatz (1998) methodology:

$$NC_i = \frac{|\{(j,k) \in E | (i,j) \in E \wedge (i,k) \in E\}|}{(ND_i^{in} + ND_i^{out})\left((ND_i^{in} + ND_i^{out}) - 1\right)} \quad (7),$$

where NC_i is a node clustering, $ND_i^{in} + ND_i^{out}$ is a total node degree of country *i*, $\{(j,k) \in E | (i,j) \in E \wedge (i,k) \in E\}$ is a set where (j,k) is a pair of nodes *j* and *k* belonging to the set of edges *E* such that has a pair of nodes (i,j) which belongs to the set of edges *E* and pair of nodes (i,k) which also belongs to the set of edges *E*. Note that clustering coefficient does not measure the size of the cluster. High clustering coefficient shows that a certain group of countries has tight financial links within the cluster but weak links out of the cluster. Community modularity is an additional measure which instead of pairs of node triangles assesses density between and within communities. Given that it evaluates the weight of each link, communities in institutional and non-institutional networks are determined by the highest equity flows. The formula (8) is based on Blondel, Guillaume, Lambiotte and Lefebvre (2008):

$$Q = \frac{1}{2m} \sum_{ij} \left[w_{ij} - \frac{k_i k_j}{2m} \right] \delta(c_i c_j) \quad (8),$$

where w_{ij} is a weight of a node *i*, $k_i = \sum_j w_{ij}$ is a sum of weights attributed to vertex *i*, $m = \frac{1}{2} \sum_{ij} w_{ij}$, c_i represents a community of a vertex *i*, δ is a function $\delta(a,b)$, which gets a value of 1 when $a = b$, 0 otherwise. This measure shows whether institutional and non-institutional networks have higher intensity clusters – communities, hence, it determines which countries have more significant impact on countries within communities.

Centrality indicator is also generalized but the measures are available at the node level. According Opsahl et al. (2010), there are main 3 ways to measure centrality: degree, closeness and betweenness. Authors highlight that even if centrality degree is easy to compute, it does not consider global network structure. Closeness centrality captures the distance from the node to the centre, e.g. how fast the node acquires the information. Its drawback is that the path length of two disconnected nodes is infinite. However, it is not relevant in this analysis because there are no

isolate nodes. Betweenness centrality assesses the exposure of the node to be between two other nodes, in other words, to be an intermediary. If the node is not between the shortest path between two nodes, the node gets a value of 0. The values of nodes for both closeness centrality and betweenness centrality are dichotomized, hence, CC and BC $\in [0,1]$. Eigenvector centrality, introduced by Bonacich (1987), is more related to degree centrality than to other centrality measures: it is similar to degree centrality by idea to sum all links between country *i* and its financial partners. Nevertheless, these links are weighted by the rank that is attributed to partner *j* by its relevance (centrality) in the whole network. In this study all four types of centrality are used because they are complementary.

Degree centrality shows the number of normalised ingoing or outgoing links. Countries having the high value of degree centrality obtain the highest number of links with other countries and can make a direct impact on directly connected countries. Regarding in-degree centrality, the interpretation is associated with equity holder countries. The highest in-degree centrality for country *i* shows that this country is linked with the highest number of creditors, hence, it is an attractive and, probably, the largest equity market for foreign investors. In-degree centrality is computed using formula (9):

$$DC_{ji}^{(in)} = \frac{ND_i^{in}}{N-1} \quad (9),$$

where N is a number of total links of country *i*. Out-degree centrality helps to find out which investors make the highest direct influence on other network countries and is expressed by formula (10):

$$DC_{ij}^{(out)} = \frac{ND_i^{out}}{N-1} \quad (10).$$

The highest out-degree also shows which countries could easily disrupt the functioning of the network and create world financial crisis. Additional information is given by weighted degree centrality including not only the number of links but also the incoming or outcoming flows. Weighted in-degree centrality expresses the level of incoming equity flows to country *i* compared to the whole network. The calculations are based on Opsahl et al. (2010) weighted degree in and out centrality formulas (11) and (12):

$$DC_{ji}^{w(in)} = e_{ji}^{in} * (\frac{w_{ji}^{in}}{e_{ji}^{in}})^{\alpha} (11),$$

where w_{ij}^{in} is a weight of ingoing links, e_{ji}^{in} is an ingoing link, α is a parameter showing strength equality in the network. Weighted out-degree centrality is used to determine whether country *i* generates the highest investment flows to foreign countries. It is expressed by:

$$DC_{ij}^{w(out)} = e_{ij}^{out} * (\frac{w_{ij}^{out}}{e_{ij}^{out}})^{\alpha} \quad (12),$$

where w_{ij}^{out} is a weight of outgoing links, e_{ij}^{out} is an outgoing link. If out-degree and weighted out-degree centralities are one of the highest in country *i*, this country is especially influential on his cluster countries given that it affects them directly. When a country *i* is affected by the crisis, it contaminates its financial partners who, consequently, spread the contagion to other related countries. Degree and weighted degree centralities show the direct influence of country *i* on its financial partners. However, it does not measure closeness of country *i* to all other countries. This information is given by closeness centrality. Since closeness centrality measures shortest average distance from country *i* to all other countries of the network, countries with the highest closeness centrality values are the most influential in respect of the whole network. In-closeness centrality is calculated by formula (13) (Freeman, 1978):

$$CCin_{(ij)} = \left[\frac{\sum_{j=1}^{N} d(i,j)}{n-1}\right]^{-1} \quad (13),$$

where $d(i,j)$ is a shortest path between two nodes (the minimum number of links between nodes required), $\left[\sum_{j=1}^{N} d(i,j)\right]^{-1}$ is inverse total length. The average distance is normalised multiplying it by $n-1$. Because the ratio is inverted, CC value diminishes when the ratio (average distance between other countries) increases. Out-closeness centrality is measured in the same manner but outflows path is used instead of inflows path (formula (14)):

$$CCout_{(ji)} = \left[\frac{\sum_{i=1}^{N} d(j,i)}{n-1}\right]^{-1} \quad (14),$$

where $\sum_{i=1}^{N} d(j,i)$ is an average distance with other nodes. In-closeness centrality quantifies the probability that country *i* has the closest in-path with other investing countries, while out-closeness centrality estimates the probability that country *i* has the closest out-path with other countries, in other words, if a country is important as an issuer or as equity holder. Turning to betweeness centrality, it exists only for a sum of node inflows and outflows (aggragate node statistics). It measures the possibility of country *i* to be in the shortest path between two other nodes. This measure is a modified version of closeness centrality and is expressed by formula (15) which is suggested by Brandes (2001):

$$BC_c(i) = \sum_{i \neq v \neq j}^{N} \frac{\sigma_{ij}(v)}{\sigma_{ij}} \quad (15),$$

where σ_{ij} is the number of shortest paths $d(i,j)$ from node *i* to node *j*, $\sigma_{ij}(v)$ is the number of the shortest paths $d(i,j)$ from node *i* to node *j* passing through node v. Betweeness centrality measure expresses the capacity of a country *i* to break investment flows from one part of the network to the other. In general, countries having high betweeness centrality degree connect different parts of the network, therefore, in the case, when the equity flows stop at these countries, all other parts of the network are affected indirectly. Other network measure, node eigenvector centrality, represents its

relation with other network participants: when a country has investment relations with significant countries in the whole network, the aforementioned country is also important and vice versa. Eigenvector centrality calculations are based on formula (16), which is proposed by Bonacich (1987):

$$\lambda EC = gc \quad (16),$$

where EC is an eigenvector centrality of a matrix, λ is its eigenvalue, g is a matrix and c is an eigenvector of matrix. Node eigenvector centrality is a part of matrix eigenvector centrality (formula (17)):

$$\lambda EC_{ij} = \sum_j g_{ij} c_j \quad (17),$$

where g_{ij} is a matrix where g_{ij} = 1 if a node i is connected to node j, 0 otherwise; c_j is an eigenvector of a node j, λ is an attributed constant value showing how eigenvalue of a node is similar to eigenvalue of a matrix. Eigenvector centrality is measured in the scale of [0,1]. It measures the relevance of a country *i* in the network evaluating the impact of its neighbours on this country. Therefore, countries investing in central countries are also important because they have easier access to other equity markets due to high number of connections obtained by central countries. However, if the central country is affected by crisis, its financial partners are first to have a negative impact.

Network statistics discussed in this section are important for further analysis because they show different aspects of the network structure. Assumptions on the changes in the network structure that are formulated based on the findings of other researches, summary statistics and financial logic help to formulate hypotheses.

2.3 Research hypotheses and limitations

International equity flows most often are analysed not disaggregating them by investor type neither in unilateral models (Gyntelberg, Loretan, Subhanij and Chan, 2014), nor bilateral models of financial integration (Al Rahahleh et al. 2017), nor structural network models of financial connectivity (Y. Zhang et al., 2017; Chuluun, 2017; Chinazzi et al., 2013; etc.). Some researchers reveal that non-institutional and institutional investors have different investment strategies (Choi et al., 2015), behaviour (Chiang, Tsai, Shu and Chen, 2012), and their cross-border investment decisions are affected by different factors (Roque, Cortez, 2014). Therefore, different patterns of international equity investment flows should cause differences not only in unilateral aspect of financial connectivity but also differences might occur in structural network models that reveal multidimensional aspects of financial connectivity.

Institutional investors account for approximately 85% of all foreign equity flows, hence, non-institutional investors are a minority. It is found that non-institutional investors are more biased

than institutional investors (Barber, Odean, 2013), prefer investments in closer or similar countries (Roque, Cortez, 2014) and have common investments with institutional investors only in developed countries, therefore, non-institutional investors could form different international equity investment network from institutional investors. This is tested by the first hypothesis.

H1: Institutional equity network measures differ from non-institutional equity network measures

The first hypothesis is described as a system of equations (18). A dependent variable Y_{ikt} expresses such total network measures as node in-degree, out-degree, in-strength and out-strength, clustering coefficient, weighted in-degree and out-degree centralities, in-closeness and out-closeness, betweenness and eigenvector centralities for country *i*, investor *k* in time *t*.

$$Y_{ikt} = \alpha + \beta * Institutional_{ikt} + \varepsilon_{ikt} \quad (18),$$

where $Institutional_{ikt}$ is a dummy variable which gets the value of 1 when investor is institutional, 0 otherwise; ε_{ikt} is an error term. Coefficient β is expected to be positive for both node in-degree and out-degree because institutional equity financial network is denser (see Table 8). Since in-degree and out-degree measures are related, central countries in institutional network must have more connections than in non-institutional network: when in financial network there are more partnerships, it is likely that the most active investing countries and countries attracting investments also have more financial partners. Institutional investors invest more than non-institutional investors, hence, node in-strength and out-strength have to be significantly higher in institutional network. Average difference between weighted in-degree and out-degree centralities is assumed to be positive because this measure evaluates the number and volume of equity flows which are higher for institutional investors. Dichotomised centrality measures (in-closeness, out-closeness, betweenness, eigenvector centralities) and clustering coefficient are expected to be insignificantly different due to similar number of financial links.

As Sh. Zhang et al. (2016) note, the number of trading countries as well as the density of clusters decreased in 2009. The application of network methodology helps to understand why after the initial crisis in the United States it passed in other countries. Since investors become more risk averse, investment network should also change its pattern (Forbes and Warnock, 2012). In addition, Acemoglu et al. (2015) findings show that denser financial networks tend to be more vulnerable to financial crises than smaller ones. As can be noticed in Tables 6 and 7, non-institutional network is smaller both by total flows and number of investing countries, hence, the gap between institutional and non-institutional network measures during crisis should differ. This is tested by hypothesis H2.

H2: The gap between institutional and non-institutional network measures is different in crisis period

In order to test hypotheses H2 and H3, four dummy variables are created: $Inst\_crisis_{ikt}$ is 1 when institutional investors invest during crisis, 0 otherwise; $Non\_inst\_crisis_{ikt}$ gets value of 1 when non-institutional investors invest during crisis, 0 otherwise; $Inst\_non\_crisis_{ikt}$ is 1 when institutional investors invest during non-crisis, 0 otherwise; $Non\_inst\_non\_crisis_{ikt}$ is 1 when non-institutional investors invest during non-crisis, 0 otherwise. Willing to compare these variables, $Inst\_crisis_{ikt}$ dummy variable becomes a reference category and is excluded from the dependence equation (19):

$$Y_{ikt} = \alpha + \beta * Non\_inst\_crisis_{ikt} + \gamma * Inst\_non\_crisis_{ikt} + \theta * Non\_inst\_non\_crisis_{ikt} + \varepsilon_{ikt} \quad (19).$$

Difference between reference category $Inst\_crisis_{ikt}$ and category $Non\_inst\_crisis_{ikt}$, included in equation, is tested in hypothesis H2. All these categories change by country *i*, type of investor *k* and time *t*. Dependent variables Y_{ikt} are the same as the ones used in equation (18) and vary based on country *i*, type of investor *k* and time *t*. Values of each category included in equation express the difference from a reference category, therefore, value of $Non\_inst\_crisis_{ikt}$ shows how non-institutional network measures differ from institutional network measures during crisis. The gap is evaluated comparing results in regression (18) and category $Non\_inst\_crisis_{ikt}$ in regression (19). Institutional investors in period 2007-2009 accounted for more total equity flows than in general (Table 6), hence, the gap in both node in-strength and out-strength have to be significantly higher. It is also expected that connectedness between countries in institutional network, therefore, even the gap is still higher during crisis. Hoffmann et al. (2013) and Roque and Cortez (2014) find that non-institutional investors do not change their investment behaviour during the financial crisis, while institutional investors prioritize more diversified investments although they occur in less transparent countries, thus, institutional investors should have even more clustered investments than non-institutional investors during crisis. Node degree and node centrality degree measures are correlated, therefore, having higher node in-degree and out-degree, higher node in-degree and out-degree centralities are expected. Weighted in-degree and out-degree centralities also should be much higher in institutional network because they are determined by amount of incoming and outcoming flows. In addition, due to the same issue, in-closeness, out-closeness, betweenness and eigenvector centralities and gap between them should not be significantly different between institutional and non-institutional networks even during crisis.

According Basak and Pavlova (2013), non-institutional investors are more risk averse than institutional investors. Gaudecker (2015) and Campbell (2006) find that even non-institutional investors differ by their willingness to risk. However, Roque and Cortez (2014) highlight that during crisis non-institutional investors are more likely to invest in the same countries, while

institutional investors are less risk averse and during crisis diversify more. Therefore, the third hypothesis assumes that only non-institutional network does not change its structure during crisis.

H3: Institutional (non-institutional) network structure changes (does not change) during crisis period

Hypothesis H3 is tested by two dependence equations – (19) and (20). How institutional network structure during crisis differs from the network structure during growth period is evaluated by differences between reference category $Inst\_crisis_{ikt}$ and category $Inst\_non\_crisis_{ikt}$ in equation (19). The same differences but in non-institutional network are expressed by equation (20):

$$Y_{ikt} = \alpha + \beta * Inst\_crisis_{ikt} + \theta * Non\_inst\_non\_crisis_{ikt} + \gamma * Inst\_non\_crisis_{ikt} + \varepsilon_{ikt} \quad (20),$$

where a reference category is $Non\_inst\_crisis_{ikt}$. The differences are calculated between the reference category $Non\_inst\_crisis_{ikt}$ and category $Non\_inst\_non\_crisis_{ikt}$. Y_{ikt} is the same dependent variables measured in three dimensions: country *i*, type of investor *k* and time *t*.

It is assumed that institutional investors significantly reduce the number and amount of equity flows in other countries (node out-degree and out-strength) during financial crisis. In the same manner, equity issuers receive less and smaller amount of investments (node in-degree and in-strength). Given that based on Sh. Zhang et al. (2016) findings investment flows decrease, clusters also should shrink. Hence, certain countries in clusters become non-attractive and investors withdraw their investments, except those who lose investments where companies are insolvent. However, when cluster shrinks, its level of completeness should increase but if one part of countries are not totally disconnected, the level of cluster completeness should decrease, therefore, clustering coefficient should not change significantly. The central institutional network countries including their financial partners (eigenvector centrality) are expected to reduce both quantity and volume of inflows and outflows (in-degree and out-degree centrality, weighted in-degree and out-degree centrality) since they are the same (based on Table 5). Even if the quantity and the volume of equity flows are expected to shrink in countries with the highest number of direct links in 2007-2009, countries having shortest path to all other countries (closeness centrality) should not significantly change their position in institutional network. The same is expected from the intermediaries (betweenness centrality).

Based on findings of Hoffmann et al. (2013), it is supposed that the quantity and the volume of investment inflows and outflows do not decrease substantially in non-institutional network during crisis – non-institutional investors should not change their investment strategies significantly. In the same manner, clusters and their central countries should not have many changes. Even slighter changes should occur in central countries having the most influential indirect links (measured by closeness centrality) because these countries are less dependent from direct

equity flows. Intermediaries should remain the same because changes in equity flows are small. Countries having the highest number of partners (degree centrality) and their financial partners (eigenvector centrality) are also assumed to have insignificant changes in equity inflows, outflows and number of partners. Hence, non-institutional investment network should not change its pattern significantly during crisis.

One of the most important factors, which influence optimal portfolio formation, according Markowitz (1952), is return and riskiness of the asset. Pyun (2016) finds that institutional and non-institutional investors differ not only by scope of investment but are also influenced by different investment factors. Nevertheless, both institutional and non-institutional investors should react negatively to increased stock market risk. According Roque and Cortez (2014), non-institutional investors prefer more transparent and less geographically distant countries. Therefore, it is probable that non-institutional investors choose closer countries even if they are riskier.

H4: Stock market and country riskiness has a negative impact on the structure of institutional and non-institutional networks during growth period and negative (no) impact on the structure of institutional (non-institutional) networks during crisis

This hypothesis is expressed by equation:

$$Y_{ikt} = \alpha + \beta * Crisis_t + \gamma * Stock\ market\ volatility_{it} + \delta * Stock\ market\ volatility * Crisis_{it} + \omega * Exchange\ rate\ volatility_{it} + \theta * Exchange\ rate\ volatility * Crisis_{it} + \vartheta * P\_debt\_to\_GDP_{it} + \tau * P\_debt\_to\_GDP * Crisis_{it} + \varepsilon_{ikt} \quad (21),$$

where Y_{ikt} denotes measures of institutional or non-institutional network structure. Both networks are analysed separately and equation (21) depicts equity market/country risk impact on both networks during growth period and crisis. $Crisis_t$ is a dummy variable that varies through time and is equal to 1 when there is crisis, 0 otherwise. $Stock\ market\ volatility_{it}$ is a stock market volatility variable in country i and time t when there is no crisis. $Stock\ market\ volatility * Crisis_{it}$ is a stock market volatility in country i and time t when there is crisis. The same logic is applied to exchange rate volatility and public debt to GDP variables. Results of Cai et al. (2017) and Bekaert et al. (2014) are in favour of "wake-up call" hypothesis – investors reconsider the riskiness of countries based on their macroeconomic factors. Cai et al. (2017) find stock market volatility and exchange rate volatility as significant factors, while Bekaert et al. (2014) concentrate more on country risk factors which are also found significant – political stability, sovereign ratings, current account, unemployment rate, government budget. In the thesis, stock market riskiness is expressed by stock market volatility and currency exchange volatility and country risk is expressed by public debt to GDP which is a substitute to sovereign ratings.

Stock market volatility is predicted to have a negative influence on centrality measures (DC-in, DC-out, WDC-in, WDC-out, CC, BC). ND-in, NS-in are expected to have negative relation

with stock market volatility because very high volatility countries are less liquid and peripherical. Since clustering coefficient shows connectedness degree in a cluster, the more financial partners are involved in a cluster, the higher volatility should be. Other variables, which are found to have impact on equity returns, hence, on the equity flows too, are stock market determinants making the equity investment riskier. Ang and Bekaert (2002) find that international diversification still has a positive value for international portfolios if the currency exchange rate risk is hedged. The higher exchange rate spread is related to lower currency liquidity. Hence, exchange rate volatility should have a negative influence on node degree and centrality. As Baumöhl et al. (2018) notice, increase in foreign exchange volatility shifts investment in less volatile equity markets. Public debt to GDP measures the probability of government to go default. If the ratio is higher than 1, it is probable that government could pay its debts only by taking another debts, thus, when default risk inceases, investors should invest less, except the cases when they are extremely willing to risk. Therefore, high indebtedness should negatively affect the number of links (NDin), volume (NSin) and position of the country in the whole equity market because with a higher default rate country becomes less attractive and more distant from financial centre (DCin, WDCin, CC, BC). Investments from countries with increasing default risk are also decreasing, thus, the number of financial partners and volume should decrease. As a consequence, their position in the institutional network (DCout, WDCout, CC, BC) should be more pheripherical. Being less rational, non-institutional investors should prefer less distant countries even when a country is riskier than others, hence, public debt to GDP is expected to have no impact on the choice of non-institutional investors.

Bae and Zhang (2015) find that equity prices in financial markets of more integrated emerging countries are more volatile during financial crisis. Hence, central countries should have less volatile markets, except developed countries with high sovereign debt. Bekaert et al. (2014) find that politically and financially riskier countries with high budget deficits are exposed to higher degree of contagion. Hence, it is more likely that equity markets with higher public debt to GDP could be developed but less central in a whole equity network. Mun (2008) analyse correlation of stock market volatility and foreign exchange rate volatility during Asian crisis in 1997. Countries with higher stock market volatililty also experienced higher foreign exchange rate fluctuations. In addition, the risk of foreign exchange rate is negatively related to the country's credit ratings (Patro, Wald and Wu, 2002). Therefore, countries with a higher default risk are exposed to higher foreign exchange rate risk. Stock market volatility, high public debt to GDP and foreign exchange rate volatility should have a negative influence on network connectedness. Bekaert et al. (2014) argue that financial links have significant impact on contagion. As a result, stock market and currency exchange rate volatilities are supposed to be insignificant investment determinants during crisis,

however, public debt to GDP should have negative impact on all network measures (in non-institutional network public debt to GDP should not make any impact).

Hypothesis H3 and H4 have sub-hypotheses which are presented in Table 12. Each sub-hypothesis (Table 12) or hypothesis consists of 13 regressions with 1 dependent variable (Table 13). Predictions of these variables are summarized in Table 13.

Table 12
Sub-hypotheses

Hyp.	Sub-hypothesis
1, 2	-
3	1: Non-institutional network structure does not change during crisis
	2: Non-institutional network structure changes during crisis
4	1: Stock market and country riskiness negatively affects institutional network connectedness in growth period
	2: Stock market and country riskiness negatively affects institutional network connectedness during crisis
	3: Stock market and country riskiness negatively affects non-institutional network connectedness in growth period
	4: Stock market and country riskiness do not affect non-institutional network connectedness during crisis

Rejection of hypothesis is based on p-value test. The level for non-rejection is 5%. Thus, the H0 hypothesis is rejected if p-value is > 0.05. Hypotheses H1, H2 and sub-hypotheses H3.1, H3.2 are rejected if more than a half (7) regressions are statistically insignificant. Hypothesis is not rejected if all sub-hypotheses are not rejected. In hypothesis H3 two sub-hypotheses have to be not rejected and in hypothesis H4 four sub-hypotheses have to be not rejected. In addition, in all sub-hypotheses in hypothesis H4 regressions are statistically significant if at least one independent variable has a significant impact on dependent variable.

Table 13
Prediction of sub-hypotheses

No	Dependent variable	Hypothesis							
		H1	H2	H3		H4			
				H3.1	H3.2	H4.1	H4.2	H4.3	H4.4
1	ND in	$\beta > 0$	$\beta > 0$	$\beta < 0$	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$
2	ND out	$\beta > 0$	$\beta > 0$	$\beta < 0$	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$
3	NS in	$\beta > 0$	$\beta > 0$	$\beta < 0$	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$
4	NS out	$\beta > 0$	$\beta > 0$	$\beta < 0$	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$
5	NC	**$\beta = 0$**	$\beta > 0$	**$\beta = 0$**	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$
6	DC in	$\beta > 0$	$\beta > 0$	$\beta < 0$	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$
7	DC out	$\beta > 0$	$\beta > 0$	$\beta < 0$	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$
8	WDC in	$\beta > 0$	$\beta > 0$	$\beta < 0$	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$
9	WDC out	$\beta > 0$	$\beta > 0$	$\beta < 0$	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$
10	CC in	**$\beta = 0$**	**$\beta = 0$**	**$\beta = 0$**	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$
11	CC out	**$\beta = 0$**	**$\beta = 0$**	**$\beta = 0$**	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$
12	BC	**$\beta = 0$**	**$\beta = 0$**	**$\beta = 0$**	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$
13	EC	**$\beta = 0$**	**$\beta = 0$**	$\beta < 0$	$\beta = 0$	$\beta < 0$	$\beta < 0$	$\beta < 0$	$\beta = 0$

Although the analysis ends up with certain outcomes, it is important to take into the consideration the limitations which in this study are unavoidable because the CPIS database is based on voluntary reporting and data for certain equity holder sectors are not available. Disaggregating data by the type of investor, financially more active countries (districts), such as Canada, China (Mainland), China (Hong Kong), Luxembourg, Singapore, Saudi Arabia, the United States and financially less active Gibraltar, Malta, Mauritius, New Zealand, Panama and Philippines in 2015 are removed, in total accounting 13 countries. In 2008, the number of countries which provide only aggregated data by country is even higher (24) including non-mentioned Aruba, Bahamas, Belgium, Brazil, Estonia, Iceland, Ireland, Isle of Man, Korea, Latvia, Poland, Slovak Republic and Switzerland. In addition, some countries, for example, Malta, provide precise data for aggregated investments in only half or less countries because investment flows in some countries are confidential (Appendix 6). The problem is that most of these countries are important in the process of network formation (the United Kingdom, Australia and Spain). As a result, the data is not precise given that in many countries the links disappear only because the data is confidential or not available. Removal of these countries from the network entails the digression from the real network. In addition, period of analysis is 2001-2016, however, stock market volatility is available from 2001 to 2015 as well as public debt to GDP. Public debt to GDP also does not contain all countries which are analysed. As a result, different data availability can cause differences in strength of relationship between dependent and independent variables. Because prior 2014 the data for the United States is not available, changes in the network structure should be interpreted carefully.

Total equity inflows and outflows increase basically due to investments generated by institutional investors. However, non-institutional investors invest in different developing countries increasing connectedness of total international equity investment network. The differences between institutional and non-institutional investors are assessed using network methodology and testing its measures using panel regressions. Each hypothesis test 13 network measures. In addition, hypotheses test general differences between institutional and non-institutional networks, gap differences between institutional and non-institutional networks during crisis, crisis impact on internal structure changes in both networks and their sensitivity to stock market and country riskiness. The results of analysis are presented in the third part of the thesis.

III. ASSESSMENT OF INTERNATIONAL EQUITY INVESTMENT CONNECTEDNESS WITH RESPECT TO INSTITUTIONAL AND NON-INSTITUTIONAL INVESTORS

This part of the thesis is dedicated to empirical analysis. It contains analysis of the network statistics showing general pattern of institutional and non-institutional networks and statistical analysis needed to check four hypotheses. First hypothesis check whether institutional network differs from non-institutional network; second, if crisis change the gap between institutional and non-institutional network structures; third, whether crisis induce internal network structure changes in respect of institutional and non-institutional investors; fourth, if stock market and country riskiness make significant impact on international equity investment connectedness with regard to institutional and non-institutional investors during growth period and crisis. Finally, the results are compared with findings of other papers.

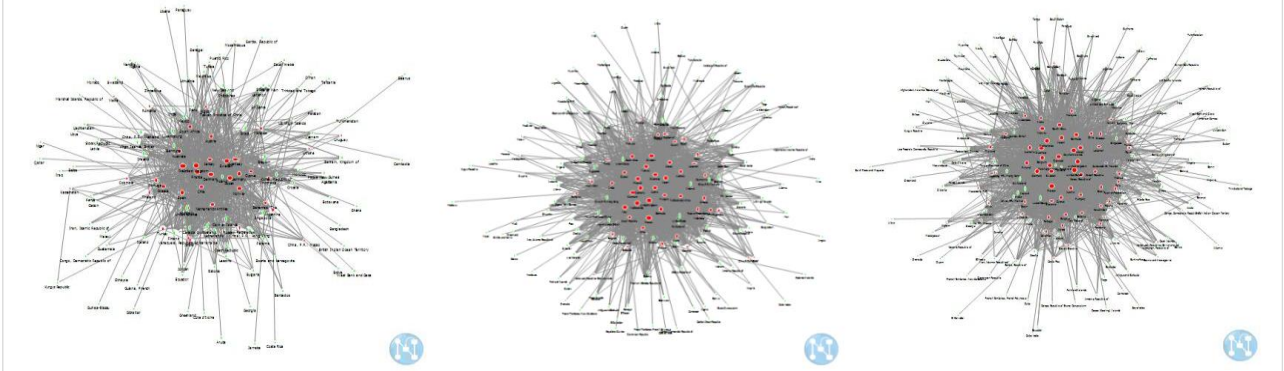
3.1 General differences between international equity investment connectedness with respect to institutional and non-institutional investors

This section is dedicated to analysis of general network statistics which are compared between institutional and non-institutional networks. In sub-section 3.1.1 institutional and non-institutional network measures, which give an idea how networks are formed, are compared. If networks are, in general, significantly different is analysed in sub-section 3.1.2.

3.1.1 Differences between international equity investment connectedness with respect to institutional and non-institutional investors

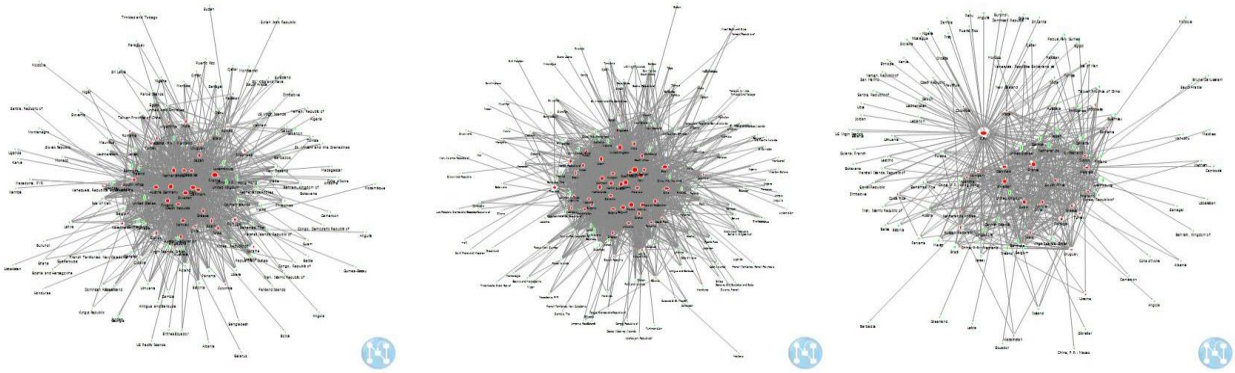
Globalisation and internationalisation processes encompass both economies and their financial markets. The positive internationalisation trend in equity markets is observed in the whole period of analysis (Figure 5). As a starting point, year 2001 is determined by few central countries receiving and generating equity flows. Other three fourth of countries are not active international equity investment network participants given that only receive investments. Although non-institutional network account for a smaller number of links than institutional network, both networks are expanding during crisis. In addition, aforementioned networks are characterized by asymmetry (investing countries vary from 28 to 68, while issuing countries from 123 to 194), hierarchy (see Figure 1 and 5) and incompleteness. The latter aspect is driven not only by the network structure itself but also because such countries as Luxembourg, Switzerland, Canada do not report disaggregated international equity investment flows, the United States provide this data only

from 2014 meanwhile the United Kingdom restrict data due to confidentiality. Nevertheless, this drawback is less relevant to the total network density.



2001 **2008** **2016**

Institutional equity investment networks



2001 **2008** **2016**

Non-institutional equity investment networks

Figure 5. Structure of international equity investment networks with respect to institutional and non-institutional investors in 2001, 2008 and 2016

Note: both institutional and non-institutional networks are becoming denser and more centralised.

Authors analysing partial international investment network (Schiavo et al., 2010; Chinazzi et al., 2013; Chuluun, 2017) find it dense. However, the same results are not applied examining international equity investment network including all countries related to equity flows (receivers, investors or both) inasmuch as the density of the network sharply decreases. Besides institutional and non-institutional networks are far from being complete (Figure 6), institutional investors obtain more partnerships in the whole world than non-institutional investors as a result of increased portfolio diversification in developing countries. Furthermore, a significant outcome is revealed comparing Figures 6 and 7 – both types of investors prefer maintaining their financial partners during crisis even though distributing less funds than usual. Given that the financial partners are considered in macro level (countries), connections in micro level could have different patterns, for instance, investments occurring in less companies (due to bankruptcy) or investments diversified in more companies which is less probable taking into consideration taxation.

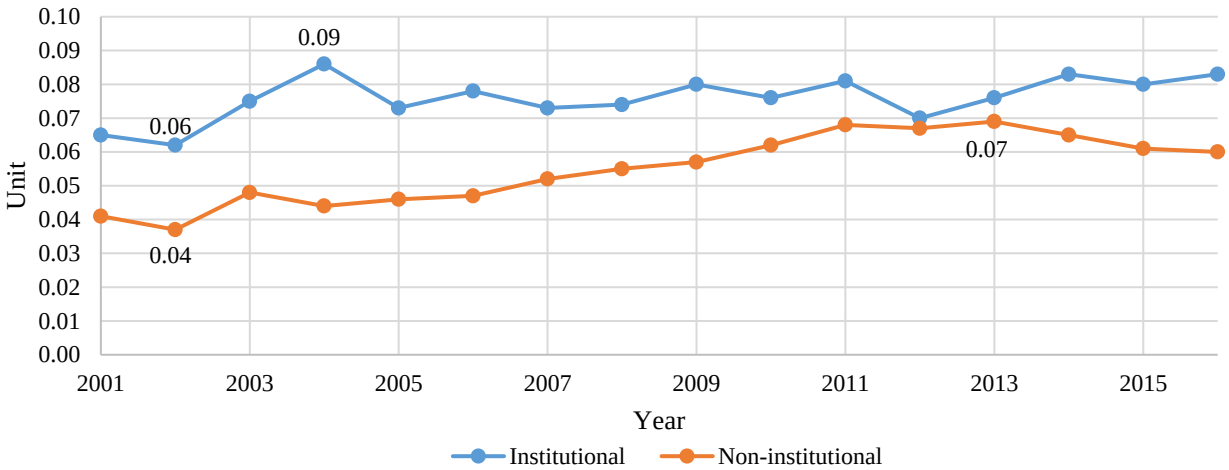


Figure 6. Network density with respect to institutional and non-institutional investors, 2001-2016

Note: completeness of both networks is low because all countries, related to equity inflows or outflows, are included. Crisis does not make impact on the number of financial connections.

Development of the network strength should be interpreted rigorously (Figure 7) because including the United States which is the largest equity issuer and holder in 2014, the value of the whole network strength drastically increases. Therefore, institutional network strength should fluctuate from 300 to 400 with a decrease in 2008 as in equity flows (see Table 5 for total equity flows). Strength of non-institutional network does not change much even with the United States demonstrating that non-institutional investors generate only a small part of the United States, as well as other developed countries, investments.

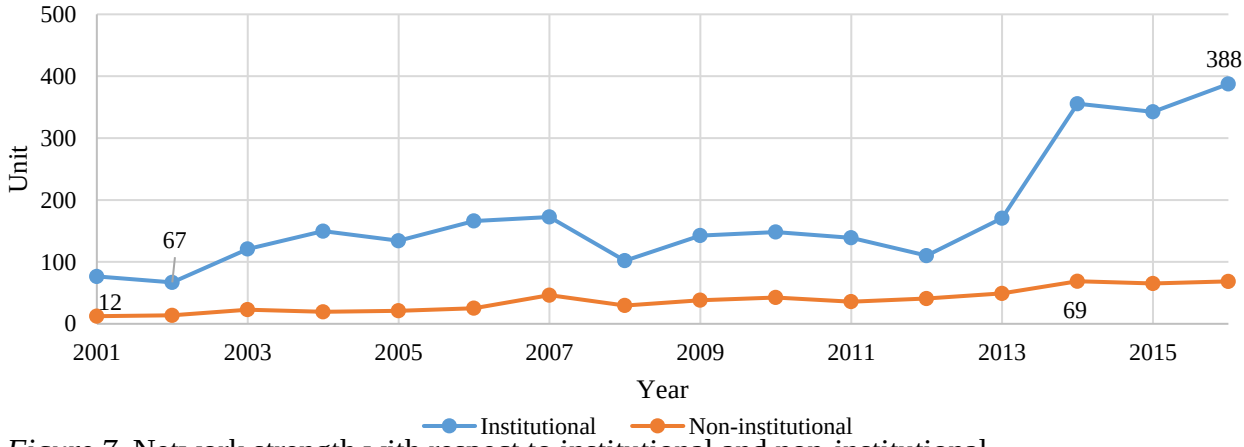


Figure 7. Network strength with respect to institutional and non-institutional investors, 2001-2016

Note: volume of non-institutional network is low. The inclusion of the United States in 2014 does not change significantly the volume. However, institutional network has significant changes in 2014. Still, the pattern of the network remains the same (see Table 7). Given that a strength is a measure of a valued density, crisis has a negative impact on this measure.

Despite of a great funding inequality, both types of investors form rather similar clusters (Figure 8). The probability that two countries are a part of the group determined by a high connectedness, on average, is between 50% in 2001 and 58.7% in 2009. Even though clusters get a form of a clique and a star, the higher coefficient is also related to increased number of reporting

countries (Table 10). Turning to non-institutional investors, their clusters are growing faster as a result of poor financial connectedness, on the other hand, reacting more sensitively to financial crisis. The sensitivity can be explained by the fact that in growth period countries within clusters obtain bilateral financial links with less connected countries, while during crisis investment flows become unilateral and clusters get more centralised. Such features as higher risk aversion, lower financial education and amount of funds could be a driving force lowering non-institutional network connectedness. However, this tendency cannot be observed among institutional investors because they prefer higher connectedness within clusters even during crisis.

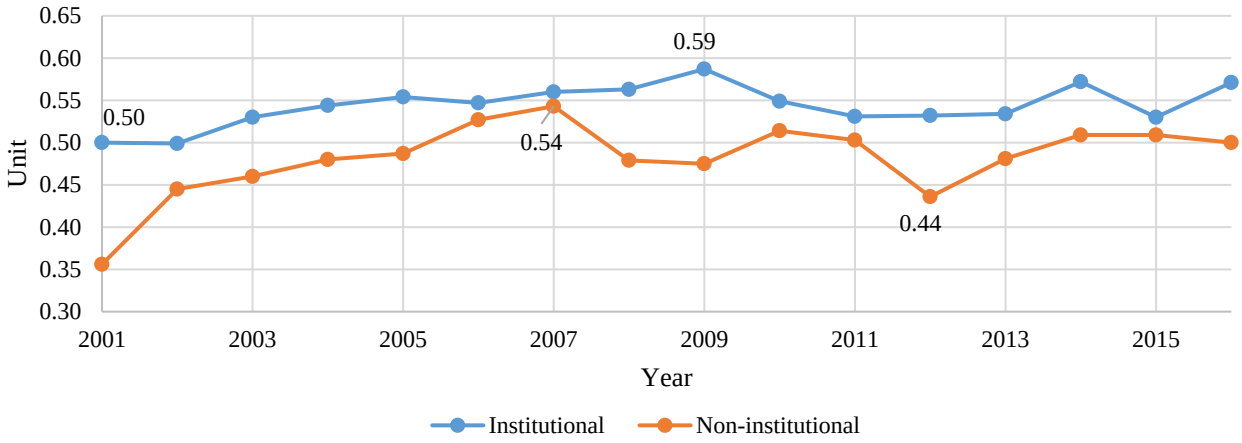


Figure 8. Network clustering coefficient with respect to institutional and non-institutional networks, 2001-2016

Note: there are few differences between institutional and non-institutional networks: clusters in institutional network are denser and countries join clusters even during crisis. Non-institutional investors, instead, reduce the number of partnerships within clusters.

