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Financial Contagion in the BRICS Stock Markets: An empirical analysis of the Lehman Brothers Collapse and European Sovereign Debt Crisis

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Abstract

This research analyzes and extends the study of contagion for BRICS emerging stock markets in the context of the last two international financial crises: the Lehman Brothers Bankruptcy Crisis and the European Sovereign Debt Crisis. We investigate changes in the relationship and the co-movements between BRICS markets in response to international shocks that are originated in advanced markets like USA and Europe. Employing data of daily stock market indices of BRICS countries, this research tests for contagion, examining the interactions and characteristics of price movements of BRICS stock markets by applying cointegration, causality and VECM/Gonzalo-Granger statistic and variance decomposition methodology on stock returns as a measure of perceived country risk. The results exhibit that both long-run and short-run relationships patterns exist between BRICS stock markets and have drastically changed during turbulent periods compared with tranquil period, pointing towards the occurrence of contagion phenomenon among BRICS markets during the last two crises. These findings also indicate that changes in the USA and the Euro Zone indices affect BRICS stock markets in the short-run, acting as a leading indicator for investing in BRICS markets. Also imply an increasing degree of global market integration, bringing major implications for portfolio diversification and policy makers.

Keywords: *Financial Contagion; Financial Crises; VAR Models; BRICS Stock Markets; Cointegration; Causality.*

JEL Classification: *G01, G11, G12, G15, G18.*

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1. Introduction

The acronym BRIC was first suggested by Jim O'Neill¹ in 2001, in his publication *"Building Better Global Economic BRICs"*. The initial four countries – Brazil, Russia, India and China corresponded to BRIC. They were the rising stars of the Emerging Markets due to their large size, population and ambitious to become world's leading economies propelled by their audacious growth. In April 2011, South Africa joined the group as a full member, in the 2011 summit in Sanya, China. Hence, the group was renamed BRICS – to reflect the group's expanded membership. Fifteen years later, after a Global Financial Crisis (GFC),² the expectations about the BRICS countries as the world's leading emerging markets economies, still holds as the growth engines of the world economy, today and in the future (Bonga-Bonga, 2015; O'Neill, 2013).

The rampant growth of the BRICS countries has substantial effects for the capitalization of their stock markets as well as for their financial dependence with other stock markets (Mensi et al., 2014; Visalakshmi & Lakshmi, 2016). BRICS economies have matured hastily and are becoming increasingly more integrated with the most developed economies in terms of trade and investment.³

In the past three decades, various countries have been hit by severe financial crises: the Mexican *"Tequila Crisis"* in 1994, the East Asian Crisis in 1997, the Russian Crisis in 1998, the Argentinean Crisis in 2002, the United States of America (USA) Subprime in 2007 and the Lehman Brothers Bankruptcy Crisis (LBBC) in 2008 and, more recently, the European Sovereign Debt Crisis (ESDC) in 2010/11.

¹ Chief economist at Goldman Sachs Asset Management (see O'Neill, 2001).

² The US Subprime Crisis in August 2007 and the collapse of the Lehman Brothers in September 2008, sparked a GFC that affected the real sector and caused a rapid, synchronized deterioration in most major economies (Gentile & Giordano, 2012, 2013). Subsequently, the effects caused the Eurozone Sovereign Debt Crisis, which served as a catalyst towards further investigation of the contagion and spillover effects among the USA, Eurozone, Emerging Markets and Asian stock markets. These interdependencies could provide evidence whether there is a seemingly growing integration in international markets with important implications for portfolio diversification (Bekiros, 2014).

³ The BRICS together constitute more than a quarter of the world's land area, more than 40% of the world's population and about 15% of global GDP. The growth potentials in those culturally and geographically disparate countries are based on diverse attributes. Brazil is a resource-rich country, with resources such as coffee, soybean, sugar cane, iron ore and crude oil. Russia is well known for its massive deposits of oil, natural gas and minerals. India has a rising manufacturing base and is a strong service provider. China has a highly skilled workforce at low wage cost and it is considered the factory of the world. South Africa, the smallest of the five BRICS countries by land mass and world GDP contribution, is the world's largest producer of platinum and chromium, and holds the world's largest known reserves of manganese, platinum group metals, chromium, vanadium and aluminum-silicates (The BRICS Report, 2012).

All these financial crises started in a specific country and region in the globe and, subsequently, their effects spread to other countries and regions. Such transmission of shocks is dubbed *contagion* (Bonga-Bonga, 2015). Notwithstanding, the contagion term is not consensual, this research follows the largest body of the empirical literature based on the Forbes and Rigobon (2002) designation, where contagion is defined as a significant increase of cross-market linkages after a shock to one country or a group of countries. This contagion effect undermines the purpose of the portfolio diversification, revealing the situation where markets that were assumed to be weakly associated before a shock are subsequently found to be strongly associated in such a way that diversification across markets fails to shield the investors from the unsystematic risk (Gentile and Giordano, 2012, 2013). This definition indicates that, if two markets present a high degree of co-movement during periods of stability and continue to be highly correlated after a shock to one market, this indicate interdependence⁴ rather than contagion.

This research enriches the literature by focusing the study on the great importance that the effects of contagion in the financial crises across BRICS countries can reveal based on the magnitude of the interaction among them and what they represent globally. The focus of this research is pointed towards the LBBC and the ESDC in order to identify if there was contagion transmission to the BRICS countries and the implications of this phenomenon due to the great impact that both crises had in the behavior of the investors, which brought massive inflows of foreign direct investment to the BRICS countries, trying to hedge their investments (Nistor, 2015).

To achieve this goal, we implemented a three-step methodology that capture the different patterns of contagion transmission across BRICS countries stock markets, following Baig and Goldfajn (1999), Beirne and Gieck (2012), Gentile and Giordano (2012, 2013), Fourie and Botha (2015), and Boubaker et al. (2016).

Our results clearly reveal an increase in the long-run connections among BRICS stock markets jointly with changes in the causality patterns, which have changed in the turbulent periods compared to the tranquil periods. The evidence suggests that contagion effects strongly influenced the BRICS stock markets over both crises. These results also reveal that BRICS countries were not able to provide portfolio diversification, indicating that both crises affected their stock markets, revealing different degrees of vulnerabilities among them.

⁴ When co-movements do not increase significantly after a shock, then any continued high level of market correlation indicates strong connections among the countries that exist worldwide (Gentile & Giordano, 2012).

This empirical research is organized as follows. Section 2 contains a literature review, Section 3 describes the data and Section 4 the econometric methodology, which is followed by Section 5, the core section, which presents the empirical results and Section 6 concludes.

2. Literature Review

2.1. Contagion Phenomenon: Definition, Theories, Transmission and Measurement

The different definitions of contagion, how it is measured, what causes contagion, how it is transmitted and why, is extremely important to understand so as to evaluate this phenomenon correctly and develop policy responses efficiently. Blaming financial crisis on contagion remains an elusive concern, highly contagious among politicians and economists. Without a clear understanding of financial contagion and the mechanisms through which it works, we can neither assess the problem nor design appropriate policy measures to control for it (Moser, 2003). Such understanding is needed to identify the economic implications both for implementing policies and for investors, who need to understand the nature of changes in stock markets to evaluate the potential benefits of international portfolio diversification and the analytical assessment of risks.

Despite the significant theoretical and empirical interest of financial contagion, there is still no consensus about whether cross-country propagation of shocks through fundamentals⁵ should be considered contagion. Hence, we need to differentiate between *pure contagion*⁶ and shock propagation through

⁵ Financial, real and political links, constitute the fundamentals links of an economy (Gentile & Giordano, 2012; Moser, 2003). The first ones exist when two economies are connected through the international financial system. Real links are fundamental economic relationships between countries. These links have usually been associated with international trade, but other types of real links, like foreign direct investment across countries, may also be present. Finally, political links are the political relationships between countries. Although this link is much less stressed in the literature, when a group of countries share an exchange rate arrangement, a common currency (in the case of the Euro Area Countries), crises tend to be clustered (Gomez-Puig & Sosvilla-Rivero, 2014).

⁶ Masson (1998) defines *pure contagion* as an unanticipated situation. Claessens et al. (2001) and Gentile and Giordano (2012) define *pure contagion* in the sense of Masson's only when the transmission process itself changes when entering crises periods: when a crisis in one country may conceivably trigger a crisis elsewhere for reasons unexplained by macroeconomic fundamentals – perhaps because it leads to shifts in market sentiment, or changes the interpretation given to existing information, or triggers *herding behavior*.

fundamentals⁷. Some have suggested *transmission* (Bordo & Murshid, 2000; Lakshmi et al., 2015); *spillovers* (Broto & Perez-Quiros, 2015; Dungey & Martin, 2007; Masson, 1998, 1999; Muratori, 2014); *interdependence* (Forbes & Rigobon, 2001, 2002, Gentile & Giordano, 2012, 2013) or *fundamentals-based contagion*⁸ (Bonga-Bonga, 2015; Kaminsky & Reinhart, 1998). This differentiation is defined by Moser (2003), indicating that shocks propagation through fundamentals is the result of an optimal response to external shocks, which is not considerate a source of pure contagion. For instance, a crisis in one country can cause disturbances in the equilibrium of other countries, causing an adjustment in the financial and real variables to a new equilibrium. In that case, financial market responses only anticipate and reflect changes in fundamentals, accelerating the adjustment to a new equilibrium, just transmitting and not causing the changes in the equilibrium. In other words, rather than causing a crisis, financial markets responses bring the crisis forward, being an example of fundamentals-based contagion rather than pure contagion (Moser, 2003).

2.2. What is Financial Contagion?

Contagion phenomenon generally is used to describe the spread of market disturbances from one country to another.⁹ In its broadest sense, therefore, financial contagion is related with the propagation of adverse shocks that have the potential to trigger financial crises. The core of the matter is to identify potential propagation mechanisms and define those that represent contagion (Moser, 2003). In spite of the greatest relevance of the contagion phenomenon, there is still no consensus on either the definition or the transmission channels of financial contagion. As a first step, it is helpful to understand what contagion does not mean and what it does mean.

The World Bank¹⁰ distinguishes three definitions of financial contagion: *broad*, *restrictive* and *very restrictive*.

⁷ The theories based on fundamentals channels are the oldest, and the general idea is that links across countries exist because the countries' economic fundamentals affect one another. These theories are usually based on standard transmission mechanisms, such as trade, monetary policy, and common shocks (e.g., oil prices).

⁸ Fundamentals-based contagion refers to the transmission of shocks that is due to real and financial linkages or fundamental relationship of any kind, such as trade or macroeconomic policy, between countries (Bonga-Bonga, 2015; Dornbusch et al., 2000; Forbes & Rigobon, 2001; Masson, 1998).

⁹ The process can be observed through co-movements in exchange rates, stock prices, sovereign spreads and capital flows (Gentile & Giordano, 2012).

¹⁰ Macroeconomics - Definitions of Contagion. Retrieved November 8, 2016, from www.go.worldbank.org/JIBDRK3YCO. (World Bank)

The broad definition: it is vague and generalist, this definition was used in the earliest stages of the research on contagion phenomenon. Under this approach, contagion is the cross-country transmission of shocks or the general cross-country spillover effects during the crisis (Gentile & Giordano, 2012, 2013).

The restrictive definition: it is suitable in more recent literature, where contagion is the transmission of shocks from one country to others or the cross-country correlation, beyond what would be explained by fundamentals or common shocks.¹¹ This definition is usually referred to as *excessco-movement*,¹² commonly explained by *herding behavior*.

The very restrictive definition: it implies an increase in the linkages after a crisis, when cross-country correlations increase during “*crisis times*” relative to correlations during “*tranquil times*”, therefore, this can only be due to factors unrelated to fundamentals, since they cannot change in a short period of time (Gentile & Giordano, 2012, 2013). In fact, Dornbusch et al. (2000) and Forbes and Rigobon (2002) argue that contagion is a significant increase in cross-market co-movements after a (negative) shock to one country (or group of countries).¹³

Forbes and Rigobon (2001) reinforce that this notion of contagion excludes a constant high degree of co-movement in a crisis period, otherwise markets would be just interdependent.¹⁴ There is contagion only if cross-market co-movements increase significantly after the shock.¹⁵ Any continued high level of market correlation suggests strong linkages between the two economies that exist in all states of the world.

Currently this very restrictive definition reveals two major advantages: firstly, it provides a straightforward framework for testing whether contagion occurs or not by comparing co-movements between two markets (such as cross-market

¹¹ Fundamentals causes of contagion include macroeconomic shocks that have repercussions on an international scale and local shocks transmitted through trade links, competitive devaluations, and financial links (Gentile & Giordano, 2012, 2013).

¹² That means a correlation that remains even after controlling for fundamentals and common shocks. Herding behavior is usually said to be responsible for co-movement beyond that what is explained by fundamentals linkages (Gentile & Giordano, 2012).

¹³ This definition is known sometimes as “*shift-contagion*”. Our definition of “*shift-contagion*” following Gentile and Giordano (2012), relies on a significant increase in cross-market co-movements after a shock, which is not related with fundamentals linkages (such as financial, real or political). The only transmission channel that could explain *contagion* is the *behavioral* one.

¹⁴ Regarding the extreme definition of contagion phenomenon, for instance, the research of Bae et al. (2000; 2003) consider extreme return shocks across countries as evidence for contagion.

¹⁵ A contagious event cannot occur in the absence of a shock, indicating that a large shock should occur (Caporin et al., 2013; Constancio, 2012).

correlations coefficients) during a relatively stable period with co-movements immediately after a shock or crisis, which does not require a specification of a structural representation for stock returns. Secondly, it allows distinguishing between permanent and temporal mechanisms of crises transmission. Identifying if the propagation of a crisis is due to permanent or temporal mechanisms has important implications for designing public policy responses (Bejarano-Bejarano et al., 2015).

This empirical research uses the very restrictive definition of contagion, because it provides an alternative explanation for transmission of crisis, namely interdependence, allowing one to answer the questions: Is there contagion or interdependence? Do the periods of highly correlated market movements provide evidence of contagion? Does the cross-market relationship change during periods of crisis? Our main goal is to try to answer these questions in the context of both crises (LBBC and ESDC) from the perspective of the BRICS countries stock markets.

2.3. Causes and Transmission of Contagion

The literature divides the concept of contagion into two broad categories (Bonga-Bonga, 2015; Dornbusch et al., 2000; Forbes & Rigobon, 2001; Masson, 1998; Pritsker, 2000), namely, *fundamentals-based*¹⁶ and *investor-behavior contagions*.¹⁷ The first category emphasizes spillovers that result from the normal interdependence among market economies, referring to the transmission of shocks that is due to real and financial linkages or fundamentals relationship of any kind, such as trade or macroeconomic policies, between countries. These forms of co-movements would not indicate contagion, according to the *restrictive* and *very restrictive* definition of contagion, which is adopted in this research. According to Gentile and Giordano (2012), fundamentals linkages cannot change suddenly in a few months after a shock has occurred. Hence, that is considered interdependence.

¹⁶ *Macroeconomics Causes*: common shocks, trade links and competitive devaluations, real and financial links and macroeconomic policies (Claessens et al., 2001; Dornbusch et al., 2000). *Fundamentals-based contagion* is caused by “*monsoonal effects*” and “*linkages*”. *Monsoonal effects* – are random aggregate shocks that hit a number of countries in a similar way (such as a major economic shift in industrial countries, a significant change in oil prices or changes in US interest rates) that may adversely affect the economic fundamentals of several economies simultaneously and, therefore, may cause a crisis (Eichengreen et al. 1996; Masson, 1998). *Linkages* – are normal interdependencies, such as those produced by trade and financial relations between countries and which can easily become a carrier of crisis (Kaminsky & Reinhart, 2000; Masson, 1998).

¹⁷ Liquidity problems, information asymmetries and costs, multiple equilibriums and changes in the rules of the game (see Claessens et al., 2001; Dornbusch et al., 2000).

The second category involves a financial crisis that is not linked to observed changes in macroeconomics or other fundamentals but is solely the result of a change in investor behavior which alters the flow of international portfolio investments in such a manner that it cannot be explained by economic fundamentals. For example, a crisis in one emerging market country can trigger investors to withdraw funds from many emerging markets without taking into account the fundamental economic differences between them¹⁸ (Bonga-Bonga, 2015). If the transmission force is based on the irrational behavior of the market agents, known as “*irrational*” *phenomena*,¹⁹ then even countries with good fundamentals can be seriously affected, in this case we have contagion.

The initial literature has generally been divided as to whether transmission through real or financial channels constitutes contagion. Forbes and Rigobon (2001, 2002) and Gentile and Giordano (2012) argue that the theoretical literature of contagion could be split into two groups: *crisis-contingent* and *non-crisis-contingent* theories.²⁰ The first one is related to the financial linkages, explaining why transmission mechanisms change during a crisis and therefore why a shock leads to an increase in the cross-market linkages. On the other hand, the second one is related to the real linkages, if transmission mechanisms are the same during a crisis as during more stable periods, and therefore cross-market linkages do not change (increase) after a shock. Theories belonging to the second group may be interpreted as interdependence rather than contagion (see Forbes & Rigobon, 2002; Gentile & Giordano, 2012).