Centrality measures give information about international equity investment market concentration. In-degree centrality has the same positive trend for both institutional and non-institutional investors (Table 14). Concentration is low but increasing, hence, countries, having direct influence on the highest number of links, extend their circle of partners. Out-degree centrality has an opposite direction – outgoing equity flows are more concentrated but the concentration is decreasing, therefore, central countries lose their influence on directly connected countries. Taking into consideration that not all countries provide disaggregated investment flows, fluctuations in centrality measures should be interpreted with caution. Weighted degree centrality shows a different aspect of centralisation – when the number of links are becoming less dependent on the few largest equity markets, the concentration of volume is increasing. To be more specific, the biggest equity markets receive and generate higher and higher investment flows. In addition, crisis makes the same impact on weighted in-degree and out-degree centralities as on clustering with a higher negative effect on non-institutional network.

Turing to indirect centrality, institutional and non-institutional investors have low closeness centrality measures but the in-closeness centrality is almost two times higher (opposite to

CD-in and CD-out), as a consequence, the network is more indirectly connected through incoming equity flows. Countries with the highest out-closeness centrality could have only a minor effect on other countries and this probability is decreasing. Betweenness centrality measures in both institutional and non-institutional networks are low, therefore, the probability that all equity flows pass through one country connecting different clusters, in many cases, is lower than 5%, hence, one country that is between two important clusters has a very low probability to disrupt equity flows in the whole network. Eigenvector centrality is measured for each node, thus, summary statistics are not presented.

Table 14

Summary of network centrality statistics with regard to institutional and non-institutional investors

Panel A: Institutional investors							
Year	***DCin***	***DCout***	***WDCin***	***WDCout***	***CCin***	***CCout***	***BC***
2001	17.4%	59.9%	322351	383909	22.8%	**15.6%**	3.3%
2002	**16.9%**	55.0%	**282073**	**312134**	**20.4%**	12.1%	3.7%
2003	19.9%	57.3%	513773	415594	24.4%	14.1%	3.5%
2004	21.1%	57.8%	580749	453082	24.1%	14.4%	3.9%
2005	21.6%	57.1%	596737	541785	26.9%	14.7%	2.9%
2006	21.1%	53.2%	702245	748820	26.1%	11.3%	3.5%
2007	18.5%	58.1%	682964	677841	21.5%	10.2%	4.2%
2008	**20.5%**	**56.5%**	**426130**	**312216**	**25.6%**	**11.2%**	**3.4%**
2009	21.1%	**60.6%**	610072	460247	25.9%	11.8%	4.7%
2010	20.0%	52.1%	654967	545512	23.8%	**9.9%**	**2.4%**
2011	22.5%	52.6%	656509	523921	27.4%	13.1%	3.7%
2012	21.0%	54.9%	528016	342252	25.5%	13.7%	3.7%
2013	22.7%	56.3%	862689	708471	27.0%	13.4%	4.2%
2014	24.4%	54.0%	990623	3107151	27.2%	13.1%	5.7%
2015	**24.6%**	53.1%	974330	3040184	**27.8%**	12.6%	**6.0%**
2016	23.3%	**50.1%**	**1310391**	**3194935**	25.9%	11.2%	2.9%
Panel B: Non-institutional investors							
Year	***DCin***	***DCout***	***WDCin***	***WDCout***	***CCin***	***CCout***	***BC***
2001	16.4%	77.0%	**71139**	**84042**	23.3%	**20.6%**	5.8%
2002	**12.4%**	63.2%	91114	92926	**14.5%**	10.8%	6.0%
2003	14.2%	64.6%	135159	129718	15.6%	11.5%	**6.1%**
2004	16.5%	55.0%	143526	134282	21.3%	12.1%	4.1%
2005	15.3%	**69.1%**	152796	139482	20.1%	12.7%	3.8%
2006	15.2%	66.2%	209422	168745	18.6%	12.3%	3.8%
2007	14.3%	63.3%	469657	276827	17.5%	10.2%	2.9%
2008	**16.6%**	**60.9%**	**268230**	**224161**	**21.0%**	**11.3%**	**5.0%**
2009	17.6%	55.3%	322255	248590	21.0%	8.9%	3.7%
2010	17.6%	53.8%	327403	242209	21.9%	9.0%	3.5%
2011	18.8%	59.0%	279505	198888	22.7%	11.1%	4.4%
2012	18.3%	55.8%	335448	221487	22.0%	10.1%	3.8%
2013	**19.6%**	47.9%	431980	245071	**24.8%**	10.2%	**2.3%**
2014	18.0%	55.5%	416794	432326	19.5%	9.8%	4.6%
2015	17.5%	53.0%	412342	435383	19.1%	9.7%	4.6%
2016	17.2%	**47.4%**	**427163**	**454628**	19.2%	**7.9%**	3.7%

Note: both networks share mostly the same qualities: issuing countries extend the number of partners but central investing countries lose their position, investment inflows and outflows are increasing, issuing countries have a shortest path to all other countries than investing countries. In addition, probability that all investment flows pass through one country is very low and decreasing through time.

Institutional and non-institutional networks share partially the same trends: countries extend their number of partners, total equity investment flows, are likely to form clusters but only non-institutional investors weaken clustering during crisis. The highest centralisation degree appears among investing countries. Hence, there are few main investing countries having the highest number of direct links, e.g. affect direct partners. Adding weight to these connections, differences between centralisation of ingoing and outgoing equity flows in non-institutional network are almost vanished. In addition, strength and weighted degree centrality in non-institutional network is less affected by discrepancies caused by missing data. Moreover, the probability that countries can make influence on the whole network through indirect links is not more than 27.8% in institutional network and 24.8% in non-institutional network in period 2001-2016 and the probability that all investment flows from one cluster to another pass through one country is even lower.

3.1.2 Significance of differences in international equity investment connectedness with respect to institutional and non-institutional investors

Trend graphs and a table representing institutional and non-institutional network indicators give an understanding how network statistics are changing during the period of analysis and diverge between different types of investors. Although institutional and non-institutional networks in some part differ by their characteristics, flows are related positively (Figure 9) and the distribution of values has a form of "V" because the dataset has a time variable (2001-2016).

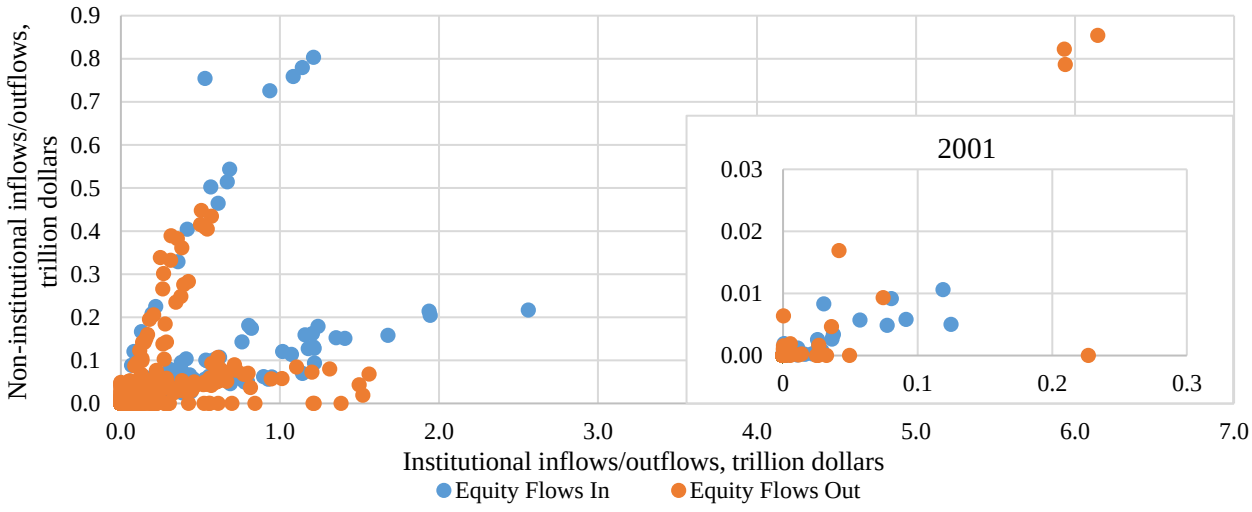


Figure 9. Relation between institutional and non-institutional flows, 2001-2016

Note: red dots represent a total amount of investments of each country in period 2001-2016. Blue dots express a total amount of investments that each country received in period 2001-2016. Relationships get a form of letter "V" because analysis consists of 16 years. A subsample is in a lower right corner, which shows how looks a distribution of equity flows analysing it year per year (relationship is rather linear for both equity inflows and outflows).

Inflows and outflows in each year have a certain relationship, as an example, year 2001 is given: values are less distributed and have rather linear trend. Therefore, differences between each

year trend are determined by degree of inclination – having a constant amount of institutional flows, non-institutional flows are increasing or decreasing and vice versa. In addition, institutional and non-institutional measures are correlated but their correlation changes over time. Correlation coefficients of all network measures are positive (Figure 10), hence, institutional and non-institutional investors, in general, share the same equity investment network formation tendencies.

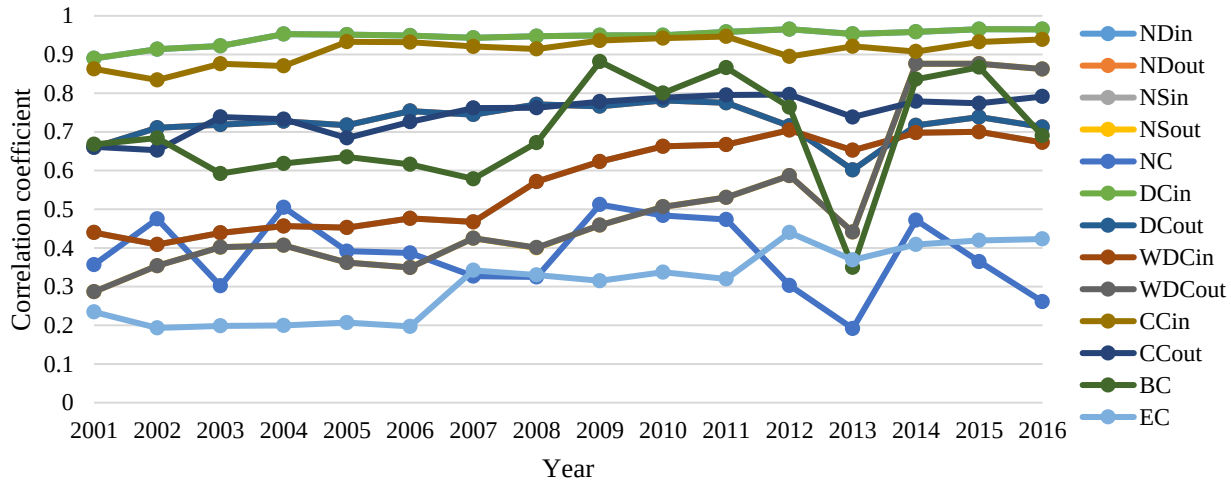


Figure 10. Correlation coefficients of measures in different networks with regard to institutional and non-institutional investors

Note: correlation coefficients between institutional and non-institutional network measures are calculated for each year in period 2001-2016 using panel data. All coefficients are positive. ND-in has the same coefficients as DC-in, ND-out as DC-out, NS-in as WDC-in, and NS-out as WDC-out, therefore, only 9 of 13 variables are visible in the graph. Since equity inflows and outflows are closely related to the node strength measure (correlations are the same), their correlation coefficients are excluded. DC-in and CC-in obtain the highest correlations (from 0.89 to 0.97 and from 0.83 to 0.95 accordingly).

Institutional and non-institutional investors choose neighbour countries on the different basis, therefore, clustering coefficient has the most volatile trend. However, investors start to use the same investment strategies because correlation of other measures increases in period 2001-2016. Node in-degree, in-degree centrality, in-closeness centrality measures have the highest correlation coefficients and in 2016 they almost reach the perfect correlation (0.97, 0.97, 0.94 accordingly)[9]. Put it differently, institutional and non-institutional investors share the same tendency to invest in similar number (ND-in), the same type of countries (DC-in) giving their preferences to the most central countries (CC-in). During crisis, correlation decreases between these network measures: node out-strength, weighted out-degree centrality, clustering coefficient, in-closeness centrality and eigenvector centrality. It demonstrates that institutional and non-institutional investors are influenced by different additional factors or some of characteristics determining investment direction and quantity (NS-out) during crisis. Consequently, the main investing countries (WDC-out), CC-in countries, countries having important neighbours (EC) and clusters (NC) in institutional and non-institutional networks are less related. Institutional and non-institutional investors also

[9] Note: node in-degree, in-degree centrality was highest in 2012/2015 with a value of 0.9654. In-closeness centrality correlation was highest in 2011 with a value of 0.9465.

form different communities. Although the centres of communities are the United States, Europe and Arabian Peninsula countries, their partners vary across time (Table 15).

Table 15

Summary of community statistics in international equity investment networks with respect to institutional and non-institutional investors

Year			2001	2006	2007	2008	2009	2010	2016
Communities	Institutional investors	United States	55	56	68	69	67	92	130
		Europe	78	75	83	69	54	35	35
		Arabian Peninsula	3	30	25	36	53	42	8
		Other	-	-	-	-	-	14	12
	Non-institutional investors	United States	23	36	31	111	97	100	130
		Europe	45	90	101	37	57	57	49
		Arabian Peninsula	13	-	-	-	-	-	8
		Other	43	31	29	3	2	-	-

Note: the dominant communities are the United States community and the European community, however, over the time, both institutional and non-institutional investor prefer obtaining closer relations with the United States.

In 2001, Europe had the largest community in the world, however, it is decreasing because countries obtain closer relationships with the United States. At the beginning, institutional investors from Europe had close connections with most of South and Central American countries, North Africa, Asia and Oceania (see Appendices 8-34). The United States collaborated with Canada, Scandinavian, Eastern European, South African countries and Australia in 2001. However, over time, Central and South American, Far East countries (including China), Russia and Australia have been integrating into the United States community. Furthermore, in 2016, the United States community includes almost the whole world, except few Central American, African, Southern and Eastern European countries. Therefore, Eastern European countries replaced the United States community with the European community. The United Kingdom, instead, joined the United States community (in 2001 was in the European community). Although Arabian Peninsula countries extended their community, mainly, with other Arabian countries, finally, they entered to the United States community. Nevertheless, during crisis period (2007-2009) the United States community did not change particularly but countries of the European community obtained closer relations with Arabian Peninsula countries. Moreover, the fourth community, which does not depend on the geographical proximity, emerges after the financial crisis of 2007-2009 (see Appendices 28, 32).

Non-institutional investors in 2001, practically, did not invest in African countries. Meanwhile, European countries belonged to 3 communities. European countries, except Ireland, the Netherlands, France, Switzerland, Italy, Slovak, Czech Republic, Slovenia and Serbia, had close relationships with Middle East countries, Russia, Thailand, Vietnam, Ecuador and Colombia. The United States formed community with Mexico, Chile, Argentina, China, France, the Netherlands, Switzerland, Hungary and few African countries. In 2001 such countries as Canada, Brazil, Peru, Venezuela, Australia, Indonesia, India and many countries in Africa, Saudi Arabia, which belongs to Arabian Peninsula, had relations with South Africa, Uzbekistan, Singapore, Jersey, Malaysia,

Guernsey and others. As well as in institutional network, the United States attracted South American countries, China, Japan, and other Far East countries, however, non-institutional investors of Arabian Peninsula countries joined the United States earlier than institutional investors. Besides, financial linkages are practically divided into two communities: the United States and Europe. In addition, unlike institutional investors, majority of non-institutional investors during crisis backslide on the European community exchanging it to the United States community. Non-institutional investors in Arabian Peninsula countries re-established closer financial links among themselves in 2016 obtaining a contrarian strategy to institutional investors. Overall, the biggest community in institutional and non-institutional networks is the United States community. Turning to general differences between institutional and non-institutional networks, their statistical significance is presented in Table 16.

Table 16

Test of general differences between international equity investment networks with respect to institutional and non-institutional investors

Y	**ND in**	**ND out**	**NS in**	**NS out**	**NC**	**DC in**	**DC out**	**WDC in**	**WDC out**	**CC in**	**CC out**	**BC**	**EC**
Const	**8.97 *** (10.24)**	**8.97 *** (6.23)**	**6546.69 ** (2.11)**	**6546.69 *** (2.80)**	**0.48 *** (26.15)**	**0.06 *** (11.81)**	**0.06 *** (6.43)**	**39.46 *** (2.87)**	**39.46 ** (2.11)**	**0.12 *** (23.47)**	**0.12 *** (7.64)**	**0.001 *** (4.21)**	**0.48 *** (2.60)**
Inst. invest.	**4.10 *** (11.16)**	**4.14 *** (3.69)**	**25890.89 *** (3.02)**	**25977.53 *** (2.7)**	**0.06 *** (4.07)**	**0.02 *** (7.26)**	**0.02 *** (2.97)**	**143.13 *** (3.04)**	**143.58 *** (2.75)**	**0.040 *** (10.55)**	**0.041 *** (3.79)**	0.0003 (1.35)	0.007 (1.03)

Note: statistically significant at *** 1% level, ** 5% level, * 10% level. Number of observations is 5185, except clustering coefficient where number of observations is 5205. Coefficients present general difference between institutional and non-institutional network measures. Constant expresses the results for non-institutional investors, while independent variable shows the institutional investors' difference from non-institutional investors. All measures are significantly different except BC and EC, therefore, it is possible to claim that institutional network differs from non-institutional network.

Institutional dummy variable is regressed (non-institutional investors are chosen as a reference category) with 13 dependent variables. Dummy coefficient indicates how institutional network measures differ from non-institutional network measures. Constant coefficient expresses an initial slope position when dummy variable is equal to 0. Regressions with random effects are controlled for autocorrelation using Wooldridge test where hypothesis H0 assumes that there is no first order correlation. Since in all cases prob > F = 0.00, except betweenness centrality with prob > F = 0.01, H0 hypotheses for all regressions are rejected (see Appendix 36). Heteroskedasticity is tested using Breusch-Pagan test. All hypotheses H0 assuming that the variance is constant are rejected (except betweenness centrality and clustering coefficient). These regressions are also tested using fixed country and year effects (fixed effects eliminate omitted variable bias when the variable/s is/are constant over time) but hypothesis H0 is still rejected. Having a non-constant variance in standard errors and autocorrelation, all linear regressions are adjusted using double standard error clustering by country and year (237 clusters by country and 16 by year).

Although issuing and investing countries from institutional network obtain similar results (ND-in ≈ ND-out, NS-in ≈ NS-out, etc.), countries in non-institutional network get the same values. The differences between ingoing and outgoing links in regard to non-institutional investors are not observed because the network is smaller – on average countries in non-institutional network are connected to 4 partner countries, while in institutional network to 13 partner countries. Therefore, countries in institutional network are more connected. Institutional network is determined not only by higher density but also by four times more intensive financial flows which, in total, relatively differ in issuing ($25891m) and investing ($25987m) countries. It is as expected because the number of issuing countries is triple comparing with investing ones. Nevertheless, countries in both networks tend to cluster (see Figure 8) but the difference is small – 48 percentage points in non-institutional network and 54 percentage points in institutional network. Furthermore, the highest clustering coefficient is observed in less developed countries (see Appendix 37), for example, such countries in Europe as Lithuania, Norway and Italy, on average, have accordingly 0.72, 0.25 and 0.22 clustering coefficient in institutional network. Central countries obtaining the highest number of financial partners (these countries are the most popular destinations to investment flows, for instance, the United States and the United Kingdom (see Appendix 38)) are likely to have 2 percentage points more connections from institutional investors. In other words, these countries have the highest sensitivity to events occurring in international equity investment network and when they belong to institutional network, the risk is even higher. Countries investing in the highest number of countries (e.g. France) in institutional network are 0.02 more important, therefore, have more influence on other direct financial partners than in non-institutional network.

Institutional central (by inflows) countries are capable to attract higher quantity of investment flows than in non-institutional network ($143m). In addition, financial centres, where institutional and non-institutional investors are residents, also differ by amount of invested funds. Countries having the highest indirect influence from the side of debtor on all other countries in institutional network get a higher in-closeness degree (0.04) than in non-institutional network. The differences in out-closeness and in-closeness centralities are almost the same (0.04 and 0.041), therefore, countries with incoming and outcoming links are equally relevant in institutional network and vice versa in non-institutional network. In addition, network intermediaries do not differ significantly in institutional and non-institutional networks obtaining 0.1 percentage point. The United States, for example, is an important intermediary accounting up to 6 percentage points during period of analysis. Turing to eigenvector centrality, the significant difference between institutional and non-institutional networks in EC is not observed, therefore, both institutional and non-institutional investors prefer the most influential countries – half of neighbours are important in the whole network (0.48 points). Summarizing the results, in 11 regressions the difference between

institutional and non-institutional investors is statistically significant and in 2 regressions the difference is not significant. As a result, **hypothesis H1** is **not rejected**.

Institutional and non-institutional investors distribute their investments in a different manner having more similarities only in betweenness and eigenvector centrality measures. However, it is needed to evaluate whether the same differences remain during crisis and whether crisis have an impact on internal network changes.

3.2 Crisis impact on international equity investment connectedness with respect to institutional and non-institutional investors

Evaluating general differences between institutional and non-institutional investors in Table 16, crisis impact was not considered. Given that financial crisis of 2007-2009 affected global financial, including equity, markets, it could be a relevant explanatory factor inducing changes in international equity investment connectedness. In addition, adding crisis variable into regressions, it is possible to assess changes within and between institutional and non-institutional networks and the gap changes between institutional and non-institutional networks during crisis.

Statistical results on differences between institutional and non-institutional network measures are presented in Table 17. The data is distinguished into four groups: institutional investors during crisis, non-institutional investors during crisis, institutional investors during non-crisis and non-institutional investors during non-crisis. All these groups are dummy variables and get values of 0 or 1 (see hypotheses H2 and H3). Having them separately, it is possible to analyse differences between investors in certain periods. When institutional investors during crisis are chosen as a reference category, the results presented in the table reflect differences from this category. Autocorrelation for regressions in Table 15 is not checked because fixed year effects, first differences or standard error clustering by year in these regressions would eliminate dummy variables which are the same between countries but vary over time. Crisis dummy variable used in regressions share the same qualities as aforementioned dummy variables. However, all regressions are examined for heteroskedasticity (see Appendix 39) – the same issue occurs as in regressions used to check hypothesis H1: clustering coefficient and betweenness centrality data is not heteroskedastic but when country dummy variable is included, the data becomes heteroskedastic. Since standard errors are likely to be autocorrelated, they are clustered by country. Year variable does not have fixed effects given that it would not allow to calculate differences between institutional and non-institutional investors. Country fixed effects are not included due to increased heteroskedasticity which generates unreasonable results, for instance, non-institutional investors invest negative amount of funds both during crisis and growth period (Appendix 40).

Table 17

Test of differences based on financial crisis between and within international equity investment networks with respect to institutional and non-institutional investors

	Inst_crisis				**Non_inst_crisis**				
Y	**Independent variables**				**Independent variables**				
	Const	non_inst_ crisis	inst_non_ crisis	non_inst_ non_crisis	Const	inst_crisis	non_inst_ non_crisis	inst_ non_crisis	Inst (Table 16)
ND in	**13.12*** (14.03)**	**-4.66*** (-9.93)**	-0.06 (-0.22)	-4.03*** (-9.35)	**8.46*** (12.89)**	**4.66*** (9.93)**	**0.62*** (3.00)**	4.60*** (11.41)	**4.10*** (11.16)**
ND out	**13.12*** (6.68)**	**-4.66*** (-3.58)**	-0.01 (-0.02)	-4.03*** (-2.90)	**8.46*** (5.52)**	**4.66*** (3.58)**	0.62 (1.02)	4.65*** (3.88)	**4.14*** (3.69)**
NS in	**24198.48*** (3.35)**	**-18248.37*** (-3.01)**	**10241.56*** (3.73)**	-17514.72*** (-3.05)	**5950.11* (5.52)**	**18248.37*** (3.01)**	733.65 (0.84)	28489.94*** (3.40)	**25890.89*** (3.02)**
NS out	**24198.48*** (3.19)**	-18248.37 (-2.67)	**10349.26** (1.22)**	-17514.72*** (-2.55)	**5950.11** (2.15)**	**18248.37*** (2.67)**	733.65 (0.42)	28489.94** (2.54)	**25977.53*** (2.7)**
NC	**0.57*** (25.22)**	**-0.07*** (-2.92)**	-0.03* (-1.75)	-0.09*** (-4.23)	**0.50*** (22.15)**	**0.07*** (2.92)**	-0.02 (-1.19)	0.04** (2.02)	**0.06*** (4.07)**
DC in	**0.08*** (14.03)**	**-0.02*** (-8.15)**	0.001 (0.59)	-0.02*** (-8.11)	**0.05*** (12.88)**	**0.02*** (8.15)**	0.01 (1.29)	0.02*** (9.73)	**0.02*** (7.26)**
DC out	**0.08*** (6.68)**	-0.02 (-2.75)	0.001 (0.34)	-0.02** (-2.42)	**0.05*** (5.52)**	**0.02*** (2.75)**	0.01 (0.44)	0.02*** (3.04)	**0.02*** (2.97)**
WDC in	**139.21*** (3.35)**	**-101.02*** (-2.90)**	**53.92*** (3.62)**	-99.46*** (-3.02)	**38.18* (1.66)**	**101.02*** (2.90)**	1.57 (0.25)	154.95 (3.27)	**143.13*** (3.04)**
WDC out	**139.21*** (3.19)**	**-101.02*** (-2.58)**	54.48 (1.23)	-99.46** (-2.53)	**38.18** (2.15)**	**101.02*** (2.58)**	1.57 (0.14)	154.95** (2.51)	**143.58*** (2.75)**
CC in	**0.15*** (59.06)**	**-0.04*** (-28.08)**	**0.01*** (7.50)**	-0.03*** (-26.54)	**0.12*** (54.45)**	**0.04*** (28.08)**	**0.004*** (4.84)**	0.05*** (32.24)	**0.04*** (10.55)**
CC out	**0.15*** (8.20)**	**-0.04*** (-2.84)**	0.01 (1.52)	-0.03** (-2.47)	**0.11*** (6.68)**	**0.04*** (2.84)**	0.004 (0.58)	0.05*** (3.94)	**0.041*** (3.79)**
BC	**0.001*** (3.96)**	-0.000 (-0.17)	**0.0002** (2.25)**	-0.0001 (-0.24)	0.001*** (3.81)	0.000 (0.17)	-0.000 (-0.16)	0.0003 (1.44)	0.0003 (1.35)
EC	**0.02*** (3.90)**	-0.01 (-1.24)	-0.0003 (-0.29)	-0.01 (-1.04)	0.01** (2.06)	0.01 (1.24)	0.002 (0.74)	0.01 (1.12)	0.007 (1.03)

Note: statistically significant at *** 1% level, ** 5% level, * 10% level. NS-in, NS-out, WDC-in, WDC-out are expressed in million dollars. Other variables are expressed in percentage points. The number of observations is 5185 for all regressions, except regression where dependent variable is clustering coefficient (5205). Changes in connectedness differences comparing institutional and non-institutional networks during crisis increase (in valued network measures), decrease (in dichotomised network measures) or do not change. Both institutional and non-institutional investors incur minor network changes during crisis, however, the changes are smaller in non-institutional network.

Equity market connectivity changes in both institutional and non-institutional networks during crisis, however, inflows and outflows get the same values. During crisis, institutional investors, on average, invest in 5 countries and $18248m more than non-institutional investors, therefore, the difference between institutional and non-institutional investors increase during crisis. Given that average equity outflows and links decrease, clustering differences are also minor during crisis – they decrease by 1 percentage point. The probability that countries in clusters are linked in institutional network is 0.57, while in non-institutional network is 0.5. Hence, half of countries within clusters are connected in both networks. During crisis, institutional investors diversify their investments by 7 percentage points more within clusters than non-institutional investors.

Nevertheless, they invest even in equity markets that were not considered before – clustering in Europe and its community countries decreases, in the United States community has minor changes, while the Arabian Peninsula community becomes larger and highly clustered (see Appendix 8-34). Therefore, institutional investors during financial crisis additionally diversify their investments into community based on Arab countries. Non-institutional investors, instead, prefer to invest in closer central countries with better economic conditions than others (see correlation between ND-in and NC in Table 18), for example, clustering in African countries, Italy, Spain and Greece decreased, while in the United Kingdom, Germany, France increased.

Central countries are not preferred by institutional and non-institutional investors equally, hence, the gap remains the same, except equity flows. Such equity issuing countries, which have the highest number of partnerships as the United States, the United Kingdom or Luxembourg (see Appendix 38) and such investing countries as France, the United Kingdom or Denmark have more significant role in institutional network. Although these countries remain with the same number of partners, their direct power in institutional network weakens. Therefore, the gap differences in central countries with the highest inflows and outflows decrease. In addition, the same countries have the highest number of links, volume and have the easiest access to all other network participants. Such equity issuing countries as the United States, the United Kingdom and Luxembourg and investing countries as France and Italy do not change their differences in closeness centralities between institutional and non-institutional networks. Intermediaries (the United Kingdom, France, Italy and others) in both financial networks have the same role both during crisis and growth periods. Given that the central countries in institutional and non-institutional networks remain the same, their neighbours do not change significantly (the United States, the United Kingdom in institutional network and Luxembourg, Germany and Italy in non-institutional network). In addition, non-institutional network peculiarity is that Luxembourg, Germany and Italy have the most influential neighbours in the network, thus, these countries are highly affected by such countries as the United States and Belgium. Eigenvector value of Lithuania is 0.0004 and of Norway is 0.008, therefore, the position of the country is determined both by the level of development and rule of law – Norway is more developed but still has a low eigenvector degree because non-institutional investors are not very active in foreign investments. Institutional investors in Lithuania invest in more peripheral equity markets compared with non-institutional investors (eigenvector centrality is lower). Unlike Lithuanian institutional investors, Norwegian investors diversify their portfolios more in larger financial markets. As can be seen, although the relationship is not statistically significant, each country has its own qualities. Summarizing the results, **hypothesis H2** is **not rejected** because 8 of 13 regressions on different network measures show significant changes in gap between institutional and non-institutional networks.

Institutional and non-institutional networks are determined by various measures and they are correlated, even though, the magnitude differs by the type of correlation. Correlation between ND-in and ND-out in institutional network is high – countries are likely to have ingoing and outgoing financial links (Table 18). To be more specific, investment inflows and outflows are highly positively correlated. Issuing countries obtain the central position in the network by having more ingoing links. The same logic is applied to investing countries. In addition, a higher number of outgoing links is highly correlated with betweenness centrality. Therefore, whether a country becomes an intermediary is determined by the number of outgoing links and less likely by ingoing links. Intermediaries are also, mostly, central by outgoing links. To have highly important neighbours, country has to have rather higher number of ingoing links, flows and be central by WDC-in. If countries have the highest number of ingoing or outgoing links, it is very probable that they have the closest financial linkages with other countries. Because correlation is a two-way relation, it does not consider the direction of the relationship. Non-institutional investors act as institutional but eigenvector centrality does not have very high correlation with other network measures.

Table 18

Summary of network measures correlations within international equity investment networks with respect to institutional and non-institutional investors

		Results for non-institutional network											
		ND in	**ND out**	**NS in**	**NS out**	**NC**	**DC in**	**DC out**	**WDC in**	**WDC out**	**CC in**	**CC out**	**BC**	**EC**
Results for institutional network	**ND in**		0.47	0.36	-	0.11	1.00	-	0.35	-	**0.90**	-	0.37	0.36
	ND out	0.64		-	0.49	-0.25	-	1.00	-	0.51	-	**0.90**	**0.75**	0.32
	NS in	0.53	-		0.15	0.00	0.34	-	1.00	-	0.33	-	0.10	0.64
	NS out	-	0.41	0.64		-0.11	-	0.47	-	1.00	-	0.35	0.54	0.53
	NC	0.04	-0.30	-0.08	-0.12		0.11	-0.25	0.00	-0.11	0.19	-0.23	-0.19	-0.07
	DC in	1.00	-	0.51	-	0.04		0.45	0.35	-	**0.88**	-	0.39	0.37
	DC out	-	1.00	-	0.39	-0.30	0.54		-	0.49	-	**0.90**	**0.77**	0.33
	WDC in	0.54	-	1.00	-	-0.08	0.52	-		0.14	0.32	-	0.10	0.66
	WDC out	-	0.43	-	1.00	-0.12	-	0.41	0.62		-	0.37	0.57	0.56
	CC in	**0.89**	-	0.17	-	0.13	**0.88**	-	0.51	-		0.33	0.31	0.32
	CC out	-	**0.88**	-	0.28	-0.25	-	**0.89**	-	0.30	0.42		0.59	0.22
	BC	0.46	**0.76**	0.40	0.63	-0.24	0.48	**0.78**	0.41	0.66	0.41	0.60		0.39
	EC	**0.74**	0.45	**0.74**	0.57	-0.15	0.56	0.45	**0.78**	0.60	0.50	0.33	0.63	

Note: $x = 0$ (no correlation), $0 < x \leq 0.2$ (very low correlation), $0.2 < x \leq 0.4$ (low correlation), $0.4 < x \leq 0.6$ (medium correlation), $0.6 < x \leq 0.8$ (high correlation), $0.8 < x < 1$ (very high correlation), $x = 1$ (perfect correlation).

Turning to financial crisis, internal institutional and non-institutional network changes due to crisis are presented in Table 17. When the reference category is inst_crisis, internal changes of institutional network are evaluated comparing the reference category to inst_non_crisis; when the reference category is non_inst_crisis, the differences between the latter category and non_inst_non_crisis are referred to non-institutional network.

Institutional investors during crisis do not change the number of partnerships significantly, however, the inflows decrease less than outflows, therefore, issuing countries are not the same as investing and the latter are affected more by crisis. In contrast to average countries, central investing countries do not reduce significantly their investments, hence, institutional investors incur more loses and invest less from countries in periphery. Although such countries as the United States and the United Kingdom continue investing even during crisis, they get less inflows by $54m and, thus, become less central in the whole network. In other words, institutional network from the side of issuing countries flattens. As can be seen, in-closeness centrality countries are the same as in-degree and weighted in-degree centrality countries (Appendix 38) and their possibility to spread financial contagion decrease during crisis. The number of outgoing links, volume and closeness of such countries as France, the United Kingdom and Japan do not significantly change during crisis. As DC-out and BC are highly correlated, the same countries as the United States, France and Cayman Islands enhance their centrality positions as intermediaries slightly (by 0.02 percentage points). Countries having partnerships with leading equity markets, in growth period, have a tendency to change their circle of partners involving less important network participants, however, these changes are not statistically significant. Although clustering coefficient is higher by 3 percentage points during crisis only at 10% level, it is observed that institutional investors invest more in cluster countries at the same time extending partnerships in other clusters and communities, for instance, Arabian Peninsula. Due to the fact that during crisis institutional network has only partial changes (5 of 13 network measures are statistically significant), **sub-hypothesis H3.1** that institutional network changes its pattern during crisis is **rejected**.

Non-institutional network incurs even less internal changes than institutional network. Significant variables are those which are very highly correlated (ND-in and CC-in). Therefore, countries, in general, have 0.62 less ingoing links and issuing central countries, e.g. the United States, Germany, the United Kingdom and Luxembourg, lower their closeness to other network countries by 0.4 percentage point. Nevertheless, even these changes are not crucial. Non-institutional investors from France, Italy, Germany, Sweden, Denmark, Belgium, Luxembourg, Ireland, Chile and Brazil do not consider crisis as a relevant factor affecting portfolio diversification – they remain loyal to their partners and maintain their central positions in DC-out, WDC-out and CC-out. Finally, countries receiving investments react more to network changes than investing ones because they are more dependent on foreign investors. Although clustering does not change significantly during crisis, it is found that it decreased in Europe, Asia, partially in Africa, Brazil and Argentina, however, such countries as Australia, Canada, Venezuela, Colombia, Chile, Bolivia, Peru became more clustered, hence, countries belonging to the United States community are more likely to invest within clusters. Furthermore, increase in ingoing links is positively but low (0.11,

see Table 16) correlated with clustering, therefore, when countries within clusters obtain more ingoing links it is improbable that the cluster density will increase. Hence, a higher clustering in Arabian Peninsula countries is determined by increased connectedness within the cluster, in other words, non-institutional Arab investors avoid investments in culturally distant countries during crisis. Given that 2 of 13 regressions are statistically significant, it is assumed that the whole non-institutional network does not change its pattern during crisis, as a result, **sub-hypothesis H3.2** is **not rejected**. Because sub-hypothesis H3.1 is rejected, the whole **hypothesis H3** is **rejected**.

Although crisis does not make significant impact on the structure of institutional and non-institutional networks, stock market and country risk determinants should be evaluated as possible contagion channels in institutional and non-institutional networks clarifying whether institutional and non-institutional investors change their risk preferences during crisis.

3.3 Market riskiness impact on international equity investment connectedness with respect to institutional and non-institutional investors

Investment is determined not only by returns and riskiness of an asset itself. In a global market, the country/market riskiness is also relevant because investors have a possibility to choose assets in different foreign markets. The most common aforementioned risk measures are the stock market volatility, exchange rate volatility and country financial risk expressed by the level of public indebtedness to GDP. Average stock market 1-year volatility and stock market 1-year volatility of countries with the highest network centrality values (see Appendix 38) are presented in Table 19.

Table 19

Summary statistics of stock market/country riskiness measures for the main central and average countries: stock market volatility

	US	**UK**	**JP**	**IT**	**FR**	**DE**	**LU**	**CH**	**NL**	**SE**	**CL**	**IE**	**DK**	**Average**
2001	0.22	0.17	0.22	0.22	0.23	0.23	0.22	0.17	0.20	**0.33**	0.15	0.18	0.20	**0.24**
2002	0.22	0.21	0.24	**0.27**	**0.28**	**0.29**	0.21	0.24	**0.29**	**0.33**	0.14	0.20	0.21	**0.24**
2003	**0.25**	**0.25**	0.22	**0.29**	**0.35**	**0.38**	0.20	**0.30**	**0.40**	**0.32**	0.15	0.21	**0.24**	**0.23**
2004	0.15	0.15	0.20	0.17	**0.22**	**0.25**	0.15	0.19	**0.26**	**0.21**	0.14	0.14	0.17	**0.20**
2005	0.11	0.09	0.16	0.11	0.13	0.14	0.11	0.11	0.13	0.15	0.12	0.12	0.12	**0.18**
2006	0.10	0.10	0.16	0.12	0.13	0.14	0.13	0.11	0.12	0.15	0.12	0.13	0.14	**0.19**
2007	0.12	0.13	0.18	0.13	0.15	0.15	0.15	0.14	0.14	0.19	0.15	0.16	0.16	**0.20**
2008	0.21	0.22	**0.26**	0.21	**0.24**	0.22	**0.24**	0.21	0.23	**0.26**	0.22	**0.30**	0.23	**0.23**
2009	**0.40**	0.34	**0.38**	**0.38**	**0.38**	**0.36**	**0.38**	0.32	**0.40**	**0.39**	0.26	**0.46**	**0.37**	**0.34**
2010	**0.26**	0.23	**0.26**	**0.31**	**0.28**	**0.27**	**0.29**	0.20	**0.27**	**0.28**	0.17	**0.32**	**0.27**	**0.25**
2011	**0.19**	0.18	**0.21**	**0.26**	**0.23**	**0.20**	**0.20**	0.16	**0.20**	**0.21**	0.15	**0.24**	**0.20**	**0.18**
2012	**0.21**	0.19	**0.20**	**0.33**	**0.27**	**0.27**	**0.21**	0.19	**0.22**	**0.27**	0.19	**0.22**	**0.21**	**0.19**
2013	0.14	0.14	**0.20**	**0.28**	**0.21**	**0.19**	**0.17**	0.13	**0.16**	**0.18**	0.13	**0.16**	**0.17**	**0.15**
2014	0.11	0.11	**0.22**	**0.21**	0.15	0.14	0.14	0.13	0.13	0.13	0.14	0.15	0.15	**0.15**
2015	0.13	0.13	**0.18**	**0.24**	**0.18**	**0.18**	**0.17**	0.16	0.16	0.16	0.11	**0.17**	**0.17**	**0.16**

Note: average stock market 1Y volatility is calculated using stock market volatility data from World Bank. Average value is highest in 2009 and lowest in 2014. Countries with the highest centrality values, in general, have lower stock market volatility than average but in 2009 the volatility, in many cases, was higher than average, hence, financial crisis makes major financial markets more volatile.

The highest volatility in period 2001-2016 is observed in 2009 in all countries not dependently whether they are central or not. Average stock market volatility in 2009 reaches its highest value (0.34), however, central countries exceed it. In contrary, during growth period (2005-2007, 2014) central countries are less volatile than average. Therefore, they are a good source of portfolio diversification when the equity markets are not affected by crisis, nevertheless, it is better to invest in average countries during financial instability periods. In addition, both stock market turmoil in 2002 and global financial crisis of 2008 lead to higher stock market volatility in central countries but the effect is larger in the latter case. Nevertheless, this tendency is common not only among central countries, for instance, the highest stock market volatility is in Mongolia (1.42) in 2005 and the lowest – in Tanzania (0.02) in 2010 and both countries are not the main equity holders or issuers. In other words, these countries are outliers.

Exchange rate volatility is the most volatile of three measures that are chosen to express the riskiness of an equity market or country. Table 20 reports average exchange rate 1-month volatility and exchange rate 1-month volatility in central countries. The 1-month volatility is selected given that it is the most significant factor regressing dependent variables comparing to other exchange rate volatilities but not significantly more correlated among other regressors (see Appendices 41-42).

Table 20

Summary statistics of stock market/country riskiness measures for the main central and average countries: exchange rate 1M volatility

	IT FR DE LU NL IE euro	**UK pound**	**JP yen**	**CH franc**	**SE krone**	**CL peso**	**DK krone**	**Average**
2001	**11.39**	8.04	10.04	**11.23**	**11.76**	7.95	**11.09**	**10.08**
2002	**8.92**	6.57	**9.51**	**9.77**	**9.74**	**9.03**	**8.90**	**8.24**
2003	10.02	7.68	8.04	**11.23**	**10.85**	8.01	9.97	**10.03**
2004	**10.30**	**9.78**	**9.10**	**11.73**	**11.26**	**11.08**	**10.30**	**8.59**
2005	**8.86**	8.00	8.55	**9.61**	**10.00**	**8.90**	**8.92**	**8.61**
2006	7.58	7.54	**8.02**	**8.56**	**9.61**	6.64	7.54	**7.61**
2007	5.85	6.62	8.76	6.71	8.36	5.48	5.84	**6.30**
2008	12.50	11.93	**14.99**	13.53	**15.37**	**15.31**	12.55	**13.86**
2009	**12.33**	**13.82**	**12.93**	**12.99**	**20.17**	**12.01**	**12.33**	**11.72**
2010	**11.42**	**9.84**	**10.15**	**10.09**	**13.82**	9.74	**11.47**	**9.94**
2011	**11.59**	8.28	8.89	**14.84**	**15.53**	**11.21**	**11.68**	**8.98**
2012	**8.10**	6.28	6.95	**7.99**	**9.79**	**8.37**	**8.08**	**7.91**
2013	7.18	7.22	**11.70**	**8.33**	**10.19**	7.27	7.16	**7.59**
2014	5.65	5.32	**6.89**	**6.38**	**7.94**	**8.03**	5.66	**6.30**
2015	**11.84**	8.29	8.00	**15.20**	**11.45**	9.28	**11.68**	**9.70**
2016	8.02	**12.03**	**11.81**	7.91	**9.40**	**10.80**	7.94	**8.85**

Note: exchange rates are expressed by local currency per 1 USD dollar. In addition, euro, UK pound and Denmark krone currencies are also used in other countries. Euro, UK pound, Japanese yen are the least volatile currencies because are the main currencies. The most volatile currencies of central countries are Swiss franc and Sweden krone. All exposed currencies have the highest volatility during financial crisis as an average volatility.

Although currencies are related to the major world economies, other world countries use such currencies as the United Kingdom pound or Denmark krone. In addition, the United States dollar does not appear in the table because is used as a reference currency. The United Kingdom pound is the least volatile currency comparing with two other major currencies: the Eurozone euro, and Japanese yen. Nevertheless, all currencies practised in central countries are the most volatile in 2009 exceeding average volatility which is 11.72. In addition, in 2007 all central countries have lower than average volatility. This implicates that central countries are highly affected by economic cycles. Furthermore, meanwhile Swiss franc is one of the most volatile currencies in this table, the highest exchange rate volatility, in general, is in Turkmenistan (365.91) in 2008 and the lowest – in Malaysia (0.002) in 2003. There are countries which have fixed exchange rates with the United States dollar, hence, their exchange rate volatility is 0. Such countries are Bahamas (peg rate 1:1), North Korea (peg 1:2.2 until July 2002), Eritrea (peg rate 1:15), Myanmar (fixed rate 1:6.445 until 2008 August), Cuba (convertible peso 1:1) and Cayman Islands (pegged 1:0.825). These currencies are not assumed as the least volatile currencies since the volatility is constant most or all of the time. Turning to public debt to GDP, the results are presented in Table 21.

Table 21

Summary statistics of stock market/country riskiness measures for the main central and average countries: public debt to GDP

	US	**UK**	**JP**	**IT**	**FR**	**DE**	**LU**	**CH**	**NL**	**SE**	**CL**	**IE**	**DK**	**Average**
2001	0.53	0.34	**1.54**	**1.05**	0.58	0.58	0.07	0.54	0.49	0.63	0.14	0.35	0.49	**0.72**
2002	0.55	0.34	**1.64**	**1.02**	0.60	0.59	0.07	0.60	0.48	0.60	0.15	0.32	0.49	**0.73**
2003	0.59	0.36	**1.70**	**1.00**	0.64	0.63	0.07	0.59	0.49	-	0.13	0.31	0.46	**0.71**
2004	0.65	0.39	**1.81**	**1.00**	0.66	0.65	0.07	0.61	0.50	0.48	0.10	0.30	0.44	**0.67**
2005	**0.65**	0.40	**1.86**	**1.02**	**0.67**	**0.67**	0.07	0.58	0.49	0.48	0.07	0.27	0.37	**0.60**
2006	**0.64**	0.41	**1.86**	**1.03**	**0.64**	**0.66**	0.08	**0.52**	0.44	0.43	0.05	0.25	0.32	**0.51**
2007	**0.64**	0.42	**1.83**	**1.00**	**0.64**	**0.64**	0.08	**0.50**	0.42	0.38	0.04	0.25	0.27	**0.44**
2008	**0.73**	**0.50**	**1.92**	**1.02**	**0.68**	**0.65**	0.15	**0.49**	**0.54**	0.37	0.05	0.44	0.33	**0.44**
2009	**0.86**	**0.64**	**2.10**	**1.13**	**0.79**	**0.72**	0.16	0.47	**0.56**	0.40	0.06	**0.62**	0.40	**0.47**
2010	**0.95**	**0.76**	**2.16**	**1.15**	**0.82**	**0.81**	0.20	0.46	**0.59**	0.38	0.09	**0.86**	0.43	**0.46**
2011	**0.99**	**0.81**	**2.32**	**1.16**	**0.85**	**0.78**	0.19	0.46	**0.62**	0.37	0.11	**1.10**	0.46	**0.47**
2012	**1.02**	**0.85**	**2.38**	**1.23**	**0.90**	**0.80**	0.22	0.47	**0.66**	0.37	0.12	**1.19**	0.45	**0.48**
2013	**1.05**	**0.86**	**2.44**	**1.29**	**0.92**	**0.77**	0.23	0.46	**0.68**	0.40	0.13	**1.19**	0.45	**0.49**
2014	**1.05**	**0.88**	**2.49**	**1.33**	**0.95**	**0.74**	0.23	0.46	**0.68**	0.45	0.15	**1.05**	0.45	**0.51**
2015	**1.05**	**0.89**	**2.48**	**1.33**	**0.96**	**0.71**	0.21	0.46	**0.65**	0.43	0.18	**0.79**	0.46	**0.54**

Note: high public debt to GDP does not depend largely if the country is equity investment centre because part of these countries have high public debt to GDP rate and part of them – very low. Hence, it depends more on economy of the country.

While stock market and currency exchange volatilities have comparable trends, the similarity of public debt to GDP to stock market and currency exchange volatilities is less obvious. Average public debt to GDP reaches the highest point in 2003 and then it is decreasing until 2008. Since 2008 more than half central countries exceed an average debt to GDP. Such countries are the United States, the United Kingdom, France, Germany, the Netherlands and Ireland (since 2009). Japan and Italy are exceptions given that their public debt to GDP are always high (Japan has the

highest debt/GDP rate but it differs from others because its debt is majorly internal), therefore, their abilities to finance themselves without taking further debts are the lowest. However, there are countries with a higher public debt to GDP rate: in Liberia (5.23) it is reached in 2003. The lowest public debt is in Hong Kong (0.0006) in 2015.

Influence of these three measures on the network structure in growth and crisis periods is analysed in regressions including crisis dummy variable, all three riskiness measures (stock price and exchange rate volatilities and public debt to GDP) and their interactions with crisis. Latter variables represent stock price and exchange rate volatilities and public debt to GDP during crisis (crisis=1), stock price and exchange rate volatilities and public debt to GDP define the same variables, when there is no crisis (crisis = 0) and crisis represents crisis impact alone (crisis = 1 and other variables = 0). Debt to GDP is analysed separately from stock market and exchange rate volatilities due to high collinearity measured by variance inflation factor (Table 22).

Table 22

Variance inflation factor statistics of regressions with market/country riskiness factors

	Institutional network				**Non-institutional network**			
Variable	**VIF**				**VIF**			
Crisis	9.19	7.42	3.64	2.83	9.19	7.55	3.72	2.81
Public debt/GDP	7.84	-	-	3.61	7.89	-	-	3.91
Public debt/GDP_crisis	3.04	-	-	3.03	3.06	-	-	3.06
Stock_1Yvolat	2.76	2.64	1.95	-	2.79	2.69	1.98	-
Stock_1Yvolat_crisis	8.03	7.86	-	-	8.19	8.12	-	-
Exch_1Mvolat	2.85	2.84	2.83	-	3.02	3.01	3.00	-
Exch_1Mvolat_crisis	4.88	4.73	4.54	-	5.05	4.91	4.69	-

Note: VIF statistics are calculated for a regression with a dependent node in-degree variable. Stock market volatility is highly correlated with stock market volatility during crisis. Public debt to GDP is highly correlated with stock market volatility. Therefore, stock market volatility during crisis is omitted, while public debt to GDP is analysed separately.

Crisis dummy variable and its multiplication with stock market 1-year volatility (stock_1Yvolat_crisis) have a very high collinearity. Excluding stock_1Yvolat_crisis, crisis dummy variable changes direction and many variables become insignificant. Testing exchange rate volatility and its interaction with crisis on network measures, the results remain the same analysing stock market volatility and exchange rate volatility together but excluding stock_1Yvolat_crisis variable, therefore, stock_1Yvolat_crisis variable is omitted. Having the same issue as in regressions with crisis, autocorrelation is not analysed purportedly. However, the heteroskedasticity test hypothesis H0 for almost all regressions is rejected. Including country fixed effects hypothesis H0 is rejected for all regressions (see Appendix 43). Therefore, regressions are fixed for heteroskedasticity using standard error clustering by country. In addition, given that the data is panel and both types of investors are analysed separately, regressions are checked using random and fixed country effects. Because the Hausman test hypothesis H0 that the differences in coefficients is not systematic is rejected (example with dependent ND-in variable: chi^2=15.37 and Prob>chi^2=0.0040) in regressions with the stock market and exchange rate volatilities, country fixed

effects are used. However, regressions with independent public debt to GDP variable fail to reject Hausman test (chi^2=3.48 and Prob>chi^2=0.3239), hence, random effects are used. What effect risk factors make on institutional network structure is presented in Table 23.

Table 23

Stock market/country riskiness impact on international equity market connectedness: institutional investors

Panel A: Institutional investors									
Y	Independent variables					Independent variables			
	Const	Crisis	Stock_ 1Yvolat	Exch _volat	Exch _volat _crisis	Const	Crisis	Debt/ GDP	Debt/ GDP _crisis
ND in	**22.52*** (15.49)**	**1.48** (2.01)**	**-13.27*** (-2.91)**	0.04 (0.53)	0.03 (0.47)	9.82*** (11.03)	1.13*** (3.43)	1.66 (1.25)	-0.07 (-0.15)
ND out	**26.57*** (26.571)**	**6.33*** (3.30)**	**-34.25*** (-4.13)**	0.24* (1.70)	-0.22 (-1.65)	7.74*** (4.69)	0.92 (0.88)	4.03* (1.79)	4.03 (0.65)
NS in	**38703.96*** (3.36)**	1086.72 (0.33)	**-101135.3*** (-3.23)**	-553.07 (-1.40)	13.78 (0.04)	2511.4 (0.31)	7380.25 (1.63)	**7380.25** (1.96)**	**-19031.41** (-2.19)**
NS out	**35045.76** (2.34)**	**12568.8** (2.22)**	**-92532.05** (-2.08)**	-734.31* (-1.75)	-256.07 (-0.81)	-7427.92 (-0.51)	12387.52* (1.69)	70627.71* (1.69)	-30656.42 (-1.22)
NC	**0.55*** (20.48)**	0.006 (0.23)	0.15* (1.77)	-0.002 (-0.84)	0.001 (0.38)	0.59*** (17.94)	0.03 (0.81)	**-0.18*** (-3.95)**	0.01 (0.18)
DC in	**0.12*** (21.22)**	0.006 (1.55)	-0.05* (-2.58)	0.0002 (0.76)	0.0002 (-0.08)	0.06*** (12.63)	0.004** (2.19)	0.002 (0.54)	-0.0003 (-0.11)
DC out	**0.15*** (11.76)**	**0.03*** (3.24)**	**-0.17*** (-4.10)**	**0.002** (2.10)**	**-0.002** (-2.19)**	0.05*** (5.24)	0.003 (0.46)	0.01 (1.02)	0.008 (0.55)
WDC in	**199.21*** (3.38)**	8.81 (0.53)	**-521.61*** (-3.25)**	-2.73 -1.39	-0.34 (-0.21)	41.34 (1.09)	35.28 (1.56)	**196.67** (1.97)**	**-100.26** (-2.12)**
WDC out	**180.13** (2.43)**	**70.79** (2.27)**	**-483.23** (-2.15)**	-3.26 (-1.55)	-2.18 (-1.22)	-15.83 (-0.20)	58.82 (1.57)	345.72* (1.74)	-152.23 (-1.17)
CC in	**0.20*** (36.48)**	-0.004 (-1.55)	**-0.06*** (-3.47)**	0.0001 (0.45)	0.0001 (0.52)	0.16*** (51.84)	-0.006*** (-4.04)	-0.003 (-0.85)	0.0008 (0.34)
CC out	**0.52*** (19.12)**	**0.06*** (2.91)**	**-0.34*** (-4.66)**	0.004 (1.64)	-0.004* (-1.89)	0.12*** (6.73)	-0.002 (-0.15)	0.02 (1.11)	0.02 (0.71)
BC	**0.003*** (8.20)**	0.0003 (0.86)	-0.002* (-1.95)	0.00002 (1.02)	-0.00004* (-1.74)	0.001*** (3.37)	0.000 (0.03)	0.0002 (0.64)	-0.0004 (-0.65)
EC	0.0003 (0.16)	0.005 (2.23)	0.0002 (0.03)	-0.00005 (-0.50)	-0.0001 (-0.74)	0.02 (3.20)	0.002 (1.51)	-0.001 (-0.36)	-0.002 (-0.62)

Note: statistically significant at *** 1% level, ** 5% level, * 10% level. Number of observation is 1073, except regression with clustering coefficient where number of observations is 1074. When result is not statistically significant and the value is less than 0.0001, the value attributed in the table is 0.000. Stock market volatility is a significant factor during growth period, however, it is not considered during crisis due to heteroskedasticity problem. Exchange rate volatility induces higher portfolio diversification in more countries during growth period but during crisis it has an opposite impact. Debt to GDP is more relevant factor to institutional investors because it affects more network characteristics.

Stock market volatility during crisis is omitted, hence, independent stock market volatility variable represents an impact on the network structure during growth period. When economies burst, institutional investors, in general, consider both number of partnerships and amount of funds. Increased stock market volatility affects negatively the number of partnerships in issuing countries (by 12) and investing countries (by 33). In other words, issuing countries lose their partners because they become unattractive, while investing countries avoid investment in such countries with the magnitude greater than few times. Due to increasing stock market volatility issuing countries lose,

on average, more investments than investing countries suspend. Therefore, issuing countries are more sensitive to an amount of flows they get than to the maintenance of obtained partnerships. The same rule stands for central countries, except that such central countries as the United States, the United Kingdom and Luxembourg get less investments but do not lose their partnerships. In addition, all countries, including central countries, attract more funds when their public debt to GDP increases. Thus, during growth period higher public debt to GDP signals higher profit, nevertheless, its impact is still overcome by increased stock market volatility. When exchange rate volatility increases, financial centres have a higher incentive to diversify their investments in more countries. This could be explained by a willingness to hedge investments distributing portfolio investments in a larger array of stocks denoted in different currencies. Such issuing central countries as the United States, the United Kingdom, Luxembourg and France become less influential on all other markets through indirect contagion channels by 6 percentage points, while such central investing countries as the United Kingdom, France, Denmark and Guernsey become less "dangerous" to other equity markets by 31 percentage point when stock market volatility increases. As can be seen, the United Kingdom becomes less influential both as a debtor and an equity holder.

Clustering is negatively affected only by increasing public debt to GDP. Given that institutional investors appreciate countries with a higher debt to GDP as a potential source of additional profit, countries become less connected in their clusters because communities enlarge and the probability of two countries to be connected in the clusters decreases. In addition, neither stock market volatility nor exchange rate volatility have significant influence on clustering. Given that the highest clustering occurs among less developed countries, these countries do not change their riskier partners who, mostly, are close geographically. This can be a sort of home bias. Intermediaries and neighbours of leading financial markets are not affected by stock market, exchange rate volatilities and increased insolvency risk. Summarizing all results, stock market/country riskiness make significantly negative impact on network measures in 10 of 13 regressions, therefore, **sub-hypothesis H4.1 is not rejected.**

Exchange rate volatility becomes less influential during crisis, however, it makes an opposite impact considering the results in growth period. Countries, connected to the highest number of other countries (France, the United Kingdom, Guernsey, etc.), invest in less countries when exchange rate volatility increases. As a result, they become less connected. In addition, countries determined by the easiest access to all other equity markets (the United Kingdom, France, Denmark and Guernsey), also become less influential because they invest in less countries (DC-in and CC-in countries are almost identical). Increased public debt to GDP is much more important to issuing countries during crisis. The paradox appears when ordinary countries suffer 2.5 more during crisis than they gain during growth period, while central countries lose two times less investments

during crisis than they turn a profit in economically favourable conditions. Therefore, countries which are more distant from central countries become targets of crisis.

Exchange rate volatility and public debt to GDP are not influential on the number of obtained partnerships, role of intermediaries, the most important financial partners of central countries and tendency to create tighter links among countries within clusters. Overall, only 3 of 13 measures of institutional network are affected negatively by exchange rate volatility and public debt to GDP, thus, **sub-hypothesis H4.2** that stock market/country riskiness negatively influence institutional network pattern **is rejected**.

Stock market/country riskiness impact on non-institutional network structure is summarized in Table 24. The same testing procedures are used as for institutional network.

Table 24

Stock market/country riskiness impact on international equity market connectedness: non-institutional investors

Panel B: Non-institutional investors									
Y	Independent variables					Independent variables			
	Const	Crisis	Stock_ 1Yvolat	Exch _volat	Exch _volat _crisis	Const	Crisis	Debt/ GDP	Debt/ GDP _crisis
ND in	**15.48*** (11.46)**	-0.17 (-0.32)	**-12.38*** (-2.88)**	0.10 (1.10)	-0.02 (-0.25)	5.60*** (7.34)	0.31 (0.97)	**3.32** (2.29)**	**-1.13*** (-2.60)**
ND out	25.76 (11.13)	2.15 (1.13)	**-26.71*** (-3.34)**	0.20 (1.03)	-0.11 (-0.63)	5.36*** (3.53)	0.21 (0.25)	**5.21** (2.12)**	-0.32 (-0.22)
NS in	**7305.16 ** (2.50)**	1955.29 (0.65)	**-16345.95 *** (-2.79)**	-284.70 (-1.05)	39.12 (0.49)	-134.06 (-0.08)	4530.88 (1.45)	**9906.56 ** (2.35)**	-7854.80 * (-1.86)
NS out	**16614.13 *** (3.70)**	3600.16 (1.05)	-21399.95 (-1.64)	-21399.95 (-1.45)	19.79 (0.17)	-2351.27 (-1.03)	4033.49 ** (2.52)	**15493.9 ** (2.30)**	-6485.42 (-1.41)
NC	**0.50*** (14.09)**	-0.05 (-1.41)	0.01 (0.10)	-0.0001 (-0.04)	0.003 (0.93)	0.49*** (16.87)	0.007 (0.23)	**-0.12*** (-3.04)**	-0.02 (-0.30)
DC in	**0.09*** (12.76)**	-0.002 (-0.77)	**-0.04** (-2.00)**	.0004 (0.94)	0.00 (0.01)	0.04*** (9.17)	0.002 (1.18)	**0.01** (2.23)**	**-0.005** (-2.22)**
DC out	**0.15*** (10.30)**	0.01 (1.04)	**-0.12** (-2.44)**	.0010 (0.94)	0.0005 (-0.51)	0.04*** (3.86)	0.002 (0.37)	0.02* (1.73)	-0.001 (-0.13)
WDC in	**36.41** (2.55)**	14.16 (0.71)	**-76.23*** (-2.82)**	-1.77 (-1.08)	0.23 (0.50)	1.54 (0.15)	29.14 (1.38)	**55.23** (2.30)**	-47.04* (-1.71)
WDC out	**97.51*** (3.79)**	24.09 (1.07)	-115.19 (-1.53)	-1.35 (-1.46)	0.13 (0.17)	-9.77 (-0.75)	23.11** (2.50)	**84.55** (2.26)**	-32.39 (-1.20)
CC in	**0.14*** (18.74)**	-0.008 (-2.44)	-0.04* (-1.69)	0.0005 (1.00)	0.0004 (1.26)	0.12*** (33.54)	-0.003 (-1.76)	0.003 (0.42)	-0.0005 (-0.17)
CC out	**0.50*** (19.14)**	0.02 (0.83)	**-0.18** (-2.45)**	0.001 (0.46)	-0.0003 (-0.17)	0.08*** (4.63)	0.005 (0.55)	**0.05** (2.17)**	-0.003 (-0.19)
BC	0.000 (1.14)	-0.0002 (-0.63)	0.0001 (0.08)	0.000 (0.44)	0.0003 (0.96)	0.0009** (2.01)	0.0003* (1.67)	0.0006 (1.07)	-0.0004 (-0.96)
EC	**0.01** (2.1)**	-0.0007 (-0.14)	-0.03 (-1.42)	0.000 (0.07)	-0.00002 (-0.06)	0.01 (1.62)	0.004 (1.51)	0.007 (1.52)	-0.01 (-1.15)

Note: statistically significant at *** 1% level, ** 5% level, * 10% level. Number of observations is 1073, except regression with clustering coefficient where the number of observations is 1074. When the result is not statistically significant and the value is less than 0.0001, the value attributed in the table is 0.000. Stock market has a negative impact on network structure during growth period, however, public debt to GDP is the most influential factor. During the crisis, almost none of factors make significant influence on network structure.

Breusch-Pagan test hypothesis H0 for almost all regressions is rejected, and including country fixed effects hypothesis H0 is rejected for all regressions (see Appendix 44). Therefore, regressions are adjusted for heteroskedasticity clustering standard errors by country. In regressions with stock market and exchange rate volatilities Hausman test is rejected (chi^2=16.88 and Prob>chi^2=0.0020), while in regressions with public debt to GDP is not rejected (chi^2=0.69 and Prob>chi^2=0.8747), hence, in the first case, fixed effects and, in the second case, random effects are used.

The disparity between investors could be traced to macroeconomic fundamentals. Besides requiring a lower stock market volatility, non-institutional investors put more weight to rising public debt to GDP. The results reveal that ordinary countries as well as such central countries as the United States, the United Kingdom and Luxembourg, obtain higher number of partners and attract investments, meanwhile, France, Italy and the United States invest in the same number of countries but the equity outflows increase. In addition, latter countries become more connected to the whole equity market by 5 percentage points. In the same manner as institutional investors, non-institutional investors are likely to diversify their portfolios in countries with a higher public debt. Moreover, the communities of the Arabian Peninsula and Others (Table 13) are merging with the European and the United States communities, therefore, non-institutional investors tend to diversify their portfolios.

In terms of the stock market volatility, issuing countries lose part of their connections (12) but investing countries renounce partnerships with other countries twice as issuing ones. Central issuing countries and ordinary issuing countries have a significant decrease in inflows, nevertheless, central countries (the United States, the United Kingdom and Luxembourg) have minor effect because of increased inflows with regard to public debt to GDP. Hence, central countries are less sensitive to increased stock market volatility. The number of partnerships with France, Italy, the United States and other important investing countries diminishes by 12 percentage points, however, this leads to decrease in closeness to all other market participants by 18 percentage points. Put it differently, when central countries diversify their portfolios in a smaller number of countries, their indirect impact on other countries weakens. Nevertheless, they remain relevant intermediaries and neighbours of other central countries. Turning to exchange rate volatility, non-institutional investors do not consider diversification of portfolios in different number of countries as a way to hedge exchange rate volatility. Summarizing the results, 8 of 13 predicted outcomes are the same, therefore, **sub-hypothesis H4.3** that stock market riskiness negatively affects non-institutional network connectedness in growth period, is **not rejected**.

Unlike institutional investors, non-institutional investors renounce partnerships with countries which have higher insolvency problems regardless of their position in the network. In addition, these countries lose less during crisis than gain during growth period. Another risk factor,

exchange rate volatility, is not a relevant investment determinant not even during crisis. Consequently, non-institutional investors invest in other equity markets independently in which currency stocks are denominated. One of the reasons could be that non-institutional network is less expanded, for example, in Africa. Clustering coefficient is also not determined by any of two risks – even less developed countries prefer investing in riskier countries only because they are in some way closer: geographically, culturally, etc. 11 of 13 predicted outcomes are the same, hence, **sub-hypothesis H4.4** that stock market and country riskiness do not affect non-institutional network connectedness during crisis **is not rejected**. Sub-hypotheses H4.1 and H4.3 are not rejected – stock market riskiness negatively affects institutional and non-institutional network connectedness in growth period. Other factors do not affect negatively institutional network connectedness in crisis, thus, sub-hypothesis H4.2 is rejected. Given that one sub-hypothesis is rejected, **hypothesis H4**, that stock market and country riskiness has a negative impact on the structure of institutional and non-institutional networks during growth period and negative (no) impact on the structure of institutional (non-institutional) networks during crisis, is also **rejected**.

3.4 Discussion and implications

Topic about differences between institutional and non-institutional investors is old but at the same time new and relevant: due to globalisation financial markets became less predictable and reactions to global events more sudden, therefore, both institutional and non-institutional investors must adapt to a changing financial environment facing new forms of financial connectivity and contagion. Using network methodology, it is possible to complement findings about their qualities by analysing structural differences within and between international equity investment networks. The summary of results is presented in Table 25.

Roque and Cortez (2014) analysing determinants of investment flows by institutional and non-institutional investors from 20 countries and Giofré (2013) analysing determinants of investment flows from Italy, France, Spain and Sweden get rather opposite results. Giofré (2013) highlights that both institutional and non-institutional investors prefer more transparent, geographically close markets. Although Roque and Cortez (2014) agree that both investors are likely to invest in more transparent markets, non-institutional investors are more linked to neighbour financial markets. Findings of this research support the idea that institutional and non-institutional investors have different roles and preferences in the international equity markets. Besides having a higher number of partners, institutional investors account for four times higher investment volume than non-institutional investors. The latter type of investors prefers investing in the expanding community of the United States. Therefore, the results complement findings of Goetzmann and Kumar (2008) that households in the United States diversify their portfolios by

holding more but highly correlated stocks. Institutional investors, in general, invest in the communities of the European countries, the United States and Arabian Peninsula countries, however, countries in Arabian Peninsula are especially considered during crisis. In addition, in 2001 institutional and non-institutional investors invested in a small number of African countries, nevertheless, institutional investors from all communities invested in African countries, while non-institutional investors only from the United States community. Although in 2001 only few African countries from the United States (institutional) community were more clustered, in 2016, practically the whole continent is highly connected. Non-institutional investors, instead, still avoid African countries with an exception of Algeria, Democratic Republic of Congo, Cameroon, Egypt, Gabon, Republic of Congo, Namibia, Kenya, Tanzania and Zambia.

Table 25
Summary of results

No	Y	Hypothesis							
		H1	H2	H3		H4			
				H3.1	H3.2	H4.1	H4.2	H4.3	H4.4
		Inst / indiv	Inst / indiv (crisis)	Inst / inst (crisis)	Indiv / indiv (crisis)	Risk, Inst	Risk, Inst (crisis)	Risk, Indiv	Risk, Indiv (crisis)
1	ND in	β > 0	β > 0	***β = 0***	***β < 0***	β < 0	***β = 0***	β < 0	***β < 0***
2	ND out	β > 0	β > 0	***β = 0***	β = 0	β < 0	***β = 0***	β < 0	β = 0
3	NS in	β > 0	*β < 0*	β < 0	β = 0	β < 0	β < 0	β < 0	β = 0
4	NS out	β > 0	*β < 0*	β < 0	β = 0	β < 0	***β = 0***	***β > 0***	β = 0
5	NC	*β > 0*	β > 0	**β = 0**	β = 0	β < 0	***β = 0***	β < 0	β = 0
6	DC in	β > 0	***β = 0***	***β = 0***	β = 0	***β = 0***	***β = 0***	β < 0	***β < 0***
7	DC out	β > 0	***β = 0***	***β = 0***	β = 0	β < 0	β < 0	β < 0	β = 0
8	WDC in	β > 0	*β < 0*	β < 0	β = 0	β < 0	β < 0	β < 0	β = 0
9	WDC out	β > 0	*β < 0*	***β = 0***	β = 0	β < 0	***β = 0***	***β > 0***	β = 0
10	CC in	*β > 0*	**β = 0**	*β < 0*	***β < 0***	β < 0	***β = 0***	***β = 0***	β = 0
11	CC out	*β > 0*	*β < 0*	**β = 0**	β = 0	β < 0	***β = 0***	β < 0	β = 0
12	BC	**β = 0**	**β = 0**	*β < 0*	β = 0	***β = 0***	***β = 0***	***β = 0***	β = 0
13	EC	**β = 0**	**β = 0**	***β = 0***	β = 0	***β = 0***	***β = 0***	***β = 0***	β = 0
In favour of hyp. rejection, total:		2	5	**8**	2	3	**10**	5	2
Sub-hypothesis is:		Not rejected	Not rejected	**Rejected**	Not rejected	Not rejected	**Rejected**	Not rejected	Not rejected
Hypothesis is:		Not rejected	Not rejected	**Rejected**		**Rejected**			

Note: values in italic are different than were expected, while values in bold are in favour of hypothesis rejection. The values in bold and italic do not necessary coincide where hypotheses predict differences without any direction.

Institutional investors should be more careful diversifying their portfolios in different countries because clustering is higher in institutional network. Higher clustering leads to higher vulnerability to financial shocks inside the clusters. On the other hand, the highest risk of contagion occurs when the system of financial markets depends on few central countries. Feroldi and Gaffeo (2014) analysing total financial portfolio and Schiavo et al. (2010) analysing equity investments find that both types of investment networks are hierarchical and consist of G7 countries. The results

of the thesis reveal that both institutional and non-institutional investors are prone to global risk because such countries as the United States, the United Kingdom, Italy and France are important intermediaries connecting separate clusters in the financial market. The United States, the United Kingdom, Luxembourg (also Germany for non-institutional investors) are the most attractive financial markets by the number of connections, volume and they can easily spread shocks to the whole financial market from the side of debtors. Institutional investors from the United States, the United Kingdom and Japan are the most relevant investors who affect financial network through direct links. France, Guernsey and Cayman Islands are highly connected to the whole equity network and make the highest indirect impact on the other countries in the network. Although countries, which affect other countries directly and indirectly, are not the same, they are close partners, therefore any kind of connection can affect the whole equity market. Given that companies do not distinguish type of investors, non-institutional investors increase vulnerability of the whole equity financial market having the highest number of connections and proximity with such investing countries as Chile and Ireland. Brazil acts as a one of intermediaries, while non-institutional investors from Belgium have close connections with other central countries. Therefore, low clustering in the United States, the United Kingdom, Central European, Scandinavian countries and Italy should be considered with a reserve because almost all these countries are financial centres. Chuluun (2017) highlights dependence of central countries. In fact, central countries in both networks are closely related. Nevertheless, central countries, except intermediaries and the financial partners which are connected to all major financial markets, are less influential in non-institutional network.

Institutional and non-institutional investors diversify their portfolios differently even during crisis. Hoffmann et al. (2013) and Roque and Cortez (2014) find that non-institutional investors prefer more transparent financial markets during crisis, while institutional investors prefer stocks which diversify better their portfolios even if those stocks are in less transparent financial markets. Results of the thesis suggest additional outcomes – both institutional and non-institutional investors invest less during crisis but the gap in the volume of investments narrows, while the difference in obtained relationships increases. In addition, both institutional and non-institutional investors cluster their investments in a similar manner – approximately half of countries in the clusters are connected. However, institutional investors diversify their portfolios in the markets which were not taken into consideration before – clustering in the European community is lower, in the United States community does not have distinct changes, while the Arabian Peninsula community increases. Non-institutional investors, on the other hand, prefer investments in closer, central countries with sound economies.

In addition, central countries in non-institutional network have a smaller impact on other countries regarding the number of links, volume and contagion though indirect links. However, inflows in such issuing central countries as the United States, the United Kingdom or Luxembourg and outflows from such investing countries as France, the United Kingdom and Denmark in institutional and non-institutional networks become more similar. The United States, the United Kingdom and France (for institutional investors), France, Italy and Netherlands (for non-institutional investors) are very important intermediaries in the whole network and they remain in this position even during crisis. In addition, the United States, the United Kingdom and Japan (for institutional investors), Luxembourg, Germany and Italy (for non-institutional investors) are the most central based on the position of their financial partners, hence, they have tight financial links among themselves and crisis also does not make any impact on their position in institutional network.

Neither institutional nor non-institutional investors change heavily their investment strategies during crisis. Institutional investors maintain their partnerships but the volume of investments is affected negatively. As Chinazzi et al. (2013) notice that central countries are less affected by crisis, institutional investors from central countries also invest similar amounts of funds during crisis and growth period, therefore, ordinary countries are more affected by crisis. Non-institutional investors, instead, practically, do not change their investments except that issuing countries lose part of their partners. The similarity between institutional and non-institutional networks are observed through countries which affect the whole network indirectly – both types of investors reduce their significance during crisis. Given that institutional network shrinks significantly during crisis, intermediate countries (the United States, France and Cayman Islands) improve their position during crisis.

Ang and Bekaert (2002) notice that international diversification has a positive value for international portfolios if the currency exchange rate risk is hedged. Results of the thesis reveal that increasing exchange rate volatility during growth period motivates such central countries as the United States, the United Kingdom France and Italy to diversify portfolios in more countries, nevertheless, during crisis it creates an opposite effect – central countries invest in less countries weakening their indirect influence on other network participants. Therefore, the results differ from Cai et al. (2017) who conclude that leading countries are not determined by exchange rate volatility. Non-institutional investors, on the other hand, assume that exchange rate volatility is an irrelevant risk factor, therefore, they diversify their investments not considering the currency. The reason could be that non-institutional investors prefer investments in major and sound equity markets. Bekaert et al. (2014) find that during crisis investors care more about macroeconomic factors than stock market riskiness. The results of the thesis cannot show whether macroeconomic factors are

more important during crisis, however, institutional investors evaluate both stock market volatility and financial soundness. In addition, stock market volatility has a negative overwhelming impact on the network structure during growth period. Countries with increasing public debt to GDP experience a paradoxical situation – during crisis they lose 2.5 times more investments due to increasing public debt to GDP than gain during growth period, while central countries during crisis lose only a half volume of investments that they get during growth period. Non-institutional investors, instead, put the highest attention to financial soundness of a country during growth period but during crisis this factor becomes less relevant.

As it was noticed, both institutional and non-institutional investors should consider indirect connectedness because countries which affect the whole investment network are closely related to those which have diversified investments in the highest number of countries. Therefore, investors should invest in countries that belong to different communities and are less clustered. Neither institutional nor non-institutional investors are advised to invest only in the United States, the United Kingdom, Luxembourg, Germany, France, Italy, Chile and other central countries. However, investors could diversify their portfolios in Scandinavian countries, Australia, Estonia, Lithuania, Russia, India, Mongolia, Egypt, South Africa and avoid countries in Central Africa. Given that non-institutional investors have less diversified portfolios, they should carefully examine Botswana (due to high clustering degree) and Myanmar (institutional investors prefer not to invest in this country) before investing. In addition, countries in Arabian Peninsula and its neighbours in Africa become highly connected during crisis. Only Saudi Arabia is suggested as a possible destination country in Arabian Peninsula because it is less connected. In 2016 there is an additional community whose less clustered members are Anguilla, Cayman Islands, Curacao & St. Maarten, Dominican Republic and Trinidad and Tobago. These countries could be considered but before investing macroeconomic conditions should be evaluated. Another group of countries, which belong to the same community and are highly clustered, are Bahrain, Jordan, Sudan, Syria, West Bank and Gaza and Yemen and are not suggested as possible targets.