2.4. Contagion: Testing and Measurement

Gentile and Giordano (2012, 2013) describe contagion as the amount of co-movement among asset prices which exceeds what is explained by fundamentals, since fundamentals cannot change in a few months. They argue that a degree of

¹⁸ This event is known as “*Fight-to-quality phenomenon*” and refers to a sudden shift in investment behaviors in a period of financial turmoil where investors try to sell assets perceived as risky and instead purchase safe assets. An important feature of *flight-to-quality* is an insufficient risk taking behavior by investors. Though excessive risk taking can be a source of financial crisis, insufficient risk taking can severely dislocate credit and other financial markets during the financial crisis. These shifts in portfolio investments result in further negative shocks to the financial sector. In accordance to this phenomenon demand for 10-year US Treasuries and gold increased during the recent financial turmoil (Kazi & Wagan, 2014).

¹⁹ This can occur in the form of speculative attacks, financial panics, herd behavior, loss of confidence, and increased risk aversion (Gentile & Giordano, 2012, 2013).

²⁰ *Crisis-Contingent Theories*: multiple equilibria, endogenous liquidity shocks, political contagion and random global monetary shocks. *Non-Crisis-Contingent Theories*: trade, policy coordination, country reevaluation and random real global shocks.

extreme connection or asymmetry that goes beyond interdependencies must be present in order for contagion to be present.

Research on contagion range from testing conditional correlation to contagion of bond spreads, sovereign ratings, credit default swaps (CDS) spreads, stock market returns, differences in interest rates, common trends and cycles, monetary policy and currency market (Bianconi et al., 2013; Caporin et al., 2013; Fourie & Botha, 2015; Gentile & Giordano, 2012, 2013, Gomez-Puig & Sosvilla-Rivero, 2011, 2014; Matos et al., 2015). For instance, Andenmatten and Brill (2011), following Forbes and Rigobon (2002) methodology, also performed a bivariate test for contagion to examine whether the co-movement of sovereign CDS premium increased significantly after the beginning of Greek debt crisis in October 2009. Their findings revealed that in European countries, both contagion and interdependence occurred. In addition, Baig and Goldfajn (1999) in the context of the Asian crisis, using the same methodology, performed a cross-market correlation for exchange rates, stock returns, interest rates, and sovereign bond spreads. The findings for sovereign spreads highlighted strong evidence of contagion and high correlation among exchange rate, stock returns and interest rates co-movements. They conclude that spreads directly reflecting the risk perception of financial markets, indicating that pure contagion may be the result of the behavior of investors or other financial agents (Claessens et al., 2001).

Bonga-Bonga (2015) provides evidence of contagion phenomenon by analyzing financial contagion between South Africa and its BRICS equity market from December 1996 to May 2012, the initial period corresponds with the liberalization of a number of BRICS equity markets. By applying a conditional correlation framework, they find evidence of cross-transmission and dependence between South Africa and Brazil. Furthermore, the research also ascertained that South Africa is more affected by crises originating from China, India and Russia than these countries are by crises from South Africa. Furthermore, Matos et al. (2015) performed a test to identify common trends and cycles between BRIC's stock markets, providing evidence of contagion effect, with Brazil and China financial markets playing a leading role in the transmission of contagion. They conclude that worldwide investors should consider reactions in Chinese and Brazilian markets during a crisis as a predictor of other BRIC reactions through the *contagion channel*.²¹

²¹ Trade, banks/lending institutions, portfolio investors and wake-up calls/fundamentals reassessment (Forbes, 2012).

A wide range of empirical techniques has been used to quantify contagion in the literature. For instance, Forbes (2012) refers tools to measure contagion range from *cross-market correlations analysis* (Forbes & Rigobon, 2001, 2002) to *probability analysis* (Constancio, 2012; Eichengreen et al., 1996; Gomez-Puig & Sosvilla-Rivero, 2011, 2014) to *latent factor/GARCH models* (Bekaert et al., 2011, 2005; Dungey & Yalama, 2010) to *extreme values/co-exceedance/jump* (Bae et al., 2003; Berger & Pukthuanthong, 2012; Boyer et al., 2006; Forbes, 2012) and *VAR models* (Beirne & Gieck, 2012; Fourie & Botha, 2015; Matos et al., 2015).

More related to our approach, Boubaker et al. (2016) use VAR-VECM to measure contagion between US stock market and developed and emerging stock markets during the Subprime crisis in September 2008. They provided significant evidence of contagion effects between the US stock market and the developed and emerging equity markets after the global financial crisis. Beirne and Gieck (2012) use a global VAR to measure interdependence and contagion across bonds, stocks and currencies for over 60 economies during periods of crisis. Their analysis reveals that shocks to equity markets typically originate in the US and that bond market shocks tend to originate in the Eurozone. Gentile and Giordano (2012, 2013) use cointegration and VECM/Granger causality tests to measure the existence and direction of contagion in European countries during the LBBC and ESDC, pointing out the occurrence of contagion phenomenon in both crises. Fourie and Botha (2015) using the same methodology provided by Gentile and Giordano (2012, 2013), but for sovereign ratings, proved contagion in European countries, during the two recent windows of crises: Lehman Crisis and European Union Sovereign Debt Crisis.

3. Data

Our main objective is to test for contagion during the last two international financial crises,²² using an important financial market indicator: The Stock Market Index (SMI). Further on, we apply a tree-step econometric analysis²³ to test for contagion that will be discussed in detail later. We will analyze the different connections and co-movement between countries to identify any cross-market or cross-country connections that can explain and assess contagion phenomena in the BRICS stock markets.

²² The recent Lehman Brother bankruptcy Crisis (LBBC) and the European Sovereign Debt Crisis (ESDC).

²³ First: A bivariate dynamic cointegration analysis. Second: Granger causality test and VECM/GonzaloGranger statistic.Third: We apply the Variance decomposition method following Baig and Goldfajn (1999), Beirne and Gieck (2012), Gentile and Giordano (2012, 2013), Fourie and Botha (2015) and Boubaker et al. (2016).

Morgan Stanley Capital International (MSCI) for *large-caps* is the main source used for stock price indices. The sample consists of five countries from the Emerging Markets known as BRICS: (Brazil (BRA), Russia (RUS), India (IND), China (CHI) and South Africa (SAF)) and one developed country, the United States (USA), using daily stock indices closing prices for each country. The daily frequency sample was considered, because interdependence phenomena can explode in a few days. So, if we had considered weekly or monthly data, we could have lost the measurement of interactions (innovations), which may last only a few days (Gentile & Giordano, 2012, 2013; Jin & An, 2016; Voronkova, 2004).

Table 1. Variables Explanation

Variables	Explanation	Type
BRA	Log-level value of MSCI Brazil Stock Price Index	Exog./Endogenous
RUS	Log-level value of MSCI Russia Stock Price Index	Exog./Endogenous
IND	Log-level value of MSCI India Stock Price Index	Exog./Endogenous
CHI	Log-level value of MSCI China Stock Price Index	Exog./Endogenous
SAF	Log-level value of MSCI S. Africa Stock Price Index	Exog./Endogenous
USA	Log-level value of MSCI U. States Stock Price Index	Exogenous

Notes: Regarding to national holidays, the index level was assumed to stay the same as that on the previous trading day. The USA variable is implicitly imputed in the data, because as it is stated in the literature that linkage patterns may be distorted when the influence of the US market is not taken into consideration (see Bekaert et al., 2011; Gentile & Giordano, 2012, 2013; Khalid & Kawai, 2003; Yang et al. 2003).

The daily stock indices (in log-level) were presented also through graphical representation over the period of the study (see Appendix A). Visually, all indices were recovering jointly from 2003 until the beginning of the 2008 as a period of economic growth that lasting until 2007. But subsequently, the USA subprime mortgage crisis, undermined the confidence of banks in each other's solvability decreased sharply leading to the breakdown of the interbank lending market and turmoil on the financial marketing the second half of 2007. Large downturns in stock prices followed and the interconnectedness of stock market indices rose again as all markets suffered from similarly intensive losses. Hence, after April 2008 until the insolvency of Lehman Brothers in September 2008, stock markets' tendencies started to move jointly (see Appendix A).

Regarding daily data, it is necessary to consider the differences in time zones and in trading hours of the exchanges when interpreting the results. Therefore, we considered a central time window around the two crises (LBBC and ESDC) as

suggested by Jin and An (2016). A two-day rolling average, as suggested by Forbes and Rigobon (2002) to account for time synchronization of different markets, which lay in different time zones has not been considered in this research due to severe autocorrelation problem as highlighted by Chiang et al. (2007) and Ahmad et al. (2013).

3.1. Variable Transformation

We took natural logarithms of our data before proceeding to the analysis process (see table 1). The log form of stock indices were used in order to reduce the heteroskedasticity present in the data (Singh & Kaur, 2016), smoothing out the fluctuations, to make the data series linear and very helpful for the purpose of further analysis (Verma & Rani, 2016). Moreover, for evaluating the rate of daily returns needed for further analysis, the initially log-level variables were taken and calculated (Ahmad et al., 2013; Malliaris & Urrutia, 1992; Mensah & Alagidede, 2017; Pragidis & Chionis, 2014; Syriopoulos et al. 2015) on the following basis:

$$R_t = [\log(P_t) - \log(P_{t-1}) \times 100] = \left[\log\left(\frac{P_t}{P_{t-1}}\right) \times 100 \right] \quad (\text{eq. 1})$$

where, R_t is the percentage daily returns value at time t , P_t and P_{t-1} , are the percentage daily returns value at two successive days: t and $t - 1$, respectively.

After the transformation, the percentage daily stock return variables were defined as: *SRBRA*, *SRRUS*, *SRIND*, *SRCHI*, *SRSAF* and *SRUSA*. Daily closing prices of the BRICS stock markets were retrieved from *Thomson Reuters Datastream* database and are expressed in US dollars,²⁴ and the time range of the time series goes from January 1, 2003 to October 31, 2016.²⁵ *Eviews 9.0* and *R programming*²⁶ were used for arranging the data and implementation of econometric analyses.

4. Methodology

In order to test for contagion, we implemented a three-step methodology coherent with our definition of contagion as *a significant increase of cross-market linkages after a shock to one country or a group of countries* based on both crises (LBBC and ESDC). This methodology will provide three different indicators that

²⁴ Using US dollars avoid problems related to the local currency (See Bekaert & Harvey, 1995; Chen et al., 2002; Mollah et al., 2014; Roll, 1992; Singh & Kaur, 2016).

²⁵ Data was set in the begin of 2003 to avoid contamination in the stock market from earlier bond crises in Russia and Latin America (Cronin et al., 2016, p. 6).

²⁶ The *OPTMALAG* command from *R programming*, chooses the lag order that maximize Johansen statistics.

together corroborate to assess contagion phenomenon in the BRICS stock markets.

As first step, we implement the Johansen cointegration test to detect the cross-market connections in the long-run, allowing the identification of signs of contagion and the detection of the so called “*Contagion Windows*” by looking direct in the data without any kind of previous assumptions. We use a *bivariate dynamic cointegration analysis*²⁷ to test for the presence of new long-run relationship among BRICS countries through the application of the dynamic rolling cointegration analysis²⁸ (*rolling indicator*) for each pair of countries. Any increase of the percentage of cointegrated countries over the total number of possible pairs signals a shift²⁹ of the shock transmission channels and represents the first indicator of potential contagion. According to the results obtained in this step, it is possible to detect contagion windows by looking directly into the data, finding evidence which either confirms or rejects the assumption of the time periods during which the contagion process could have started to propagate during the two financial crises analyzed – LBBC and ESDC.

In order to determine the number of cointegrating equations, a VECM(k) was applied according to Johansen (1988),

$$\begin{aligned}\Delta X_t &= \eta_x + \sum_{i=1}^k \lambda_{x,i} \Delta X_{t-i} + \sum_{i=1}^k \theta_{x,i} \Delta Y_{t-i} + \alpha_1 \beta' \begin{bmatrix} X_{t-1} \\ Y_{t-1} \end{bmatrix} + \epsilon_{x,t} \\ \Delta Y_t &= \varphi_y + \sum_{i=1}^k \lambda_{y,i} \Delta Y_{t-i} + \sum_{i=1}^k \theta_{y,i} \Delta X_{t-i} + \alpha_2 \beta' \begin{bmatrix} X_{t-1} \\ Y_{t-1} \end{bmatrix} + \epsilon_{y,t}\end{aligned}\quad (eq. 2)$$

where, ΔX_t and ΔY_t are daily changes of stock returns referred to markets X and Y , X_t and Y_t are the correspondent log-price indices (in log-level). The long-run impact matrix can be expressed as $\Pi = \alpha \beta'$, where $\alpha' = [\alpha_1, \alpha_2]$, and $[\epsilon_x, \epsilon_y]$ is a vector of white noise processes. The vector of coefficient β contains the parameters of the common stochastic, trend, while α_1 and α_2 measure the speed of convergence. In particular, $\beta' \begin{bmatrix} X_{t-1} \\ Y_{t-1} \end{bmatrix}$ represents a common stochastic trend

²⁷ To individuate significant connections among pairs of markets, the bivariate Johansen cointegration test is applied to allows the identification of relations between pairs of markets which lead to slow price adjustment processes – long-run connections (Gentile and Giordano 2012, 2013).

²⁸ See the recent contributions of Mylonidis and Kollias (2010), Arce et al. (2012), Peri and Baldi (2013) and Ludwig (2014).

²⁹ We defined “shift” as a significant increase in cross-market co-movements after a shock, not related with fundamentals links (Gentile and Giordano, 2012).

towards which price dynamic slowly converges. Hence, the Johansen cointegration test mainly relies on the assumption that the rank of Π equals the number of cointegrating vectors. If the matrix Π has a rank r , there are r cointegrating relations. When $r = 0$, there is no long-run relation among international markets and the equation 2 would be reduced to a VAR(k).

Now, for detecting possible periods of contagion, the above dynamic Johansen cointegration test is applied between all the possible pairs of countries with a *rolling window of 1000-days*,³⁰ by computing at each step t (t , represents each month) of the procedure the following *rolling indicator* of cross-country connections:

$$\left[\begin{array}{c} \text{Percentage of} \\ \text{Cross - Country Connections} \end{array} \right]_t = \left[\frac{\text{\# of long - run relations}}{\text{Max.\# of Long - run relations among all countries}} * 100 \right] \quad \text{eq. 3}$$

Using the rolling indicator in equation 3, it is possible to discriminate as follows:

- Crisis periods are identified recording the *highest* values of cross-country connections.
- Tranquil periods are identified recording the *lowest* values of cross-country connections.

By comparing these highest and lowest percentage values, it may be possible to either confirm or reject the assumption made regarding the timing of the two crises episodes investigated: Contagion occurs when cross-country co-movements (percentage of cointegrated countries, known as cross- country connections), increase during the crisis periods relative to cross-country connections during the tranquil periods.

As second step, through the *Granger causality test* and *Vector Error Correction Model (VECM)/Gonzalo-Granger statistic*, which capture new significant short connections among the BRICS countries after a financial shock, allowing also the identification of which country propagates the impulses of contagion – *leading countries* and which country is the target of contagion – *follower countries*.

³⁰ The length of 1000 days-window is chosen in order to make the cointegration results more robust, allowing to explore the asymptotic properties of the Johannsen test (Gentile and Giordano, 2012, 2013). Further, in the presence of autocorrelation coefficients, the power of the trace test is as low as the nominal size for a window length of 250 days and becomes acceptable for windows of at least 1000 days – four years (Ludwig, 2014, 19).

The Granger causality test provides evidence for short-run relationship among BRICS countries. Alongside with cointegration technique (long-run relationship), it allows one to find out which country has a dominant role in the contagion process, being able to influence others “leading country” and it allows one to identify the most fragile country, in other words, it is possible to identify the reaction of this country related to other countries’ price innovations “follower country”.

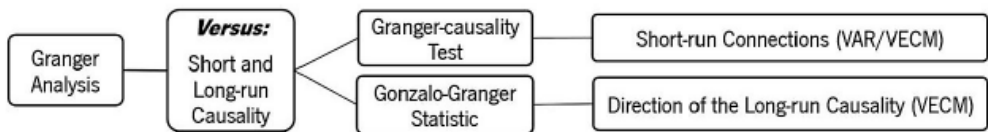


Figure 1. Framework implementation of the Granger Causality Methodology

In order to apply the Granger causality test, the following considerations were taken into account: first, the time series were tested for unit root in each sub-period established in the first step followed by the cointegration test among pairs of countries. Second, the results of unit root test applied earlier revealed that all the time series are nonstationary at log-level. However, the series are stationary at their first difference (I(0)), that is, all the series are integrated of Order one (I(1)). Based on these results, if the series are found to be (I(1)) and not cointegrated,³¹ the causality test proceeded according to the following equations:

$$\Delta X_t = \alpha_x + \sum_{i=1}^k \beta_{x,i} \Delta X_{t-i} + \sum_{i=1}^k \theta_{x,i} \Delta Y_{t-i} + \epsilon_{x,t}$$

$$\Delta Y_t = \alpha_y + \sum_{i=1}^k \beta_{y,i} \Delta Y_{t-i} + \sum_{i=1}^k \theta_{y,i} \Delta X_{t-i} + \epsilon_{y,t} \quad (eq. 4)$$

However, if the series are found to be (I(1)) and cointegrated, causality test will be tested based on equation 5. For cointegrated series, different approaches to causality testing have to be applied. Based on results of Sims et al. (1990), Demetriades and Hussein (1996) argue that test statistics derived from a level VAR framework are not valid unless the variables employed are either (I(0)) or (I(1)) and cointegrated. This assumption drives the causality test for equation 4 if the series are not cointegrated.