This implicate that although non-institutional investors diversify their investments in less countries, they choose such countries that institutional investors do not consider, for example, Myanmar. Therefore, governments should think how could restrict non-institutional investors investing in risky countries or enhance their financial literacy because non-institutional investors are affected more by country risk than market risk factors. In addition, the highest financial centres in Europe are related to the United States community, except Italy which is related to Eastern European countries. However, financial contagion from the United States, the United Kingdom, Western and Central European countries can easily affect Italy, because it is a central country, and, consequently, Eastern European countries, especially Poland, Bosnia and Herzegovina, Serbia,

Romania and Ukraine. Hence, government could stimulate investors from aforementioned countries to diversify their portfolios better. Finally, given that institutional investors punish countries with less sound financials, these countries, including Liberia, Bissau-Guinea, Eritrea, Lebanon, Jamaica, Seychelles, Burundi, Iraq, Togo, etc., should consider how to make their economies more stable and prepare for huge losses during crisis. Central countries having to pay attention to their financial soundness are Japan, Greece, Italy and Belgium.

The drawback of the research is a lack of some important countries, therefore, a possible research extension could be the same analysis including missing countries. It would allow an easier interpretation of weighted network measures. In addition, given that the thesis analyses only few risk factors, the research can be extended including country development, political risk, civil war, geographical distance, stock market return, volatility and other variables. Although many less developed countries receive investments, the purpose of it is not clear because countries with sovereign risk also attract foreign investments. Additionally including country development and political or civil war variables would help to understand whether institutional and non-institutional investors prefer countries with unstable economies taking into consideration that both types of investors invest in such countries. An important extension would be an inclusion of geographical distance variable willing to understand whether geographical proximity is related to the tendency to cluster. Finally, certain institutional and non-institutional investors could have different preferences, therefore, the research can be limited to such investors as banks, insurance, mutual funds or households.

CONCLUSIONS AND RECOMMENDATIONS

1. Institutional and non-institutional investors can be defined by more than one term depending which characteristic is emphasized. Given that non-institutional investors are not professional, they have less funds, as a result counting for a small part of international equity market, lower access to financial markets, have a higher propensity to herd, be risk-averse and home-biased. Although non-institutional investors are a minority, they provide additional liquidity in equity markets when institutional investors are restricted. Portfolio diversification of both investors is induced by such foreign equity investment factors as market riskiness, development, policy, transparency and familiarity. Consequently, their investment choices incidentally form more complex links among equity markets creating certain dependency structures which enhance financial connectedness and contagion.
2. Given that contagion determines spread of crisis in connected equity markets, international equity investment market connectedness and contagion are measured similarly. The methodologies used to assess financial connectedness and contagion are CAPM, factor models, correlation, wavelet, cointegration, VAR, GARCH, DCC and network. CAPM models assess market risk, factor models besides market risk include more variables, correlation and wavelet methods are suitable analysing integration/connectedness trends using high frequency data, VAR analyse multiple time series correlations, GARCH and its modifications are suitable assessing volatility spillovers, adjusted for heteroskedasticity, however, they do not assess indirect connections. The best methodology is a network methodology but willing to analyse statistical dependency, this methodology must be combined with other methods. Using these methodologies, contagion is found to arise in different forms: through banking sector, herding behaviour, risk-aversion of investors based on market macroeconomic fundamentals and through multilateral connections. To assess the influence of institutional and non-institutional investors portfolio diversification decision on formation of international equity investment connectedness, the network methodology is chosen. An advantage of this methodology is the possibility to capture not only the first order but also the higher order relationships, degree of network centralisation, clustering, formation of communities within network, detect weak links and possible sources of contagion in the network.
3. Other papers analysing international equity investment network do not disaggregate it by types of investors, therefore, this is one of the novelties of the thesis. In order to arrive at the results, the research had to pass three stages. Firstly, while it is common that researches are limited to investing countries, the thesis, instead, covers full networks with matrices reaching up to 192 countries. Analysis include the longest period possible provided by IMF from 2001 to 2016.

Secondly, given that incoming and outcoming links are not the same and equity issuing and investing countries partially differ, analysis is based on both binominal and valued graphs. The network statistics are calculated from bilateral equity flows matrices for separate years and the results are used in descriptive statistics, trend and community structure analysis, however, these statistics later are aggregated in the panel data used to test statistical significance in differences of international equity investment connectedness formation with respect to institutional and non-institutional investors. Thirdly, in order to get the results, the research includes analysis of general differences in equity market connectedness regarding institutional and non-institutional investors and differences in growth and crisis periods both between and within networks. Furthermore, it is evaluated how such market risks as stock market and exchange rate volatilities and country risk as public debt to GDP affect international equity investment connectedness formation with respect to institutional and non-institutional investors. The analysis combines network method with OLS with standard error double clustering, country clustering and random or fixed effects with country clustering models.

4. The results are obtained regressing panel data that contains calculated network statistics for 32 separate full international equity investment networks and such risk factors as exchange rate volatility covering 225 countries and autonomous regions for 16-year time span. Using OLS with standard error double clustering, the results reveal that institutional and non-institutional investors form different international equity investment networks: institutional network is larger, denser, more clustered and hierarchical. Although non-institutional investors generate four times lower equity flows, the United States, the United Kingdom, Italy and France are important intermediaries connecting separate clusters which differ in both networks. Taking into consideration that central countries have the tightest links between themselves, the networks have features of hierarchy and flatness where central countries have at least one strong link in smaller structures such as communities and clusters affecting other countries indirectly, therefore, low clustering does not imply that countries are not highly connected. In addition, central equity issuing and investing countries are not the same, hence, higher connectedness arises from both debtor and holder sides. Using OLS with standard error clustering by country, it is found that structural differences between institutional and non-institutional networks remain even during crisis, however, the gap of investment volume between institutional and non-institutional investors narrows, while the gap of the number of connections widens. This suggest that the flows in institutional network are distributed in a larger array of countries and vice versa in non-institutional network. Nevertheless, crisis does not induce significant internal changes neither in institutional nor in non-institutional network. Institutional investors from ordinary countries maintain their partnerships but investments are

smaller, meanwhile, institutional investors from central countries do not change their investments significantly. Non-institutional investors, instead, invest in less countries but maintain the volume of investments. Both types of investors choose such intermediaries as the United States, France and Cayman Islands which improve their position during crisis. Using random and country effects with country clustering models, it is found that both institutional and non-institutional investors from ordinary and central countries react negatively to market riskiness. Moreover, central countries determined by the highest indirect links and stock market volatility, lose their central position by 31% in institutional and by 18% in non-institutional networks. Changes in risk attitude are not possible to assess due to multicollinearity problem, however, it is found that institutional investors from central countries invest in more countries during growth period and in less countries during crisis when exchange rate volatility increases. Non-institutional investors, instead, are not affected by exchange rate volatility but they react more to higher public debt to GDP. Increase in public debt to GDP during growth period is a positive sign for both investors, but during crisis countries, which have less sound economics, lose significant volume of investments from institutional investors and partnerships with non-institutional investors. However, during growth period both types of investors extend country clusters obtaining partnerships with countries having higher public debt to GDP. In addition, when ordinary and central countries are determined by increased public debt to GDP, taking into account growth period and crisis, paradoxically, ordinary countries have approximately $12000m losses, while central countries gain of $96m with regard to institutional investors.

5. It is recommended to consider both direct and indirect links while investing in international equity markets. Investors should choose countries which belong to different communities and are less clustered. None of investors are advised to invest only in the United States, the United Kingdom, Luxembourg, Germany, France, Italy, Chile and other central countries. Investors could diversify their portfolios in Scandinavian countries, Australia, Estonia, Lithuania, Russia, India, Mongolia, Egypt and South Africa. Although non-institutional investors do not invest much in Central African countries, further portfolio diversification in these countries is not suggested due to low diversification. Furthermore, countries in Arabian Peninsula and its neighbours in Africa become highly connected during crisis, except Saudi Arabia. Part of non-institutional investors invest in risky countries, therefore, governments should evaluate which strategy is better – restrictions, that are more difficult to obtain in open financial markets, or enhancement of literacy of non-institutional investors. The United States affects Eastern European countries through Italy, especially Poland, Bosnia and Herzegovina, Serbia, Romania and Ukraine. Hence, government could stimulate investors from aforementioned countries to diversify their portfolios better. Turning to research extensions, although the analysis includes

all possible data from CPIS database, it lacks some important countries, therefore, more countries should be included from other sources, if possible, because the interpretation of weighted network measures would be more straightforward. In addition, the research can be extended including country development, political risk, civil war, geographical distance, stock market return and volatility variables. As it was noticed, many less developed countries, including countries with sovereign risk, receive investments, however, these relationships are unclear. Adding stock market return and volatility variables could be assessed whether these countries provide more returns or investors have chosen wrong stock markets for portfolio diversification. Geographical distance variable would clarify if clustering is related to geographical distance. Finally, willing to understand how certain investor groups diversify their portfolios, the study can be narrowed including only such investors as banks, insurance, mutual funds or households.

REFERENCES

1. Abid, I., Kaabia, O., & Guesmi, K. (2014). Stock market integration and risk premium: Empirical evidence for emerging economies of South Asia. *Economic Modelling, 37*, 408-416. doi:10.1016/j.econmod.2013.11.015
2. Acemoglu, D., Ozdaglar, A., & Tahbaz-Salehi, A. (2015). Systemic Risk and Stability in Financial Networks. *American Economic Review, 105*(2), 564-608. doi:10.1257/aer.20130456
3. Aggarwal, R., Kearney, C., & Lucey, B. (2012). Gravity and culture in foreign portfolio investment. *Journal of Banking and Finance, 36*(2), 525-538, doi:10.1016/j.jbankfin.2011.08.007
4. Ahmed, S., Coulibaly, B., & Zlate, A. (2017). International financial spillovers to emerging market economies: How important are economic fundamentals? *Journal of International Money and Finance, 76*, 133-152. doi:10.1016/j.jimonfin.2017.05.001
5. Ahmed, W. M. A. (2017) The impact of foreign equity flows on market volatility during politically tranquil and turbulent times: The Egyptian experience. *Research in International Business and Finance, 40,* 61-77, doi:10.1016/j.ribaf.2016.12.006
6. Al-Khouri, R. (2015). Determinants of foreign direct and indirect investment in the MENA region. *Multinational Business Review, 23*(2), 148-166. doi:10.1108/mbr-07-2014-0034
7. Allen, F., & Gale, D. (2000). Financial Contagion. *Journal of Political Economy, 108*(1), 1-33. doi:10.1086/262109
8. Allen, F., Bernardo, A. E., & Welch, I. (2000). A Theory of Dividends Based on Tax Clienteles. *The Journal of Finance, 55*(6), 2499-2536. doi:10.1111/0022-1082.00298
9. Anderson, C. W., Fedenia, M., Hirschey, M., & Skiba, H. (2011). Cultural influences on home bias and international diversification by institutional investors. *Journal Of Banking & Finance, 35*(4), 916-934. doi:10.1016/j.jbankfin.2010.09.006

10. Ang, A., & Bekaert, G. (2002). International Asset Allocation With Regime Shifts. *The Review of Financial Studies, 15*(4), 1137-1187. doi:10.1093/rfs/15.4.1137
11. Audrino, F., & Trojani, F. (2006). Estimating and predicting multivariate volatility thresholds in global stock markets. *Journal of Applied Econometrics, 21*(3), 345-369. doi:10.1002/jae.869
12. Bae, K. H., Zhang, X. (2015). The Cost of Stock Market Integration in Emerging Markets. *Asia-Pacific Journal of Financial Studies, 44*(1), 1–23. doi:10.1111/ajfs.12079
13. Bae, S. C., Min, J. H. & Jung, S. (2011). Trading Behavior, Performance, and Stock Preference of Foreigners, Local Institutions, and Individual Investors: Evidence from the Korean Stock Market. *Asia-Pacific Journal of Financial Studies, 40*, 199–239. doi:10.1111/j.2041-6156.2011.01037.x
14. Baele, L. (2005). Volatility Spillover Effects in European Equity Markets. *Journal of Financial and Quantitative Analysis, 40*(02), 373-401. doi:10.1017/s0022109000002350
15. Baele, L., & Inghelbrecht, K. (2009). Time-varying Integration and International diversification strategies. *Journal Of Empirical Finance*, *16*(3), 368-387. doi:10.1016/j.jempfin.2008.11.001
16. Baele, L., & Inghelbrecht, K. (2010). Time-varying integration, interdependence and contagion. *Journal Of International Money & Finance*, *29*(5), 791-818. doi:10.1016/j.jimonfin.2009.12.008
17. Baele, L., & Soriano, P. (2010). The determinants of increasing equity market comovement: Economic or financial integration? *Review of World Economics, 146*(3), 573-589. doi:10.1007/s10290-010-0060-z
18. Baig, T., & Goldfajn, I. (1999). Financial Market Contagion in the Asian Crisis. *IMF Economic Review, 46*(2), 167-195. doi:10.2307/3867666

19. Bailey, W., Kumar, A., & Ng, D. (2008). Foreign Investments of U.S. Individual Investors: Causes and Consequences. *Management Science, 54*(3), 443-459. doi:10.1287/mnsc.1070.0793
20. Baker, M., & Wurgler, J. (2006). Investor Sentiment and the Cross-Section of Stock Returns. *The Journal of Finance, 61*(4), 1645-1680. doi:10.1111/j.1540-6261.2006.00885.x
21. Baldwin, R. (2016). *The great convergence: Information technology and the new globalization*. Cambridge, MA: Belknap Press of Harvard University Press.
22. Bao, S. R., & Lewellyn, K. B. (2017). Ownership structure and earnings management in emerging markets—An institutionalized agency perspective. *International Business Review, 26*(5), 828-838. doi:10.1016/j.ibusrev.2017.02.002
23. Barber, B. M., & Odean, T. (2000). Trading Is Hazardous to Your Wealth: The Common Stock Investment Performance of Individual Investors. *The Journal of Finance, 55*(2), 773-806. doi:10.1111/0022-1082.00226
24. Barber, B. M., & Odean, T. (2013). The Behavior of Individual Investors. *Handbook of the Economics of Finance, 2*, 1533-1570. doi:10.1016/b978-0-44-459406-8.00022-6
25. Barber, B. M., Odean, T., & Zhu, N. (2009). Do Retail Trades Move Markets? *The Review of Financial Studies,* 22(1), 151-186. doi:10.1093/rfs/hhn035
26. Barrot, J., Kaniel, R., & Sraer, D. (2016). Are retail traders compensated for providing liquidity?. *Journal Of Financial Economics*, *120*(1), 146-168. doi:10.1016/j.jfineco.2016.01.005
27. Basak, S., & Makarov, D. (2014). Strategic Asset Allocation in Money Management. *The Journal of Finance, 69*(1), 179-217. doi:10.1111/jofi.12106
28. Basak, S., & Pavlova, A. (2013). Asset Prices and Institutional Investors. *American Economic Review, 103*(5), 1728-1758. doi:10.1257/aer.103.5.1728
29. Baumöhl, E., Kočenda, E., Lyócsa, Š., & Výrost, T. (2018). Networks of volatility spillovers among stock markets. *Physica A, 409*, 1555-1574. doi:10.1016/j.physa.2017.08.123

30. Beirne, J., & Gieck, J. (2014). Interdependence and Contagion in Global Asset Markets. *Review of International Economics, 22*(4), 639-659. doi:10.1111/roie.12116
31. Bekaert, G. (1995). Market Integration and Investment Barriers in Emerging Equity Markets. *The World Bank Economic Review, 9*(1), 75-107. doi:10.1093/wber/9.1.75
32. Bekaert, G., & Harvey, C. (1995). Time-Varying World Market Integration. *The Journal of Finance, 50*(2), 403-444. doi:10.2307/2329414
33. Bekaert, G., & Hoerova, M. (2016). What do asset prices have to say about risk appetite and uncertainty? *Journal Of Banking & Finance*, *67*, 103-118. doi:10.1016/j.jbankfin.2015.06.015
34. Bekaert, G., Ehrmann, M., Fratzscher, M., & Mehl, A. (2014). The Global Crisis and Equity Market Contagion. *The Journal of Finance, 69*(6), 2597-2649. doi:10.1111/jofi.12203
35. Bekaert, G., Harvey, C. R., & Lumsdaine, R. L. (2002). Dating the integration of world equity markets. *Journal Of Financial Economics*, *65*(2), 203-247.
36. Bekaert, G., Harvey, C. R., Lundblad, C. T., & Siegel, S. (2011). What Segments Equity Markets? *Review of Financial Studies, 24*(12), 3841-3890. doi:10.1093/rfs/hhr082
37. Bekaert, G., Harvey, C., & Ng, A. (2005). Market Integration and Contagion. *The Journal of Business, 78*(1), 39-69. doi:10.1086/426519
38. Belke, A., & Dubova, I. (2018). International spillovers in global asset markets. *Economic Systems*, *42*(1), 3-17. doi:10.1016/j.ecosys.2017.07.001
39. Berger, T., & Pozzi, L. (2013). Measuring time-varying financial market integration: An unobserved components approach. *Journal Of Banking & Finance*, *37*(2), 463-473. doi:10.1016/j.jbankfin.2012.09.015
40. Bhttacharya, U., Hackethal, A., Kaesler, S., Loos, B., & Meyer, S. (2012). Is Unbiased Financial Advice to Retail Investors Sufficient? Answers from a Large Field Study. *Review Of Financial Studies*, *25*(4), 975-1032. doi:10.1093/rfs/hhr127

41. Billio, M., & Caporin, M. (2010). Market linkages, variance spillovers, and correlation stability: Empirical evidence of financial contagion. *Computational Statistics & Data Analysis, 54*(11), 2443-2458. doi:10.1016/j.csda.2009.03.018
42. Black, F. (1986). Noise. *The Journal of Finance, 41*(3), 529-543. doi:10.2307/2328481
43. Blondel, V. D., Guillaume, J., Lambiotte, R., & Lefebvre, E. (2008). Fast unfolding of communities in large networks. *Journal of Statistical Mechanics: Theory and Experiment, 2008*(10), 1-12. doi:10.1088/1742-5468/2008/10/p10008
44. Bohl, M. T., Brzeszczynski, J., & Wilfling, B. (2009). Institutional investors and stock returns volatility: Empirical evidence from a natural experiment, *Journal of Financial Stability, 5*(2), 170-182. doi.org/10.1016/j.jfs.2008.02.003
45. Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics, 31*(3), 307-327. doi:10.1016/0304-4076(86)90063-1
46. Bonacich, P. (1987). Power and Centrality: A Family of Measures. *American Journal of Sociology, 92*(5), 1170-1182. doi:10.1086/228631
47. Bonaventura, M., Giudici, G., & Vismara, S. (2017). Valuation and performance of reallocated IPO shares. *Journal of International Financial Markets, Institutions and Money*, In Press, Corrected Proof. doi.org/10.1016/j.intfin.2017.05.005.
48. Cai, C. X., Mobarek, A., & Zhang, Q. (2017). International stock market leadership and its determinants. *Journal of Financial Stability, 33,* 150-162. doi:10.1016/j.jfs.2016.10.002
49. Calvet, L. E., Campbell, J. Y., & Sodini, P. (2009). Fight Or Flight? Portfolio Rebalancing by Individual Investors. *Quarterly Journal of Economics, 124*(1), 301-348. doi:10.1162/qjec.2009.124.1.301
50. Campbell, J. Y. (2006). Household Finance. *The Journal of Finance, 61*(4), 1553-1604. doi:10.1111/j.1540-6261.2006.00883.x

51. Caporale, G. M., Gil-Alana, L. A., & Orlando, J. C. (2016). Linkages Between the US and European Stock Markets: A Fractional Cointegration Approach. *International Journal Of Finance & Economics, 21*(2), 143-153. doi:10.1002/ijfe.1537.
52. Carrieri, F., Chaieb, I., & Errunza, V. (2013). Do Implicit Barriers Matter for Globalization? *Review of Financial Studies, 26*(7), 1694-1739. doi:10.1093/rfs/hht003
53. Carrieri, F., Errunza, V., & Hogan, K. (2007). Characterizing World Market Integration through Time. *Journal of Financial and Quantitative Analysis, 42*(04), 915-940. doi:10.1017/s0022109000003446
54. Çelik, S., & Isaksson, M. (2014). Institutional investors and ownership engagement. *OECD Journal: Financial Market Trends, 2013*(2), 93-114. doi:10.1787/fmt-2013-5jz734pwtrkc
55. Chaudhary, P. (2016). Test of CAPM: A Study of India and US. *International Journal of Financial Management, 6*(2), 51-58. doi:10.21863/ijfm/2016.6.2.032
56. Chiang, S., Tsai, L., Shu, P., & Chen, S. (2012). The trading behavior of foreign, domestic institutional, and domestic individual investors: Evidence from the Taiwan stock market. *Pacific-Basin Finance Journal, 20*(5), 745-754. doi:10.1016/j.pacfin.2012.03.002.
57. Chinazzi, M., Fagiolo, G., Reyes, J. A., & Schiavo, S. (2013). Post-mortem examination of the international financial network. *Journal Of Economic Dynamics & Control, 37*(8), 1692-1713. doi:10.1016/j.jedc.2013.01.010.
58. Choi, J. J., Kedar-Levy, H., & Yoo, S. S. (2015). Are individual or institutional investors the agents of bubbles? *Journal of International Money and Finance, 59*, 1-22. doi:10.1016/j.jimonfin.2015.09.004
59. Choi, N. Y., & Sias, R. W. (2012). Why Does Financial Strength Forecast Stock Returns? Evidence from Subsequent Demand by Institutional Investors. *Review of Financial Studies, 25*(5), 1550-1587. doi:10.1093/rfs/hhs001

60. Choi, N., Fedenia, M., Skiba, H., & Sokolyk, T. (2017). Portfolio concentration and performance of institutional investors worldwide. *Journal Of Financial Economics, 123*(1), 189-208. doi:10.1016/j.jfineco.2016.09.007
61. Chuluun, T. (2017). Global portfolio investment network and stock market comovement. *Global Finance Journal, 33,* 51-68. doi:10.1016/j.gfj.2016.08.002
62. CPIS database (2017). Access to Macroeconomic & Financial Data. Retrieved from: http://data.imf.org/?sk=B981B4E3-4E58-467E-9B90-9DE0C3367363
63. DEMİR, S., & COŞKUN KADERLİ, Y. (2015). The Effects Of International Integration On Cost Of Equity: Application Of Turkey's Tourism Sector. *Journal Of Accounting & Finance,* 193-208. Retrieved from: https://search.proquest.com/openview/de2ac223b4a39e85b4270c468f362fde/1?pq-origsite=gscholar&cbl=2042221
64. Diebold, F. X., & Yilmaz, K. (2013). Measuring the Dynamics of Global Business Cycle Connectedness. *SSRN Electronic Journal*, 1-28. doi:10.2139/ssrn.2369340
65. Diebold, F. X., & Yilmaz, K. (2015). Trans-Atlantic Equity Volatility Connectedness: U.S. and European Financial Institutions, 2004–2014. *Journal of Financial Econometrics, 14*(1), 81-127. doi:10.1093/jjfinec/nbv021
66. Dimitrios, K., & Vasileios, O. (2015). A Network Analysis of the Greek Stock Market. *Procedia Economics and Finance, 33,* 340-349. doi:10.1016/s2212-5671(15)01718-9
67. Døskeland, T. M., & Hvide, H. K. (2011). Do Individual Investors Have Asymmetric Information Based on Work Experience? *The Journal of Finance, 66*(3), 1011-1041. doi:10.1111/j.1540-6261.2011.01658.x
68. Dungey, M., & Gajurel, D. (2015). Contagion and banking crisis – International evidence for 2007–2009. *Journal of Banking & Finance, 60,* 271-283. doi:10.1016/j.jbankfin.2015.08.007

69. Dutta, A. (2018). Implied volatility linkages between the U.S. and emerging equity markets: A note. *Global Finance Journal, 35*, 138-146. doi:10.1016/j.gfj.2017.09.002

70. Elliott, M., Golub, B., & Jackson, M. O. (2014). Financial Networks and Contagion. *SSRN, 104* (10): 3115–3153, doi:10.2139/ssrn.2175056.

71. Engle, R., & Granger, C. (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica, 55*(2), 251-276. doi:10.2307/1913236

72. Erdogan, B. (2014). The Role of Uncertainty Avoidance in Foreign Investment Bias. Research Papers in Economics, *15*(14), 1-29. Retrieved from: http://hdl.handle.net/10419/106640.

73. Fagiolo, G., & Mastrorillo, M. (2012). The International-Migration Network. *SSRN Electronic Journal*, 1-33. doi:10.2139/ssrn.2191190

74. Feroldi, V., & Gaffeo, E. (2014). At the Core of the International Financial System. *Global Economy Journal, 14*(2), 163-188. doi:10.1515/gej-2014-0006.

75. Fisher, K. L., & Statman, M. (2000). Investor Sentiment and Stock Returns. *Financial Analysts Journal, 56*(2), 16-23. doi:10.2469/faj.v56.n2.2340

76. Forbes, K. J., & Warnock, F. E. (2012). Capital flow waves: Surges, stops, flight, and retrenchment. *Journal Of International Economics, 88*(2), 235-251. doi:10.1016/j.jinteco.2012.03.006.

77. Forbes, K., & Rigobon, R. (2002). No Contagion, Only Interdependence: Measuring Stock Market Comovements. *The Journal of Finance, 57*(5), 2223-2261. doi: 10.3386/w7267

78. Foucault, T., Sraer, D., & Thesmar, D. J. (2011). Individual Investors and Volatility. *The Journal of Finance, 66*(4), 1369-1406. doi:10.1111/j.1540-6261.2011.01668.x

79. Freeman, L. C. (1978). Centrality in social networks conceptual clarification. *Social Networks, 1*(3), 215-239. doi:10.1016/0378-8733(78)90021-7

80. Fuchs-Schündeln, N., & Funke, N. (2003). Stock market liberalizations: Financial and macroeconomic implications. *Review of World Economics, 139*(4), 730-761. doi:10.1007/bf02653111

81. Gaigalienė, A. (2014). Tarptautinio fnansinio tinklo identifkavimo ypatumų analizė. *Applied Economics: Systematic Research, 8*(2), 119-140. doi:10.7220/AeSr.2335.8742.2014.8.2.7.

82. Garg, R., & Dua, P. (2014). Foreign Portfolio Investment Flows to India: Determinants and Analysis. *World Development, 59*, 16-28. doi:10.1016/j.worlddev.2014.01.030.

83. Gaudecker, H. V. (2015). How Does Household Portfolio Diversification Vary with Financial Literacy and Financial Advice?. *Journal Of Finance*, *70*(2), 489-507. doi:10.1111/jofi.12231

84. Gehringer, A. (2012). Financial Liberalization, Growth, Productivity and Capital Accumulation: The Case of European Integration. *International Review of Economics & Finance, 25*, 291-309. doi:10.1016/j.iref.2012.07.015.

85. Giannetti, M., & Koskinen, Y. (2009). Investor Protection, Equity Returns, and Financial Globalization. *Journal of Financial and Quantitative Analysis, 45*(1), 135-168. doi:10.1017/s0022109009990524

86. Gyntelberg, J., Loretan, M., Subhanij, T., & Chan, E. (2014). Exchange rate fluctuations and international portfolio rebalancing. *Emerging Markets Review*, *18,* 34-44, doi:10.1016/j.ememar.2013.11.004.

87. Giofré, M. (2013). International diversification: Households versus institutional investors. *The North American Journal of Economics and Finance, 26*, 145-176. doi:10.1016/j.najef.2013.08.003

88. Giofré, M. (2014). Domestic investor protection and foreign portfolio investment. *Journal Of Banking & Finance*, *46,* 355-371. doi:10.1016/j.jbankfin.2014.05.027.

89. Giofré, M. (2017). Financial education, investor protection and international portfolio diversification. *Journal Of International Money & Finance*, 71, 111-139. doi:10.1016/j.jimonfin.2016.11.004.

90. Goetzmann, W. N., & Kumar, A. (2008). Equity Portfolio Diversification. *Review of Finance, 12*(3), 433-463. doi:10.1093/rof/rfn005

91. Graham, M., Kiviaho, J., Nikkinen, J., & Omran, M. (2013). Global and regional co-movement of the MENA stock markets. *Journal Of Economics & Business*, 65, 86-100. doi:10.1016/j.jeconbus.2012.09.005

92. Griffin, J., Harris, J., & Topaloglu, S. (2003). The Dynamics of Institutional and Individual Trading. *The Journal of Finance, 58*(6), 2285-2320. doi:10.1046/j.1540-6261.2003.00606.x

93. Guesmi, K., & Nguyen, D. K. (2011). How strong is the global integration of emerging market regions? An empirical assessment. *Economic Modelling, 28*(6), 2517-2527. doi:10.1016/j.econmod.2011.07.006

94. Guesmi, K., & Nguyen, D. K. (2014). Time-varying regional integration of stock markets in Southeast Europe. *Applied Economics*, *46*(11), 1279-1290. doi:10.1080/00036846.2013.870656

95. Guesmi, K., & Teulon, F. (2014). The determinants of regional stock market integration in middle east: A conditional ICAPM approach. *International Economics, 137*, 22-31. doi:10.1016/j.inteco.2013.10.006

96. Guesmi, K., Ftiti, Z., & Abid, I. (2013). Greece's Stock Market Integration with Southeast Europe. *Journal of Economic Integration, 28*(4), 668-682. doi:10.11130/jei.2013.28.4.668

97. Guesmi, K., Moisseron, J., & Teulon, F. (2014). Integration versus segmentation in Middle East North Africa Equity Market: Time variations and currency risk. *Journal Of International Financial Markets, Institutions & Money, 28*, 204-212. doi:10.1016/j.intfin.2013.10.005

98. Guidolin, M., & Pedio, M. (2017). Identifying and measuring the contagion channels at work in the European financial crises. *Journal of International Financial Markets, Institutions and Money, 48,* 117-134. doi:10.1016/j.intfin.2017.01.001

99. Guidotti, R., Gardoni, P., & Chen, Y. (2017). Network reliability analysis with link and nodal weights and auxiliary nodes. *Structural Safety*, *65*, 12-26. doi:10.1016/j.strusafe.2016.12.001.

100. Han, A., & Chung, C. Y. (2013). Are individual investors less informed than institutional investors? Unique evidence from investor trading behaviours around bad mergers in Korean financial market. *Applied Economics Letters, 20*(12), 1145-1149. doi:10.1080/13504851.2013.791012

101. Han, L., Zheng, Q., Li, L., & Yin, L. (2015). Do foreign institutional investors stabilize the capital market?. *Economics Letters*, 136, 73-75. doi:10.1016/j.econlet.2015.09.008

102. Hellmanzik, C., & Schmitz, M. (2017). Taking gravity online: The role of virtual proximity in international finance. *Journal of International Money and Finance, 77*, 164-179. doi:10.1016/j.jimonfin.2017.07.001

103. Hoffmann, A. O., Post, T., & Pennings, J. M. (2013). Individual investor perceptions and behavior during the financial crisis. *Journal Of Banking & Finance*, *37*(1), 60-74. doi:10.1016/j.jbankfin.2012.08.007.

104. Huang, E. J. (2015). The role of institutional investors and individual investors in financial markets: Evidence from closed-end funds. *Review Of Financial Economics*, *26*, 1-11. doi:10.1016/j.rfe.2015.05.001.

105. You, L., & Daigler, R. T. (2010). Is international diversification really beneficial? *Journal Of Banking & Finance*, *34*(1), 163-173. doi:10.1016/j.jbankfin.2009.07.016

106. Ivković, Z., Sialm, C., & Weisbenner, S. (2008). Portfolio Concentration and the Performance of Individual Investors. *The Journal of Financial and Quantitative Analysis*, *43*(3), 613-655. doi:10.1017/S0022109000004233

107. Jain, P. K., Kuvvet, E., & Pagano, M. S. (2017). Corruption's impact on foreign portfolio investment. *International Business Review, 26*(1), 23-35. doi:10.1016/j.ibusrev.2016.05.004.

108. Jain, R. (2007). Institutional and individual investor preferences for dividends and share repurchases. *Journal Of Economics & Business, 59*(5), 406-429. doi:10.1016/j.jeconbus.2007.04.004.

109. Kanas, A., & Karkalakos, S. (2017). Equity flows, stock returns and exchange rates. *International Journal Of Finance & Economics, 22*(2), 159-168. doi:10.1002/ijfe.1574

110. Kaniel, R., Saar, G., & Titman, S. (2008). Individual Investor Trading and Stock Returns. *The Journal of Finance, 63*(1), 273-310.doi:0.1111/j.1540-6261.2008.01316.x

111. Karolyi, G. A., Ng, D. T., & Prasad, E. S. (2015). The Coming Wave: Where Do Emerging Market Investors Put Their Money? (No. w21661). National Bureau of Economic Research. doi:10.3386/w21661

112. Kasibhatla, K. M., Stewart, D., Sen, S., & Malindretos, J. (2006). Are Daily Stock Price Indices in the Major European Equity Markets Cointegrated? Tests and Evidence. *The American Economist, 50*(2), 47-57. doi:10.1177/056943450605000205

113. Kawano, L. (2014). The Dividend Clientele Hypothesis: Evidence from the 2003 Tax Act. *American Economic Journal: Economic Policy, 6*(1), 114-136. doi:10.1257/pol.6.1.114

114. Khallouli, W., & Sandretto, R. (2012). Testing for "Contagion" of the Subprime Crisis on the Middle East and North African Stock Markets: A Markov Switching EGARCH Approach. *Journal of Economic Integration, 27*(1), 134-166. doi:10.11130/jei.2012.27.1.134

115. Koestner, M., Loos, B., Meyer, S., & Hackethal, A. (2017). Do individual investors learn from their mistakes? *J Bus Econ 87,* 669–703. doi:10.1007/s11573-017-0855-7

116. KPMG (2015). IFRS compared to US GAAP: An overview. Retrieved from: https://home.kpmg.com/content/dam/kpmg/pdf/2015/12/US-GAAP-comparison-2015-overview.pdf

117. Kramer, M. M. (2012). Financial Advice and Individual Investor Portfolio Performance. *Financial Management, 41*(2), 395-428. doi:10.1111/j.1755-053x.2012.01185.x

118. Kuvvet, E. (2013). Threats to Foreign Equity Investments in International Capital Markets: Nationalism and Militarism. *Review Of Pacific Basin Financial Markets & Policies, 16*(3), 1-16. doi:10.1142/S0219091513500185.

119. Lagoarde-Segot, T., & Lucey, B. (2007). Capital Market Integration in the Middle East and North Africa. *Emerging Markets Finance and Trade, 43*(3), 34-57. doi:10.2753/ree1540-496x430303

120. Lai, M., Tan, S., & Chong, L. (2013). The Behavior of Institutional and Retail Investors in Bursa Malaysia during the Bulls and Bears. *Journal Of Behavioral Finance, 14*(2), 104-115. doi:10.1080/15427560.2013.790822.

121. Lamoureux, C., & Lastrapes, W. (1990). Persistence in Variance, Structural Change, and the GARCH Model. *Journal of Business & Economic Statistics, 8*(2), 225-234. doi:10.2307/1391985

122. Lee, K. (2017). Herd behavior of the overall market: Evidence based on the cross-sectional comovement of returns. *The North American Journal of Economics and Finance, 42*, 266-284. doi:10.1016/j.najef.2017.07.006

123. Li, W., Rhee, G., & Wang, S. S. (2017). Differences in herding: Individual vs. institutional investors. *Pacific-Basin Finance Journal*, 45, 174-185. doi:10.1016/j.pacfin.2016.11.005

124. Liao, L., Chou, R. Y., & Chiu, B. (2013). Anchoring effect on foreign institutional investors' momentum trading behavior: Evidence from the Taiwan stock market. *North American Journal Of Economics & Finance, 26*, 72-91. doi:10.1016/j.najef.2013.07.001.

125. Lydeka, Z., & Gaigalienė, A. (2013). International financial network characteristics as the measure of financial integration. *Applied Economics: Systematic Research, 7*(2), 59-69. doi:10.7720/AESR.1822-7996.2013.7.2.4.

126. Liu, H., Chuang, W., Huang, J., & Chen, Y. (2016). The overconfident trading behavior of individual versus institutional investors. *International Review Of Economics & Finance*, *45*, 518-539. doi:10.1016/j.iref.2016.07.016

127. Longstaff, F. A. (2010). The subprime credit crisis and contagion in financial markets. *Journal of Financial Economics, 97*(3), 436-450. doi:10.1016/j.jfineco.2010.01.002

128. Lucey, B. M., & Zhang, Q. (2010). Does cultural distance matter in international stock market comovement? Evidence from emerging economies around the world. *Emerging Markets Review, 11*(1), 62-78. doi:10.1016/j.ememar.2009.11.003

129. Luchtenberg, K. F., & Seiler, M. J. (2014). Do Institutional and Individual Investors Differ in Their Preference for Financial Skewness?. *Journal Of Behavioral Finance*, *15*(4), 299-311. doi:10.1080/15427560.2014.968718

130. Luchtenberg, K. F., & Vu, Q. V. (2015). The 2008 financial crisis: Stock market contagion and its determinants. *Research in International Business and Finance, 33*, 178-203. doi:10.1016/j.ribaf.2014.09.007

131. Lučić, D., Radišić, M., & Dobromirov, D. (2016). Causality between corruption and the level of GDP. *Economic Research-Ekonomska Istraživanja, 29*(1), 360-379, doi:10.1080/1331677X.2016.1169701.

132. Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance, 7*(1), 77-91. doi:10.2307/2975974

133. Mensi, W., Boubaker, F. Z., Al-Yahyaee, K. H., & Kang, S. H. (2017). Dynamic volatility spillovers and connectedness between global, regional, and GIPSI stock markets. *Finance Research Letters*, In Press, Corrected Proof. doi:10.1016/j.frl.2017.10.032

134. Merli, M., & Roger, T. (2013). What drives the herding behavior of individual investors?. *Finance*, *34*(3), 67-104. Retrieved from: https://halshs.archives-ouvertes.fr/halshs-01026483

135. Minoiu, C., Kang, C., Subrahmanian, V., & Berea, A. (2015). Does financial connectedness predict crises? *Quantitative Finance*, *15*(4), 607-624. doi:10.1080/14697688.2014.968358

136. Mobarek, A., Muradoglu, G., Mollah, S., & Hou, A. J. (2016). Determinants of time varying co-movements among international stock markets during crisis and non-crisis periods. *Journal of Financial Stability, 24*, 1-11. doi:10.1016/j.jfs.2016.03.003

137. Mollah, S., Quoreshi, A. S., & Zafirov, G. (2016). Equity market contagion during global financial and Eurozone crises: Evidence from a dynamic correlation analysis. *Journal of International Financial Markets, Institutions and Money, 41*, 151-167. doi:10.1016/j.intfin.2015.12.010

138. Mun, K. (2008). Effects of Exchange Rate Fluctuations on Equity Market Volatility and Correlations: Evidence from the Asian Financial Crisis. *Quarterly Journal of Finance and Accounting, 47*(3), 77-102. Retrieved from http://www.jstor.org/stable/40473500

139. Muzur, L., Suesse, Th., & Krivitisky, P. N. (2015). Investigating foreign portfolio investment holding: gravity model with social network analysis, *National Institute for Applied Statistics Research Australia, University of Wollongong, Working Paper 24*, 17-15. Retrieved from: http://ro.uow.edu.au/niasrawp/37

140. Naitram, S. M. (2014). Offshore Financial Centers in the Global Capital Network. *Global Economy Journal*, *14*(3/4), 435-451. doi:10.1515/gej-2013-0059.

141. Nardo, M., Ndacyayisenga, N., Papanagiotou, E., Rossi, E., & Ossola, E. (2017). Measures and drivers of Financial Integration in Europe. *European Commission, Joint Research Centre, Report EUR 28469 EN*. doi:10.2760/92134.

142. Oatley, T., Winecoff Kindred, W., Pennock, A., & Danzman, S. B. (2013). The political economy of global finance: A network model. *Perspectives on Politics*, *11*(1), 133-153, doi:10.1017/S1537592712003593.

143. Opsahl, T., Agneessens, F., & Skvoretz, J. (2010). Node centrality in weighted networks: Generalizing degree and shortest paths. *Social Networks, 32* (3), 245-251, doi:10.1016/j.socnet.2010.03.006.

144. Palac-Mcmiken, E. D. (1997). An Examination of ASEAN Stock Markets: A Cointegration Approach. *Asean Economic Bulletin, 13*(3), 299-311. doi:10.1355/ae13-3b

145. Pyun, J. H. (2016). Net Equity and Debt Flows to Emerging Market and Developing Economies in the Post-Crisis Era. *Emerging Markets Finance & Trade*, *52*(11), 2473-2494. doi:10.1080/1540496X.2016.1162150.

146. Qian, X., & Steiner, A. (2014). International Reserves and the Composition of Foreign Equity Investment. *Review Of International Economics*, *22*(2), 379-409. doi:10.1111/roie.12113.

147. Rahahleh, N. A., Bhatti, M. I., & Adeinat, I. (2017). Tail dependence and information flow: Evidence from international equity markets. *Physica A: Statistical Mechanics and Its Applications, 474*, 319-329. doi:10.1016/j.physa.2017.01.063

148. Reyes, J., Schiavo, S., & Fagiolo, G. (2008). Using complex networks analysis to assess the evolution of international economic integration: The cases of East Asia and Latin America. *The Journal of International Trade & Economic Development, 19* (2), 215-239, doi:10.1080/09638190802521278.

149. Royen, A. V. (2002). Financial Contagion and International Portfolio Flows. *Financial Analysts Journal, 58*(1), 35-49. doi:10.2469/faj.v58.n1.2508

150. Roque, V., & Cortez, M. C. (2014). The determinants of international equity investment: Do they differ between institutional and noninstitutional investors? *Journal Of Banking & Finance, 49*, 469-482. doi:10.1016/j.jbankfin.2014.06.015.

151. Rua, A., & Nunes, L. C. (2009). International comovement of stock market returns: A wavelet analysis. *Journal Of Empirical Finance, 16*(4), 632-639. doi:10.1016/j.jempfin.2009.02.002

152. Schiavo, S., Reyes, J., & Fagiolo, G. (2010). International trade and financial integration: a weighted network analysis. *Quantitative Finance, 10*(4), 389-399. doi:10.1080/14697680902882420.

153. Schnatterly, K., Shaw, K. W., & Jennings, W. W. (2007). Information advantages of large institutional owners. *Strategic Management Journal, 29*(2), 219-227. doi:10.1002/smj.654

154. Schumacher, M., & Żochowski, D. (2017). The Risk Premium Channel and Long-Term Growth. *ECB Working Paper Series,* 2114. Retrieved from: https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2114.en.pdf?6697751e8a7309a89d59f420c0a4e0c3

155. Seasholes, M. S., & Zhu, N. (2010). Individual Investors and Local Bias. *Journal Of Finance, 65*(5), 1987-2010. doi:10.1111/j.1540-6261.2010.01600.x

156. Shah, A., & Deo, M. (2016). Integration of the Indian Stock Market : At the angle of Time-Frequency. *Journal of Economic Integration, 31*(1), 183-205. doi:10.11130/jei.2016.31.1.183

157. Sias, R. (2004). Institutional Herding. *The Review of Financial Studies, 17*(1), 165-206. doi:10.1093/rfs/hhg035

158. Solnik, B., Boucrelle, C., & Fur, Y. L. (1996). International Market Correlation and Volatility. *Financial Analysts Journal, 52*(5), 17-34. doi:10.2469/faj.v52.n5.2021

159. Stepanyan, G. G. (2017). Financial Liberalization and Foreign Institutional Investors: Literature Review *In* Institutional Investors in Global Capital Markets, 17-50, doi:10.1108/S1569-3767(2011)0000012004.

160. Stiglitz, J. (2003). Globalization and the economic role of the state in the new millennium. *Industrial and Corporate Change, 12*(1), 3-26. doi:10.1093/icc/12.1.3

161. Stock, J., & Watson, M. (2001). Vector Autoregressions. *The Journal of Economic Perspectives, 15*(4), 101-115. doi:10.1257/jep.15.4.101

162. Tabak, B. M., Serra, T. R., & Cajueiro, D. O. (2010). Topological properties of stock market networks: The case of Brazil. *Physica A: Statistical Mechanics and Its Applications, 389*(16), 3240-3249. doi:10.1016/j.physa.2010.04.002

163. Teulon, F., Guesmi, K., & Mankai, S. (2014). Regional stock market integration in Singapore: A multivariate analysis. *Economic Modelling, 43*, 217-224. doi:10.1016/j.econmod.2014.07.045

164. Todea, A., & Pleşoianu, A. (2013). The influence of foreign portfolio investment on informational efficiency: Empirical evidence from Central and Eastern European stock markets. *Economic Modelling, 33*, 34-41, doi:10.1016/j.econmod.2013.03.017.

165. Wu, J., Li, S., & Selover, D. D. (2012). Foreign Direct Investment vs. Foreign Portfolio Investment. *Management International Review, 52*(5), 643-670. doi:10.1007/s11575-011-0121-0.

166. Zeng, Y. (2016). Institutional investors: Arbitrageurs or rational trend chasers. *International Review Of Financial Analysis, 45*, 240-262. doi:10.1016/j.irfa.2016.03.006

167. Zhang, Y., Cao, X., He, F., & Zhang, W. (2017). Network topology analysis approach on China's QFII stock investment behavior, *Physica A: Statistical Mechanics and its Applications, Vol. 473*, 77-88, doi:10.1016/j.physa.2016.12.054.

168. Zhang, Sh., Wang, L., Liu, Zh., & Wang, X. (2016). Evolution of international trade and investment networks. *Physica A: Statistical Mechanics and its Applications, 462*, 752-763, doi:10.1016/j.physa.2016.06.117.

APPENDICES

Appendix 1

The Vocabulary of Terms

Centrality – strong direct, indirect or other type of node impact on other nodes in the network.

Clustering coefficient – probability that the neighbours of a node are also neighbours among themselves.

Community – a cluster of countries based on their weighed links.

Contagion – vulnerability of financial markets to be affected by financial shocks in other financial markets.

Contagion channel – an instrument which spreads financial shocks in other financial markets.

Equity market connectedness – integration of equity markets forming direct and indirect links among equity markets.

Financial intergration – gradual convergence between international and local markets (Berger and Pozzi, 2013).

Globalisation – an integration process, which started in 18th century but now determined by fast technological changes and fragmented production in the whole world, especially in developing countries (Baldwin, 2016).

Institutional investor – a legal entity investing on behalf of its investors and is regulated by monetary authorities.

International diversification – portfolio diversification in different international markets.

International equity investment network – a network consisting of countries, which invest in equities in other countries.

Node degree – real number of node connections compared to the whole network.

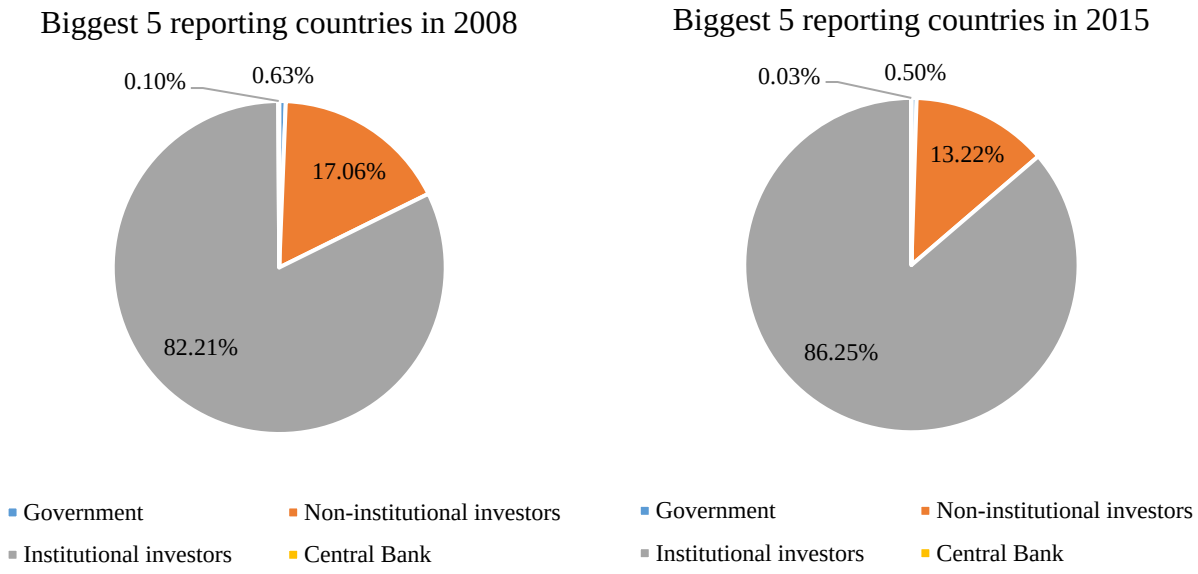
Node strength – real number of node connections weighted by the value of link.

Non-institutional investor – a non-professional investor having restricted access to financial markets due to regulations and required minimum investments.

Portfolio diversification – investment in assets, which are less correlated obtaining a lower risk with a higher profit.

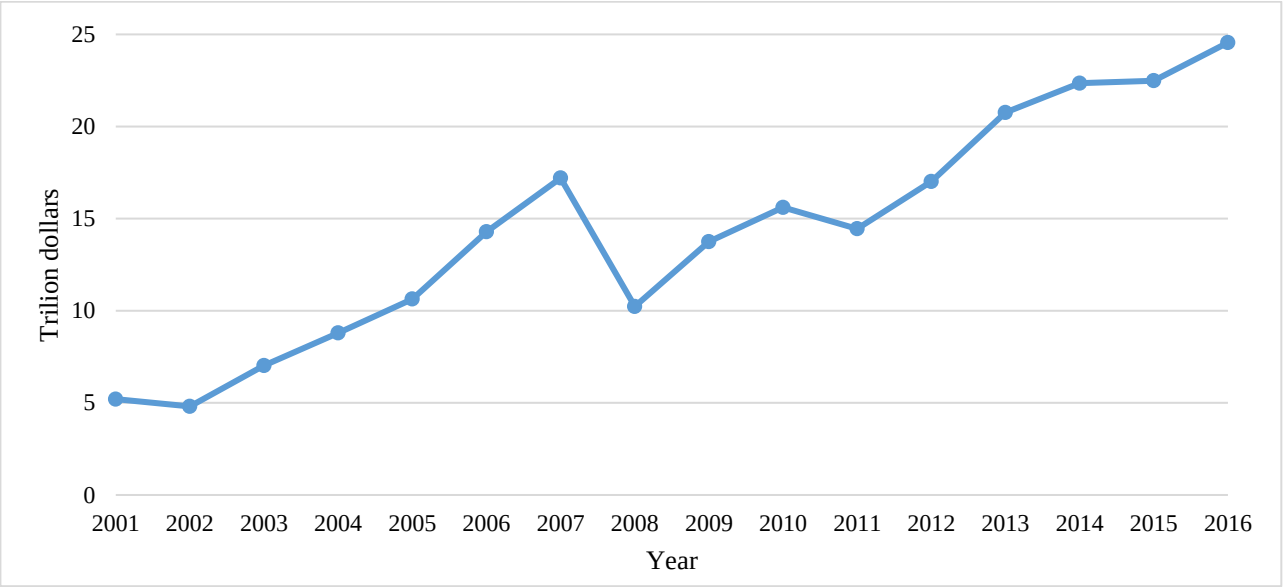
Appendix 2

Coordinated portfolio structure in 2008 and 2015



Appendix 3

Development of total equity flows, 2001–2016



Appendix 4

ISO codes of world countries

Country	Code	Country	Code	Country	Code
Afghanistan	AF	Costa Rica	CR	Isle of Man	IM
Albania	AL	Cote d'Ivoire	CI	Israel	IL
Algeria	DZ	Croatia	HR	Italy	IT
American Samoa	AS	Cuba	CU	Jamaica	JM
Andorra	AD	Curacao	CW	Japan	JP
Angola	AO	Curacao & St. Maarten	SX	Jersey	JE
Anguilla	AI	Czech Republic	CZ	Jordan	JO
Antigua and Barbuda	AG	Denmark	DK	Kazakhstan	KZ
Argentina	AR	Djibouti	DJ	Kenya	KE
Armenia	AM	Dominica	DM	Kyrgyz Republic	KG
Aruba	AW	Dominican Republic	DO	Kiribati	KI
Australia	AU	Ecuador	EC	Korea (Dem. Rep.)	KP
Austria	AT	Egypt	EG	Korea (Rep.)	KR
Azerbaijan	AZ	El Salvador	SV	Kosovo (Rep.)	XK
Bahamas	BS	Equatorial Guinea	GQ	Kuwait	KW
Bahrain	BH	Eritrea	ER	Lao People's Dem. Rep.	LA
Bangladesh	BD	Estonia	EE	Latvia	LV
Barbados	BB	Ethiopia	ET	Lebanon	LB
Belarus	BY	Falkland Islands	FK	Lesotho	LS
Belgium	BE	Faroe Islands	FO	Liberia	LR
Belize	BZ	Fiji	FJ	Libya	LY
Benin	BJ	Finland	FI	Liechtenstein	LI
Bermuda	BM	France	FR	Lithuania	LT
Bhutan	BT	French Polynesia	PF	Luxembourg	LU
Bolivia	BO	French Southern Territories	TF	Macedonia	MK
Bonaire, Sint Eustatius, Saba	BQ	Gabon	GA	Madagascar	MG
Bosnia and Herzegovina	BA	Gambia	GM	Mayotte	YT
Botswana	BW	Georgia	GE	Malaysia	MY
Brazil	BR	Germany	DE	Malawi	MW
British Indian Ocean Territory	IO	Ghana	GH	Maldives	MV
British Virgin Islands	VG	Gibraltar	GI	Mali	ML
Brunei Darussalam	BN	Greece	GR	Malta	MT
Bulgaria	BG	Greenland	GL	Marshall Islands	MH
Burkina Faso	BF	Grenada	GD	Martinique	MQ
Burundi	BI	Guadeloupe	GP	Mauritania	MR
Cabo Verde	CV	Guam	GU	Mauritius	MU
Cayman Islands	KY	Guatemala	GT	Mexico	MX
Cambodia	KH	Guernsey	GG	Myanmar	MM
Cameroon	CM	Guyana	GY	Micronesia	FM
Canada	CA	Guiana (French)	GF	Moldova	MD
Central African Republic	CF	Guinea	GN	Monaco	MC
Chad	TD	Guinea-Bissau	GW	Mongolia	MN
Chile	CL	Haiti	HT	Montenegro	ME
China (Mainland)	CN	Honduras	HN	Montserrat	MS
China, P.R.: Macao	MO	Hong Kong	HK	Morocco	MA
Christmas Island	CX	Hungary	HU	Mozambique	MZ
Cyprus	CY	Iceland	IS	Namibia	NA
Cocos (Keeling) Islands	CC	Yemen	YE	Nauru	NR
Colombia	CO	India	IN	Nepal	NP
Comoros	KM	Indonesia	ID	Netherlands	NL
Congo (Dem. Rep.)	CD	Iran	IR	Netherlands Antilles	AN
Congo, (Rep.)	CG	Iraq	IQ	New Caledonia	NC
Cook Islands	CK	Ireland	IE	New Zealand	NZ

Country	Code	Country	Code	Country	Code
Nicaragua	NI	Saudi Arabia	SA	Timor-Leste	TL
Niger	NE	Seychelles	SC	Togo	TG
Nigeria	NG	Senegal	SN	Tokelau Islands	TK
Niue	NU	Serbia, Republic of	RS	Tonga	TO
Norfolk Island	NF	Sierra Leone	SL	Trinidad and Tobago	TT
Norway	NO	Singapore	SG	Tunisia	TN
Oman	OM	Sint Maarten	SX	Turkey	TR
Pakistan	PK	Syrian Arab Republic	SY	Turkmenistan	TM
Palau	PW	Slovak Republic	SK	Turks and Caicos Islands	TC
Panama	PA	Slovenia	SI	Tuvalu	TV
Papua New Guinea	PG	Solomon Islands	SB	Uganda	UG
Paraguay	PY	Somalia	SO	Ukraine	UA
Peru	PE	South Africa	ZA	United Arab Emirates	AE
Philippines	PH	South Sudan	SS	United Kingdom	UK
Pitcairn Islands	PN	Spain	ES	United States	US
Poland	PL	Sri Lanka	LK	Uruguay	UY
Portugal	PT	St. Kitts and Nevis	KN	US Pacific Islands	CU
Puerto Rico	PR	St. Lucia	LC	US Virgin Islands	VI
Qatar	QA	St. Vincent, the Grenadines	VC	Uzbekistan	UZ
Reunion	RE	Sudan	SD	Vanuatu	VU
Romania	RO	Suriname	SR	Vatican	VA
Russian Federation	RU	Swaziland	SZ	Venezuela	VE
Rwanda	RW	Sweden	SE	Vietnam	VN
Saint Helena	SH	Switzerland	CH	Wallis and Futuna	WF
Saint Pierre and Miquelon	PM	Taiwan	TW	West Bank and Gaza	PS
Samoa	WS	Tajikistan	TJ	Western Sahara	EH
San Marino	SM	Tanzania	TZ	Zambia	ZM
Sao Tome and Principe	ST	Thailand	TH	Zimbabwe	ZW

Appendix 5

Equity investment allocation of investing countries with regard to institutional and non-institutional investors in 2016

	Inst.	Non-inst.		Inst.	Non-inst.		Inst.	Non-inst.
Argentina	1%	99%	France	85%	15%	Mexico	100%	0%
Australia	100%	0%	Germany	57%	43%	Mongolia	65%	35%
Austria	67%	33%	Greece	30%	70%	Netherlands	92%	8%
Bangladesh	100%	0%	Guernsey	100%	0%	Norway	86%	14%
Belarus	5%	95%	Honduras	100%	0%	Pakistan	99%	1%
Belgium	52%	48%	Hungary	75%	25%	Peru	100%	0%
Bermuda	100%	0%	Iceland	95%	5%	Poland	97%	3%
Bolivia	100%	0%	India	37%	63%	Portugal	69%	31%
Brazil	46%	54%	Indonesia	100%	0%	Romania	77%	23%
Bulgaria	62%	38%	Israel	65%	35%	Russian Fed.	58%	42%
Cayman Islands	100%	0%	Italy	60%	40%	Slovak Rep.	88%	12%
Chile	64%	36%	Japan	94%	6%	Slovenia	84%	16%
China, Macao	100%	0%	Jersey	100%	0%	South Africa	95%	5%
Colombia	96%	4%	Kazakhstan	61%	39%	Spain	57%	43%
Costa Rica	10%	90%	Korea	89%	11%	Sweden	83%	17%
Curacao, St. Maarten	100%	0%	Kosovo	100%	0%	Thailand	93%	7%
Cyprus	97%	3%	Kuwait	56%	44%	Turkey	66%	34%
Czech Rep.	49%	51%	Latvia	84%	16%	Ukraine	0%	100%
Denmark	93%	7%	Lebanon	100%	0%	United Kingdom	96%	4%
Egypt	100%	0%	Lithuania	82%	18%	United States	88%	12%
Estonia	80%	20%	Macedonia	100%	0%	Venezuela	100%	0%
Finland	84%	16%	Malaysia	2%	98%	West Bank, Gaza	35%	65%

Appendix 6

Reporting Data of Economies by Sector of Holder and Economy of Nonresident Issuer (December 2015)

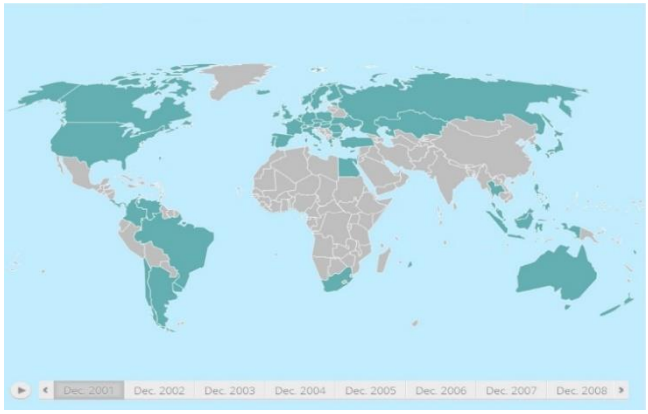
Economy	Central Bank	Deposit-taking Corporations except the Central Bank	Other Financial Corporations				General Government	Nonfinancial Corporations, Households and NPISHs			
			Total	Insurance Corporations and Pension Funds	Money Market Funds	Other		Total	Nonfinancial Corporations	Households	NPISHs
Argentina		+	+			+	+	+			
Aruba			+					+			
Australia		+	+	+	+	+	+				
Austria	+	+	+	+		+	+	+	+	+	
Bahrain		+	+	+			+				
Bangladesh		+						+	+		
Barbados	+	+	+	+							
Belarus	+	+						+	+		
Belgium	+	+	+	+	+	+	+	+	+	+	+
Bermuda		+	+	+	+		+				
Bolivia		+									
Brazil		+	+	+		+		+	+	+	+
Bulgaria		+	+	+		+		+	+	+	+
Cayman Islands		+									
Chile		+	+	+		+	+	+	+		
China, Macao		+					+				
Colombia		+	+	+	+	+	+	+	+		
Costa Rica		+	+			+		+		+	
Cyprus	+	+	+	+		+		+	+	+	+
Czech Republic		+	+	+	+	+	+	+	+	+	
Denmark		+	+	+		+	+	+	+	+	+
Egypt		+	+	+							
Estonia	+	+	+	+		+	+	+	+	+	+
Finland	+	+	+	+	+	+	+	+	+	+	+
France		+	+	+	+	+	+	+	+	+	+
Germany	+	+	+	+	+	+	+	+	+	+	+
Greece	+	+	+	+	+	+	+	+	+	+	+
Guernsey		+	+	+	+		+				
Honduras	+	+	+	+			+				
Hungary	+	+	+	+	+	+	+	+	+	+	+
Iceland	+	+	+	+		+		+	+	+	
India		+	+	+	+			+	+		
Indonesia		+	+	+	+	+		+	+	+	
Israel		+	+	+		+		+	+	+	+
Italy	+	+	+	+		+	+	+	+	+	+

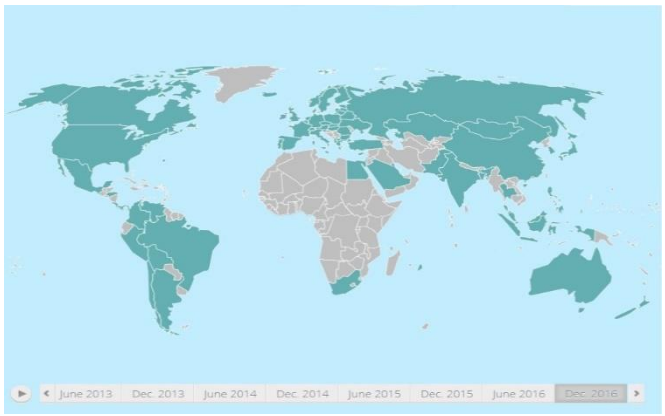
Economy	Central Bank	Deposit-taking Corporations except the Central Bank	Other Financial Corporations				General Government	Nonfinancial Corporations, Households and NPISHs			
			Total	Insurance Corporations and Pension Funds	Money Market Funds	Other		Total	Nonfinancial Corporations	Households	NPISHs
Japan	+	+	+	+		+	+	+			
Jersey		+	+			+	+				
Kazakhstan	+	+	+	+		+	+	+	+	+	
Korea,???		+	+				+	+			
Kosovo	+	+	+	+							
Kuwait		+	+	+	+	+	+	+	+	+	+
Latvia	+	+	+	+		+		+	+	+	+
Lebanon		+	+	+		+					
Lithuania	+	+	+	+		+	+	+	+	+	+
Malaysia		+						+	+		
Mexico		+	+	+		+		+	+		
Mongolia			+			+		+	+		
Netherlands	+	+	+	+	+	+	+	+	+	+	
Norway	+	+	+	+	+	+	+	+	+	+	+
Pakistan		+	+	+		+		+	+		
Palau							+				
Panama		+	+	+		+	+	+	+		
Poland		+	+	+		+		+	+		
Portugal	+	+	+	+	+	+	+	+	+	+	+
Romania		+	+	+		+		+	+	+	
Russian Federation		+	+	+		+		+	+	+	
Slovak Republic	+	+	+	+	+	+		+	+	+	+
Slovenia	+	+	+	+	+	+	+	+	+	+	+
South Africa		+	+	+	+	+		+		+	
Spain	+	+	+	+	+	+	+	+	+	+	+
Sweden	+	+	+	+		+	+	+	+	+	+
Thailand	+	+	+	+	+	+	+	+	+	+	
Turkey		+	+	+		+		+	+	+	
Ukraine		+						+	+	+	
United Kingdom		+	+	+	+	+	+	+	+	+	
Uruguay		+						+		+	
Venezuela	+		+	+		+	+	+	+		
West Bank and Gaza		+									
Total	**27**	**64**	**58**	**52**	**23**	**48**	**37**	**53**	**46**	**37**	**22**

Source: CPIS database (2017).

Appendix 7

Map of coordinated portfolio reporting countries in 2001, 2008 and 2016

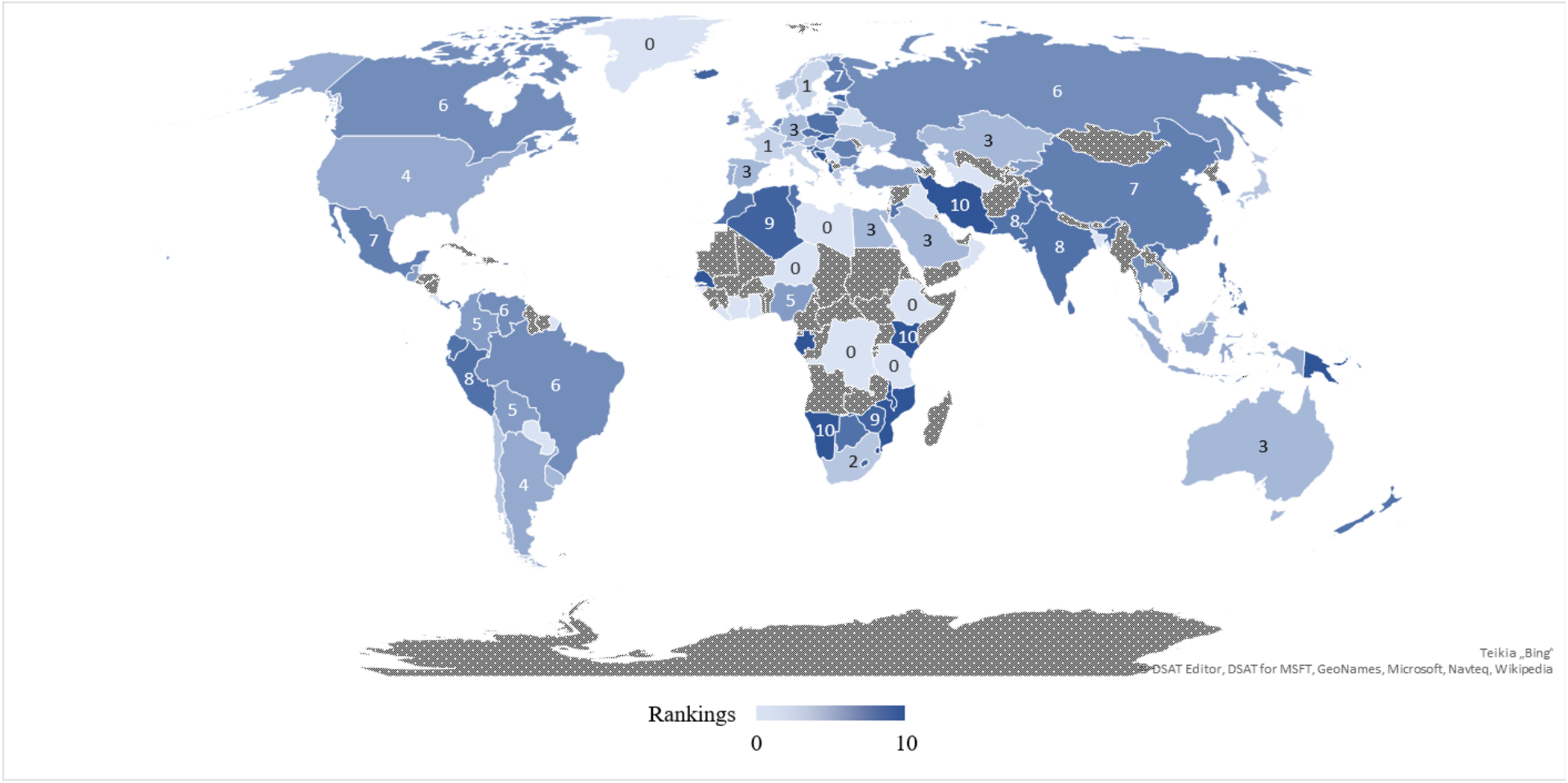




Source: CPIS database (2017).
Note: Countries in brown do not provide coordinated portfolio data.

Appendix 8

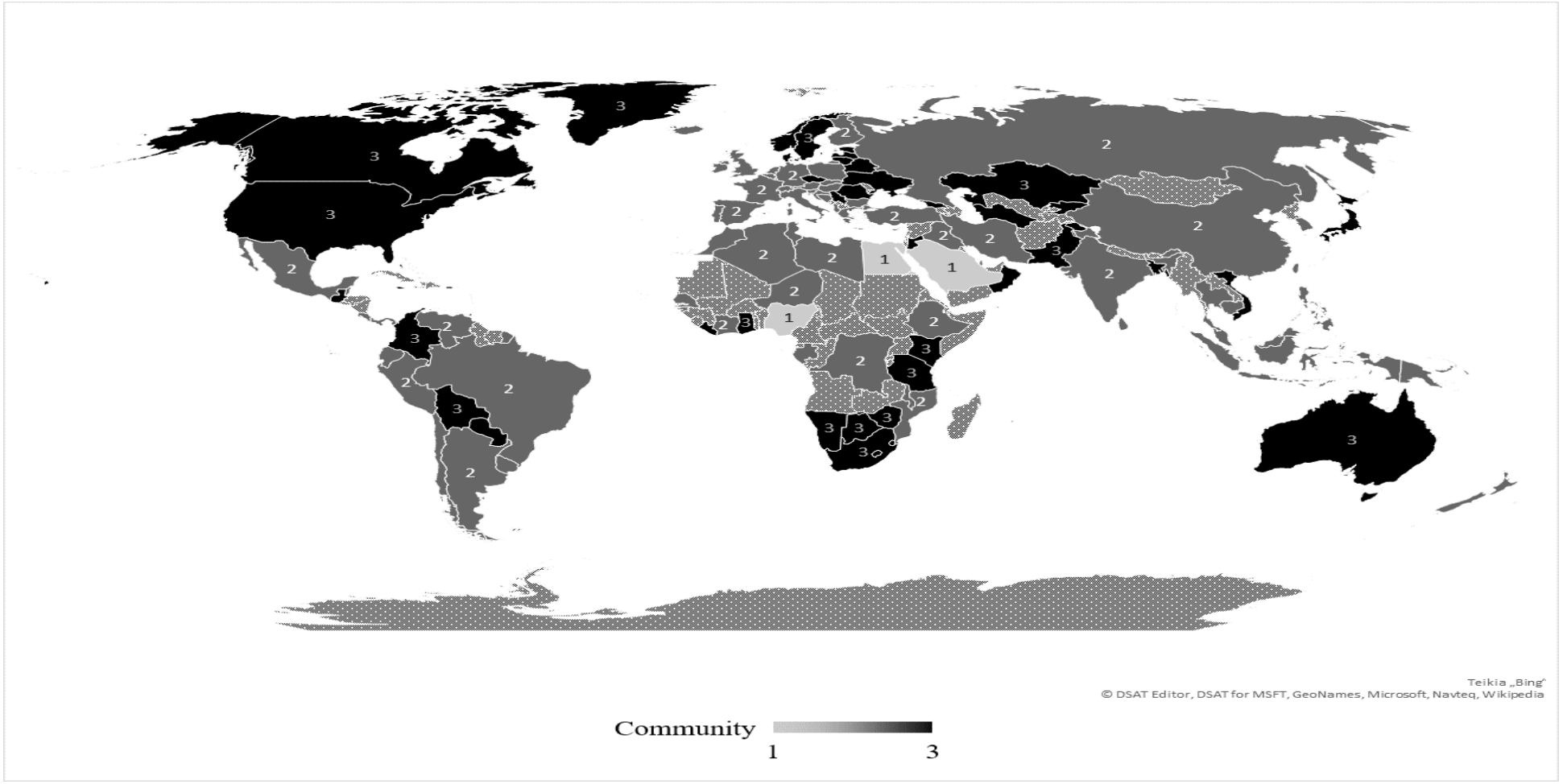
Clustering map of international equity investment network regarding institutional investors in 2001



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian countries as Norway is 2, Sweden and Denmark is 1. Clustering coefficient in Baltic countries: Lithuania is 8, Latvia is 3 and Estonia is 9. Clustering coefficient in such South European countries as Italy is 1, Spain is 3 and Greece is 2.

Appendix 9

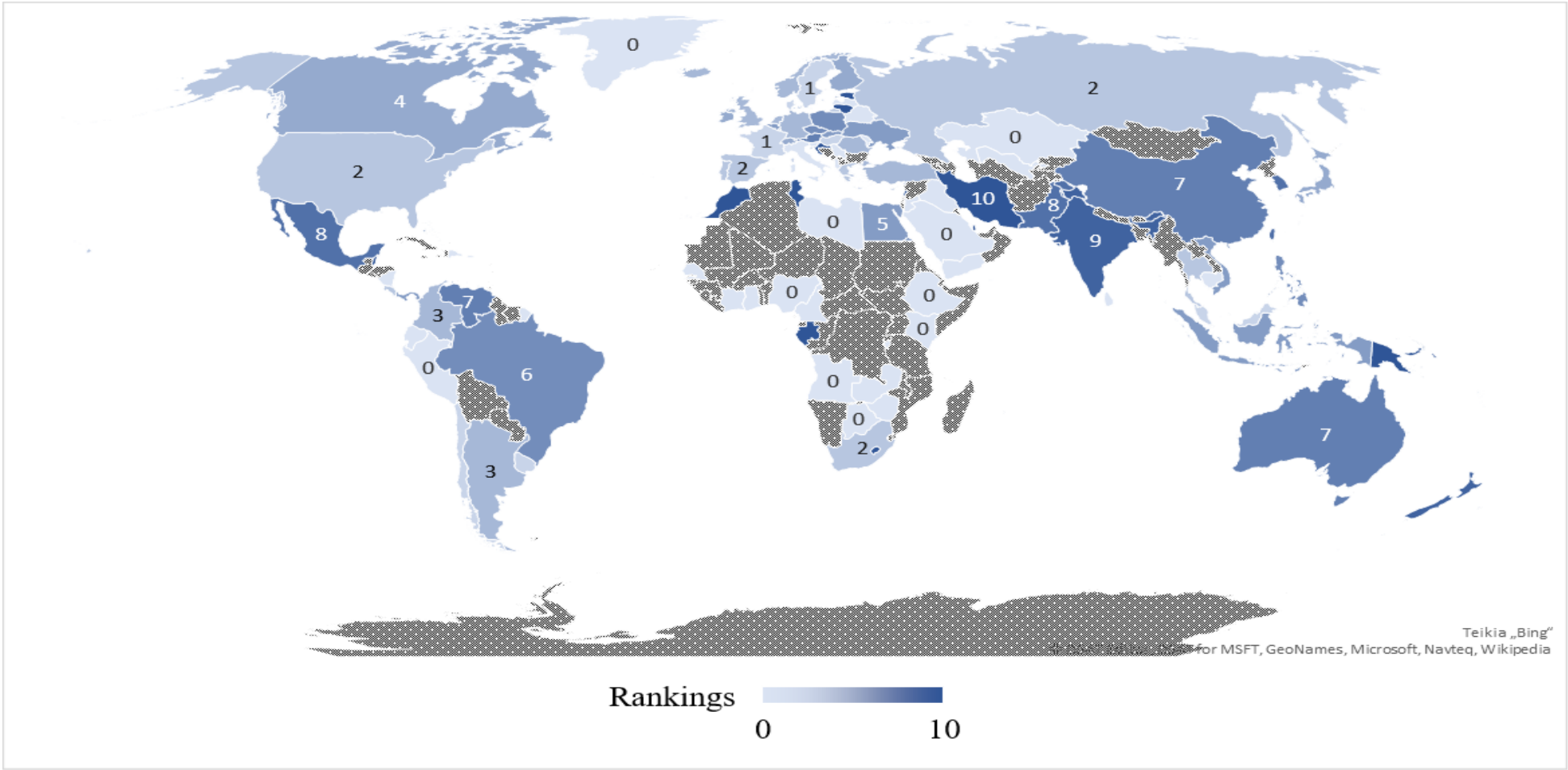
Community map of international equity investment network regarding institutional investors in 2001



Note: countries are grouped in 3 communities. The first community consists of few Arabian Peninsula countries and its neighbours in North Africa, Oceania and few other countries. The second community is mainly formed of European countries, Central and South America and Asia. The third community contains North and South America, South Africa and Australia.