³¹The Equation 4 is only valid if the series are not cointegrated (MacDonald and Kearney, 1987).

On the other hand, Engle and Granger (1987) and Granger (1988) argue that in the presence of cointegration, causality tests derived from the cointegration relationship, which ignore the ECT, are misspecified and suggest the re-parameterization of the model in the equivalent error correction model form (VECM). Therefore, the causality test in this case is conducted in the following equations:

$$\begin{aligned}\Delta X_t &= \alpha_x + \sum_{i=1}^k \beta_{x,i} \Delta X_{t-i} + \sum_{i=1}^k \theta_{x,i} \Delta Y_{t-i} + \phi_x ECT_{x,t-1} + \epsilon_{x,t} \\ \Delta Y_t &= \alpha_y + \sum_{i=1}^k \beta_{y,i} \Delta Y_{t-i} + \sum_{i=1}^k \theta_{y,i} \Delta X_{t-i} + \phi_y ECT_{y,t-1} + \epsilon_{y,t}\end{aligned}\quad (eq. 5)$$

The VECM-based test allows the differentiation between two types of causality: the short-run dynamics of the VAR and the disequilibrium adjustment of the error correction mechanism (ECM). Indeed, the F-test on the estimated coefficients θ_i provides evidence regarding a short-term adjustment dynamics. The t-test of the estimated coefficient ϕ provides evidence for the existence of an arbitrage type error correction mechanism that drives the variables back to their long-term equilibrium relationship that is embodied in the cointegration vector. In this step, the objective is to identify the creation of new short-run relations among countries as evidence of contagion (θ_i), conducting the Granger causality test separately for each contagion window (sub-periods defined in the first step) based on the stock returns of all countries. Regarding the lag length k ,³² the criteria is chosen in order to generate a white noise error term ϵ_t .

We analyze the contagion windows defined in the previous step, looking for changes in the short-run connections between countries. Hence, changes in the connections detected after a crisis period is a signal of shocks transmission through countries and consequently, a signal of contagion. Moreover, together with the short-run versus³³ of the connections, the detection of the long-run versus of the countries connections is also very important and reached by implementing the Gonzalo-Granger statistic, allowing the identification of the

³² The criteria information is given by the Akaike information criterion (AIC), the Schwartz information criterion (SIC), the Hannan-Quinn criterion (HQ) and the Likelihood ratio statistic (LR). In this research, the SIC is preferable only when the serial correlation is not an issue. Otherwise, the preferable criterion will be the one that guarantees no serial correlation.

³³ The versus of the long-run (cointegrated analysis) is two types of causality: short-run connections obtained by the Granger causality test and the long-run causality, which is obtained in the context of the cointegration analysis based on the first step and it is applied in the Gonzalo-Granger statistic.

direction of connections in the crisis episodes. In order to detect the direction of the long-run causality among BRICS countries, we apply Gonzalo and Granger (1995) methodology³⁴ to identify the direction through which adjustment is done. Hence, it is possible to estimate which country is the *leader* and which is the *follower* in the contagion transmission in the context of a bivariate cointegration analysis (Engle and Granger, 1987). Furthermore, we can measure the speed of convergence to the long-run equilibrium (α) of the two hypothesized countries, while (β) contains the parameters of the common stochastic trend (Gentile and Giordano, 2012, 2013).

Gonzalo and Granger's model of price-discovery is based on the following VECM specification given by Arce et al. (2012), adapted to our context (with USA stock return as a exogenous variable):

$$\begin{bmatrix} \Delta X_t^k \\ \Delta Y_t^j \end{bmatrix} = v_0 + ECT + USA + \begin{bmatrix} \sum_{i=1}^p \lambda_{1,i} \Delta X_{t-i}^k \\ \sum_{i=1}^p \delta_{2,i} \Delta Y_{t-i}^j \end{bmatrix} + \begin{bmatrix} \sum_{i=1}^p \delta_{1,i} \Delta Y_{t-i}^j \\ \sum_{i=1}^p \lambda_{2,i} \Delta X_{t-i}^k \end{bmatrix} + \begin{bmatrix} u_{1,t} \\ u_{2,t} \end{bmatrix} \quad (eq.6)$$

The above empirical model is a VAR system formed by two equations defined from the vector, which includes X_t^k and Y_t^j as the pair of BRICS stocks markets, $k, j = \text{Brazil, Russia, India, China, South Africa}$ ($k \neq j$); and an error correction term (ECT) defined by the expression $\alpha(X_{t-1}^k - \beta_2 Y_{t-1}^j - \beta_3 Z_{t-1}^{USA} - \beta_4)$, where β_2, β_3 and β_4 are estimated in an auxiliary cointegration regression and the parameter vector $\alpha' = (\alpha_1, \alpha_2)$ contains the error correction coefficients measuring each price's expected speed of adjustment. Furthermore, the exogenous variable (USA) is defined by the expression $\sum_{i=1}^p v_i^{USA} \Delta Z_{t-i}^{USA}$. The estimation of the VECM equation is restricted to the existence of a cointegration relation between the stock market from both pair of countries. This cointegration relation appears in the ECT as $(X_{t-1}^k - \beta_2 Y_{t-1}^j - \beta_3 Z_{t-1}^{USA} - \beta_4)$. The parameters $\lambda_{1,i}, \lambda_{2,i}, \delta_{1,i}, \delta_{2,i}$ and $v' = (v_{1,i}, v_{2,i})$ for $i=1, \dots, p$, with p indicating the total number of lags, contain the coefficients of the VAR system that measure the effect of the lagged first difference in the pair of stocks from BRICS countries markets based on the first

³⁴The method proposed by Gonzalo and Granger (1995) decomposes the time series X_t as: $X_t = \alpha(\beta' \alpha) \beta' X_t + \beta_1 (\alpha_1 \beta_1)^{-1} \alpha_1 X_t$ where first component is $I(0)$ and the transitory part, while the second component is $I(1)$ and the permanent part (see Gonzalo and Granger, 1995, Equation 11). The decomposition of the $[X_t, Y_t]$ into two components (transitory and permanent), allow the obtainment of different kind of information. For example, policymakers may be primarily interested in the trend (permanent component) behavior, but those concerned with business cycles are more interested in the cyclical component (transitory component). Moreover, singling out the common factors allow us to investigate how they are related to other variables (Gonzalo and Granger, 1995).

difference of such stocks at time t . Finally, u_t denotes a White noise vector $u_{i,t} \sim N(0,1)$.

The price-discovery for the pair of stocks from the BRICS markets, denoted by GG_{X^k} and GG_{Y^j} , respectively, can then be constructed from the elements of the vector α' , which contains the coefficients that determine each market's contribution to price-discovery:

$$GG_{X^k} = \frac{\alpha_2}{(\alpha_2 - \alpha_1)} \quad GG_{Y^j} = \frac{-\alpha_1}{(\alpha_2 - \alpha_1)} \quad eq.(7)$$

Given that $[GG_{X^k} + GG_{Y^j}] = 1$, we would conclude that the $X^k(Y^j)$ market leads the price-discovery process whenever GG_{X^k} is higher (lower) than 0.5. The intuition for this is the faster the speed in eliminating the price difference from the long-term equilibrium attributable to a given stock market, the higher the corresponding α according equation 6, and the higher the price discovery (Arce et al. 2012).

At this point, we adapted the equation 7 to the view of Gentile and Giordano (2012, 2013), for instance, assuming a pair of countries, as in the first step, the long-run coefficients matrix Π in equation 2 can be expressed as $\Pi = \alpha\beta'$, where α measures the speed of convergence to the long-run equilibrium of the two hypothesized countries, while β contains the parameters of the common stochastic trend. Furthermore, following equation 4, if the parameter of the speed adjustment of the first country (α_1) is statistically not significant, while the parameter of the speed adjustment of the second country (α_2) is positive and significant, it means that the adjustment process towards the long-term relationship is determined by changes to the variable of the second country in response to changes of the variable of the first country, indicating that the leading role in the contagion transmission is played by the first country. Otherwise, if (α_1) is negative and statistically significant, while (α_2) is not significant, this implies that the second country plays the *leading role*. However, when both countries are significant³⁵, both countries contribute to the contagion transmission process and the Gonzalo-Granger statistic, defined as $\left[\frac{\alpha_2}{(\alpha_2 - \alpha_1)'}\right]$, allows one to determine which country makes the greatest contribution to the contagion transmission process. Hence, if the application of the ratio in equation 7 for the first stock market exceeds 0.5, the price of the first country plays a more important role, while if it is lower than 0.5, the price of the second country plays a bigger role in the contagion transmission (Arce et al. 2012; Gentile and Giordano 2012).

³⁵ In that case, there is a shift of signals (Gentile and Giordano 2012, 2013).

Third and the last step is dedicated to the rate of involvement indicator, which identifies the most vulnerable countries, measuring how much of the domestic risk is explained by innovations in other BRICS countries. We apply the forecast-error *variance decomposition* (FEVD) to test for the exposure to external shocks as a degree of vulnerability of each country. Indicating that, as far as the proportion of the movements explained by other countries increases, the vulnerability of the system also increases and becomes more exposed to external shocks (more exposed to external markets). Following the conceptual framework discussed previously, at this point, our assumption is that contagion occurs every time the degree of vulnerability of one country – measured as the fraction of its movements due to an other country’s shocks – increases after a crisis period. In other words, an increasing degree of vulnerability after a crisis period is considered as evidence of contagion.

The FEVD, looking from the econometric point of view, measures the fraction of the forecast-error variance of an endogenous variable that can be attributed to orthogonalized shocks themselves or to another endogenous variable, giving the portion of the movements in the dependent variables that are due to their “own” shocks, versus shocks to the other variables.³⁶

Initially, the FEVD indicator is given by the moving-average representation of the VECM as follows:

$$R_t = \sum_{s=0}^{\infty} C(s)u(t - s) \tag{eq. (8)}$$

where, the $i, j - th$ component of $C(s)$ represents the impulse-response of the $i - th$ country in s periods to a shock of one standard error in the $j - th$ country, and u is the orthogonalized innovation in the sense that it has an identity covariance matrix. Initiating from this mathematical representation of the stock return, the variance of the $n - step$ forward forecast variance of the $i - th$ return time series $[R_{i,t+n}]$ is given as follows:

$$\delta_i(n)^2 = \sum_{j=1}^n C_{i,1}(j)^2 + \dots + \sum_{j=1}^n C_{i,N}(j)^2 \tag{eq. (9)}$$

³⁶ A shock to the $i - th$ variable will directly affect that variable; however, it will also be transmitted to all other variables in the system through the dynamic structure of the VAR. Variance decompositions determine how much of the s -step-forward forecast error variance of a given variable is explained by innovations to each other explanatory variables for $s = 1, 2, 3, \dots, T$.

where, N is the number of countries included in the sample ($N = 5$)³⁷. For each country stock market i the ratio:

$$W_i(k) = \frac{\sum_{j=1}^n C_{i,k}(j)^2}{\delta_i(n)^2} \quad \text{eq. (10)}$$

represents the portion of movements in country i due to shocks from country k , on the time horizon n . Therefore, for $[i = k]$ the ratio is as follows:

$$W_i(i) = \frac{\sum_{j=1}^n C_{i,i}(j)^2}{\delta_i(n)^2} \quad \text{eq. (11)}$$

indicating the portion of its forecast error variance which is explained by its own innovations. Consequently, its complement to one $[1 - W_i(i)]$ is the rate of involvement indicator, which measures the degree of vulnerability of country i , since it is the percentage of the variance of country i explained by innovations in other countries, being considered as a *measure of country exposure to external shocks*. In more detail, the *rate of involvement* – measures the degree of vulnerability of each country, as a *degree of exposure to the external shocks* – indicating how much “domestic” risk is explained by innovation in foreign countries.

All three indicators results point towards the evidence of contagion across BRICS stock markets over the last two financial crises (the LBBC and ESDC).

5. Results

5.1. Contagion Windows Definition

In the *first-step* result, we started by analyzing the connections among the BRICS markets through time. At each point of time ($t = \text{each month}$),³⁸ we estimated the linkages across markets. These linkages are able to influence and determine the stock returns between the BRICS stock markets. A sharp increase of cross-market connections signals a contagion phenomenon, as we can see in figure 1 below.

Using a 1000-days rolling window and the dynamic bivariate cointegration test, in the first of the three-step analysis, we detected the connections between markets (long-run relationships) that lead to slow price adjustment processes. Further, applying the *rolling indicator* (Percentage of connections, discussed in methodology section), it is possible to detect the increasing or decreasing

³⁷ Brazil, Russia, China and South Africa.

³⁸ The results contemplate in total 121 months and consequently, 121 rolling windows in total.

connections between markets that can confirm the assumption of tranquil or turbulent period of crisis. To identify these periods, the results of the rolling indicator are combined with the quartiles³⁹ to divide and set the precise timing of the contagion window by looking directly in the data in order to define when the contagion phenomenon started to spread between the two financial crises (LBBC and ESDC).⁴⁰ Supposing the rolling indicator exceeds the III^o quartile ($\theta_{III} = \text{UpperBound} = 75^{\text{th}}$ percentile = 40%), the percentage of relevant connections is considered significantly high and, therefore, the period is considered as turbulent. On the other hand, supposing the percentage of connections is high (but does not exceed the θ_{III}) and there are no significant changes in the number of connections, then we assume it as evidence of interdependence rather than contagion phenomenon (Gentile & Giordano, 2012, 2013). Therefore, the so called “*tranquil*” period is identified as equal or under the III^o quartile until the I^o quartile ($\theta_I = \text{Lower Bound} = 25^{\text{th}}$ percentile = 10%). Consequently, the “*crisis*” period is identified when the rolling indicator reveals a higher percentage of connections above the upper bound and the “*tranquil*” period is given when the rolling indicator reveals a lower percentage of connections equal to the θ_{III} (but without significant changes in the number of connections, indicating high interdependence) or below, until the θ_I (lower bound).

To detect and discriminate between crises periods and tranquil periods, we observed the increasing connections between the countries given by the rolling indicator. For instance, the date of the sharpest fall in the BRICS markets was May 2008⁴¹ (see Appendix A). The same month shows a sharp increase of cross-market connections, as demonstrated in Figure 1, signaling a contagion phenomenon (Gentile & Giordano, 2012). These findings strongly support the idea that contagion involves externalities and is distinct because it reflects market failure and dangerously amplified transmission of instability (Gonzalez-Paramo, 2011). Moreover, the results support the view of (Constancio, 2012, p. 110), that the spread of instability is abnormal and amplified, going beyond the bounds of normality.

³⁹ The use of quantiles to identify significant increases (abnormal) of asset price co-movements, is justified by recent econometrics techniques (Caporin et al., 2013; Gentile & Giordano, 2012, 2013; Koenker, 2005; Koenker et al. 1994; Mensi et al., 2014)

⁴⁰ Constancio(2012, p. 110) and Caporin et al.(2013) maintain that a contagious event cannot occur in the absent of a shock, a large shock should occur. Enforcing the finds in this research in line with other studies (e.g. Fourie & Botha, 2015; Gentile & Giordano, 2012, 2013).

⁴¹ May 2008 was also the month where the Dow Jones index reached the highest peak. The following months revealed that the crisis had become evident, spreading from the housing market to the global financial markets (Mollah et al., 2014).

Our results based on the rolling indicator, revealed two contagion windows (see Table 2). The *first contagion window* reveals the Lehman Brothers Crisis – from May 2008 to July 2009,⁴² while the “tranquil” period goes from January 2003 to April 2008 (when the indicator is almost always below the III^o quartile going down until the I^o quartile). At the end of the “tranquil” period, the stock market started to show high signs of co-movements, which we considered as interdependence.

Table 2. Contagion Windows Definition

Stock Market Returns	
<i>Lehman Brothers Bankruptcy Crisis</i>	<i>European Sovereign Debt Crisis</i>
Duration: 15 Months	Duration: 7 Months
01-05-2008 – 31-07-2009: Approximately 327 days. In 86.67% of the cases the rolling indicator is strictly above the upper bound III ^o Quartile ($\theta_{III^o} \rightarrow 40\%$).	01-04-2011 – 31-10-2011: Approximately 152 days. In 71.43% of the cases the rolling indicator is strictly above the upper bound III ^o Quartile ($\theta_{III^o} \rightarrow 40\%$).

⁴² The first window goes from May 2008 to July 2009. The data and the percentage indicator evidenced this period as a period of highly connections across the countries. The beginning of the contagion window shown in the graphical representation is coherent with the data from BRICS market (see Appendix A and Figure 1), but is also coherent with the signs given by the international markets. The Dow Jones index peaked in May 2008, as already mentioned earlier, giving strong support to the contagion window chosen. Indeed, the subprime crisis had devastating effects, bursting the global asset bubble and quickly jumped to the stock market. By October 2008 it had already erased around US \$25 trillion from the value of stock markets. At the end of the first quarter of 2009, global market capitalization had already fallen 53% (Chittedi, 2014).

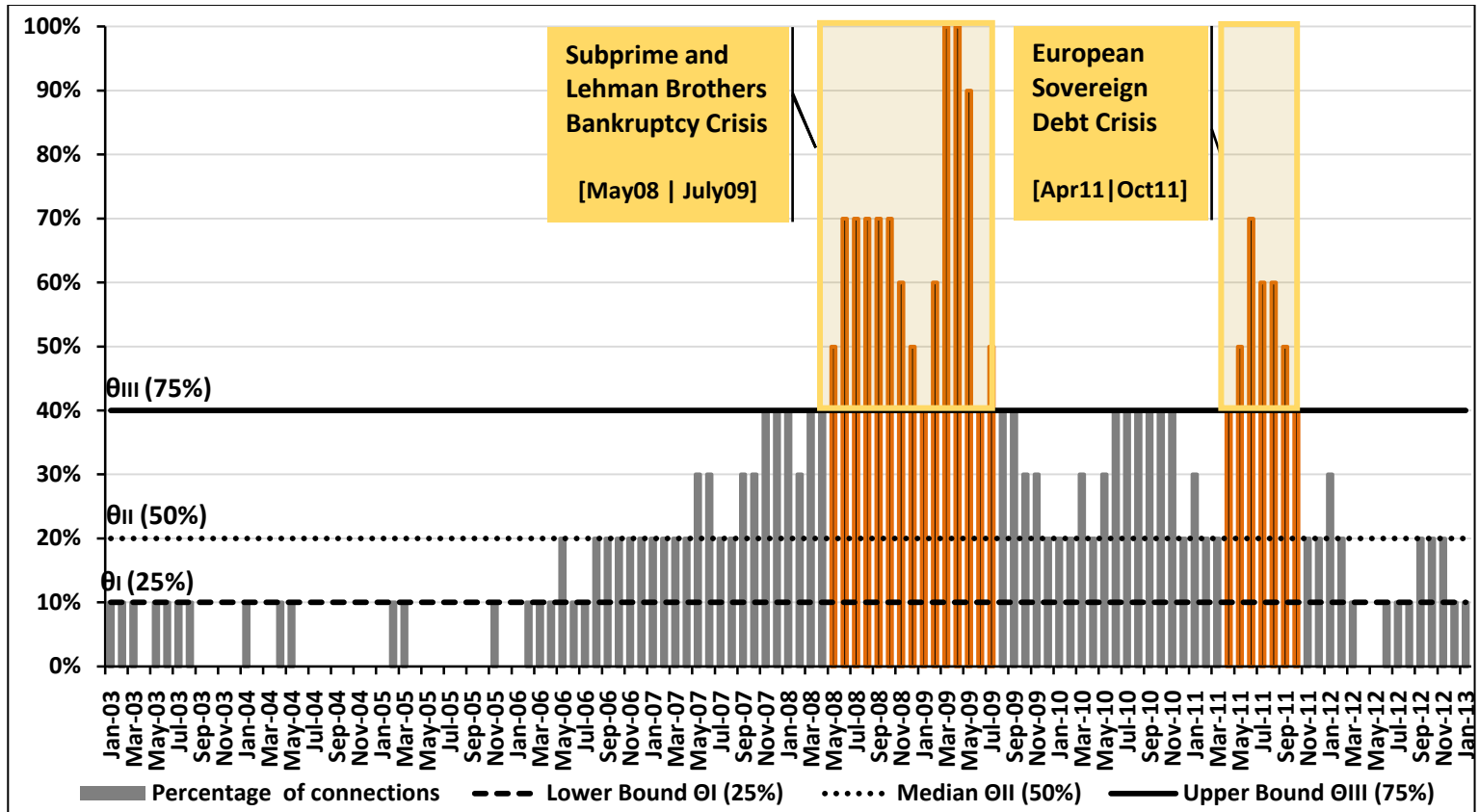


Figure 1. Graphical representation of the contagion window, using stock returns based on the results of the rolling indicator.

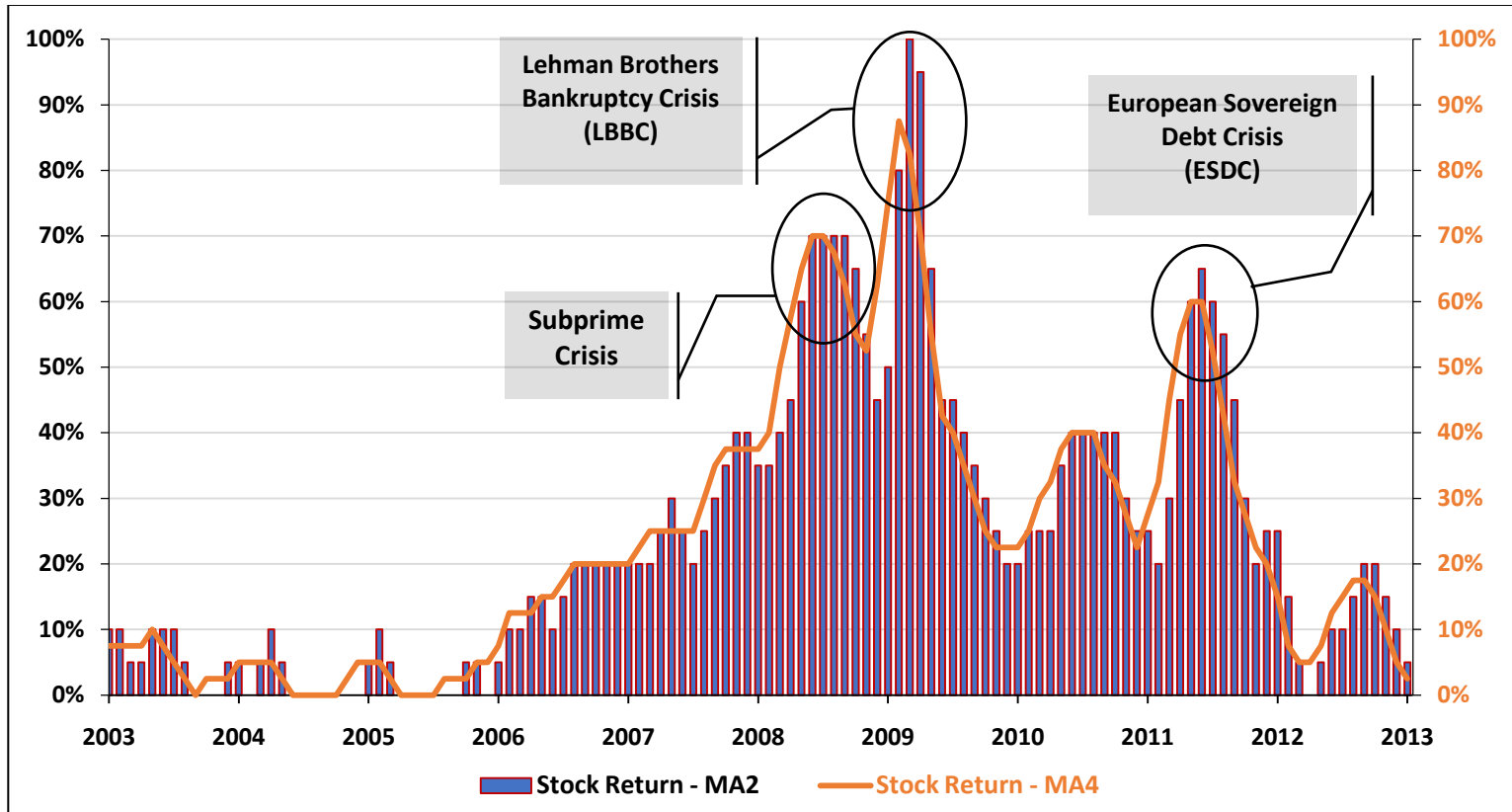


Figure 2. Graphical representation of the percentage of significant connections (rolling indicator), computed by applying a moving average of two months (MA2) and four months (MA4).

The *second contagion window* is related to the European Sovereign Debt Crisis – from April 2011⁴³ to October 2011. In this window, we considered the first and last month that did not pass the III^o quartile because the jump from the previous month was very high (20% higher), showing evidence of contagion (see Figure 1). Therefore, the “*tranquil*” period is defined from August 2009 to March 2011,⁴⁴ lasting 20 months (covering approximately 434 days). In this window, the indicator shows high co-movements in almost the whole period, but they do not grow significantly. Hence, any continued high level of market correlation suggests strong connections that exist in all states of the world, suggesting a situation of interdependence (Gentile & Giordano, 2012).

In Figure 2, we present the total amount of possible relationships obtained from the rolling indicator for the BRICS stock returns. It highlights the differences in the pattern of crisis, making it possible to see the pattern of Subprime Crisis separately from the LBBC by applying a moving average of two and four months.

The intensity of cross-market connections given by the rolling indicator shows a different pattern related to the stock market return, identifying two episodes of contagion. The first one begins around May 2008 and ends around July 2009, including consequently, both the Subprime and Lehman Bankruptcy

⁴³ The date of the sharp jump to the contagion refers to the announcement of the third country (Portugal) asking for a bailout of e78 billion (\$110 billion) from the EU and the IMF (Ray, 2015).

⁴⁴ The “*tranquil*” period defined from August 2009 to March 2011 was a period where the world financial markets were in a very high level of tension. The problems of the Eurozone started to spread across the Union. The global financial markets started to react, and the BRICS stock market was not an exception. In March 2010, the Greek Prime Minister (Papandreou) proposes a new financial package for Greece that includes additional public sector pay cuts and a 2% sales tax increase. On May 2010, IMF and Eurozone leaders agree to a e110 billion (\$143 billion) bailout package for Greece. Portugal starts to show vulnerabilities; the bond yields start to rise together with high volatility in the value of the euro (Ray, 2015). On June 2010, the Euro closes at its lowest rate of exchange against the US dollar since March 2006. In July 2010, the EU releases the results of “*stress tests*” conducted on 91 European financial institutions. The results were very bad; seven institutions did not maintain the minimum amount of capital required by examiners. In September 2010, it becomes known that the cost of bailing out Anglo Irish Bank could reach as much as e34.3 billion (\$46.6 billion). The results elevate Ireland’s budget deficit to 32% of GDP. In November 2010, Ireland’s government officially applies for bailout funds from the EU and the IMF. Embattled Irish Prime Minister Brian Cowen submits a harsh austerity budget and promises to call a general election in 2011. Within a week an e85 billion (\$113 billion) rescue package is approved by European leaders. In April 2010, Portugal’s Prime Minister (Socrates), requests a bailout relief from the EU and the IMF. The volatility in the markets exploded, and the contagion effect starts to spread. In June 2010, Standard & Poor’s downgrades Greece’s credit rating to CCC, turning Greece the world’s lowest-rated sovereign debt (Ray, 2015). The data from BRICS stock market showed that the contagion effect had reached the highest peak in the ESDC indicated by the second contagion window (see Figure 1).

Crisis. The indicator shows that the peak is achieved in March and April 2009, reaching 100% of cross-market linkages as significant (see Figure 1). The second contagion window pointing to the ESDC, from April to October 2009, reaching a peak of cross-market linkages of 70%. This result indicates that the impact in the BRICS economies seems to be weaker and shorter, compared to the first contagion window.

The first part of our research has considered until now just the long-run connections, implying just the slow price adjustment process given by the Johansen cointegration test. However, to verify the presence of a contagion effect, the total number of connections (long-run and short-run) is needed. Hence, the Granger causality test, the second step of our analysis will be applied in the next section.

5.2. Revealing the Contagion Process

In our *second-step* results, we analyze the results arising from the number of cross-market connections related with the “*crisis*” periods and compare them with the “*tranquil*” periods, by applying the cointegration test and the Granger causality test. The bivariate cointegration test allows the identification of connections between pairs of markets which lead to slow price adjustment process (long-run connections). But it is also possible to find the *versus* of each significant connection by applying the Gonzalo-Granger statistic. Furthermore, the Granger causality test identifies connections which have a short-term influence on the price discovery process (short-run connections), as demonstrated by Gentile and Giordano (Gentile & Giordano, 2012, 2013).

The results from both techniques (cointegration test/Gonzalo Granger statistic and Granger causality test), allow the identification of significant cross-market connections and the directions of the relation. Subsequently, by applying the two tests it is possible to establish which countries have a dominant role in the contagion process, because they are able to influence others “*leading countries*”, and which countries are more vulnerable and reactive to other countries’ price innovations “*follower countries*”, as one can see in Table 3. The difference lies in the time horizon of the price adjustment process induced by the existence of cross-market connections, which is the long-run for the connections identified by the bivariate Johansen cointegration test, while the short-run is the connections detected with the Granger causality test. Hence, to comprehend the relationship among markets and equilibrium restoration, the VECM according Gonzalo and Granger(1995) is applied to obtain the coefficients of ECT of speed of

adjustment parameters $[\alpha_1, \alpha_2]$ ⁴⁵ to restore the long-run relationship whenever a disequilibrium situation appears.

Our results determined that in the *first turmoil* – LBBC, that Brazil, China, and South Africa (leading countries) are statistically not significant, which brings to light that these markets are weekly exogenous. However, they are the first to be affected by innovations (excluding Russia and India) and consequently, they are transmitting the shocks to the other markets (follower countries), being responsible for the contagion transmission process. Looking closely at the coefficients of ECT in Table 3, in the long term, a shock in the financial markets (LBBC), impacts the stock market in China⁴⁶ (BRA-CHI(5%)) positively and negatively in India⁴⁷ (for IND(6%)-CHI and IND(7%)-SAF) and China (CHI(15%)-SAF). The information from the long term relationship indicates that under the LBBC, the stock market in China (BRA-CHI(5%)) provided some hedge against the contagion effect from LBBC, while India (IND(6%)-CHI and IND(7%)-SAF) and China (CHI(15%)-SAF) does not provide any hedge (Bianconi et al., 2013, p. 90).

In the *second turmoil* – ESDC, our analysis indicates that Brazil, Russia, China and South Africa (leading countries) are statistically not significant, and consequently, they are all hit by the ESDC in the first moment (excluding India). Furthermore, the innovations from the ESDC affect positively India (BRA-IND(12%)), China (BRA-CHI(16%)) and South Africa (for RUS-SAF(15%)), CHI-SAF(20%)), which means that these countries seem to have a higher level of resilience, providing some hedge against the ESDC. In contrast, India (IND(9%)-SAF) is affected negatively, and consequently, does not provide any kind of hedge.

⁴⁵ For instance, in the case of (IND-SAF) for the LBBC, a positive shock in the pair of markets recover the equilibrium level of the negative values of the ECT's; the VECM is valid since the ECT coefficient is significantly negative. This suggests that the long-run linkages are confirmed by the short-run linkages, suggesting contagion effects, since the ECT coefficient records a rise in magnitude during the instability period, suggesting thus a *shift* in the adjustment speed for the equity markets of these countries. This insight reflects the effects of the LBBC on the linkages between the US stock market and the BRICS markets (Boubaker et al., 2016). Indeed, looking at India stock market (IND-SAF), whenever a disequilibrium arises, then only 7% adjustment takes place in the first day, while the rest is reached in the coming days for India stock market (See Singh & Kaur, 2016). See Table 3.

⁴⁶ In the case of Brazil-China pair of countries, just the coefficient of ECT from China (follower country) is statistically significant.

⁴⁷ In the case of India-China and India-South Africa pair of countries, just the coefficient of ECT from India (follower country) is statistically significant.