Appendix 10

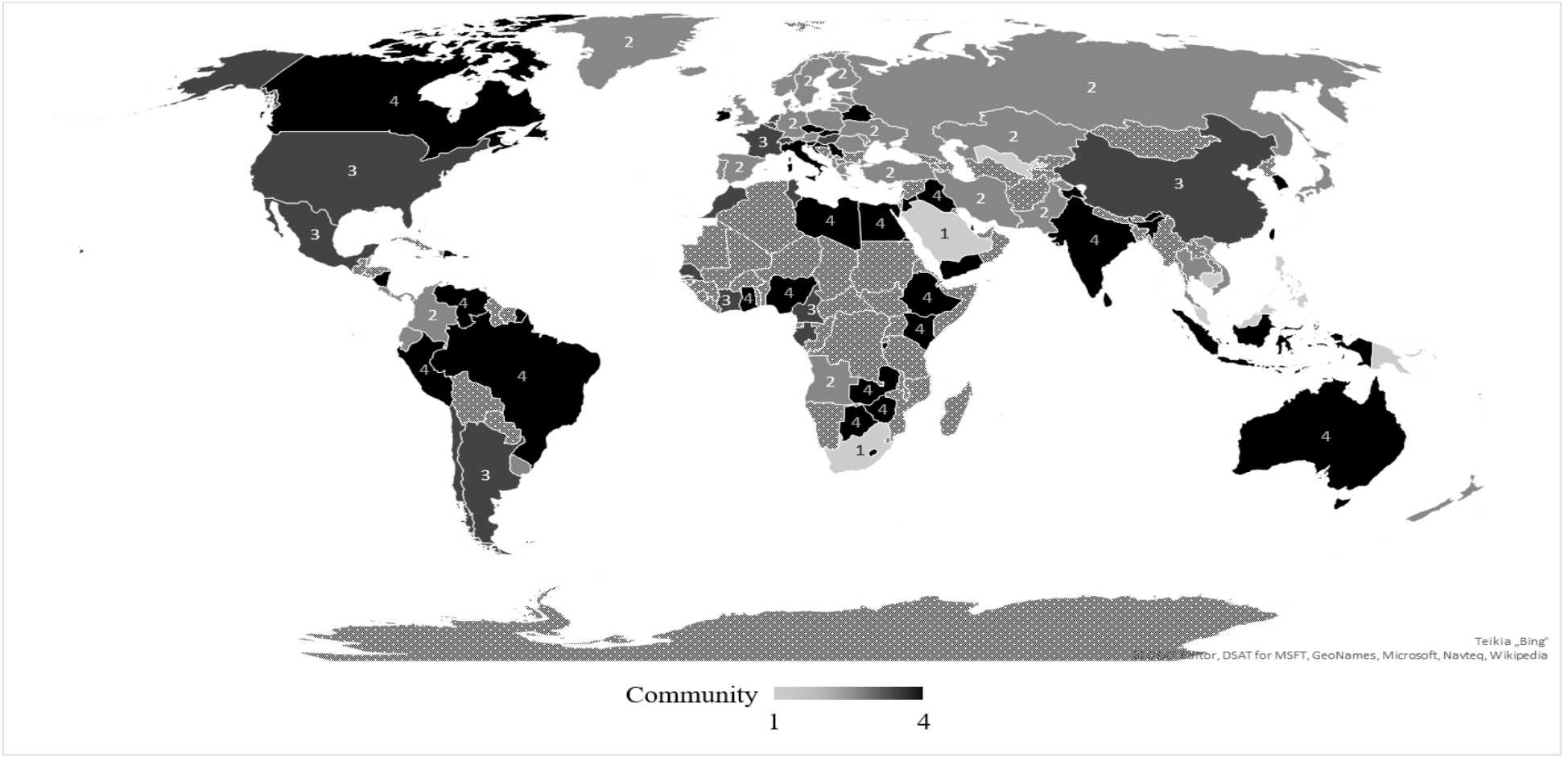
Clustering map of international equity investment network regarding non-institutional investors in 2001



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian countries as Norway is 3, Sweden and Denmark is 1. Clustering coefficient in Baltic countries: Lithuania is 10, Latvia is 0 and Estonia is 10. Clustering coefficient in such South European countries as Italy is 0, Spain is 2 and Greece is 2.

Appendix 11

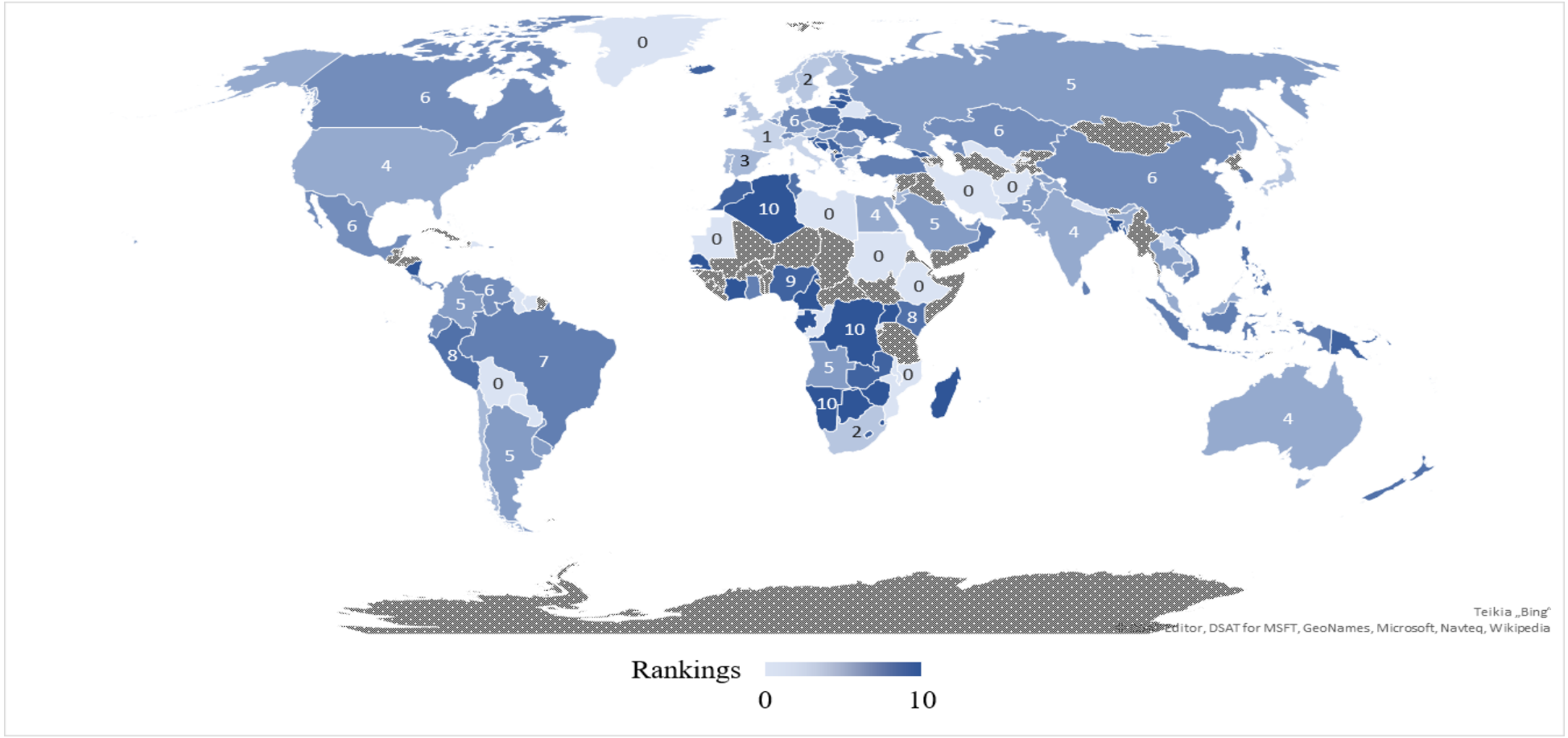
Community map of international equity investment network regarding non-institutional investors in 2001



Note: countries are grouped in 4 communities. The first community consists of Bahrain, Cambodia, Guernsey, Isle of Man, Jersey, Malaysia, Maldives, Papua New Guinea, Philippines, Saudi Arabia, Singapore, South Africa and Uzbekistan. The second community is mainly formed of European countries and Middle East. The third community contains the United States, Mexico, Argentina, Chile, China, France and few other countries. The forth community consists of few Arabian Peninsula countries and their neighbours in North Africa, Oceania, Australia, Canada and Brazil.

Appendix 12

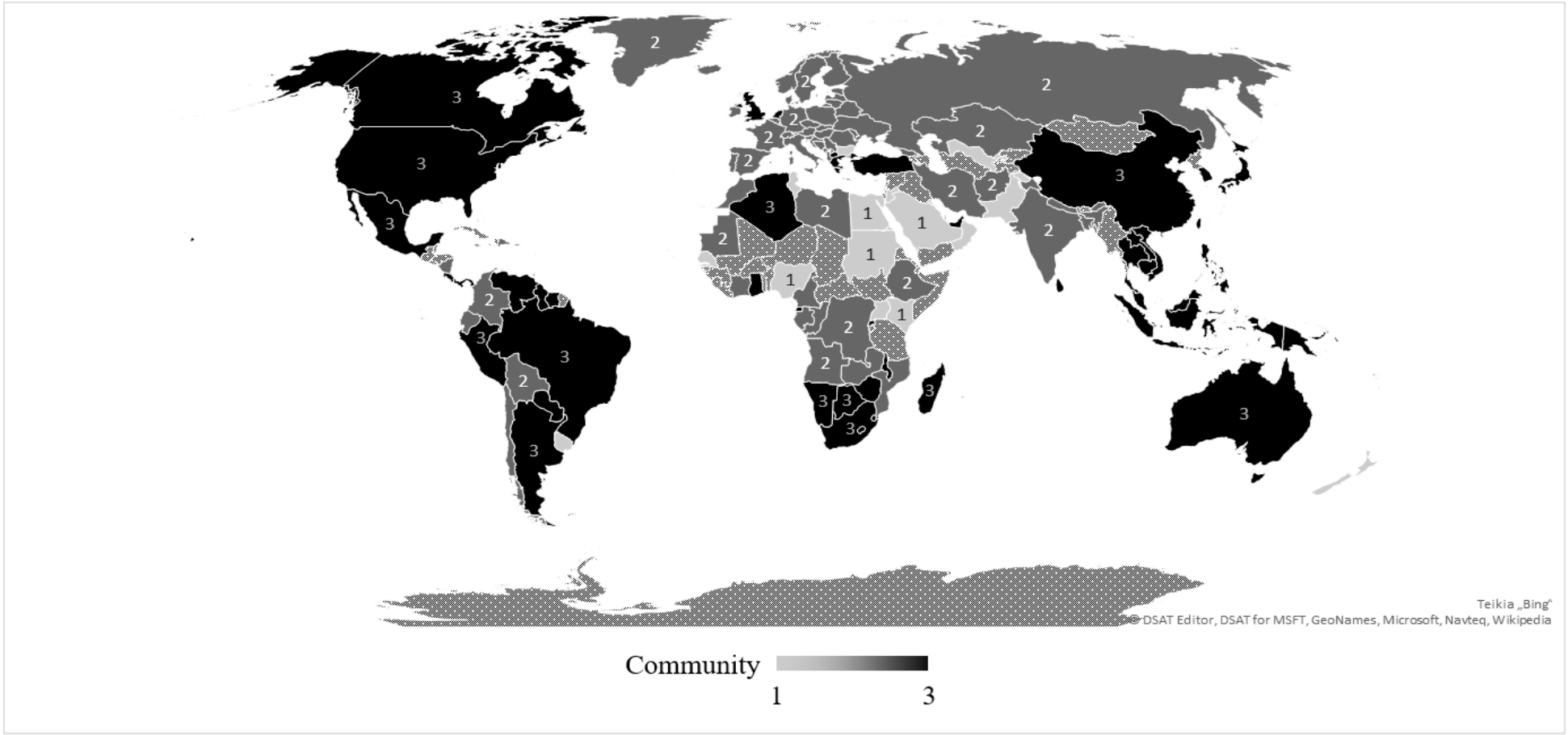
Clustering map of international equity investment network regarding institutional investors in 2006



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian countries as Norway and Sweden is 2, Denmark is 1. Clustering coefficient in Baltic countries: Lithuania is 10, Latvia and Estonia is 9. Clustering coefficient in such South European countries as Italy is 1, Spain is 3 and Greece is 4.

Appendix 13

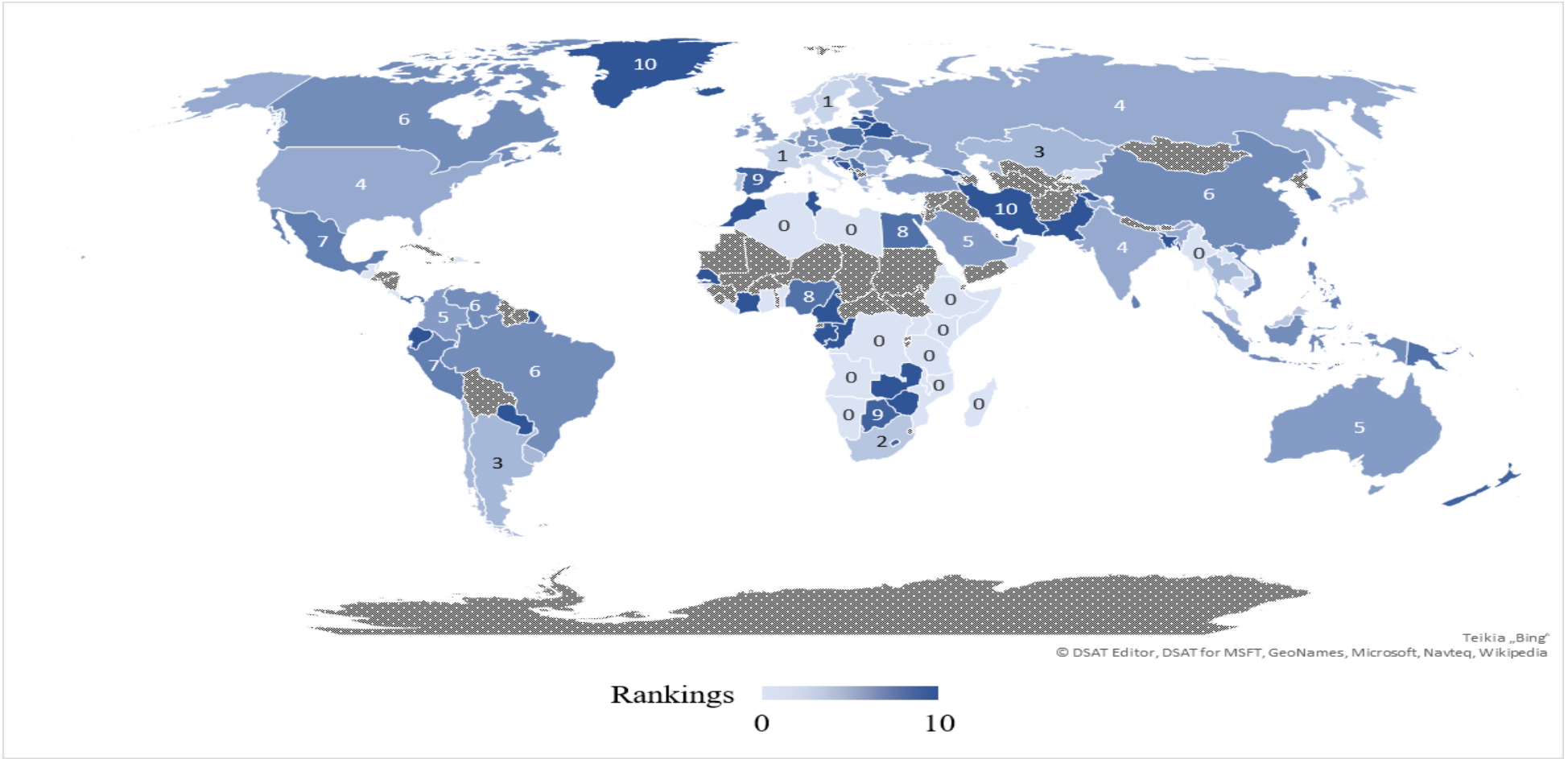
Community map of international equity investment network regarding institutional investors in 2006



Note: countries are grouped in 3 communities. The first community consists of Arabian Peninsula and its neighbours in North Africa, Oceania and few other countries. The second community is mainly formed of European countries, Middle East and Central African countries. The third community contains North and South America, South Africa, Australia and Oceania and Far East.

Appendix 14

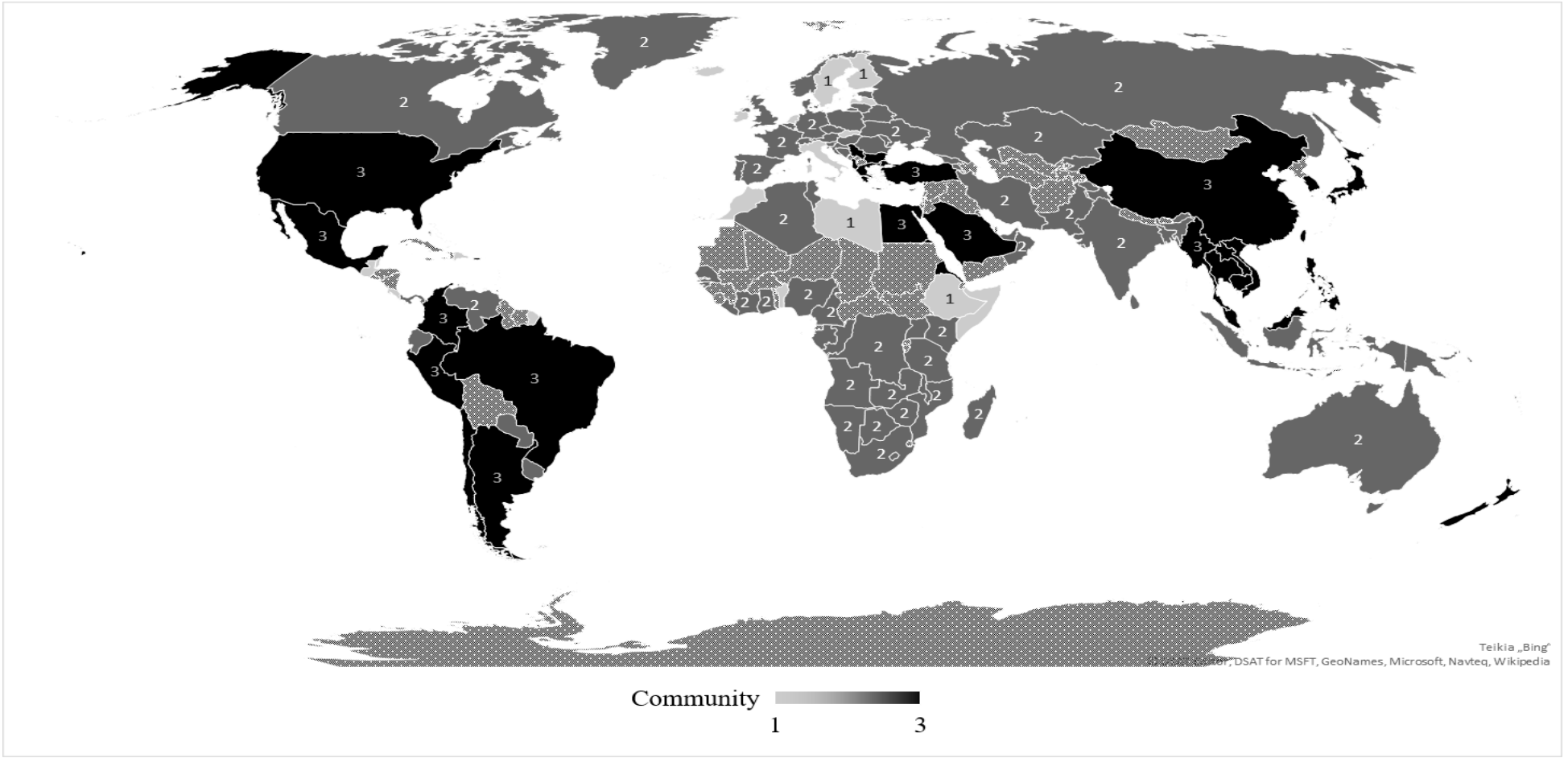
Clustering map of international equity investment network regarding non-institutional investors in 2006



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian countries as Norway, Sweden and Denmark is 1. Clustering coefficient in Baltic countries: Lithuania and Latvia is 10 and Estonia is 8. Clustering coefficient in such South European countries as Italy is 0, Spain is 5 and Greece is 3.

Appendix 15

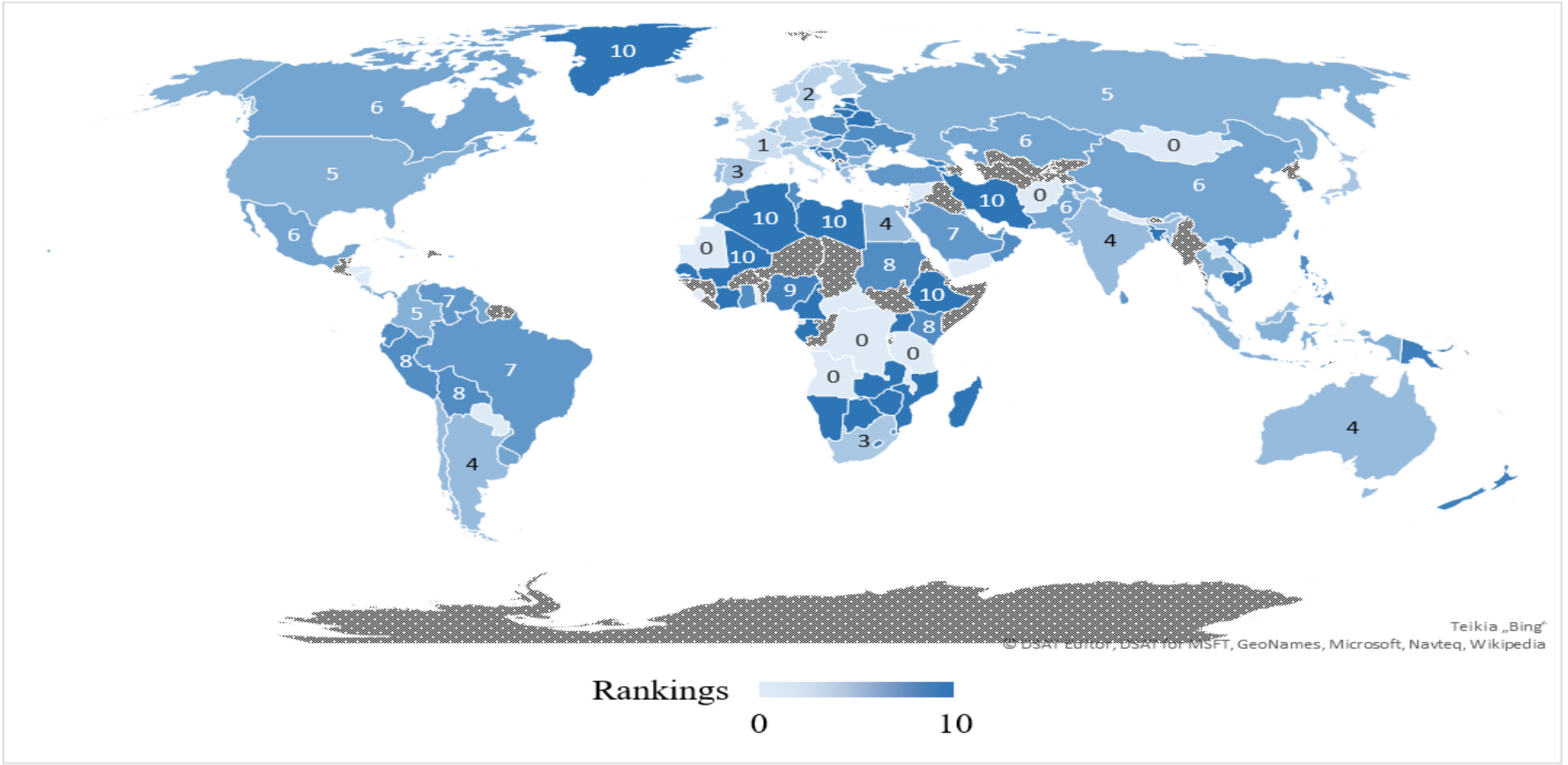
Community map of international equity investment network regarding non-institutional investors in 2006



Note: countries are grouped in 3 communities. The first community consists of few European and North and North-East African countries. The second community is mainly formed of European countries, South and Middle Africa, Canada, Greenland, Middle East, Oceania and Australia. The third community contains North and South America, South Africa, Australia and Far East.

Appendix 16

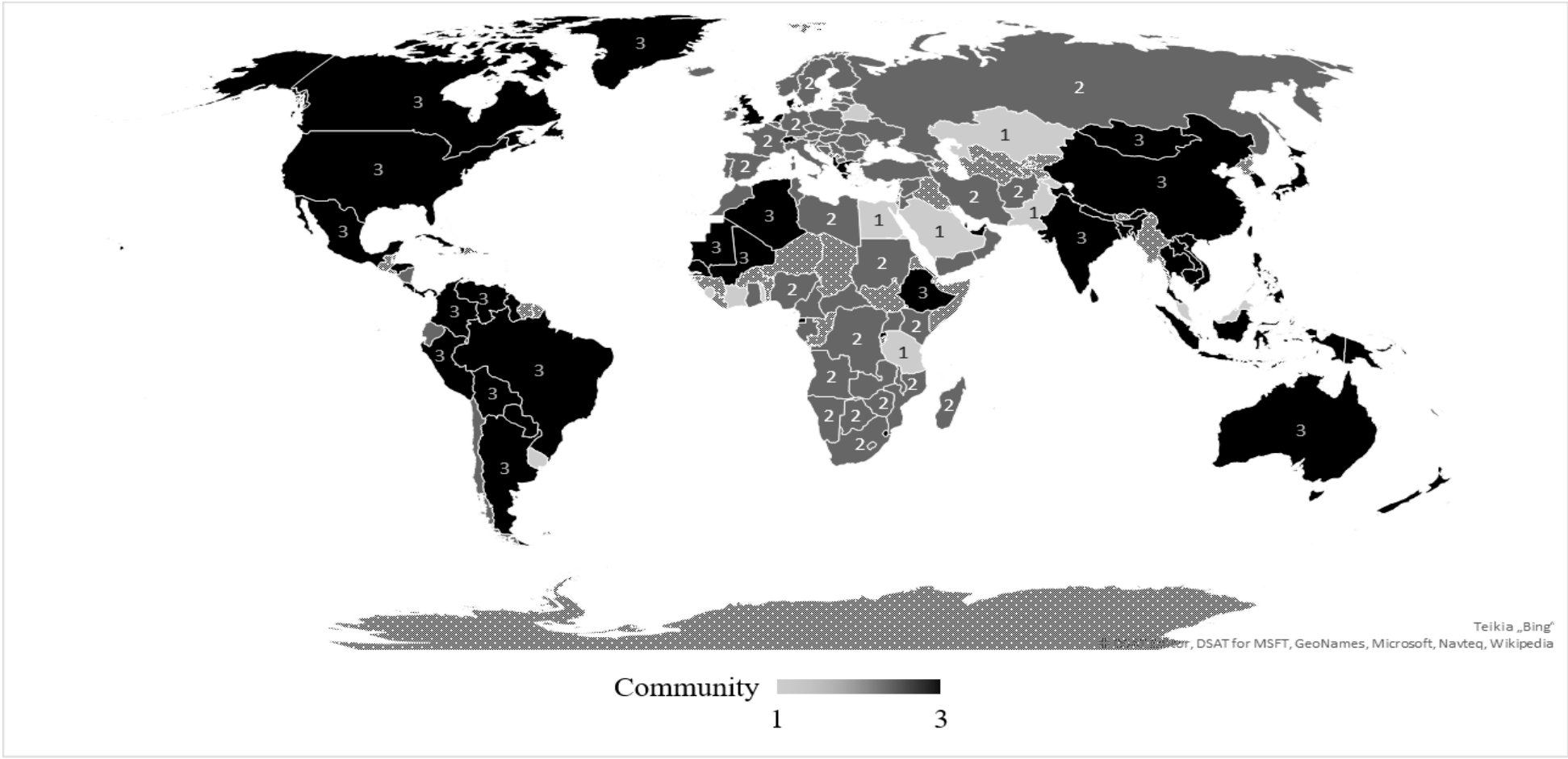
Clustering map of international equity investment network regarding institutional investors in 2007



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian countries as Norway and Sweden is 2, Denmark is 1. Clustering coefficient in Baltic countries: Lithuania, Latvia and Estonia is 10. Clustering coefficient in such South European countries as Italy is 2, Spain is 3 and Greece is 4.

Appendix 17

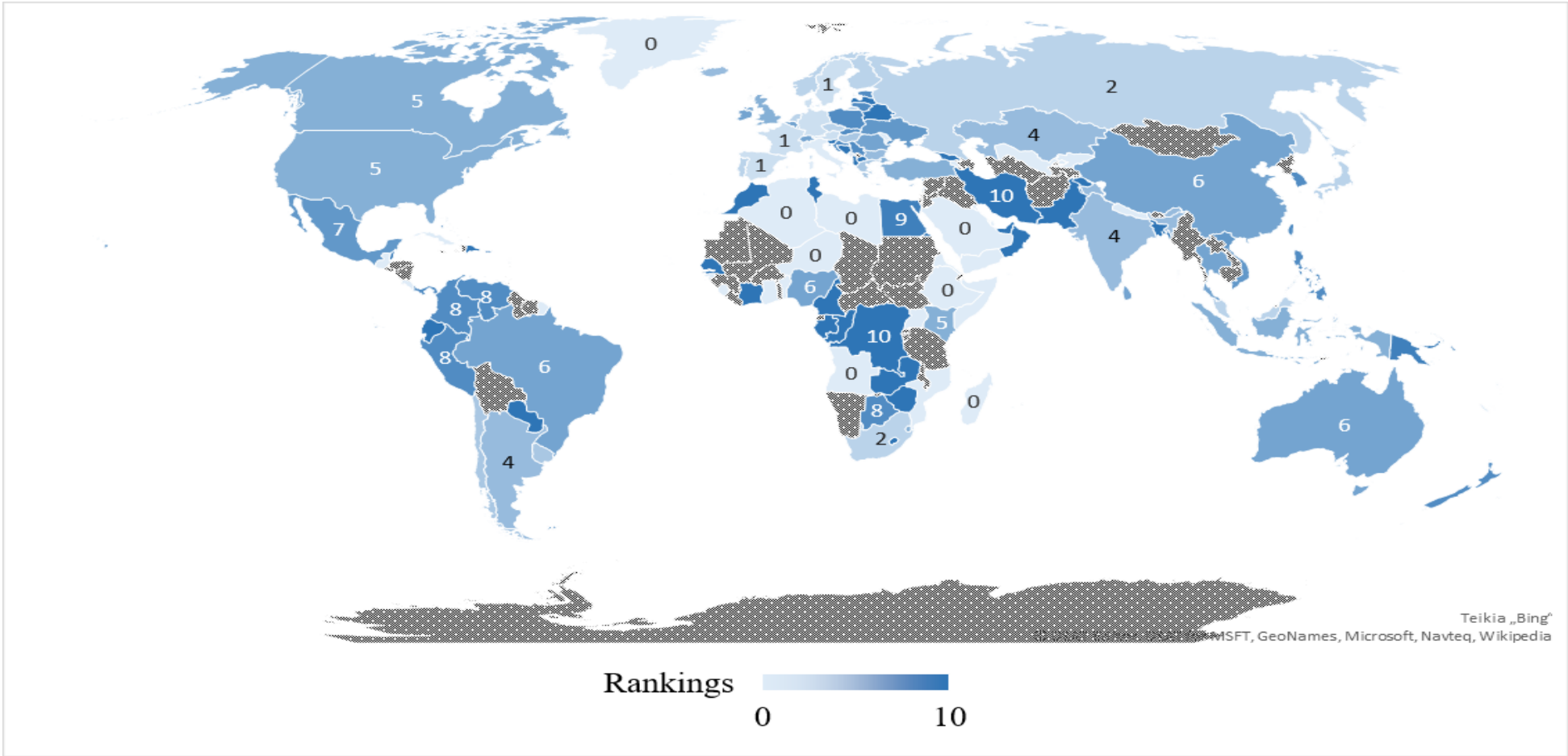
Community map of international equity investment network regarding institutional investors in 2007



Note: countries are grouped in 3 communities. The first community consists of Arabian Peninsula and its neighbours in North Africa, Oceania and few other countries. The second community is formed of European countries, Middle East, North-East, Central and South Africa. The third community contains North and South America, North-West Africa, Australia and Oceania and Far East.

Appendix 18

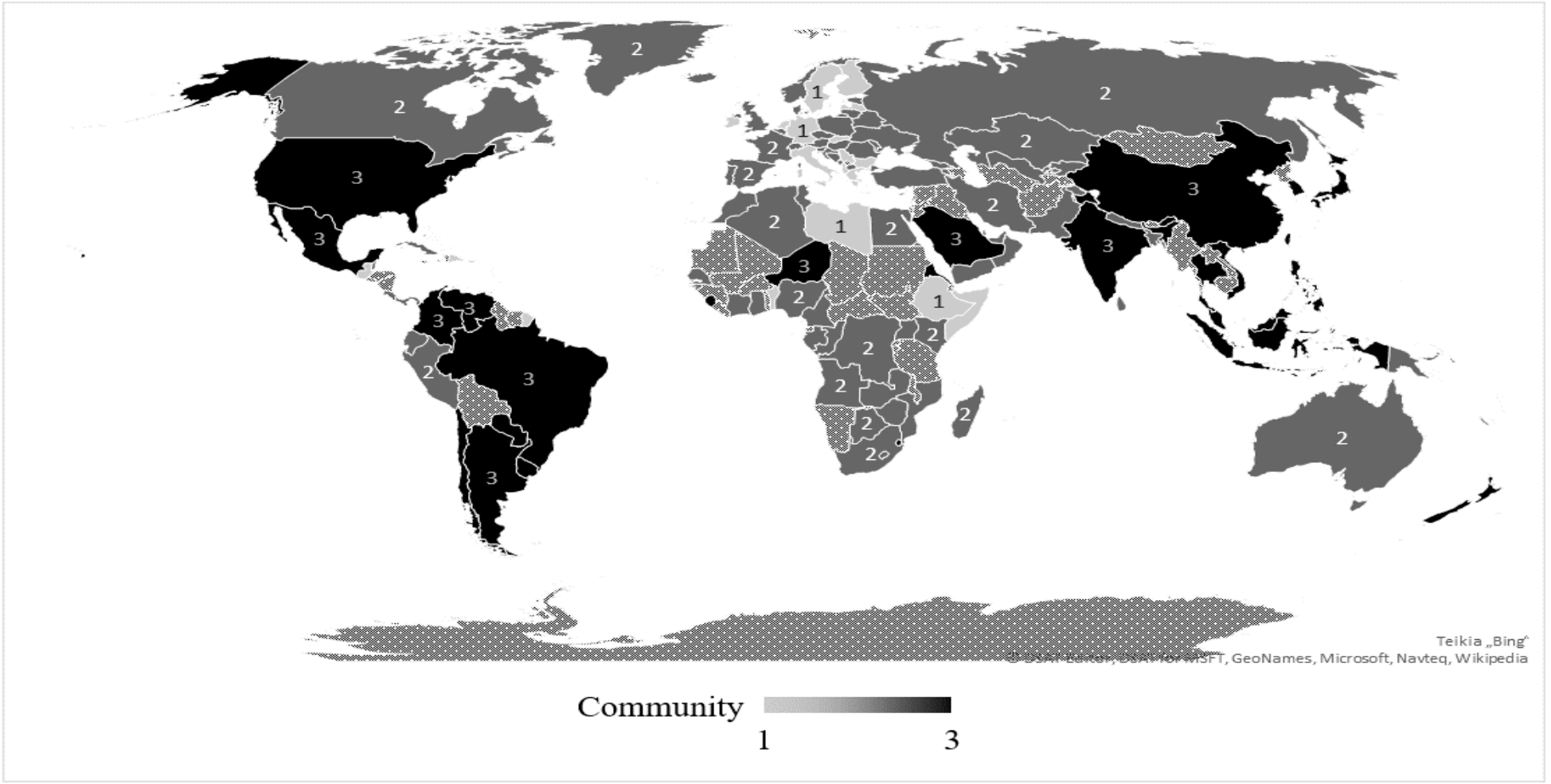
Clustering map of international equity investment network regarding non-institutional investors in 2007



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian countries as Norway is 2, Sweden and Denmark is 1. Clustering coefficient in Baltic countries: Lithuania is 8, Latvia is 10 and Estonia is 8. Clustering coefficient in such South European countries as Italy is 0, Spain is 1 and Greece is 3.

Appendix 19

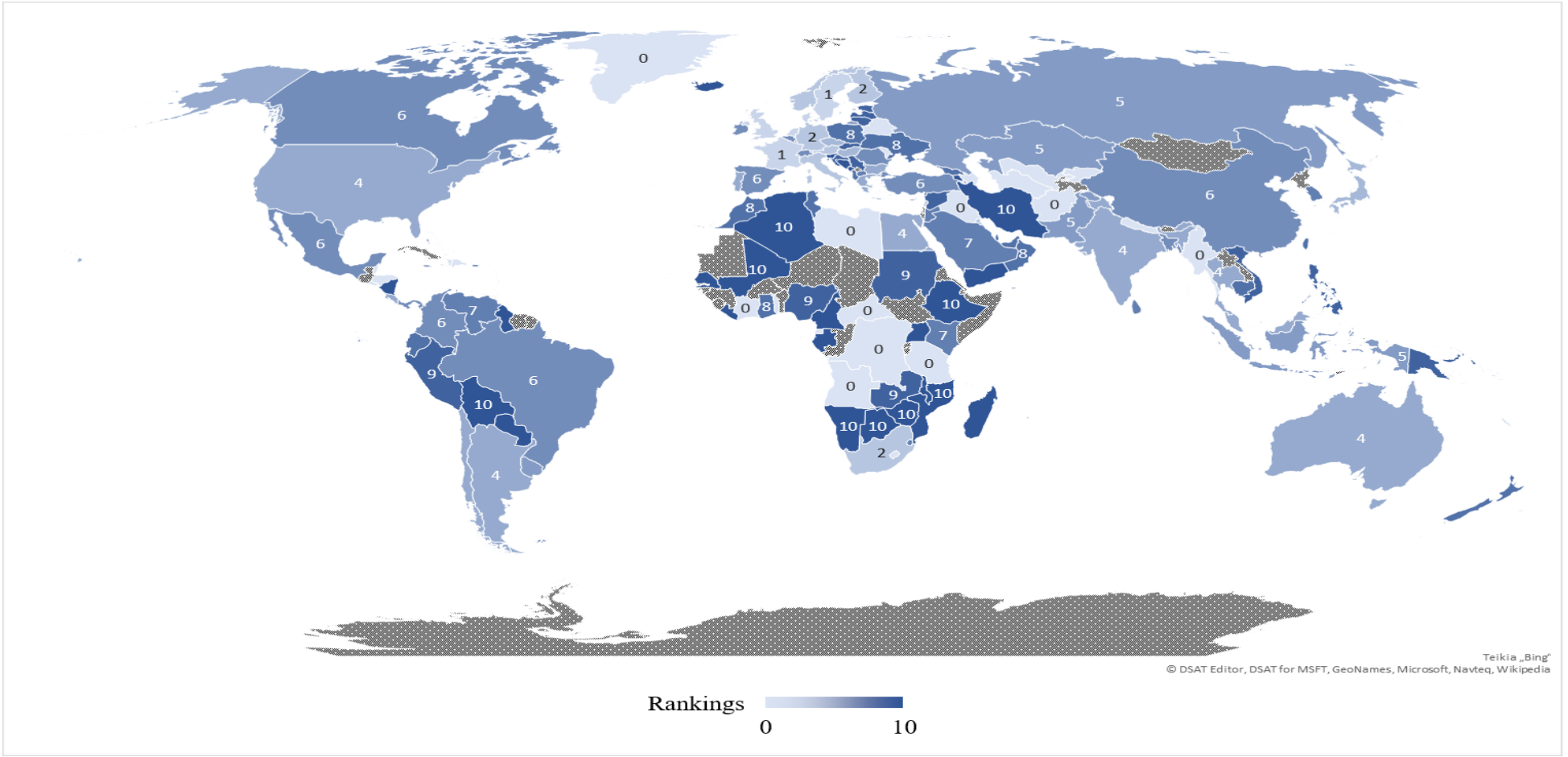
Community map of international equity investment network regarding non-institutional investors in 2007



Note: countries are grouped in 3 communities. The first community consists of half European and North and North-East African countries The second community is mainly formed of West and East European countries, Middle Asia, Canada, Greenland, Africa and Australia. The third community contains North and South America, Oceania and Far East.