Table 3. Results from Cointegration Test/Gonzalo-Granger Statistics

January 2003 to April 2008 - Tranquil period				
Pair of Countries	Gonzalo-Granger Statistic	Speed of Adjustment [α]		Results
		α_1	α_2	Leading/Follower Countries
BRAZIL - INDIA	GGBRA	-0.001675		Leading country
	GGIND		0.011453***	Follower country
May 2008 to July 2009 - Turbulent period: Subprime and Lehman Brothers Crisis				
Pair of Countries	Gonzalo-Granger Statistic	Speed of Adjustment [α]		Results
		α_1	α_2	Leading/Follower Countries
BRAZIL - CHINA	GGBRA	-0.004429		Leading country
	GGCHI		0.044729***	Follower country
INDIA - CHINA	GGIND	-0.056525***		Follower country
	GGCHI		-0.002313	Leading country
INDIA - S. AFRICA	GGIND	-0.069595***		Follower country
	GGSAF		-0.002708	Leading country
CHINA - S. AFRICA	GGCHI	-0.146660***		Follower country
	GGSAF		0.061711	Leading country
August 2009 to March 2011 - Tranquil period				
Pair of Countries	Gonzalo-Granger Statistic	Speed of Adjustment [α]		Results
		α_1	α_2	Leading/Follower Countries
BRAZIL - CHINA	GGBRA	-0.042440**		Follower country
	GGCHI		0.018214	Leading country
April 2011 to October 2011 - Turbulent period: European Sovereign Debt Crisis				
Pair of Countries	Gonzalo-Granger Statistic	Speed of Adjustment [α]		Results
		α_1	α_2	Leading/Follower Countries
BRAZIL - INDIA	GGBRA	-0.024887		Leading country
	GGIND		0.117500***	Follower country
BRAZIL - CHINA	GGBRA	0.015320		Leading country
	GGCHI		0.157903***	Follower country
BRAZIL - S. AFRICA	GGBRA	0.258053***		Leading country
	GGSAF ←		0.237389***	Leading country
RUSSIA - S. AFRICA	GGRUS	0.081265		Leading country
	GGSAF		0.150673***	Follower country
INDIA - S. AFRICA	GGIND	-0.085531*		Follower country
	GGSAF		0.093486	Leading country
CHINA - S. AFRICA	GGCHI	0.023620		Leading country
	GGSAF		0.200972***	Follower country

Notes: The results obtained from the VECM in the context of the Granger causality test, allow the obtainment of the speed of adjustment of the first country (α_1) and second country (α_2) respectively, in other words, the coefficients of error correction terms. [***] indicates the level of significance at 1% level; [**] at 5% level; [*] at 10% level. [←] represents the leading country that makes the greatest contribution to the contagion transmission process by applying the Gonzalo-Granger statistic.

Analyzing the results of long and short connections among the markets, it is possible to notice that Brazil, China and South Africa dominated the stock market during the LBBC as leading countries (May 2008 to July 2009) and the number of cross-markets connections increased sharply from 8 (January 2003 to April 2008) to 12 (May 2008 to July 2009). Thereafter, when the analysis is directed to the ESDC (April 2011 to October 2011), the number of cross-market connections increased from 7 (August 2009 to March 2011) to 10 (April 2011 to October 2011), wherein, China clearly lost the dominant role in the contagion transmission played in the Lehman Crisis.

Regarding Brazil and South Africa, Brazil is the major leading country in the ESDC, playing a dominant role in the contagion transmission structure by influencing Russia, India, China (both short/long-run) and South Africa⁴⁸ stock markets; it is followed by South Africa with much less intensity, playing a leading role in Brazil and India stock markets.

A higher dominant role can be seen in the ESDC for Brazil stock market (now influencing also South Africa, see Appendix B, Table 3 and Figure 3), while for China, the dominant role of influencing other markets diminished clearly. Furthermore, South Africa, which during the LBBC had been able to influence Brazil, India and China stock markets, in the recent ESDC, it was only capable of influencing Brazil and India, losing the dominant role in transmitting contagion to China's stock market.

Regarding the LBBC, it is possible to analyze that Brazil and China were the greatest leading countries in the contagion transmission. In the first crisis, there is evidence of high connections concentrated in the leading countries (Brazil, China and South Africa); while in the second crisis the evidence points towards a dominant role in the contagion transmission mechanism coming strongly from Brazil, with much less intensity from the others. In 2008-09 crisis, Russia and India absorbed shocks without being able to influence other countries (pure follower country), signaling a high degree of vulnerability. In the case of China, this market absorbed shocks but also spread them, while in the case of Brazil, which is a major contributor to the contagion transmission (even in tranquil periods of times), was highly capable of spreading shocks to all other countries (in both crises) and was not influenced by any of them, excepting for South Africa in both crises.

⁴⁸ The result in absolute value did not exceed 0.5 for Brazil (-11, 48). For South Africa, the value (12, 48) exceeded in absolute value 0.5. Therefore, the price of the second asset (South Africa (SAF)), plays a bigger role compared to the first asset (Brazil (BRA)), see Table 3 above.

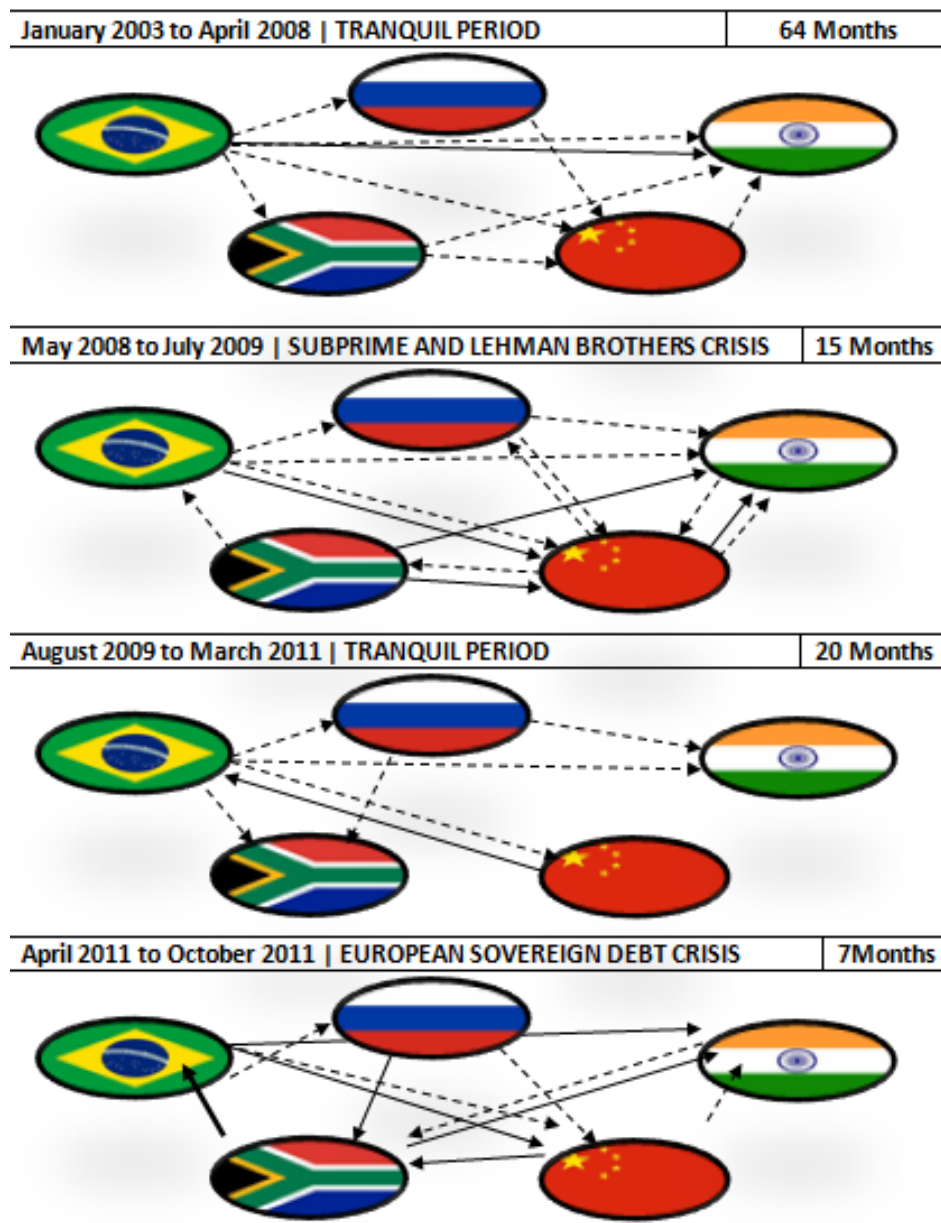


Figure 3. Stock return contagion test: short and long-run connections before and after the crises episodes.

Notes: *Dashed line* represents the short-run connections, *solid line* is used to indicate the long-run connections and the *thick solid line* indicates that both countries contribute to the contagion transmission. Although one country plays a bigger role (*“leading country”*).

Our results also reveal the risk profile of India and China in the LBBC as sharply higher compared to the other countries based on the number of relevant connections. Therefore, the contagion process is mainly related to India and China stock markets. While in the ESDC, the risk profile of India and South Africa is the same but lower than the previous crisis, indicating that the process of contagion is mainly related with these two countries, with Brazil as a major source in spreading the contagion to all BRICS stock markets in both crises. One difference between the two crises studied that clearly emerges, is related to the amount of short-run connections during LBBC (10 short-run connections over 14 total connections) compared to the ESDC (5 short-run connections over 11 total connections). Moreover, it seems that the LBBC is characterized by a strong increase in the number of short-run links, while the ESDC is characterized by a higher level of long-run connections (7 long-run links⁴⁹ over 11 total connections).

The most important result from this analysis is related to the evidence of contagion as opposed to interdependence or spillover. The number of connections detected among countries (in both contagion windows), increased after the “*crisis episodes*” but did not remain at such a high level after the shock. Indeed, the number of connections increased intensively during “*crisis periods*” and then decreased drastically during “*tranquil periods*”. This movement is a critical test to distinguish between contagion and interdependence. As stated earlier in this research, contagion is a significant increase in the co-movement between assets during a period of crisis, compared with a tranquil period. Therefore, if there is a high level of market co-movement in all periods, that is the case of interdependence. As it is possible to see in this research (see Figure 1 and Figure 2), a higher number of connections in the BRICS stock markets which do not hold steady after a shock, returning to the low values once the crisis is gone, is a signal of a temporary distortion of the transmission channels due to shocks – that is contagion, instead of a systematic change in the common economic structure, based on the real or financial links.⁵⁰

5.3. Measuring Countries Degree of Exposure to the Contagion Process

The *last step* is reached by applying the variance decomposition methodology, following Gentile and Giordano (2012, 2013). This methodology allows one to measure of each country’s degree of exposure to the influence of foreign markets, indicating *the rate of involvement in the contagion process*.

⁴⁹ The influence of Brazil over South Africa, even though weaker, was considered (see Table3).

⁵⁰ These theories are usually based on standard transmission mechanisms, such as trade, monetary policy, and common shocks, for example, oil prices (See Gentile & Giordano, 2012, 2013; Kishor & Singh, 2014; Nikkinen et al., 2013).

Furthermore, the results in Table 4 below reveal that South Africa is incredibly more significantly involved in the ESDC compared with its involvement in the LBBC. Indeed, all the BRICS countries exhibited a significant increase in the involvement of the contagion process in the second crisis ESDC. Regarding South Africa, for a time frame of 5 days (short term), the ratio of the forecast error variance (*the rate of involvement indicator*)⁵¹ explained by foreign markets increased from 2.82% (LBBC) to 31.32% (ESDC), making South Africa the most involved country in the contagion process with the highest degree of exposure to external shocks followed by India (from 11.27% to 27.30%), Russia (from 9.21% to 24%), China (from 21% to 31.36%) and Brazil (from 4.87% to 14.26%), with the lower degree of exposure to the contagion process.

Directing the analysis to the two crises considered, the variance decomposition methodology provides an insight about the contagion intensity for the countries in the sample. For instance, during the LBBC, the most involved country in the contagion process was China, the degree of exposure rose (from 12.92% to 21%) after the crisis, much higher than the other countries. Still in the LBBC window, it is interesting to notice that South Africa represented the lowest level of vulnerability (from 9.23% to 2.82%), followed by India (from 11.82% to 11.27%), indicating that these two countries seem to have a strong degree of exogeneity to the system, not being affected essentially by the LBBC compared to the other countries.⁵²

Concerning the ESDC, in the short-term, the most exposed country to external shocks and consequently more vulnerable and involved in the contagion process is South Africa (from 6.52% to 31.32%), followed by Russia (from 9.31% to 24%), India (from 4.52% to 27.30%), Brazil (from 2.08% to 14.26%) and lastly, China (from 24.24% to 31.36%).

Focusing the analysis on the ESDC, our results highlight that South Africa, Russia, India and Brazil are countries more exposed to financial contagion, mostly because of their higher degree of fragility (31.32%, 24%, 27.30% and 14.26%) in the short period, while for the long period the degree of fragility was (59.69%, 51%, 38.45% and 55.82%) for South Africa, Russia, Brazil and India, respectively. Furthermore, China records the worst performance in terms of rise of rate of involvement, mostly because of its high pre-Lehman vulnerability (from 24.24% to

⁵¹ The degree of vulnerability of each country.

⁵² Looking at the long period, for South Africa (from 14.28% to 4.15%), Russia (from 12.17% to 9.44%) and Brazil (from 6.26% to 5.14%) was essentially unaffected in the LBBC, whereas for India (from 14.75% to 17.86%) there was an increase in the vulnerability to external shocks. As regards South Africa, the results indicate that it is even more unaffected compared to the short period.

31.36% for the short period; and from 32.60% to 50.38% for the long period). Comparing both crises in terms of growth rate of vulnerability, the results indicate that South Africa is the most exposed to the financial contagion (28.50% for the short period; and 55.54% for the long period), followed by India (16.03%) and Russia (14.79%) in the short period. In the long period, Russia (41.56%) overtakes India (37.96%), becoming more exposed to the financial contagion than India, followed by Brazil with a growth rate of vulnerability of (33.31%), indicating a large increase in the degree of exposition to external markets in contrast with the short period.

Table 4. Rate of Exposure to the Contagion Process based on the Stock Returns.

Countries	Forecast Horizon (Days)	Tranquil period	Turbulent period	Df ₁	Tranquil period	Turbulent period	Df ₂
		Pre-Lehman Bankruptcy	Lehman Bankruptcy		Pre-Sovereign Debt Crisis	EU Sovereign Debt Crisis	
Brazil	5	2.16	4.87	2.71 ↑	2.08	14.26	12.18 ↑
	10	6.26	5.14	-1.12 ↓	2.26	38.45	36.19 ↑
Russia	5	7.72	9.21	1.49 ↑	9.31	24.00	14.69 ↑
	10	12.17	9.44	-2.73 ↓	13.91	51.00	37.09 ↑
India	5	11.82	11.27	-0.55 ↓	14.52	27.30	12.78 ↑
	10	14.75	17.86	3.11 ↑	19.91	55.82	35.91 ↑
China	5	12.92	21.00	8.08 ↑	24.24	31.36	7.12 ↑
	10	13.42	28.19	14.77 ↑	32.60	50.38	17.78 ↑
S. Africa	5	9.23	2.82	-6.41 ↓	6.52	31.32	24.80 ↑
	10	14.28	4.15	-10.13 ↓	6.40	59.69	53.29 ↑

Notes: The results are presented in percentage and the variance decomposition was computed based on 5 days (short period) and 10 days (long period) forecast horizon. Table 4 indicates the rate of involvement indicator $[1 - W_i(i)]$, measuring the degree of vulnerability of country i (each country's stock market) explained by innovations in all other countries, working as a measure of country's exposure to the external shocks (see Web Appendix B.3). [Df₁] represents the difference between tranquil and turbulent period in the Lehman Crisis. [Df₂] represents the difference between tranquil and turbulent period in the Sovereign Debt Crisis. For the results of each country's contribution to the contagion process individually.

6. Conclusion

Our research contributes to a better understanding of the contagion phenomenon by analyzing the changes in cross-market connections for the BRICS stock markets. The application of VECM cointegration/Granger causality

methodology detected contagion measuring shifts in the shocks transmission channels caused by the creation of new long-run equilibrium together with the raising of new short-run connections, by analyzing changes in the long/short-run connections in both contagion windows (LBBC and ESDC).

Our findings reveal that there was evidence of contagion in both crises, given that the number of cross-market connections increased sharply after such crises events occurred and reduced afterwards. Moreover, new long-run relationship between BRICS markets was created, causing a deterioration of the diversification benefits in both crises compared to the tranquil times (see Summary of the Results, Appendix C).

In the last decades, the BRICS countries underwent an important process of trade and financial liberalization to benefit from the advantages of market integration. Therefore, integrated financial markets allow, investors to allocate consumption risk more efficiently, decreasing the costs of capital faced by firms and stimulating investment and economic growth. However, an increased financial integration has intensified contagion effects across markets, causing severe welfare losses for large geographical regions and facilitating the transmission of international shocks to domestic stock markets. The consequences have important implications for the decisions of investors', regulatory and monetary authorities and for the effective portfolio diversification (Zouhair et al., 2014). Indicating that the effects of contagion in the BRICS markets can change investors' behavior, leading to high correlations and financial instability in the markets, which can cause phenomena like "*fight-to-quality*", "*heard behavior*" and "*bandwagon*" effects⁵³ may arise (Gentile & Giordano, 2012; Kazi & Wagan, 2014).

Evidence from the impact caused by both crises in the BRICS stock markets also provides meaningful insights pertinent to international asset pricing, risk management and the dynamic interactions in the global economy. For instance, gold's ability to act as a safe haven in the case of South Africa may have financial implications regarding the presence of diversification opportunities during extreme market conditions. With the "*financialization*" of the commodity markets, gold and oil can provide further protection against losses when the traditional assets (equities and bonds) experience large declines. Hence, including BRICS commodities in traditional portfolios, allow investors to avoid the downside risk in their investments. Gold can also provide protection against dollar

⁵³ A way of thinking in group, in which investor's probability of adopting any belief increases with the proportion who have already done so. Hence, investors do not discriminate among economic fundamentals across countries.

devaluations (Mensi et al., 2014). This research is also particularly helpful for portfolio risk managers, energy traders, policymakers and international investors who should be cautious about making investments in simultaneous markets that exhibit *pure* contagion. Knowledge of the dependencies between BRICS markets is crucial for policymakers to help them discern the directions of the co-movements and to safe guard the BRICS stock markets from contagion during future crises or major events.

Understanding the reasons of financial contagion between BRICS and international stock markets can help policymakers to develop a prevailing financial system to make BRICS markets more immune to international shock transmission, limiting their exposure to the contagion effects by improving stock market liquidity, as the BRICS markets increasingly become more integrated with the international markets.

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APPENDICES

Appendix - A: Movement of BRICS and USA stock market

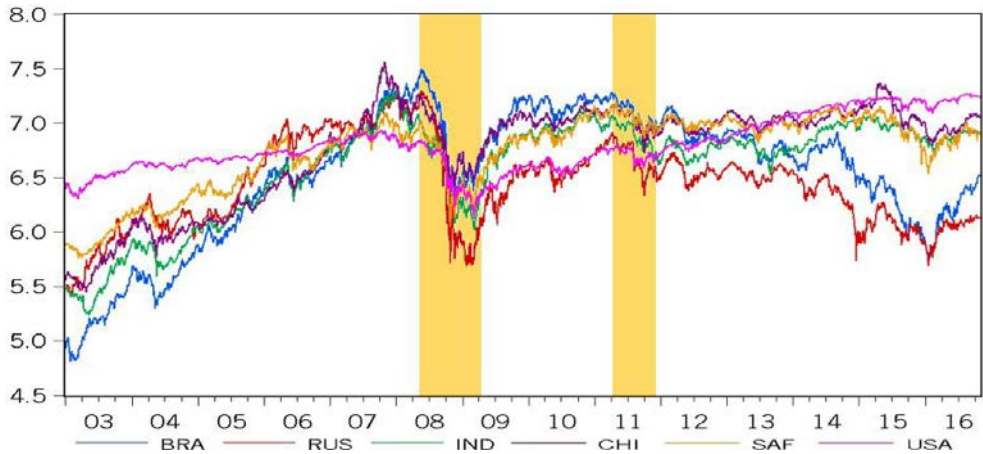


Figure A1. Movement of BRICS and USA stock market

Notes: Indices for full sample in daily log-level from January 1, 2003 to October 31, 2016 (13 years and 10 months, 3609 observations). The Highlighted first shadow refers to the period of the GFC 2007-2008 and the second shadow period refers to the European Sovereign Debt Crisis started in 2011 that will be studied in this research as a contagion window. The source is the author's own, generated using EVIEWS 9.0 program.

Appendix - B: BRICS significant long/short-run connections

January 2003 to April 2008 - TRANQUIL PERIOD											64 Months	
Leading	Brazil ↓		Russia ↓		India ↓		China ↓		S. Africa ↓		Total	
Follower	L	S	L	S	L	S	L	S	L	S		
Brazil	-	-	-	-	-	-	-	-	-	-	-	0
Russia	-	25.32237***	-	-	-	-	-	-	-	-	-	1
India	17.31886**	24.05892***	-	-	-	-	-	19.78111***	-	19.48169***	-	3
China	-	82.19540***	-	15.84963***	-	-	-	-	-	-	34.70646***	3
S.Africa	-	22.47240***	-	-	-	-	-	-	-	-	-	1
Total	4		1		0		1		2			8
May 2008 to July 2009 - SUBPRIME AND LEHMAN BROTHERS CRISIS											15 Months	
Leading	Brazil ↓		Russia ↓		India ↓		China ↓		S. Africa ↓		Total	
Follower	L	S	L	S	L	S	L	S	L	S		
Brazil	-	-	-	-	-	-	-	-	-	5.140423*	-	1
Russia	-	8.971141**	-	-	-	-	-	6.109858**	-	-	-	2
India	-	11.05739***	-	6.185956**	-	-	19.49457**	13.01904**	20.04872***	-	-	4
China	20.23250***	6.795994*	-	6.575766**	-	16.81226***	-	-	30.33040***	-	-	4
S.Africa	-	-	-	-	-	-	-	7.534769*	-	-	-	1
Total	3		2		1		3		3			12
August 2009 to March 2011 - TRANQUIL PERIOD											20 Months	
Leading	Brazil ↓		Russia ↓		India ↓		China ↓		S. Africa ↓		Total	
Follower	L	S	L	S	L	S	L	S	L	S		
Brazil	-	-	-	-	-	-	20.76682***	-	-	-	-	1
Russia	-	14.12754***	-	-	-	-	-	-	-	-	-	1
India	-	10.58508**	-	11.07829**	-	-	-	-	-	-	-	2
China	-	26.93599***	-	-	-	-	-	-	-	-	-	1
S.Africa	-	10.57669*	-	17.87384***	-	-	-	-	-	-	-	2
Total	4		2		0		1		0			7
April 2011 to October 2011 - EUROPEAN SOVEREIGN DEBT CRISIS											7Months	
Leading	Brazil ↓		Russia ↓		India ↓		China ↓		S. Africa ↓		Total	
Follower	L	S	L	S	L	S	L	S	L	S		
Brazil	-	-	-	-	-	-	-	-	23.57002**	-	-	1
Russia	-	13.02791***	-	-	-	-	-	-	-	-	-	1
India	19.62523**	-	-	-	-	-	-	4.862423*	15.79387**	-	-	3
China	17.52990**	8.602761**	-	10.18745***	-	-	-	-	-	-	-	2
S.Africa	-	-	15.79805**	-	-	6.371144*	16.42875**	-	-	-	-	3
Total	3		2		1		2		2			10

Notes: The table represents the long-run (L = long-term relation extract from the bivariate cointegration test). The values represented for the long-term are from Johansen cointegration statistic. Regarding the short-run (S = short-term relation detected applying the Granger causality test). The values presented is based on the Chi-square value statistic [χ^2]. [***] indicates rejection of the null hypothesis of no long-run or short-run relationship at 1% level; [**] at 5% level; [*] at 10% level. [#] represents the influence from one country to other countries. The number in bold identifies that both countries contribute to the contagion transmission process. Therefore, by applying Gonzalo-Granger statistic $\left[\frac{\alpha_2}{(\alpha_2 - \alpha_1)} \right]$, it is possible to establish which country makes the greatest contribution to the contagion transmission process. For instance, South Africa (in bold) contributes more to the contagion transmission than Brazil. Hence, South Africa plays a leading role in the contagion transmission. [-] indicates no significant connections among couple of countries from BRICS stock markets.

Appendix - C: Summary of the Results

The main results obtained in our research and summarized in Table C1, corroborate with the discovery of more short-run than long-run connections. Indeed, short connections are higher due to the nature of equity prices – shorter-term and more responsive, responding faster to shocks (Fourie and Botha, 2015). Therefore, in the short-run the domestic and global destabilizing factors cause varying levels of vulnerability in the BRICS stock market and price movements. These disturbances are temporary in nature since the variables revert to their equilibrating process to maintain the long-run co-movements. One adverse effect of such disparity is that it could possibly create arbitrage opportunities and short term speculative gains (Visalakshmi and Lakshmi, 2016). Another interesting feature regards Brazil. This country plays a major role in both crises as a leading country, serving as a channel of transmission and spreading the contagion effect to all other countries. Even in tranquil periods, its links are strong among the other BRICS countries. Another surprising finding pertains to South Africa, the smaller country among BRICS, but the only one connected with and capable of influencing Brazil in both contagion windows.⁵⁴

Table C1. Summary Results from Three-step Methodology in both Crises.

Sbprime Lehman Brothers Bankruptcy Crisis <i>2008-05-01 - 2009-07-31: 15 Months</i>	European Sovereign Debt Crisis <i>2011-04-01 - 2011-10-31: 7 Months</i>
Contagion Evidence: The number of cross-market connections has largely increased between the tranquil and the turbulent pe-riod: there is evidence of a contagion process.	Contagion Evidence: The number of cross-market connections has largely increased between the tranquil and the turbulent pe-riod: there is evidence of a contagion process.
Direction of Contagion: Brazil, China and South Africa dominated the stock market, playing a leading role in the transmission mechanism. South Africa was able to lead two major countries, India and China. Nevertheless, China was connected and influenced by all other countries to-gether with India, whereas Brazil was just connected with South Africa. India and Russia are considered pure follower countries.	Direction of Contagion: Brazil plays a major role in the contagion transmis- sion, being able to influence all other countries fol- lowed by far by South Africa, playing a leading role in the transmission mechanism. China has lost its leading role in the shock transmission mechanism. India (as a pure follower country) and South Africa were the most influenced by other countries.
Contagion Process: Exposure to External Shocks: China was the most exposed country in the Lehman Crisis both in the short period and in the long pe-riod. In the case of South Africa, the results revealed that this country is strongly not exposed, neither in the short period nor in the long period, revealing a high degree of exogeneity to the system. India also presents a weak degree of exposure in the short pe-riod, but was affected in the long period. Brazil and Russia in contrast, show an increase in the degree of exposure in the short period but in the long period, they present a lower rate of vulnerability.	Contagion Process: Exposure to External Shocks: All countries are highly involved, becoming more ex- posed to the financial contagion. South Africa is the most exposed country in this crisis with the highest degree of fragility. Brazil, Russia and India, show al- most the same rise in the rate of involvement both in the short and long period, indicating a high degree of exposure to external markets and consequently, increasing domestic risk explained by innovations in foreign countries. Nevertheless, China seems to have the lower rate of vulnerability, comparing to the other BRICS countries.

⁵⁴ South Africa has the most developed and opened financial market among BRICS countries with rapid financial market development and sophistication, being globally well recognized as a source possessing sophisticated professional services and financial expertise (see Liu et al. 2013; Zhang et al. 2013). This financial influence is capable of transmitting financial shocks in great degree and magnitude to the other BRICS countries (Bonga-Bonga 2015).



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Impact of Health Care Employees' Job Satisfaction on Organizational Performance Support Vector Machine Approach

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Abstract

This study is undertaken to search for key factors that contribute to job satisfaction among health care workers, and also to determine the impact of these underlying dimensions of employee satisfaction on organizational performance. Exploratory Factor Analysis (EFA) is applied to initially uncover the key factors, and then, in the next stage of analysis, a popular data mining technique, Support Vector Machine (SVM) is employed on a sample of 249 to determine the impact of job satisfaction factors on organizational performance. According to the proposed model, the main factors are revealed to be management's attitude, pay/reward, job security and colleagues.

Keywords: *Job Satisfaction; Health Care Workers; Support Vector Machine (SVM)*

JEL Classification: J28, J54, J59, J81.

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1. Introduction

The shortage of health care employees in Turkey, particularly in the fields of nursing and doctoral care, as well as forecasted increases in required healthcare services have attracted increasing attention in hopes of discovering important and necessary strategies for improving job satisfaction and developing ways to retain current personnel. Job satisfaction is an essential measurement for managers as well as for policy makers.

Although the definition of job satisfaction is not clear, it remains a primary factor in achieving an excellent system (Huber, 2000). Developing a high level of commitment among nurses is one of the main human resource department policies. Shared values, including vocational commitment towards patient care and nursing are factors that influence nurses positively (McCabe, 2008). Other important factors include strong leadership, teamwork and support. Nurses acknowledge that training and development factors are important factors in health care delivery.

As noted above, there is currently a huge shortage of health care employees in Turkey. Focusing on the job satisfaction issues of these employees can be a constructive strategy to increase retention of current personnel, as well as to attract qualified professionals.

Since they play a significant role in social life, the responsibility of health care institutions for public health cannot be underestimated. The productive use of personnel can improve the performance of employees as well as increase job satisfaction. Medical care is a service industry that differs from others because of its work requirements, which encompass and combine many talents with a variety of necessary and important expertise (Fang et al, 2009). This study focuses on the empirical point of view between job satisfaction and organizational performance.

2. Literature

The definition of job satisfaction is open-ended, with many versions presented in the literature. There is no one universal definition for "*job satisfaction*", since it refers to general as well as to specific work satisfaction. The specificities include intrinsic and extrinsic satisfactions. It is a multi-dimensional concept that has been linked to various job aspects (Anderson, 1984). Assessing the nature of job tasks is considered to be intrinsic job satisfaction whereas assessing external issues to the job task, i.e. benefits, bonuses and salary is viewed as extrinsic (Hirschfeld, 2000). Spector (1997) defines job satisfaction as

"the extent to which people like (satisfaction) or dislike (dissatisfaction) their jobs". Herzberg (1968) described two factor theories: *"hygiene"* factors and *"motivators"*. Extrinsic factors such as administration, company strategies, work conditions, salary, and relationships among co-workers are considered *"hygiene"* factors which can cause job dissatisfaction. Intrinsic factors such as recognition, achievement, personal development, advancement, and responsibility are referred to as *"motivators"* that can create job satisfaction. Previous studies have shown that there are various factors explaining job satisfaction because it cannot be associated solely with one factor (Blegen, 1993).

There are complex problems in health care such as growing demand and the cost of providing it, as well as patients' expectations. Solutions to these problems are difficult to find. The concept of "quality" in health care has been introduced (Ruiz-Lopez, 2001) because of the many requirements for excellence. *"Satisfaction"*, therefore, becomes a necessary additional qualifier or indicator of quality (Una Cidon et al., 2012).

Since job satisfaction has a multifaceted structure, it is linked to organizational commitment (Alpander, 1990; Curry, et al., 1986; Knoop, 1995; Lum et al., 1998), and the relationship between satisfaction and organizational commitment is considered to be particularly important.

The concept of motivation is studied in the early 1950's (Herzberg et al. 1959; Vroom, 1964) from the managerial point of view. These early studies discuss thoroughly the factors that motivate people in their work environment. To improve health care practices, management units should provide a suitable environment for workers that characteristically links to job satisfaction, motivation and any other desired outcomes (Vilma and Egle, 2007). There are various factors affecting motivation such as general job satisfaction, salary, promotion, organization and educational background (Tzeng, 2002; Davidhizar, 2004). Rewards and incentives may be insufficient when employees are encouraged to pursue external objectives (Herzberg et al., 1959; Deci and Ryan, 1985). This creates the necessity to look for other significant factors that contribute to employee satisfaction.

Some studies suggest that a supportive learning and working environment is the most crucial factor for job satisfaction, especially in the field of nursing (Jang et al. 2005; Kangas, et al. 1999; Brooks-Carthon, et al. 2011). An ageing population with an increasing number of patients suffering from chronic diseases is included in the factors affecting work environments negatively, resulting in dissatisfied employees. To improve the environment and prevent persistent employee dissatisfaction, Richer et al. (2009) suggest *"appreciative inquiry"* to create radical

changes. Knowles (1990) reports that a supportive learning environment is considered to be a critical of human resource development, and he acknowledges the need for the development of individual workers through improvements to the educational aspect.

The interaction between job satisfaction (or dissatisfaction) and personnel management is considered (Kokkinene et al., 2007; Ali and Mohammad, 2006), showing that this is essential for organizations, and good management of employees is therefore important. At the same time, shortcomings in personnel management may create dissatisfaction among employees (Newman et al., 2002).

Other studies have shown that low wages coupled with lack of pension programs and insurance are often connected to low levels of job satisfaction (Case et al. 2002; Harris-Kojetin et al. 2004). Kirpal (2004) points out the policy makers' responsibility in terms of potential negative effects as well as work identity by looking at workers in the current system from a qualitative point of view. He places emphasis on the fact that work identity is changing and moving towards a more flexible, more highly skilled and mobile workforce. Job satisfaction and dissatisfaction are related to staff turnover and the mobility of the health care sector. It is therefore vital to be aware that increasing workloads and low payment are connected to the dissatisfaction of employees.

Work environment is another significant factor affecting job satisfaction. The influence of hospital units in terms of whether they are open or closed has a profound impact. Employees working in open units tend to be less satisfied with their work in general and experience problems, both with their colleagues and management. On the other hand, employees who work in closed units generally tend to be more satisfied with their work, have better relations with their colleagues and also have positive cooperative relations with management (Khokher, et al. 2009).