Appendix 20

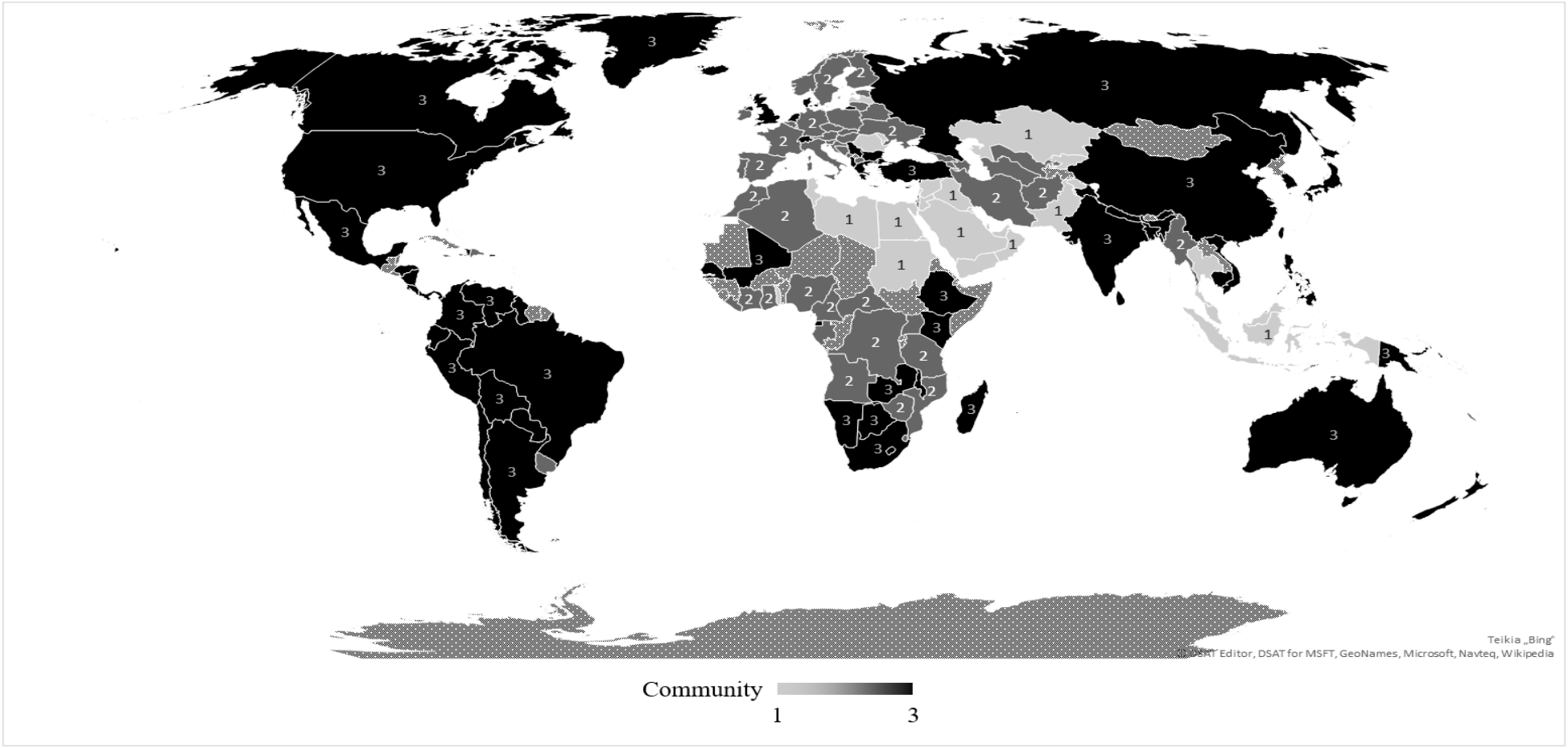
Clustering map of international equity investment network regarding institutional investors in 2008



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian countries as Norway is 2, Sweden and Denmark is 1. Clustering coefficient in Baltic countries: Lithuania, Latvia and Estonia is 9. Clustering coefficient in such South European countries as Italy is 4, Spain is 6 and Greece is 4.

Appendix 21

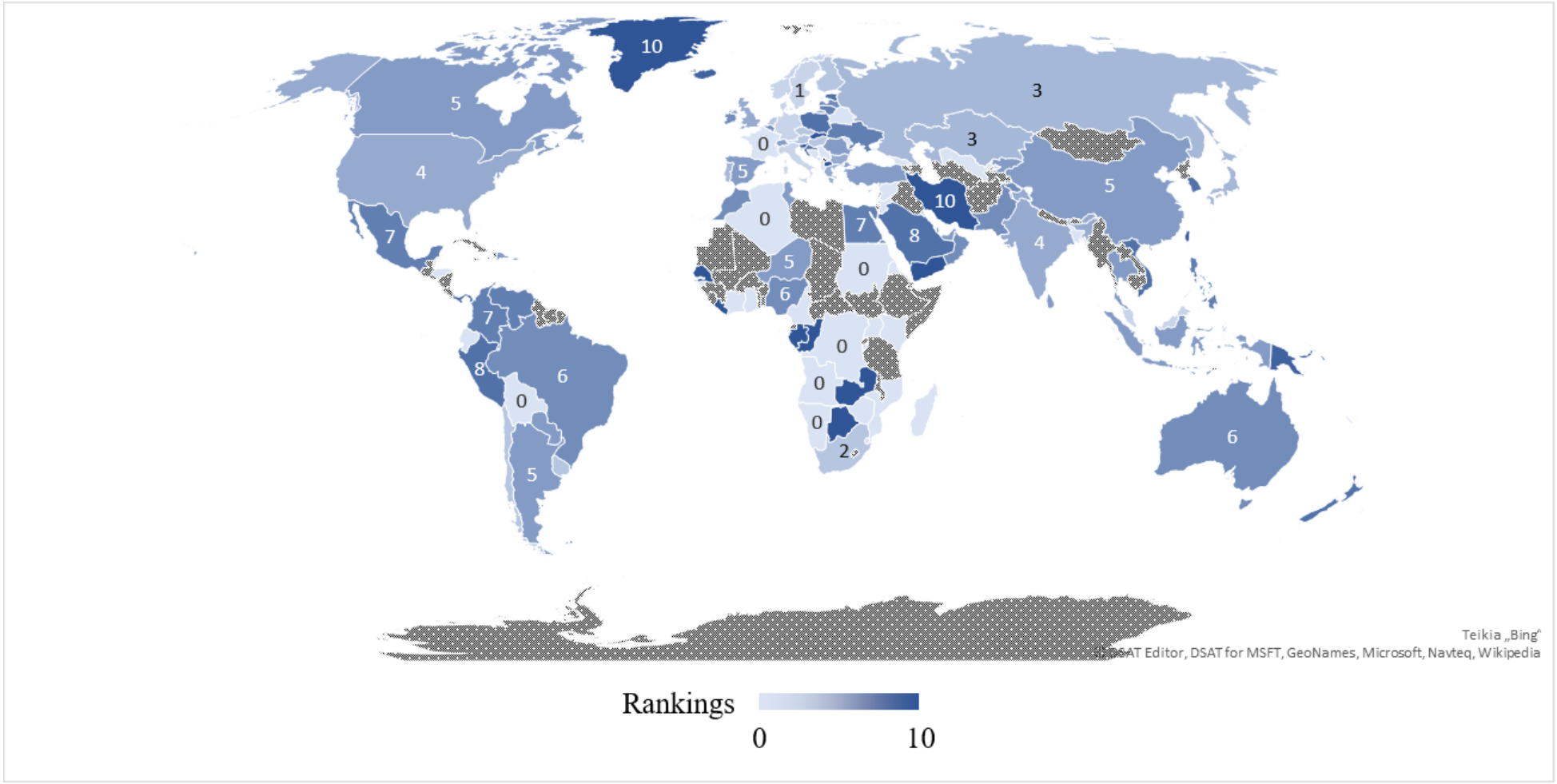
Community map of international equity investment network regarding institutional investors in 2008



Note: countries are grouped in 3 communities. The first community consists of Arabian Peninsula and its neighbours in North Africa, Oceania and few other countries. The second community is mainly formed of European countries and Central African countries. The third community contains rest of the world.

Appendix 22

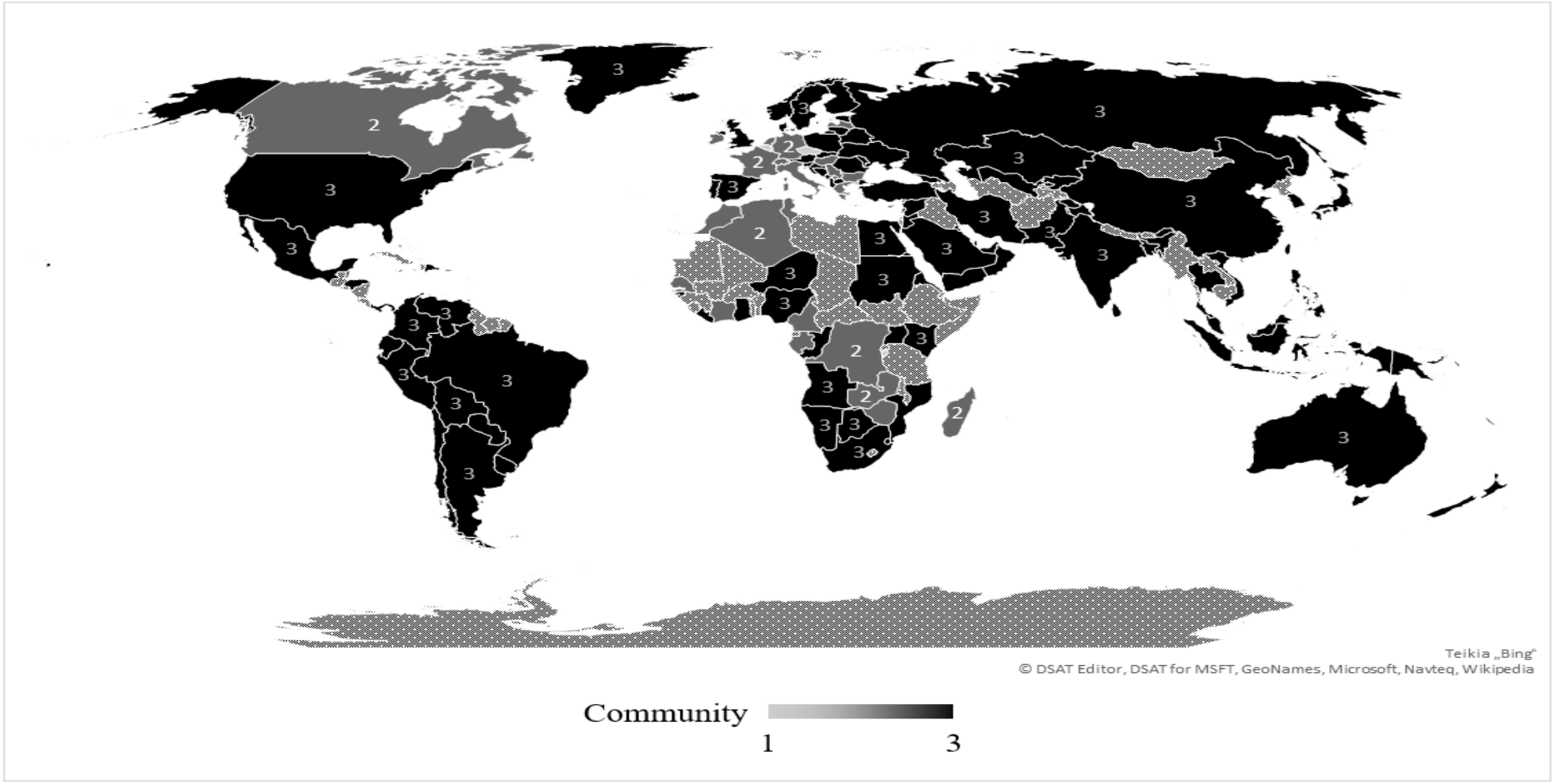
Clustering map of international equity investment network regarding non-institutional investors in 2008



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian countries as Norway, Sweden and Denmark is 1. Clustering coefficient in Baltic countries: Lithuania is 7, Latvia is 6 and Estonia is 8. Clustering coefficient in such South European countries as Italy is 1, Spain is 5 and Greece is 4.

Appendix 23

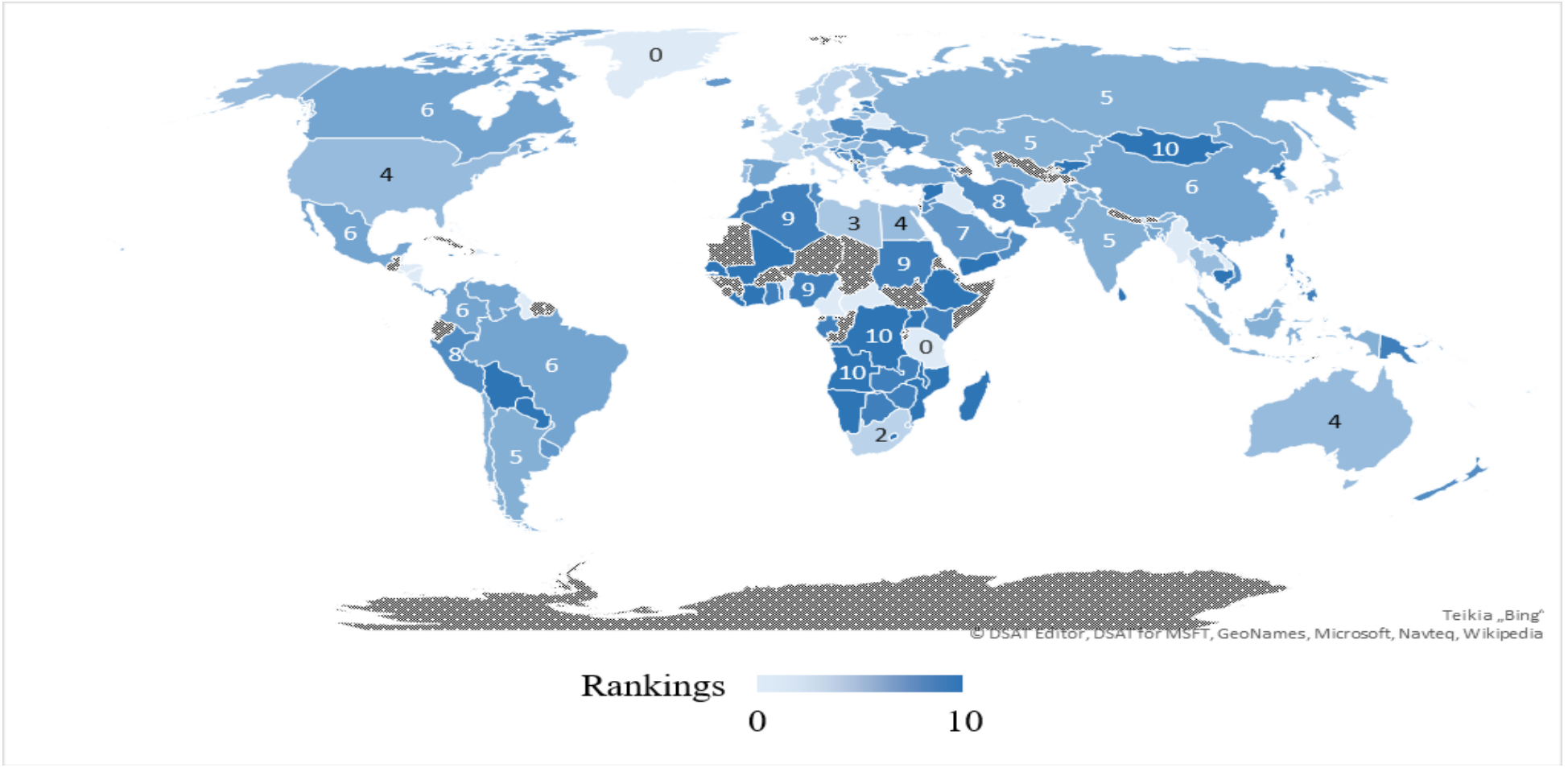
Community map of international equity investment network regarding non-institutional investors in 2008



Note: countries are grouped in 3 communities. The first community consists of Belgium, Burundi and Czech Republic. The second community is mainly formed of Central and South European countries, Canada, few Central African countries. The third community consists of rest of the world.

Appendix 24

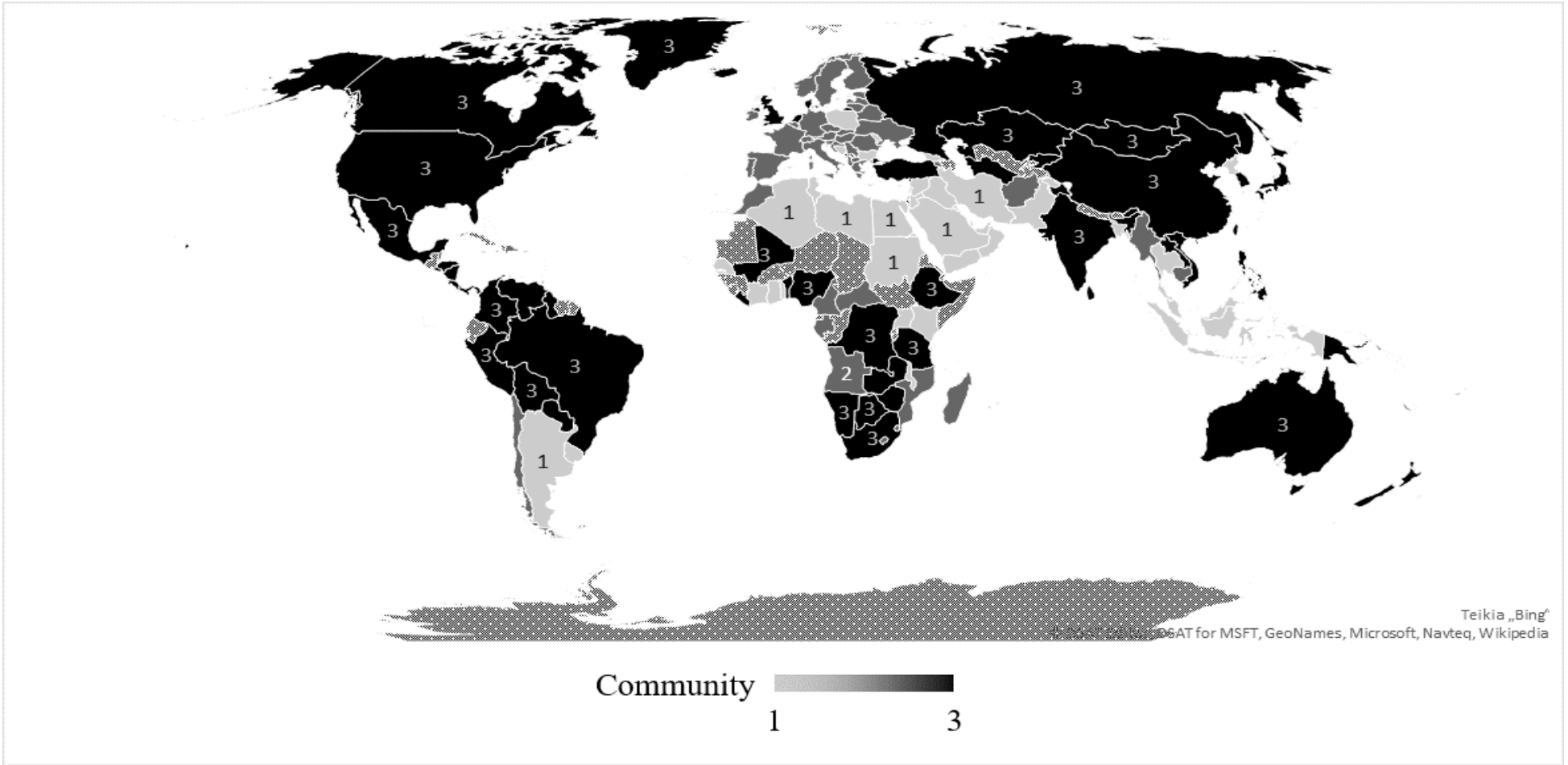
Clustering map of international equity investment network regarding institutional investors in 2009



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian countries as Norway, Sweden and Denmark is 2. Clustering coefficient in Baltic countries: Lithuania is 4, Latvia is 8 and Estonia is 9. Clustering coefficient in such South European countries as Italy is 2, Spain is 6 and Greece is 4.

Appendix 25

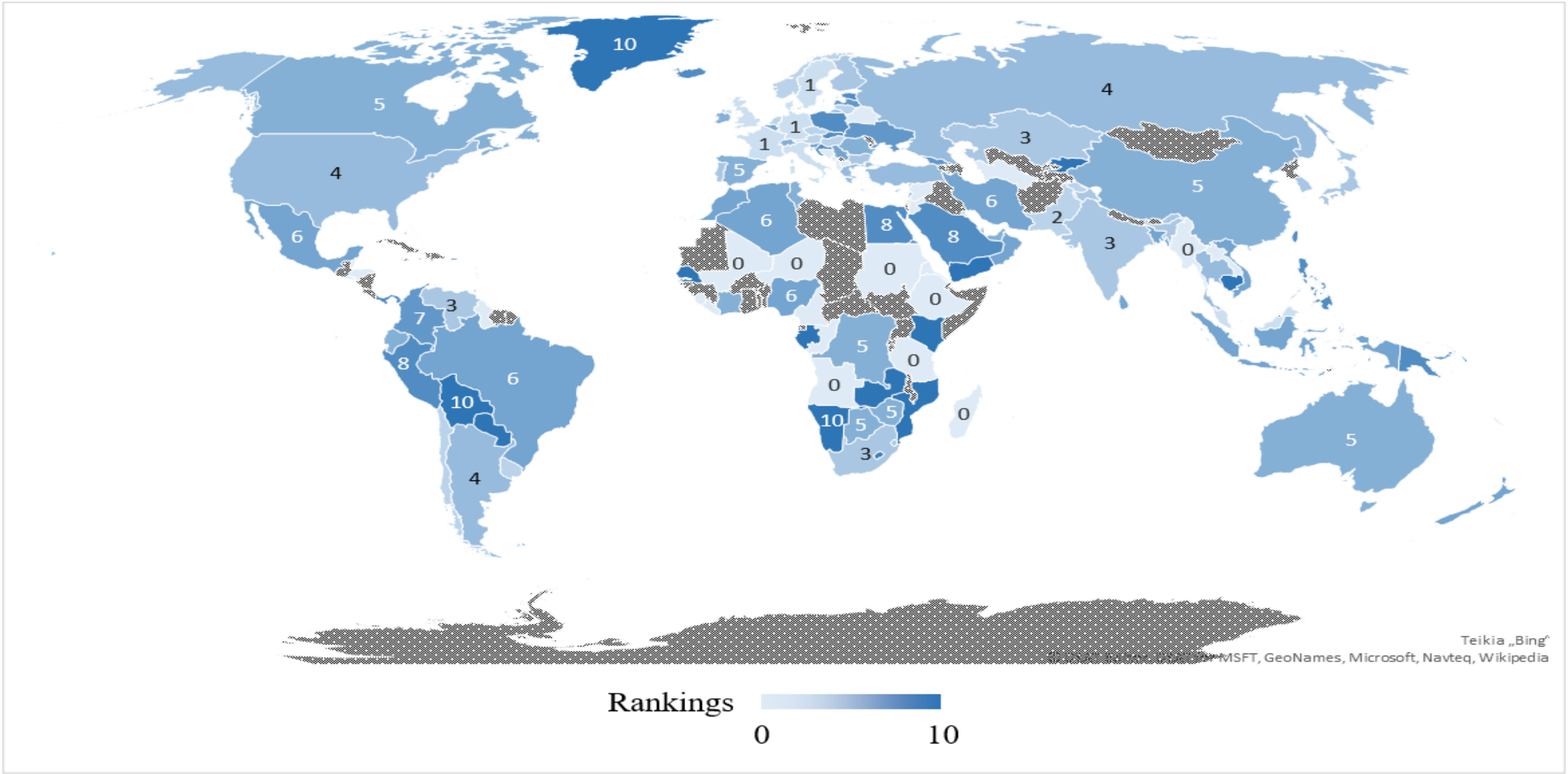
Community map of international equity investment network regarding institutional investors in 2009



Note: countries are grouped in 3 communities. The first community consists of Arabian Peninsula and its neighbours in North Africa, Oceania and few other countries. The second community is mainly formed of European countries. The third community contains North and South America, South Africa, Australia and Oceania and Asia.

Appendix 26

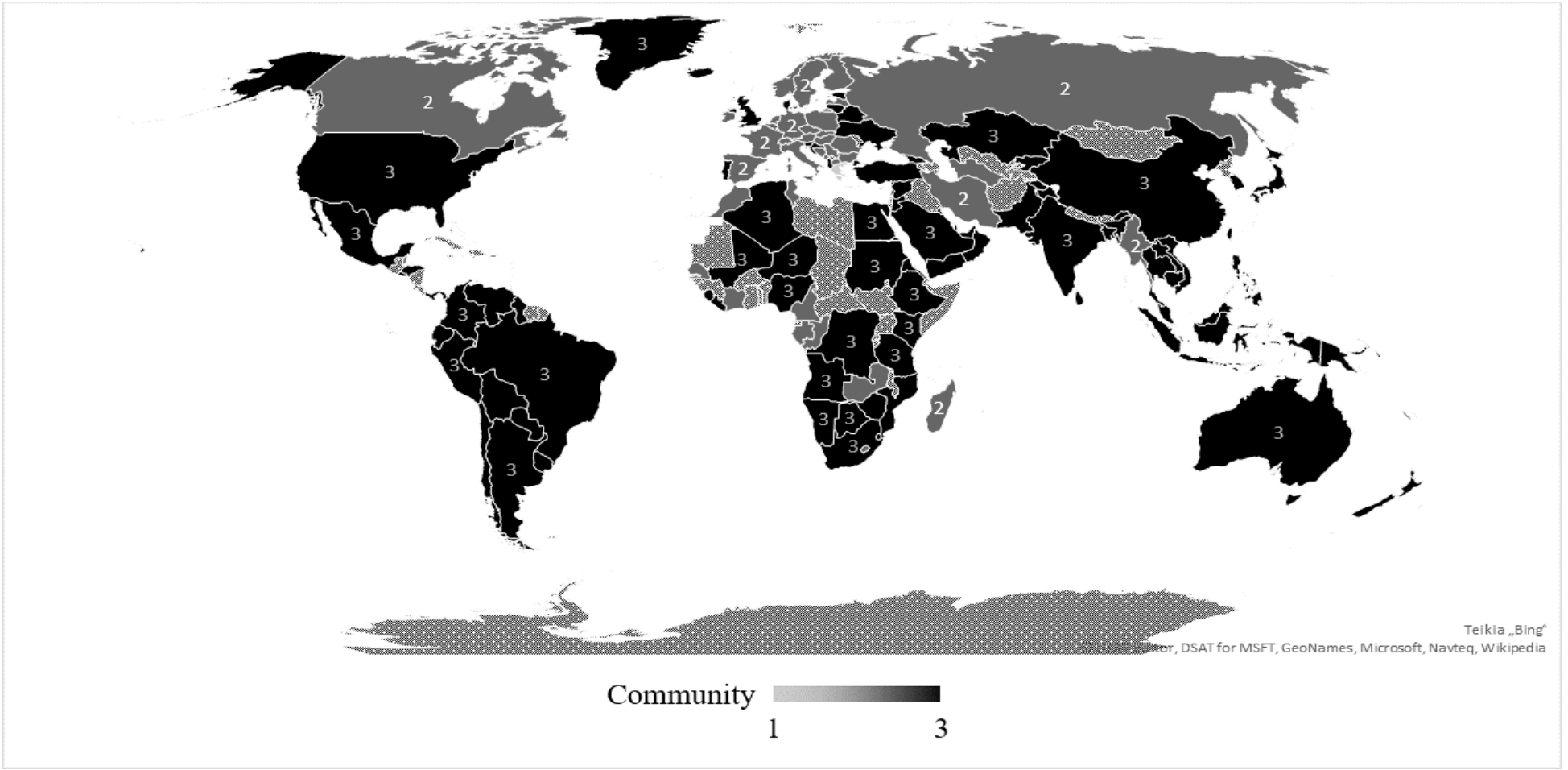
Clustering map of international equity investment network regarding non-institutional investors in 2009



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian countries as Norway is 2, Sweden and Denmark is 1. Clustering coefficient in Baltic countries: Lithuania is 2, Latvia is 7 and Estonia is 8. Clustering coefficient in such South European countries as Italy is 1, Spain is 5 and Greece is 4.

Appendix 27

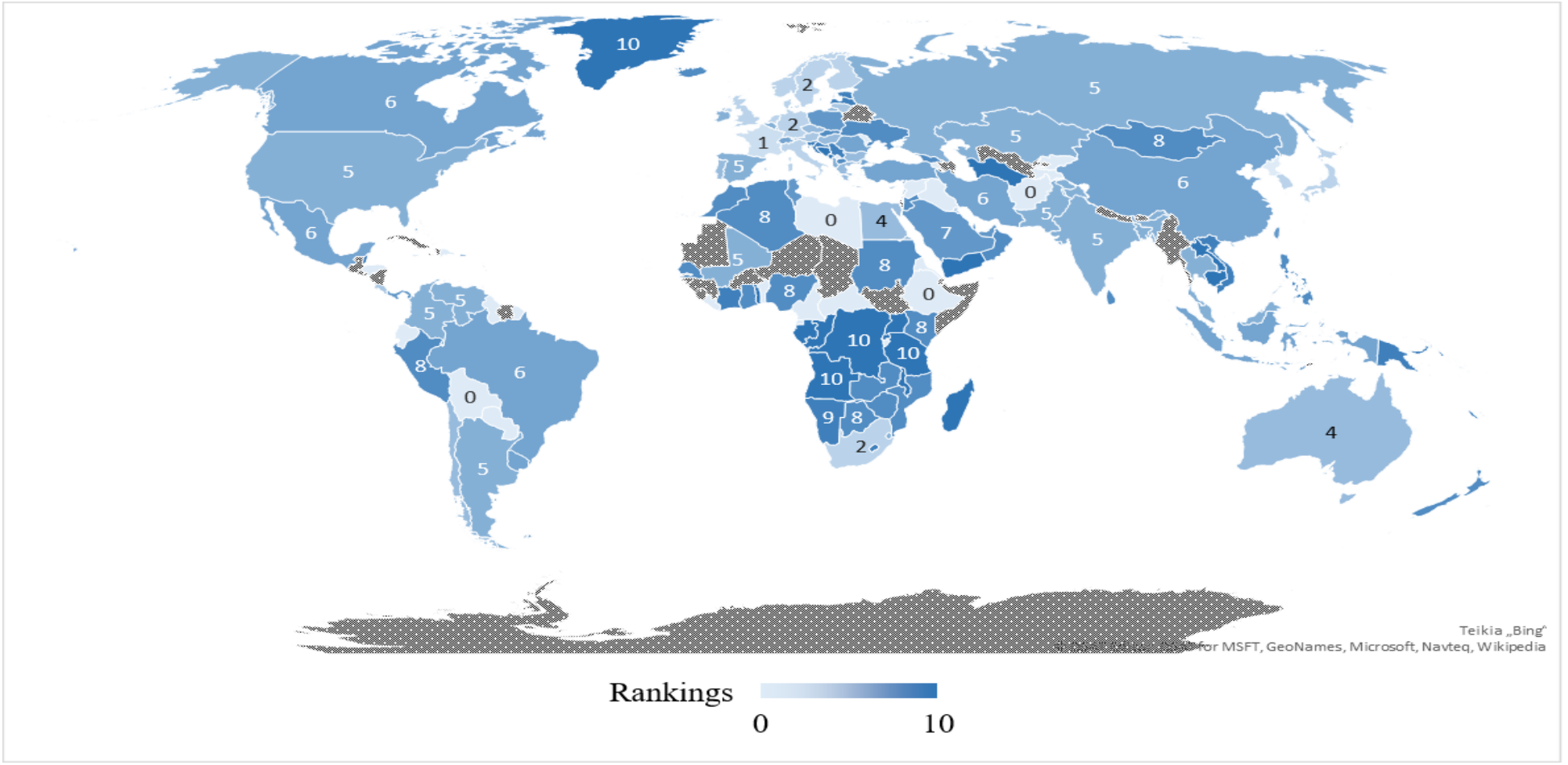
Community map of international equity investment network regarding non-institutional investors in 2009



Note: countries are grouped in 3 communities. First community consists of Cyprus and Greece. Second community consists of majority of European countries, Canada, Russia, few countries in Asia and Africa. The third community consists of rest of the world.

Appendix 28

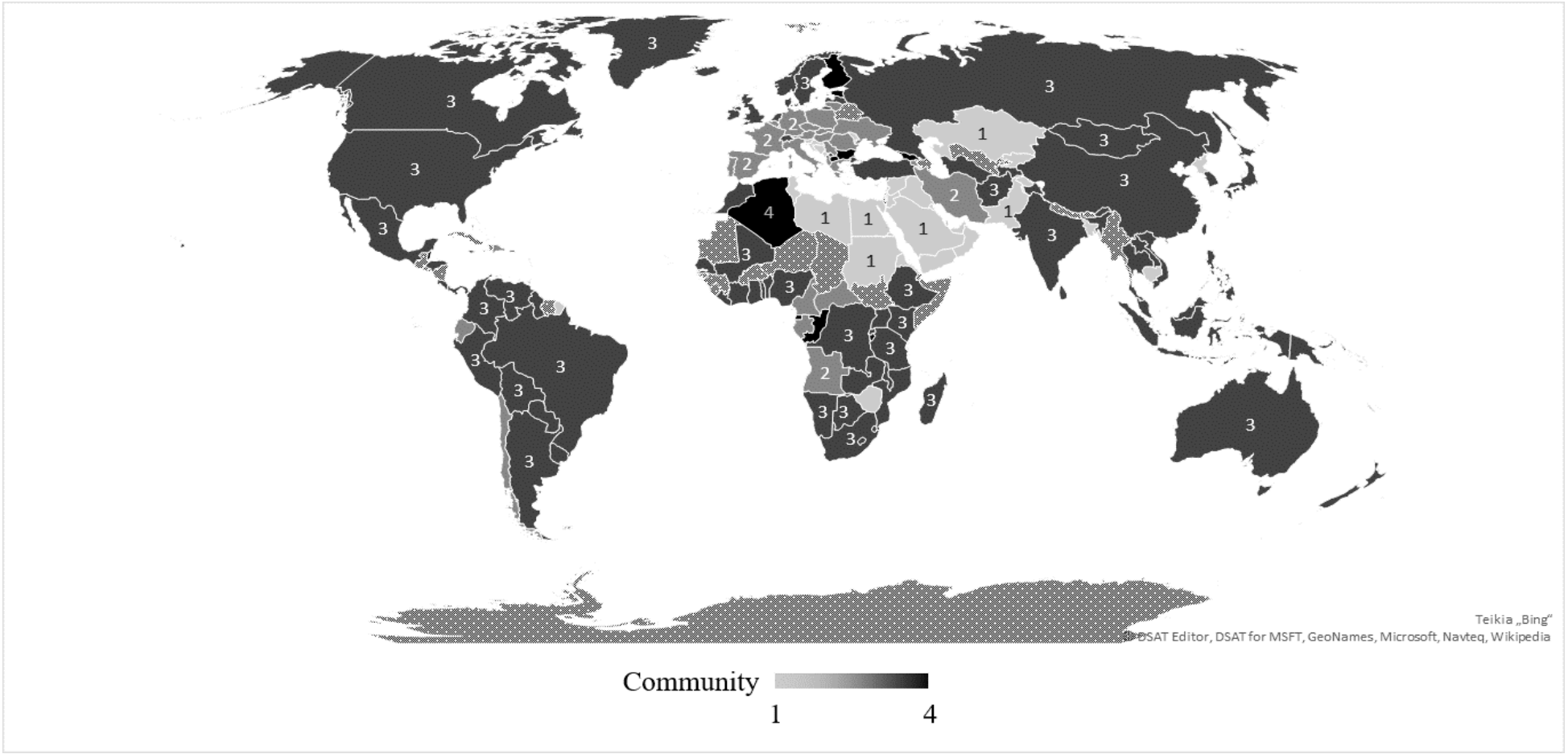
Clustering map of international equity investment network regarding institutional investors in 2010



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian countries as Norway, Sweden and Denmark is 2. Clustering coefficient in Baltic countries: Lithuania is 3, Latvia and Estonia is 9. Clustering coefficient in such South European countries as Italy is 2, Spain is 5 and Greece is 4.

Appendix 29

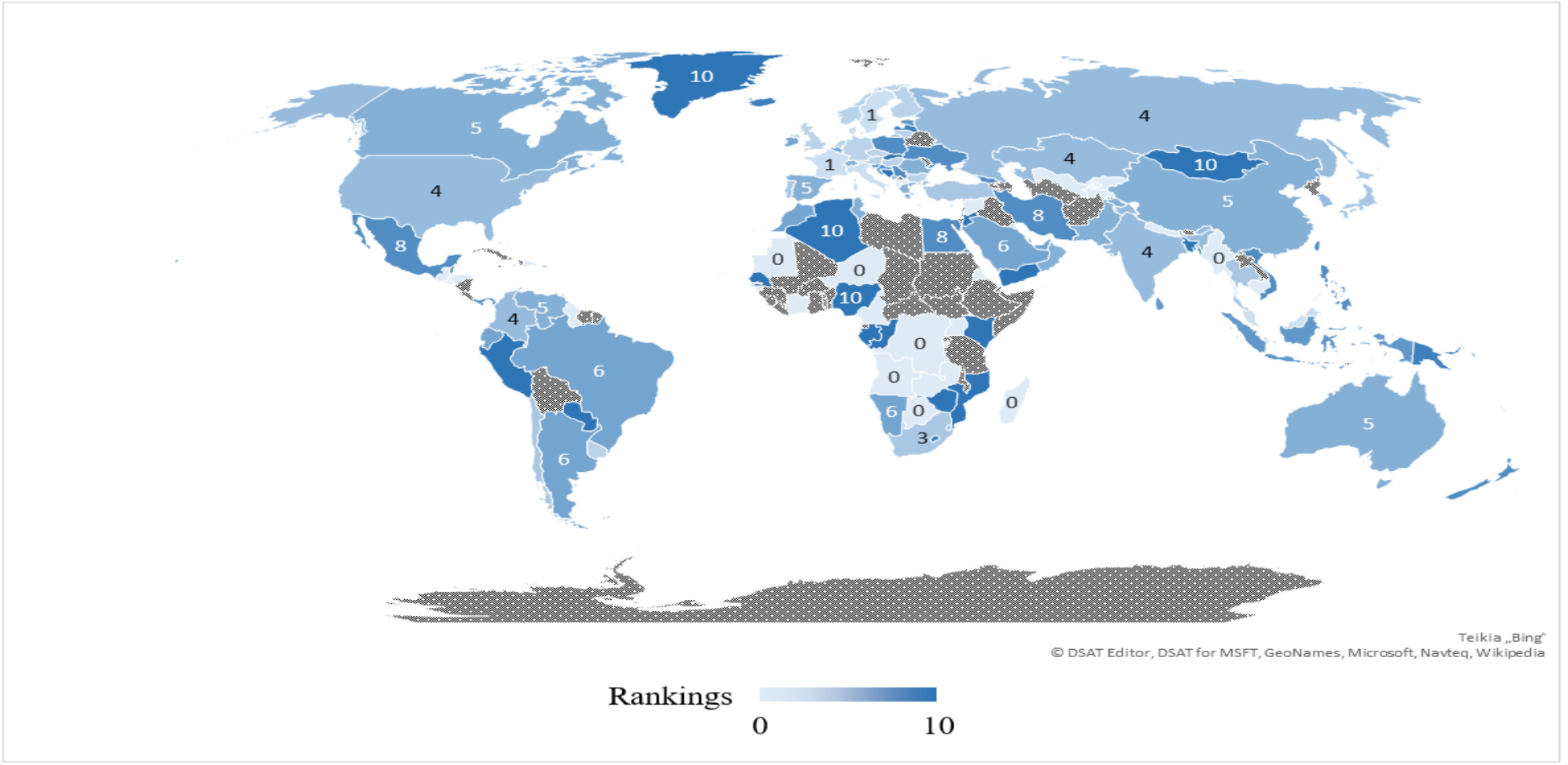
Community map of international equity investment network regarding institutional investors in 2010



Note: countries are grouped in 4 communities. The first community consists of Arabian Peninsula and its neighbours in North Africa. The second community is mainly formed of European countries. The third community contains North and South America, South Africa, Australia and Oceania and Asia. Finland, Bulgaria, Algeria and Republic of Congo belong to the forth community.