Turnover intention is another key issue within the health care system. It is common knowledge that satisfied staffs are less inclined to seek new employment, which verifies that job satisfaction profoundly impacts an individual's desire to change jobs (Chiu et al. 2005). Williams et al. (2001) discover a link between job satisfaction and turnover intention in their research. While there are some preemptive attempts and approaches to help reduce the turnover rate by improving motivation for employees, it remains, nonetheless, an enormous challenge. Under these circumstances, reducing the turnover rate as well as attempting to implement creative ways to attract new employees is challenging in view of the current shortage of health care workers. Lum (1998) and Williams et al. (2001) address the importance of job satisfaction in relation to

job turnover, while the research of Lue et al. (2005) support the thesis that job satisfaction is a key factor influencing turnover.

The administrative contribution to health care is not underestimated (Clegg, 2000); the impact of managerial responsibility has been singled out in several studies (Bolton, 2005; du Gay, 1996). Wise (2007) emphasizes the pivotal role managers' play in terms of reinventing healthcare roles and services. As well, she addressed the factors of reward and recognition together with sufficient wages provided to workers as the major starting points. Apart from the issue of pay, practical support, time and resources need to be made available. It is evident that good management in health care can be very challenging. As well, Wise (2007) points out that management style very much affects job satisfaction.

There are many studies focused on the various factors comprising job satisfaction. The impact of social capital is one such factor. The research done by Ommen et al. (2009) demonstrates that the social capital of an organization is a significant predictor of overall job satisfaction for physicians. As well, their investigation reveals that workload and professional experience are key factors underlying job satisfaction. It is desirable that colleagues in the health care system exhibit certain qualities, among them trust, mutual understanding, common goals, and ethical values. These expressed characteristics create an atmosphere that encourages employees to work cooperatively.

Job satisfaction has been linked to personal (Kaplow, 1996; Bergmann et al., 1996; Blegen, 1993) as well as organizational factors (Walsh, 1999; Adams and Parrott, 1994; Lankau, 1997). The relationship between job satisfaction and various factors has been previously studied. Kavanaugh et al (2006) examine the connection between job satisfaction and demographic predictors such as previous job experience. They demonstrate that professional experience impacts job satisfaction significantly. The study also reveals that age, education and race have little effect on job satisfaction. As well, gender, functional grouping, and hospital tenure did not impact job satisfaction significantly.

Work environment is another factor affecting job satisfaction. Organizational culture has a positive impact on job satisfaction, and organizational culture combined with the work environment is strongly related. Gifford et al. (2002) show that organizational culture is a powerful attribute affecting work environment. In an organization where employees share positive interaction, and meet personal satisfaction as well as organizational goals, a constructive organizational culture might help to develop job satisfaction and establish a positive working environment (Mulcahy and Betts, 2005).

Interpersonal relationships between employees are considered by several researchers. Adam and Bond (2000) discover that human relationships are the best predictors of job satisfaction, and that job satisfaction is significantly predicted by professional relationships in the work environment. Likewise, Dunn et al. (2005) identify the fact that relationships among nursing staff is the single most important factor for building job satisfaction, contributing to high-quality patient care. As a result of this research, McNeese-Smith (1999) declares that a good relationship between nurses coupled with collaboration with health care staff in general is an essential ingredient for job satisfaction.

Job satisfaction and performance has been studied from differing points of view. It has been generally believed for some time that creating a positive working environment for employees affects productivity as well as the happiness of the workers. However, this view has been questioned in recent years. There is no conclusive evidence confirming that a happy person is a productive employee. There are studies showing conflicting results concerning the relationship between job satisfaction and performance. Packard and Motowidlo (1987) study job performance and satisfaction among hospital nurses, coming to the conclusion that job satisfaction and job performance is not correlated. Their controversial remarks concerning the relationship between job satisfaction and performance are supported by empirical results. To the contrary, Al Ahmadi (2008) investigates the factors influencing nursing performance. He discovers that job performance is strongly correlated with job satisfaction and organizational commitment. Furthermore, Fang et al. (2009) attempt to determine the effect of leadership upon employee job satisfaction, work performance and organizational commitment as well as the relationship between these variables. They discover that work satisfaction has a significant, positive and direct effect on work performance and organizational commitment.

There are few studies focusing on the impact of job satisfaction dimensions on organizational performance in the health care system. My research reveals that the relationship between job satisfaction and organizational performance has not yet been widely investigated.

3. Research Methodology

3.1. Support Vector Machine (SVM)

The Support Vector Machine (SVM), originally developed by Vapnik (Vapnik, 1995), is one of the most robust and accurate methods in data mining algorithms. Its theoretical foundation is derived from statistical learning theories, but it differs in that it combines statistical methods with machine learning methods.

SVM is a supervised learning method that generates input-output mapping functions from a set of training data. Basically, SVM learns through observation. There is an input space, an output space, and a training set. The nature of the output space determines the learning type, for example, binary or multiple classification problems. The standard SVM formulation solves only the binary classification problems.

SVM maps data into a high dimensional feature space. The mapping functions can be set to be either classification or regression. SVM belongs to the family of maximal margin classifiers. There are four kernel functions (linear, polynomial, radial-based and sigmoid) that can be used to solve classification problems when input data cannot be easily separated. To separate the input data easily, the kernel functions are used to transform the input data into high dimensional feature space.

The aim of SVM is to find the optimal hyperplane that separates clusters of vectors in such a way that cases with one category of the target variable are on one side of the plane, and cases in the other category are on the other side. The vectors near the hyperplane are the support vectors. A separator, drawn as a hyperplane, is placed between the two separated classes. The ultimate aim of SVM is to establish a maximal margin between the separated classes (Figure 1). This offers good classification performance on the training data, and also provides high predictive accuracy for future data from the same distribution. The characteristics of new data after separation can be used for prediction. Since SVM's learning ability is independent of the dimensionality of the future space, it provides good performance (Cristianini and Shawe, 2000).

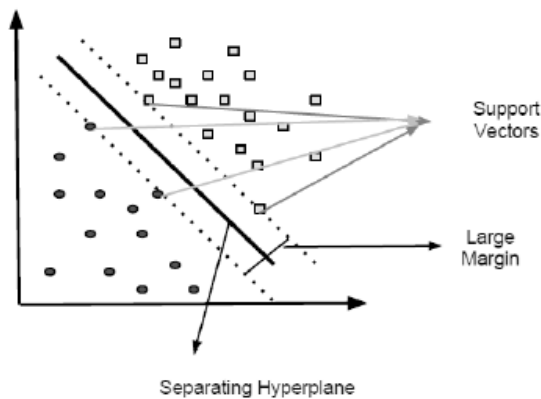


Figure 1. Illustration of Support Vector Machine (SVM)

3.2. Survey Instrument

A cross sectional on-line survey is conducted between June, 2011 and December, 2011. The data for the study is gathered by using a self-administered questionnaire pertaining to employee satisfaction, demographic variables and organizational performance. Respondents are asked to indicate their level of agreement based on five-point Likert scales ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The survey constructs (e.g. employee satisfaction and organizational performance) are based on Zaim and Zaim's (2007) measure of employee satisfaction and organizational performance. Demographic information, such as age, gender, and experience are collected. The participants are asked to rate their perception of satisfaction with their job and their perception of organizational performance.

3.3. Sample Description

The cross-sectional online questionnaire is posted to 600 employees; out of whom 260 questionnaires are returned. Eleven of these returned questionnaires are eliminated. As a result, the response rate is almost 42%. A total of 249 health care workers are surveyed, using 44 items to assess demographic variables, employee satisfaction and job performance. The sample comprises workers with different levels of experience and education. The key demographic variables are gender, age, marital status, number of years in their profession, education and number of years working in a health care setting. As seen in Table 1, the gender level is distributed evenly. The majority of respondents are between 30 and 40 years old (53.01%); with only 3% over 50. 64% of the respondents are married, and almost 36% are single. Among the respondents, post graduate degree holders

comprise almost 55.4%, while 29.3% holds an undergraduate degree. The high school, college and PhD degree holders comprise a very small proportion of the total. 27.71% of the respondents have between 6 to 10 years' experience in health care, and 11.24% of respondents have more than 20 years. Almost 46% of these employees are nurses, while 32.93% are practitioners and 21.29% are administrative personnel.

Table 1. Demographic Data of Respondents

	Number	Percent
Gender		
<i>Male</i>	126	50.6
<i>Female</i>	213	49.4
Age		
<i>Less than 30 years</i>	71	28.51
<i>31-40</i>	132	53.01
<i>41-50</i>	43	17.27
<i>51 years or more</i>	3	1.21
Marital Status		
<i>Single</i>	89	35.7
<i>Married</i>	160	64.3
Education		
<i>High School</i>	12	4.82
<i>College</i>	11	4.42
<i>Undergrad</i>	73	29.32
<i>Master</i>	138	55.42
<i>Ph.D</i>	15	6.02
Experience		
<i>Less than 5 years</i>	57	22.89
<i>6-10 years</i>	69	27.71
<i>11-15 years</i>	43	21.29
<i>16-20 years</i>	42	16.87
<i>20 years or more</i>	28	11.24
Number of years working in health care setting		
<i>Less than 5 years</i>	73	29.32
<i>6-10 years</i>	72	28.92
<i>11-15 years</i>	46	18.47
<i>16-20 years</i>	34	13.65
<i>20 years or more</i>	24	9.64
Profession		
<i>Nurses</i>	114	45.78
<i>Practitioners</i>	82	32.93
<i>Administrative</i>	53	21.29

4. Analysis and Findings

4.1. Exploratory Factor Analysis (EFA)

Before carrying out decision tree models, a principal component factor analysis is used through SPSS for Windows. In order to extract the dimensions and to test the validity and reliability of the analysis, the exploratory factor analysis and Cronbach's alpha for internal consistency are employed to determine the satisfaction of the employees' items. Varimax orthogonal rotation is carried out during the EFA procedure. Manageable and meaningful factors contributed to the decision tree models in order to determine the impact of factors on organization performance. There is no missing data found in the survey.

It is vital to determine the suitability of the data size before factor analysis. Both the KMO (Kaiser-Meyer-Olkin measure of sampling adequacy) Index and Bartlett's Test of Sphericity are used to check the adequacy of sample size. KMO represents the ratio of the squared correlation between variables to the squared partial correlation between variables. The values of KMO range between 0 and 1. Any value close to 1 shows that the patterns of correlation are compact, and therefore the analysis should result in distinct and reliable factors (Field, 2005). According to Kaiser (1974), KMO values between 0.7 and 0.8 are good; values between 0.8 and 0.9 are great; and values above 0.9 are superb.

The sample size of the data set in this study is adequate for use in factor analysis according to KMO test results, since the KMO Index value is 0.934 (Table 2), which is superb. In addition, Bartlett's Test of Sphericity signifies whether the R-matrix is an identity matrix. It should be significant at $p < 0.05$, and it determines whether the population correlation matrix resembles an identity matrix. If there is an identity matrix, every variable correlates poorly with all the other variables, which means correlation coefficients are close to zero, leaving them perfectly independent from each other. In factor analysis, clusters of variables that measure similar things are identified. To determine clusters, the variables should correlate. Therefore, the test provides statistical analysis to prove that the matrix has significant correlations among the variables (Field, 2005). Bartlett's Test of Sphericity demonstrated that it is a highly significant $p < 0.000$. This indicates that the correlation coefficient matrix is not an identity matrix. Accordingly, the data used in this study is quite sufficient for exploratory factor analysis procedures.

Table 2. KMO and Bartlett's Test results

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.9340
Bartlett's Test of Sphericity	<i>Approx. Chi-Square</i>	5307.537
	<i>df</i>	276
	<i>Sig.</i>	0.0000

The beginning of the factor extraction process is designed to determine the linear components (eigenvectors) within the data sets by calculating the eigenvalues of the correlation coefficient matrix. The largest eigenvalue associated with each of the eigenvectors provides a single indicator of the substantive importance of each component. Factors with relatively large eigenvalues are retained, while those factors with relatively small eigenvalues are omitted. SPSS uses Kaiser's criterion of retaining factors with eigenvalues greater than 1. Table 3 lists the eigenvalues associated with each component (factor). There are 24 components, which correlate with 24 eigenvectors. It is obvious that the first four factors explain relatively large amounts of variance, whereas the rest of the factors explain only small amounts of variance. SPSS by default extracts all factors with eigenvalues greater than 1, which leaves us with four main factors.

Table 3. Total Variance Explained by Initial Eigen Values

Initial Eigen Values							
Component	Total	% of Variance	Cumulative %	Component	Total	% of Variance	Cumulative %
1	11.753	48.971	48.971	13	0.317	1.321	91.767
2	3.068	12.785	61.756	14	0.291	1.214	92.981
3	1.548	6.451	68.207	15	0.272	1.134	94.115
4	1.36	5.668	73.875	16	0.234	0.975	95.09
5	0.694	2.891	76.766	17	0.208	0.867	95.957
6	0.64	2.669	79.434	18	0.187	0.78	96.736
7	0.566	2.358	81.792	19	0.157	0.656	97.392
8	0.505	2.104	83.896	20	0.151	0.628	98.02
9	0.439	1.829	85.725	21	0.14	0.584	98.604
10	0.433	1.805	87.53	22	0.135	0.564	99.167
11	0.351	1.461	88.991	23	0.104	0.434	99.602
12	0.349	1.454	90.445	24	0.096	0.398	100

Table 4 shows the factor loadings and communalities. Communality is the proportion of common variance within a variable. After the factors are extracted, how much variance is in common can be seen under communalities. In other words, the amount of variance in each variable that can be explained by the retained factors is represented by the communalities after extraction (Field, 2005).

Table 4 also demonstrates the factor loadings and necessary quality indicators such as eigenvalues. 24 variables of exploratory factor analysis results indicated that these factors explain 73.8% of the total variance. Varimax orthogonal rotation of the factor structure clarifies the matrix considerably. The suppression of loadings is set to 0.4, to help make the interpretation of factors easier. Based on the items loading on each factor, they are labeled as "*management's attitude (factor 1)*", "*pay/reward (factor 2)*", "*colleagues (factor 3)*", and "*job security (factor 4)*".

After extracting the underlying factors, reliability analysis is used to measure the consistency of the questionnaire used in this study. Cronbach's alpha is the most commonly used measure of scale reliability, and that is the reason it is employed. In this study, there are multiple factors extracted from the given data set. Therefore, Cronbach (1951) suggests that alpha should be applied separately to each subscale when several factors exist. Table 5 shows the internal consistency reliability estimates (Cronbach's alpha) for each dimension. The Cronbach's alpha value for each extracted factor ranged from 0.772 to 0.945 which demonstrated a satisfactory level of construct reliability (Kline, 1999).

Table 4. Varimax Rotated Factor Loading Matrix

Items	Components				
	Factor1 Management's attitude	Factor2 Pay/reward	Factor3 Col- leagues	Factor4 Job security	Communalities
Administrators help me to do my job better	0.791				0.760
I can get feedback from my managers (negative or positive)	0.769				0.767
Administrators warn us without threatening when we make mistakes	0.747				0.649
I believe that my managers encourage me in terms of working better	0.732				0.800
We can reach people we need (including administrators) at any time	0.709				0.628
I respect my administrators in general	0.705				0.627
My organization has provided the necessary education opportunities to do my job properly	0.691				0.648
I am pleased with my organization	0.632				0.676
I believe that my organization values me	0.619				0.613
I recommend my organization to my friends as well	0.619				0.753
In general, I am satisfied with premiums and bonuses		0.838			0.766
I am satisfied with my salary		0.823			0.736
I am satisfied with the social benefits (education, health, rents, etc.) that my organization provides		0.794			0.729
I believe that the wage policy is fair		0.787			0.728
I am satisfied with the social opportunities that my organization provides for me		0.770			0.732
I am satisfied with my non-wage rewards		0.767			0.705
My colleagues are prone to teamwork.			0.919		0.895
Collaboration and cooperation between me and my colleagues are at a good level			0.891		0.875
I am able to make joint decisions with my colleagues			0.876		0.854
I am able to work with my colleagues collectively			0.829		0.847
I believe that I am encouraged by my colleagues to do better work			0.666		0.681
Strong communication amongst colleagues is available			0.658		0.700
I believe that I won't be laid off without clear justification				0.862	0.798
I believe that my job is secure				0.840	0.763
Eigenvalue*	6.094	4.921	4.863	1.852	
Variance Explained (%)	25.392	20.505	20.261	7.716	
Cumulative variance explained (%)	25.392	45.897	66.159	73.875	

Notes: Extraction Method - Principal Component Analysis; Rotation Method - Varimax with Kaiser Normalization. * - Values Obtained After Rotation

Table 5. Job Satisfaction Dimensions, Descriptive Statistics and Reliability

Dimension	Mean	S.D	n
Management's attitude: Cronbach's Alpha=0.945			
I believe that my organization values me	3.454	1.231	249
Administrators help me to do my job better	3.329	1.321	249
My organization has provided the necessary education opportunities to do my job properly	3.265	1.293	249
I can get feedback from my managers (negative or positive)	3.257	1.288	249
Administrators warn us without threatening when we make mistakes	3.486	1.267	249
I respect our administrators in general	3.888	1.109	249
I can reach people we need (including administrators) at any time	3.767	1.158	249
I am pleased with my organization	3.462	1.282	249
I believe that my managers encourage me in terms of working better	3.068	1.323	249
I recommend my organization to my friends as well	3.064	1.306	249
Pay/Reward: Cronbach's Alpha=0.918			
I am satisfied with my salary	2.936	1.315	249
I believe that the wage policy is fair	2.598	1.379	249
I am satisfied with my non-wage rewards	2.277	1.341	249
In general, I am satisfied with premiums and bonuses	2.245	1.338	249
I am satisfied with social opportunities provided by the organization	2.55	1.396	249
I am satisfied with the social benefits (education, health, rents, etc.) that the organization provides for me	2.378	1.418	249
Colleagues: Cronbach's Alpha=0.943			
I am able to work with my colleagues collectively	3.759	1.11	249
Collaboration and cooperation between me and my colleagues are at a good level	3.815	1.117	249
My colleagues are prone to teamwork.	3.61	1.22	249
I am able to make joint decisions with my colleagues	3.727	1.146	249
Strong communication amongst my colleagues is provided	3.229	1.198	249
I believe that I am encouraged by my colleagues to do better work	3.185	1.237	249
Job security: Cronbach's Alpha=0.772			
I believe that I have job security	3.855	1.219	249
I believe that I won't be laid off without clear justification	4.133	1.137	249

4.2. Correlation Analysis

Correlation analysis is used to determine the correlation of each job satisfaction factor with organizational performance at the 0.05 level of significance. The analysis shed a light on a fact that there is a significant positive correlation between organizational performance and the factors comprising job satisfaction (Table 6).