Appendix 30

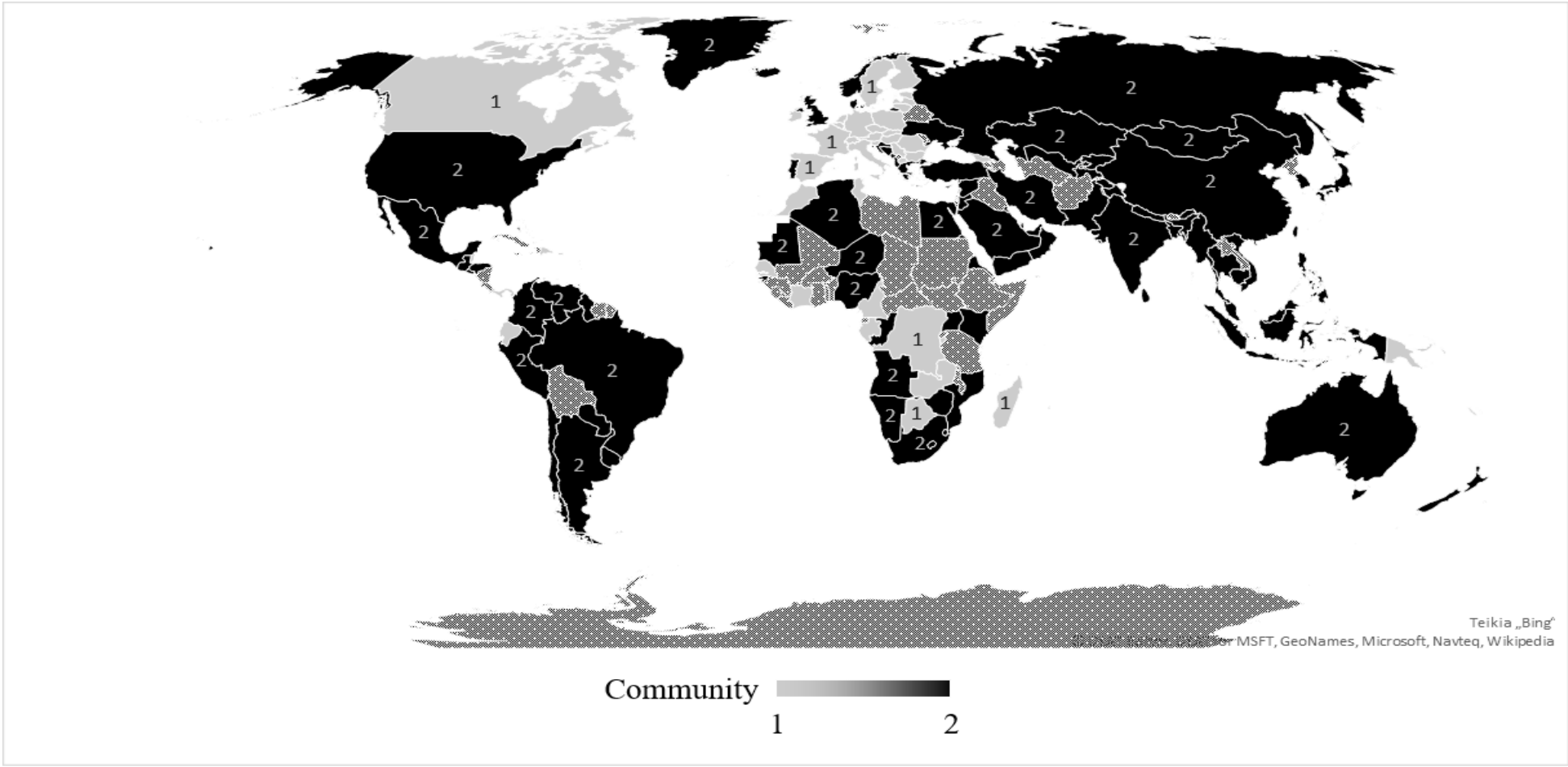
Clustering map of international equity investment network regarding non-institutional investors in 2010



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian countries as Norway is 2, Sweden and Denmark is 1. Clustering coefficient in Baltic countries: Lithuania is 2, Latvia is 9 and Estonia is 7. Clustering coefficient in such South European countries as Italy is 1, Spain and Greece is 5.

Appendix 31

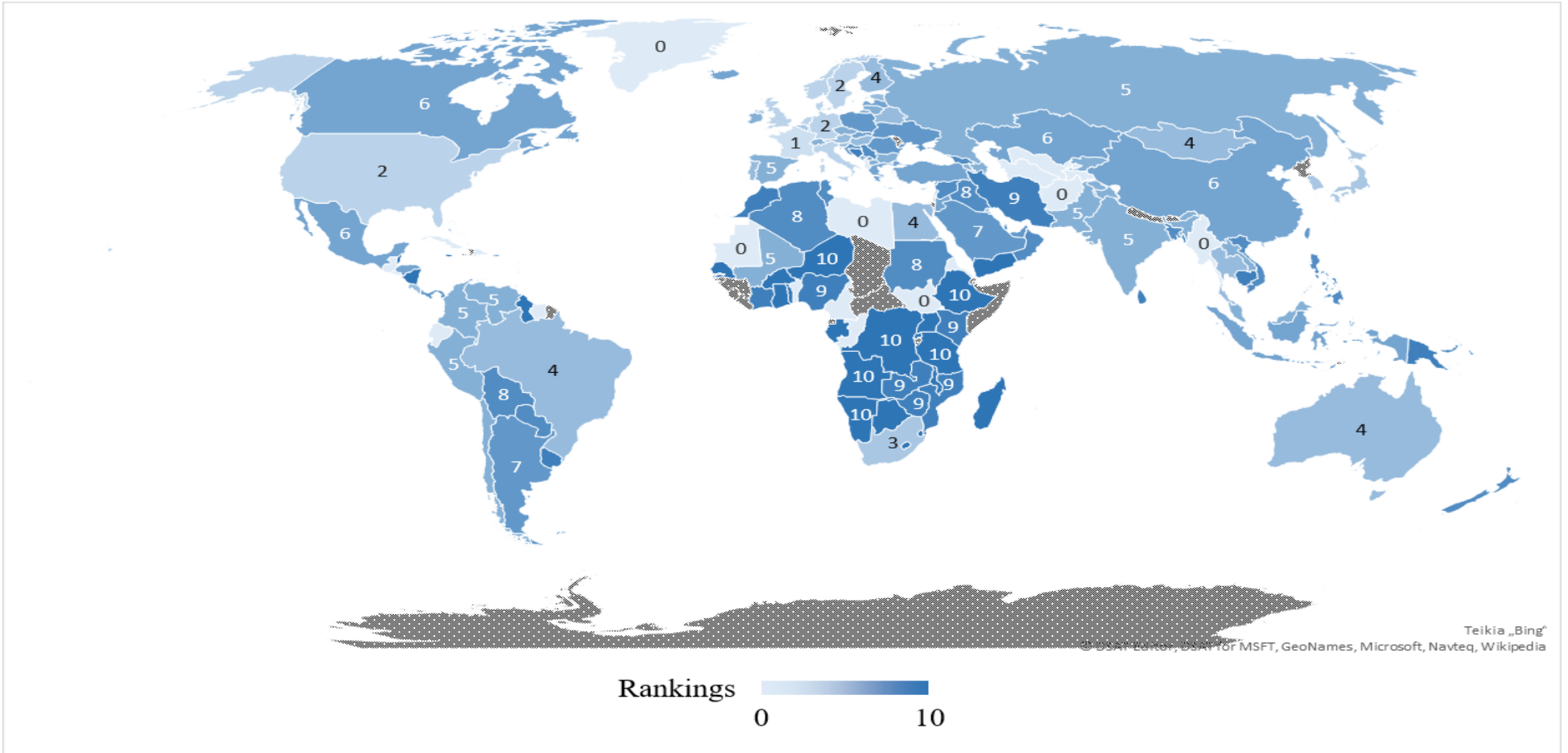
Community map of international equity investment network regarding non-institutional investors in 2010



Note: countries are grouped in 2 communities. The first community contains majority of European countries, Canada and few central African countries. The second community consists of the rest of the world.

Appendix 32

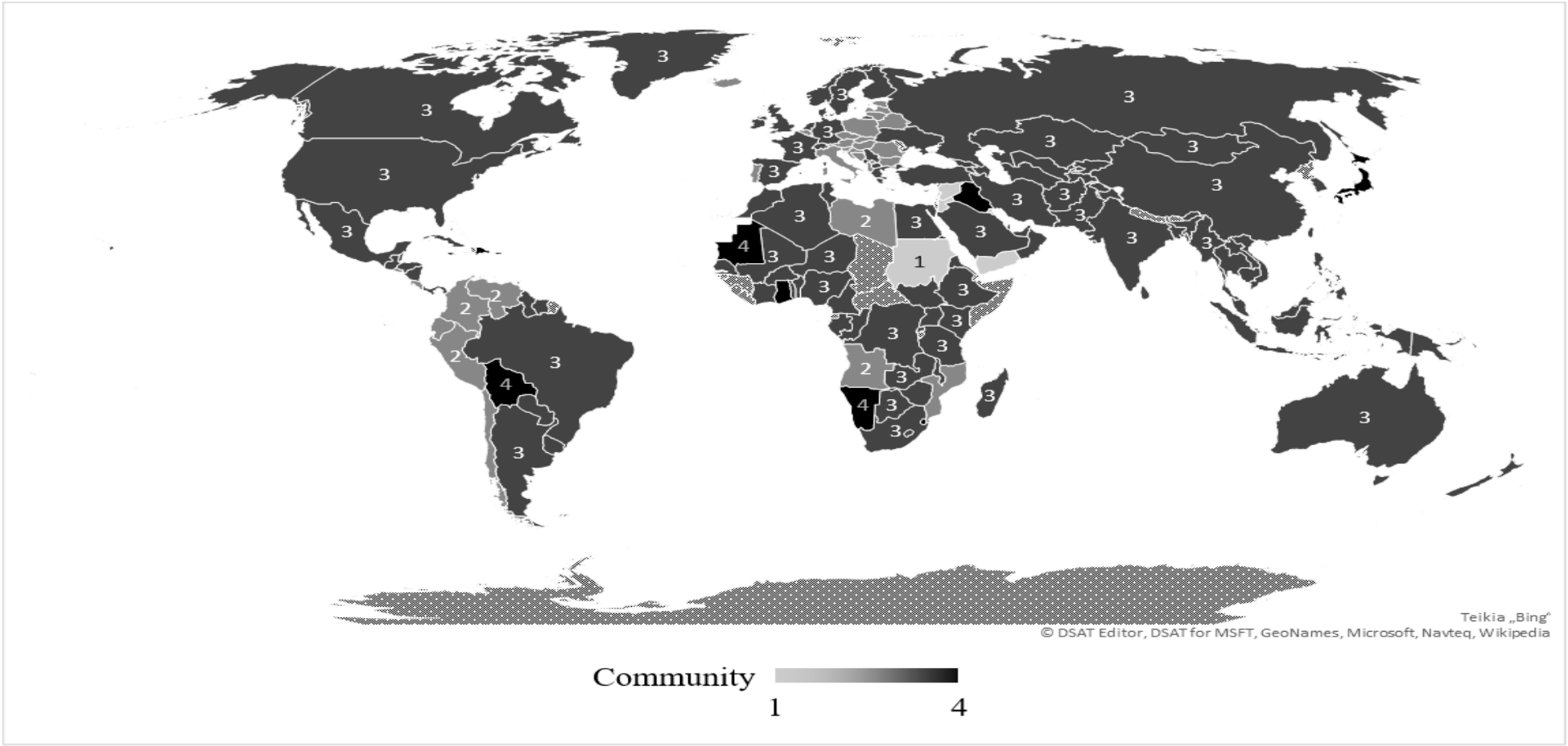
Clustering map of international equity investment network regarding institutional investors in 2016



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian Countries as Norway, Sweden and Denmark is 2. Clustering coefficient in Baltic countries: Lithuania is 5, Latvia is 6 and Estonia is 4. Clustering coefficient in such South European countries as Italy is 2, Spain is 5 and Greece is 6.

Appendix 33

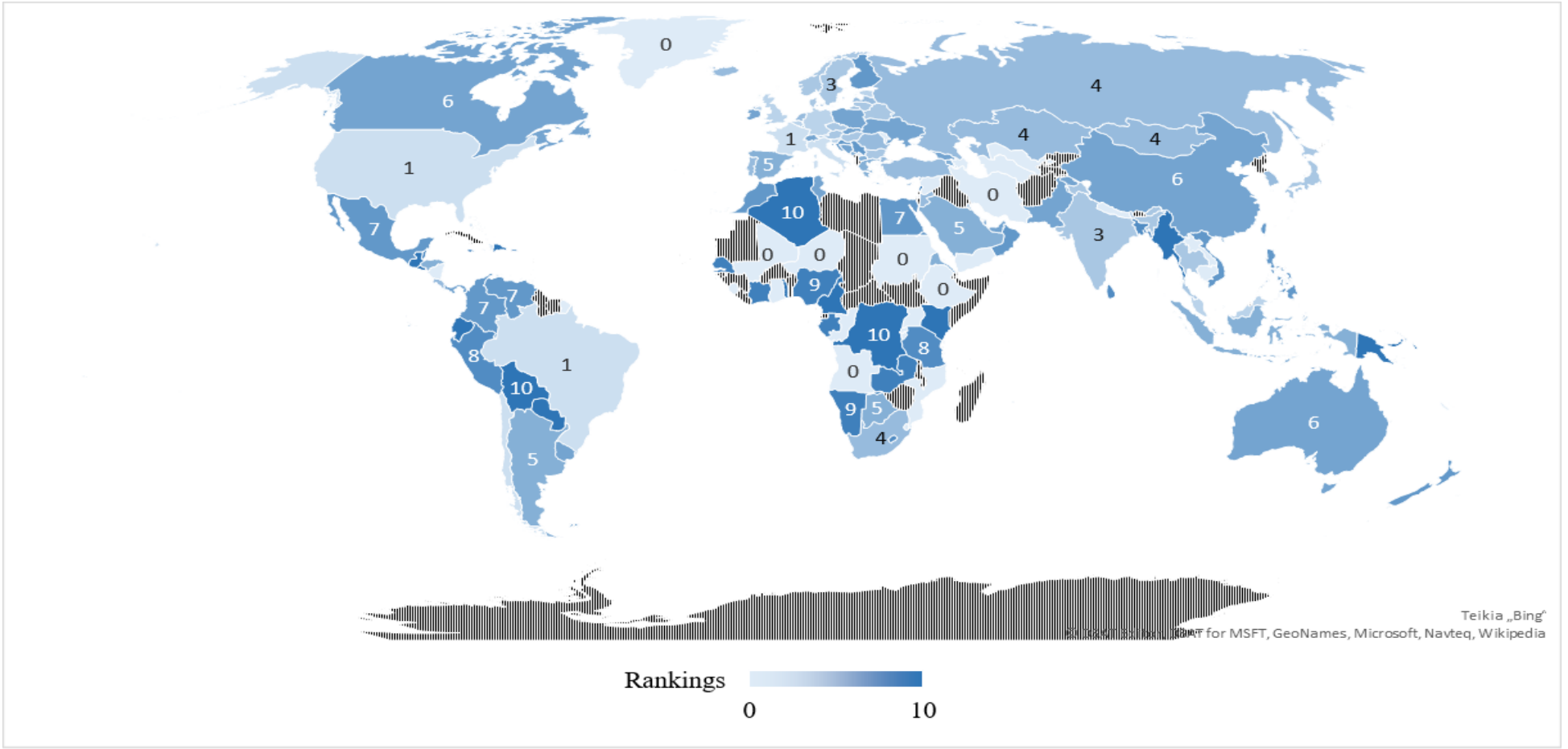
Community map of international equity investment network regarding institutional investors in 2016



Note: Countries are grouped in 4 communities. First community consists of Bahrain, Jordan, Kuwait, Lebanon, Sudan, Syria, West Bank and Gaza and Yemen. All these countries in most cases are determined by geographical proximity and by religion. Therefore, the first community can be called neighbour countries in Arabian Peninsula. Second community consists, mainly, of European countries, Central America and North Africa. Third community consists of North and South America, Australia, Asia and, mainly, South Africa. Scandinavian countries, the United Kingdom, Ireland, Switzerland and the Netherlands belong to the third community. Forth community consists of Anguilla, Bolivia, Cayman Islands, Ghana, Iraq, Jamaica, Japan, Malta, Mauritania, Puerto Rico and others.

Appendix 34

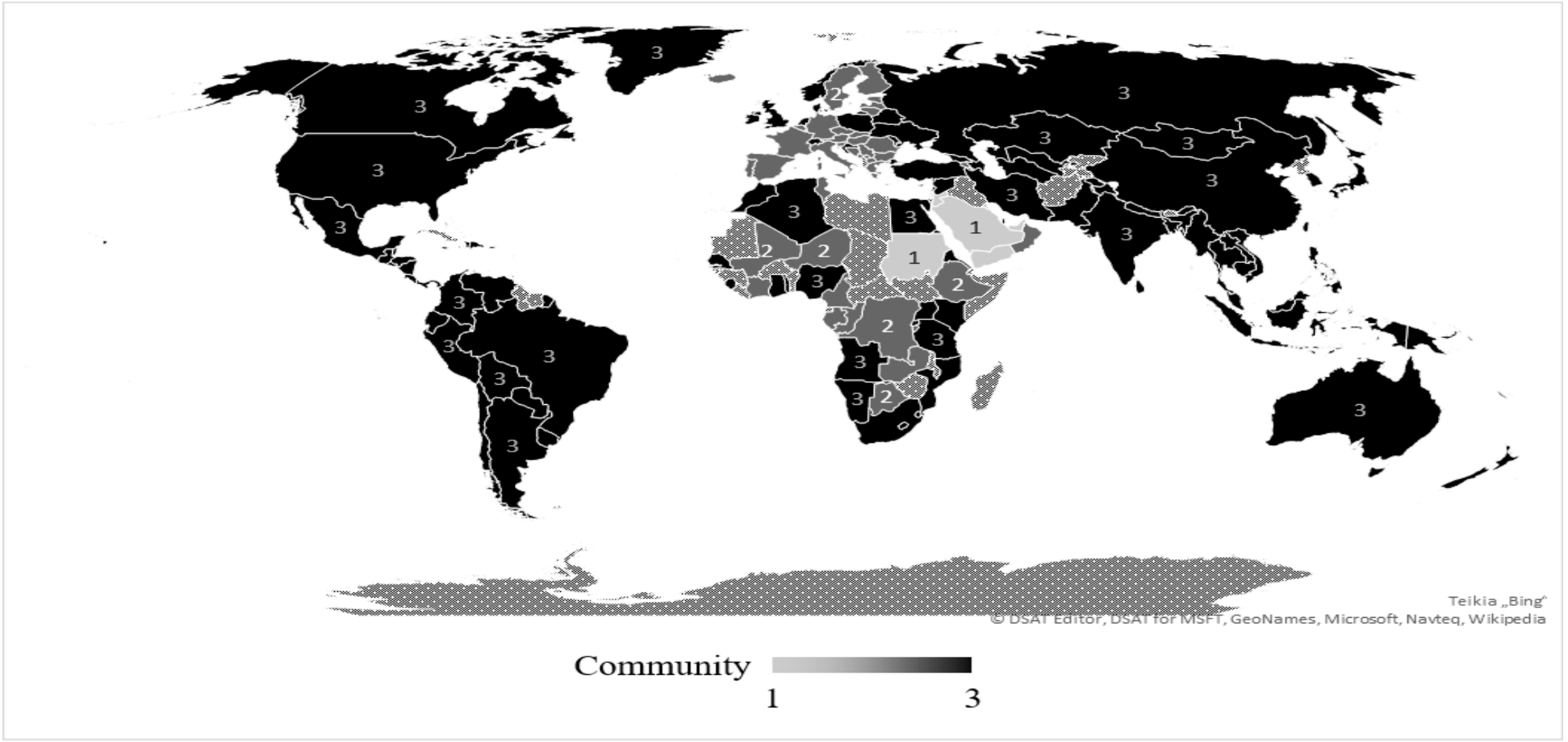
Clustering map of international equity investment network regarding non-institutional investors in 2016



Note: rankings represent value of clustering coefficient: 0 (clust. coef. < 0.1), 1 (0.1 ≤ clust. coef. < 0.2), 2 (0.2 ≤ clust. coef. < 0.3), 3 (0.3 ≤ clust. coef. < 0.4), 4 (0.4 ≤ clust. coef. < 0.5), 5 (0.5 ≤ clust. coef. < 0.6), 6 (0.6 ≤ clust. coef. < 0.7), 7 (0.7 ≤ clust. coef. < 0.8), 8 (0.8 ≤ clust. coef. < 0.9), 9 (0.9 ≤ clust. coef. < 1.0), 10 (clust. coef. = 1.0). Clustering coefficient in such Scandinavian Countries as Norway, Sweden and Denmark is 3. Clustering coefficient in Baltic countries: Lithuania is 3, Latvia is 4 and Estonia is 4. Clustering coefficient in such South European countries as Italy is 1, Spain and Greece is 5.

Appendix 35

Community map of international equity investment network regarding non-institutional investors in 2016



Note: Countries are grouped in 3 communities. First community consists of Bahrain, Jordan, Kuwait, Saudi Arabia, Sudan, United Arab Emirates, West Bank and Gaza and Yemen. All these countries are determined by geographical proximity and in most cases by religion. Therefore, the first community can be called neighbour countries in Arabian Peninsula. Second community consists, mainly, of European countries. Third community consists of North and South America, Australia, Asia and half countries in Africa. Norway, Denmark, the United Kingdom, Ireland, Switzerland and the Netherlands belong to the third community which is the mostly spread.

Appendix 36

Heteroskedasticity and autocorrelation tests used in assessment of general differences between international equity investment connectedness with regard to institutional and non-institutional investors

	Heteroskedasticity		Autocorrelation	
	chi	P > chi	F	P > F
ND in	204.30	0.0000	265.771	0.0000
ND out	132.69	0.0000	71.909	0.0000
NS in	1670.57	0.0000	114.831	0.0000
NS out	2130.65	0.0000	187.222	0.0000
NC	**3.10***	**0.0783***	59.007	0.0000
DC in	134.19	0.0000	224.536	0.0000
DC out	68.73	0.0000	93.210	0.0000
WDC in	1559.93	0.0000	71.015	0.0000
WDC out	2081.60	0.0000	165.814	0.0000
CC in	81.79	0.0000	59.128	0.0000
CC out	29.92	0.0000	92.011	0.0000
BC	**0.01***	**0.9355***	6.136	0.0137
EC	8.12	0.0044	16.919	0.0000

Note: when data is analysed as panel data with fixed year and country effects, heteroskedasticity in the test is positive, therefore, in all models, finally, double clustering is used. Breusch-Pagan test measures heteroskedasticity and Wooldridge test – autocorrelation.

Appendix 37

Country rankings by the highest clustering coefficient in international equity investment networks with respect to institutional and non-institutional investors

	Rank	INSTITUTIONAL	NON-INSTITUTIONAL
2001	1	AL, BA, GA, IR, KE, LI, MW, MZ, NA, PG, PR, SN, SK, SZ	BZ, HR, EE, GA, IR, LB, LS, LI, LT, MH, MA, PG, QA, TN
	2	ZW	IN, NZ
	3	EE	KR
	4	HR	JE, PK
	5	LS	MX
2008	1	DZ, AI, AG, AM, BO, BA, BW, CM, ET, FK, FO, GA, GY, IS, IR, LR, MG, MW, MV, ML, ME, MZ, NA, NI, PY, SN, SC, SI, UG, YE, ZW	AG, BB, BW, CD, FK, FO, GO, GL, GU, IR, LR, LI, MK, MC, PR, SN, SK, SI, VC, VI, YE, ZM
	2	EE	GI
	3	GI	PG
	4	LI	IS
	5	ZM	BH
2016	1	AO, AG, BZ, BW, BF, CD, ET, FK, GA, GH, GI, GY, JM, LS, MG, MW, MV, MA, NI, NE, RW, WS, SN, SZ, TZ, TG, UG, YE	DZ, AD, AG, BO, CM, CD, DO, EC, SV, FK, GT, JM, KE, LB, MM, PG, PY, WS, SM, SC, KN, VC, TG, VI
	2	ZW	CI
	3	ZM	GA
	4	FO	BB, BZ, MU, NA, SN, ZM
	5	KE	NG

Appendix 38

Country rankings by the highest centrality value in international equity investment networks with respect to institutional and non-institutional investors

	Institutional investors								
	Rank	DCin	DCout	WDCin	WDCout	CCin	CCout	BC	EC
2001	1	US	IT	US	UK	US	GG, IT	IT	US
	2	CH	GG	FR	JP	CH	DK, UK	UK	UK
	3	BE, KY	UK	UK	FR	BE, KY	FR	GG	JP
	4	BM, UK	DK	DE	IT	BM	SE	FR	FR
	5	LU	FR	NL	SE	UK	JP	DK	DE
2008	1	US	FR	US	UK	US	FR	UK	US
	2	LU, UK	UK	LU	NL	LU	UK	FR	UK
	3	IE, CH	DK	UK	FR	UK	DK	NL	JP
	4	FR, DE, NL	SE	FR	JP	IE, CH	SE	SE	NL
	5	BE	NL	KY	DE	FR, DE, NL	GG	IT	FR
2016	1	US	FR, GG	US	US	US	FR, GG	US	US
	2	LU, UK	KY	KY	UK	LU	KY	FR	KY
	3	FR, DE, IE	DK	LU	JP	UK	DK	KY	JP
	4	CH	US	UK	NL	IE	US	UK	UK
	5	BE	JE	JP	KY	FR	JE	NO	IE
	Non-institutional investors								
	Rank	DCin	DCout	WDCin	WDCout	CCin	CCout	BC	EC
2001	1	US	IT	LU	IT	US	IT	IT	IT
	2	DE, NL, UK	FR, SE	US	FR	DE	SE	FR	LU
	3	FR, JP, CH	DK	UK	ES	NL	FR	SE	FR
	4	CA, LU	MY	NL	SE	UK	DK	ES	US
	5	KY, FI, ES	ES	IE	AR	JP	MY	MY	IE
2008	1	US	FR	LU	DE	US	FR	FR	LU
	2	UK	IT	US	IT	UK	IT	IT	DE
	3	LU	SE	UK	FR	LU	SE	NL	IT
	4	FR	DK	FR	ES	FR	DK	DE	FR
	5	NL	DE	CH	JP	NL	AT	MY	NL
2016	1	US	US	LU	US	US	US	US	LU
	2	DE, UK	CL	US	DE	DE, UK	CL	FR	DE
	3	IE, LU	IT	IE	IT	IE, LU	IT	BR	IT
	4	FR, CH	BR	UK	BE	CH	FR	UK	US
	5	CA	FR	KY	FR	FR	BR	CL	BE

Appendix 39

Heteroskedasticity tests used in assessment of differences based on financial crisis between and within international equity investment networks with respect to institutional and non-institutional investors

	Heteroskedasticity			
	Without fixed country effect		With fixed country effect	
	chi	P > chi	chi	P > chi
ND in	210.62	0.0000	2441.10	0.0000
ND out	133.69	0.0000	3444.69	0.0000
NS in	1907.60	0.0000	74574.78	0.0000
NS out	2603.70	0.0000	138861.88	0.0000
NC	1.94	0.1633	20.69	0.0000
DC in	137.02	0.0000	1342.34	0.0000
DC out	68.21	0.0000	3305.73	0.0000
WDC in	1750.85	0.0000	75919.95	0.0000
WDC out	2506.93	0.0000	122956.57	0.0000
CC in	100.22	0.0000	68.97	0.0000
CC out	29.11	0.0000	1203.16	0.0000
BC	1.03	0.3104	22249.39	0.0000
EC	8.18	0.0042	51078.05	0.0000

Note: when data is analysed as panel data with fixed year and country effects, heteroskedasticity in the test is positive, therefore, in all models, finally, double clustering is used. Breusch-Pagan test measures heteroskedasticity.

Appendix 40

Test of differences based on financial crisis between and within international equity investment networks with respect to institutional and non-institutional investors using country fixed effects and standard clustering by country

	Inst_crisis					**Non_inst_crisis**				
Y	**Independent variables**					**Independent variables**				
	Const	non_inst_ crisis	inst_non_ crisis	non_inst_ non_crisis	R	Const	inst_crisis	non_inst_ non_crisis	inst_ non_crisis	R
ND in	**1.42*** (13.15)**	**-5.87*** (-14.55)**	**-0.45*** (-3.03)**	-5.14*** (-14.22)	0.81	**-4.45*** (-11.80)**	**5.87*** (14.55)**	**0.73*** (5.41)**	5.42*** (14.44)	0.81
ND out	0.43 (0.99)	**-5.90*** (-4.24)**	-0.59 (-0.99)	-5.26*** (3.53)	0.68	**-5.47*** (-4.29)**	**5.90*** (4.24)**	0.63 (1.03)	5.31*** (4.18)	0.68
NS in	**-6776.32*** (-3.64)**	**-21506.55*** (-3.08)**	**9323.89*** (3.64)**	-20828.03*** (-3.11)	0.47	**-28282.86*** (-3.30)**	**21506.55*** (3.08)**	678.52 (0.70)	30830.44*** (3.36)	0.47
NS out	-6837.91 (-1.10)	**-21523.44*** (-2.77)**	9402.12 (1.10)	-20766.38*** (-2.69)	0.22	**-28361.35*** (-2.69)**	**21523.44*** (2.77)**	757.06 (0.41)	30925.57** (2.52)	0.22
NC	**0.07*** (5.31)**	**-0.10*** (-3.88)**	**-0.04** (-2.07)**	-0.10*** (-4.76)	0.40	-0.02 (-1.22)	**0.09*** (3.88)**	-0.01 (-0.70)	0.06*** (2.89)	0.40
DC in	**0.01*** (11.58)**	**-0.03*** (-13.84)**	-0.001 (-13.84)	-0.03*** (-13.78)	0.88	**-0.02*** (-10.67)**	**0.03*** (13.84)**	**0.002*** (3.06)**	0.03*** (13.46)	0.88
DC out	0.002 (0.66)	**-0.03*** (-3.53)**	-0.002 (-0.66)	-0.03*** (-3.12)	0.71	**-0.03*** (-3.50)**	**0.03*** (3.53)**	0.002 (0.49)	0.03*** (3.41)	0.71
WDC in	**-35.37*** (-3.53)**	**-119.42*** (-2.99)**	**48.67*** (3.53)**	-118.16*** (-3.09)	0.52	**-154.79*** (-3.19)**	**119.42*** (2.99)**	1.26 (2.99)	168.09*** (3.24)	0.52
WDC out	-35.69 (-1.09)	**-119.51*** (-2.69)**	49.08 (1.09)	-117.81*** (-2.66)	0.23	**-155.20*** (-2.64)**	**119.51*** (2.69)**	1.70 (0.15)	168.59** (2.50)	0.24
CC in	**0.12*** (241.61)**	**-0.04*** (-39.56)**	**0.008*** (11.26)**	-0.04*** (-35.11)	0.71	**0.08*** (78.15)**	**0.04*** (39.56)**	**0.005*** (7.68)**	0.05*** (45.77)	0.71
CC out	-0.002 (-0.41)	**-0.05*** (-3.80)**	0.002 (0.41)	-0.05*** (-3.42)	0.72	**-0.05*** (-4.27)**	**0.05*** (3.80)**	0.002 (0.39)	0.002*** (4.33)	0.72
BC	-0.0002* (-1.77)	-0.0002 (-0.86)	0.0002* (1.77)	-0.0002 (-0.81)	0.64	-0.0004 (-1.62)	0.0002 (0.86)	0.000 (-0.02)	0.0004 (1.85)	0.64
EC	0.0009 (1.26)	-0.01 (-1.49)	-0.001 (-1.26)	-0.009 (-1.31)	0.60	-0.01 (-1.31)	0.01 (1.49)	0.002 (0.74)	0.01 (1.24)	0.60

Appendix 41

Impact of stock market volatility and different exchange rate volatilities on node out-degree during growth period and crisis with regard to institutional investors

Independent variables	Type of exchange rate volatility					
	1M	**2M**	**3M**	**6M**	**1Y**	**23D**
Crisis	**6.30*** (3.41)**	**6.10*** (3.35)**	**5.78*** (3.23)**	**5.10*** (3.02)**	**5.02*** (3.03)**	**6.77*** (3.64)**
Stock_market_1Yvolat	**-32.52*** (-4.09)**	**-32.41*** (-4.06)**	**-32.42*** (-4.03)**	**-32.93*** (-3.99)**	**-34.36*** (-4.04)**	**-34.62*** (-4.47)**
Exch_volat	**0.27** (1.98)**	0.23* (1.83)	0.20* (1.69)	0.16 (1.52)	0.21* (1.78)	0.23* (1.73)
Exch_volat_crisis	-0.24* (-1.85)	-0.21* (-1.69)	-0.17 (-1.42)	-0.09 (-0.82)	-.081 (-0.78)	-0.22* (-1.73)
Const	**25.30*** (7.23)**	**5.58*** (7.31)**	25.80 (7.37)	**26.12*** (7.40)**	**25.97*** (7.33)**	**26.61*** (7.45)**

Note: it is an example showing that the most relevant exchange rate volatility is 1-month exchange rate volatility. The regressions are conducted using random effects with robust standard error clustering by country.

Appendix 42

Variance inflation factor of riskiness independent variables measuring their impact on node out-degree during growth period and crisis with regard to institutional investors

Independent variables	Type of exchange rate volatility					
	1M	**2M**	**3M**	**6M**	**1Y**	**23D**
Crisis	3.52	3.49	3.44	3.23	3.05	3.49
Stock_market_1Yvolat	1.12	1.12	1.13	1.15	1.17	1.12
Exch_volat	1.52	1.50	1.49	1.50	1.58	1.52
Exch_volat_crisis	4.28	4.23	1.49	3.97	3.87	4.25
MEAN	**2.61**	**2.59**	**2.55**	**2.46**	**2.42**	**2.59**

Appendix 43

Heteroskedasticity tests used in assessment of stock market/country riskiness impact on international equity investment connectedness with regard to institutional investors

	Without country fixed effects		With country fixed effects	
	chi	P > chi	chi	P > chi
1Y equity price volatility and 1M exchange rate volatility				
ND in	8.79	0.0030	180.79	0.0000
ND out	36.08	0.0000	257.96	0.0000
NS in	68.40	0.0000	5407.01	0.0000
NS out	22.41	0.0000	7708.42	0.0000
NC	1.32	0.2514	0.54	0.4632
DC in	10.59	0.0011	42.99	0.0000
DC out	47.53	0.0000	192.31	0.0000
WDC in	58.79	0.0000	5303.98	0.0000
WDC out	22.51	0.0000	7701.78	0.0000
CC in	23.24	0.0000	0.50	0.4808
CC out	7.57	0.0059	9.49	0.0021
BC	13.75	0.0002	2693.06	0.0000
EC	26.69	0.0000	3713.78	0.0000
Debt to GDP				
ND in	108.47	0.0000	959.81	0.0000
ND out	209.71	0.0000	1310.88	0.0000
NS in	847.21	0.0000	24018.18	0.0000
NS out	2058.80	0.0000	37788.39	0.0000
NC	6.76	0.0093	33.87	0.0000
DC in	82.64	0.0000	425.13	0.0000
DC out	179.51	0.0000	1060.40	0.0000
WDC in	722.02	0.0000	21151.05	0.0000
WDC out	1874.34	0.0000	32180.63	0.0000
CC in	94.87	0.0000	3.87	0.0492
CC out	51.04	0.0000	386.74	0.0000
BC	339.34	0.0000	5761.11	0.0000
EC	805.78	0.0000	9881.49	0.0000

Note: when data is analysed as panel data with fixed year and country effects, heteroskedasticity in the test is positive, therefore, in all models, finally, double clustering is used. Breusch-Pagan test measures heteroskedasticity.

Appendix 44

Heteroskedasticity tests used in assessment of stock market/country riskiness impact on international equity investment connectedness with regard to non-institutional investors

	chi	P > chi	F	P > F
	Without country fixed effects		With country fixed effects	
1Y equity price volatility and 1M exchange rate volatility				
ND in	20.49	0.0000	335.01	0.0000
ND out	51.27	0.0000	182.01	0.0000
NS in	49.70	0.0000	26213.96	0.0000
NS out	31.65	0.0000	13486.19	0.0000
NC	6.39	0.0115	27.82	0.0000
DC in	17.81	0.0000	245.84	0.0000
DC out	53.79	0.0000	181.68	0.0000
WDC in	46.45	0.0000	26504.55	0.0000
WDC out	37.47	0.0000	13521.65	0.0000
CC in	14.53	0.0001	57.06	0.0000
CC out	12.14	0.0005	30.93	0.0000
BC	79.16	0.0000	2680.10	0.0000
EC	50.53	0.0000	5243.86	0.0000
Debt to GDP				
ND in	117.97	0.0000	1216.81	0.0000
ND out	125.11	0.0000	1015.18	0.0000
NS in	363.60	0.0000	82436.80	0.0000
NS out	1311.45	0.0000	22454.04	0.0000
NC	1.58	0.2087	1.31	0.2520
DC in	92.15	0.0000	928.14	0.0000
DC out	128.27	0.0000	1025.95	0.0000
WDC in	504.14	0.0000	83838.28	0.0000
WDC out	1221.03	0.0000	21813.92	0.0000
CC in	114.64	0.0000	209.98	0.0000
CC out	36.46	0.0000	438.29	0.0000
BC	494.26	0.0000	7669.26	0.0000
EC	0.89	0.3466	18756.75	0.0000

Note: when data is analysed as panel data with fixed year and country effects, heteroskedasticity in the test is positive, therefore, in all models, finally, double clustering is used. Breusch-Pagan test measures heteroskedasticity.