Table 6. The Pearson Correlation Analysis between Organizational Performance and the Factors of Job Satisfaction (n=249)

	Management's attitude	Pay/Reward	Colleagues	Job security	Performance
Management's attitude	1	0.618**	0.690**	0.385**	0.667**
Pay/Reward	0.618**	1	0.353**	0.272**	0.563**
Colleagues	0.690**	0.353**	1	0.272**	0.466**
Job security	0.385**	0.272**	0.272**	1	0.260**
Performance	0.667**	0.563**	0.466**	0.260**	1

4.3. Application of Support Vector Machine (SVM)

The model in this study is shown in figure 2 below. It basically illustrates the impact of job satisfaction on organizational performance. After employing the analysis, it is four basic underlying factors for job satisfaction are found. Our aim is to determine the relative importance of these factors on performance; hence we use the Support Vector Machine as a classification tool.

To begin the analysis, the organizational performance variable is divided into two clusters by using the two-step clustering method. The homogeneous clusters of performance variable are then labeled as successful (1) and not successful (2). Table 7 shows that 48.6% of the performance variable is labeled as successful (1) while 51.4% is labeled as not successful (2).

Table 7. Cluster of Performance as Successful and Not Successful

	Frequency	Percent	Cumulative Percent
Successful (1)	121	48.6	48.6
Not Successful (2)	128	51.4	100.0
Total	249	100.0	

In order to obtain a good indication as to how well our model will generalize in comparison to larger data sets similar to the current data, this study is partitioned into two sample groups: one sample generated the model by training it, and the other tested the model. Therefore, the data set is partitioned into training and testing data sets. By default, (SPSS Clementine v.12), 50% of the data is used for training and 50% is used for testing. For performance analysis, the test data sets are used for assessment.

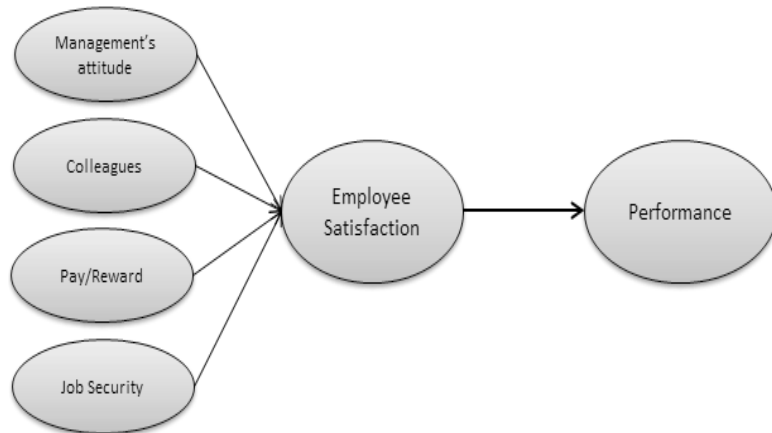


Figure 2. Impact of Job Satisfaction on Organizational Performance

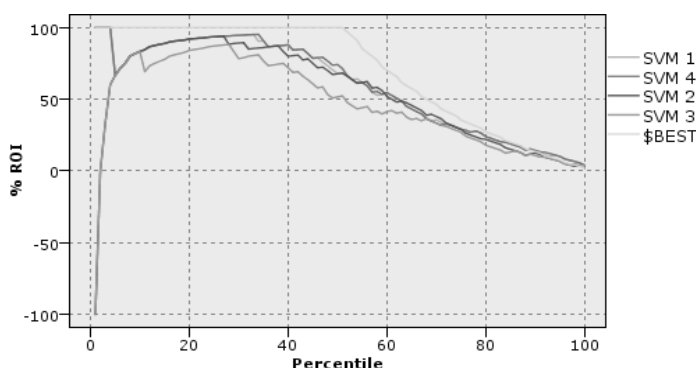
4.4. Support Vector Machine Classification Analysis

In this study, the Support Vector Machine classification technique is used to determine the impact of job satisfaction factors on organization performance. SVM in SPSS Clementine supports linear, polynomial, radial basis function (RBF) and sigmoid kernel functions. It is crucial to decide which of these kernels to use. The comparison of kernel functions in terms of performance is shown below (Table 8). There are various performance measurements to compare models used in this study such as: overall accuracy, area under curve, maximum profit and lift. Overall accuracy is the percentage of records that is correctly predicted by the model.

According to table 8, the linear and RBF SVM kernel functions outperform the sigmoid kernel significantly and perform much better than polynomial kernel functions. They are equally the most accurate models in this study. The other well-known performance measurement is AUC (Area under the ROC Curve). AUC provides an index for the performance of a model: the further the curve lays above the reference line, the more accurate the test. In terms of Area under the ROC curve performance measurement, the linear SVM kernel model has the highest proportion (89.2%). Therefore, the linear-SVM model perform better than the other kernel functions. It is obvious that "*Lift*" and "*Max profit*" performance measurements indicate that linear-SVM is the most appropriate model to use. Therefore, the linear SVM model is used to determine the impact of the factors of job satisfaction on the performance of health care organizations. Figure 3 shows the ROI performance measurement confirming that the linear-SVM model perform better than the other three SVM models.

Table 8. Performance Comparison of Kernel Functions

Model	Overall Accuracy (%)	Area Under Curve (%)	Lift (Top 30%)	Max Profit
<i>SVM-Linear</i>	83.2	0.892	1.871	230
<i>SVM-RBF</i>	83.2	0.888	1.871	225
<i>SVM-Polynomial</i>	80.8	0.873	1.819	215
<i>SVM-Sigmoid</i>	75.2	0.812	1.715	180

**Figure 3.** %ROI performance graph of SVM Models (SVM1: RBF, SVM2: Polynomial, SVM3: Sigmoid, SVM4: Linear)

4.5. Determining the Impact of Job Satisfaction Factors on Performance

Through investigating the performances of the SVM models, we determine that the best model to use is the linear-SVM. We can now focus on the linear-SVM model's results obtained, highlighting the variables that matter most in health care organization performance. Figure 4 and table 9 indicate the relative importance of each variable in estimating the model. Since the values are relative, the sum of the variables on the display is 1.0. Variable importance relates to the importance of each variable in making a prediction, not whether the prediction is accurate. The relative importance of each dimension of satisfaction is calculated and ranked by using the linear-SVM model.

Table 9. Importance of Job Satisfaction on Organizational Performance

Dimension	Importance
1) Management's Attitude	0.4077
2) Pay/Reward	0.3068
3) Job Security	0.1492
4) Colleagues	0.1363

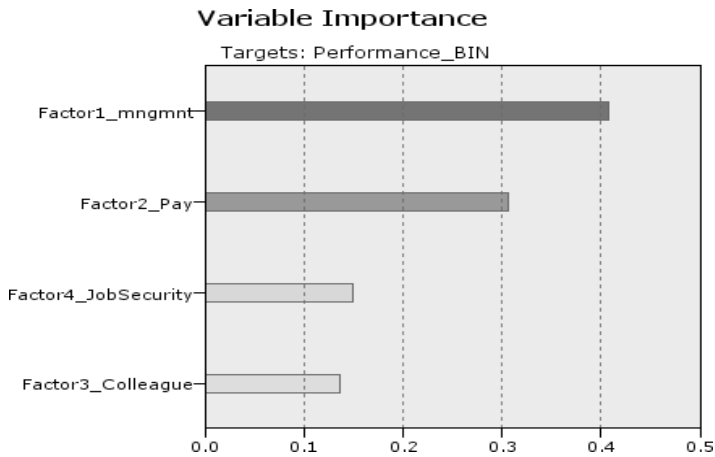


Figure 4. Relative Variable Importance of Job Satisfaction Dimensions

According to the variable importance chart, the impact of job satisfaction factors on organizational performance is, in order of their importance: management's attitude, pay/reward, job security and colleagues. Out of the four underlying dimensions of satisfaction, management's attitude with a 40.77% relative variable importance is the major factor impacting organizational performance. The pay/reward dimension is the second most significant effect on performance (30.68%). In contrast, the job security and colleague dimensions are found to have the least impact on performance, with 14.92% and 13.63% relative variable importance proportions respectively, but they are still significant and must be considered.

5. Conclusion

The determination of job satisfaction factors and their impact on organizational performance is very important in the health care system. Improving performance can significantly improve the quality and efficiency of patient care. In view of the fact that there are insufficient numbers of health care workers in Turkey as well as world wide, employee satisfaction should be given great importance by researchers, policy makers and administrators, making it imperative for administrators to understand the factors significantly impacting their organization's performance.

In this research, we adapt an Exploratory Factor Analysis (EFA) in order to extract the underlying dimensions of job satisfaction for health care employees. The EFA analysis revealed four major aspects: management's attitude, pay/reward, colleagues, and job security. We study importance of these

underlying dimensions of job satisfaction thoroughly by various researchers (Vilma & Egle, 2007; Bolton, 2005; Wise, 2007; du Gay, 1996; Khokher et al, 2009; Lum et al., 1998).

The correlation analysis between the various job satisfaction dimensions indicates that good organizational performance depends in good part upon management's attitude towards employees. In addition, the performance factor has a significant correlation to pay/rewards as well as to colleagues. Although also important, job security is the factor ranked the lowest in association with performance. At the same time, the correlation analysis shows a significant relationship connecting the various job satisfaction factors. These results contain valuable insights that can enable policy makers as well as administrators to raise the satisfaction and – by inference – the excellent performance of their employees to the betterment of society as a whole.

We also employ Support Vector Machine technique to determine the impact of the key factors creating job satisfaction and their effect on organizational performance. The linear-SVM model is selected as the most appropriate one, after assessing each of the models. The findings suggest that management's attitude towards employees is the most significant dimension of job satisfaction, and that this impacts performance greatly. This result supports the thesis that the administrative contribution in a health care organization is vital. Not surprisingly, pay/reward is found to be the second most important factor. Although they must be taken seriously, job security and colleagues are found to be the least important factors affecting performance. The correlation analysis results and the SVM-model results are parallel to each other, and in both statistical analyses, management's attitude is pinpointed as the major factor impacting organizational performance.

The study findings have practical implications for researchers as well as administrators of health care organizations. It provides decision makers with valuable insights in identifying factors to focus on in order to improve organizational performance overall. Obviously, supportive management practices will greatly improve the performance of employees.

The findings of this study are limited to health care institutions located in Istanbul, Turkey. To generalize the obtained result, further research with an enlarged sample should be conducted to test the within results. The aspects of job satisfaction can be added to the enlarged study as a means to further explore the relationship with organizational performance in detail.

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Nonprofit Organizations in Disaster Response and Management: A Network Analysis

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Abstract

This paper tracks changes in the national disaster management system with regard to the nonprofit sector by looking at the roles ascribed to nonprofit organizations in the Federal Response Plan (FRP), National Response Plan (NRP), and National Response Framework (NRF). Additionally, the data collected from news reports and organizational after action reports about the inter-organizational interactions of emergency management agencies during the September 11th attacks and Hurricane Katrina are analyzed by using network analysis tools. The findings of the study indicate that there has been an increase in the interactions of the National Voluntary Organizations Active in Disasters (NVOAD) network member organizations on par with policy changes in the NRP to involve nonprofit organizations in the national disaster planning process. In addition, those organizations close to the center of the network experienced enhanced communication and resource acquisition allowing them to successfully accomplish their missions, a finding that supports the development of strong network connections.

Keywords: NVOAD; Disaster Response; Non-profit Organizations; Networks; Resource Dependency.

JEL Classification: L10, L25, L30, H12, H84.

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1. Introduction

As the 21st century began with its unique challenges and complexities, there emerged a necessity for the integration of actions of response organizations across political jurisdictions and organizational sectors under the umbrella of a unified national disaster system. Throughout American history, charitable nonprofit organizations have had important roles and responsibilities in disaster relief. In the past, nonprofit organizations, such as the American Red Cross, were the primary first responders to disasters when government actors were not carrying the burden of saving citizen lives and properties. Governments started getting involved in disaster response in the early 20th century, and the role of the federal government in disaster management has expanded steadily since due to the increasing scope and impact of natural and manmade disasters. During this time the United States Congress chartered the American Red Cross to assume a major role in national emergency relief planning and response. After the September 11th attacks, the Federal Response Plan (FRP) was revised, and the role of nonprofit organizations expanded and became more formalized and the National Voluntary Organizations Active in Disaster (NVOAD) came to occupy an important role in the coordination of nonprofit organizations in the National Response Plan¹.

NVOAD is a platform for nonprofit organizations to coordinate their activities and share information and resources in helping (potential and actual) disaster victims throughout the preparedness, response, and recovery phases of emergency management². NVOAD was founded in 1970 after Hurricane Camille to avoid service duplication, share information among nonprofit organizations, and to communicate with the public in a more effective and coordinated manner through regular meetings among member agencies³. It has a growing pool of members including: 50 national nonprofit organizations, 55 state or territorial Voluntary Organizations Active in Disaster (VOADs), and partners, such as the Federal Emergency Management Agency (footnote 2). Due to a growing need for the contributions of nonprofit organizations in disaster relief and the increasing number, scope, and impact of disasters, NVOAD members have created standing

¹ Federal Emergency Management Agency (FEMA) report 1999: Federal Response Plan.
<http://www.fema.gov/rrr/frp/>

Federal Emergency Management Agency (FEMA) report 2008: National Response Framework.
<http://www.fema.gov/pdf/emergency/nrf/nrf-core.pdf>

² NVOAD, 2008: About US. www.nvoad.org.

³ React Online. NVOAD: National Volunteer Organizations Active in Disaster.
<http://www.reactintl.org/nvoad.htm>

committees to address issues in a more specialized and continual manner⁴. This increased coordination of nonprofit organizations in disaster response offers a unique opportunity to study the effect of these service delivery networks in disaster response.

The paper proposes several functional arguments to explain why nonprofit organizations coordinate services, share information and resources, and how rational and social choice theories offer some additional insights into understanding ongoing response behaviors. At the intersection point of both theories, resource dependency theory argues that organizations formulate their internal and external strategies to maintain independence, and at the same time, attempt to survive (Aldrich and Pfeffer, 1976; as cited in Hill and Lynn, 2003). To examine the nonprofit collaboration a network perspective and analysis is used, which is a process that has gained significant interest among scholars of public and nonprofit management (Guo and Acar, 2005; O'Toole, 1997; Provan, Veazie, Staten, and Teufel-Shone, 2005; Rethemeyer and Hatmaker, 2008; Robinson, 2006). Mizruchi and Galaskiewicz (1994) highlight the contributions of network analysis to inter-organizational analysis and organizational theory. This study goes beyond thinking of 'network' as a metaphor and develops an empirical examination of networks. This type of network analysis constitutes a field of substantial interest and importance to democratic societies that are seeking to manage problems of public service delivery with innovative means at a reasonable cost.

This article examines the following questions: What is the role of NVOAD in national disaster response? What were the structural positions of NVOAD member organizations in the disaster response networks of 9/11 and Hurricane Katrina? How has the role of NVOAD evolved in national response plans as well as actual disaster response networks? Network analysis tools are utilized to analyze data collected from newspapers and FEMA situation reports using content analysis during both the September 11th attacks and Hurricane Katrina. An analysis of the development of NVOAD's role in the United States' national disaster response is conducted by comparing the ways in which member nonprofit organizations responded differently during the attacks on September 11th, 2001 as opposed to the response to Hurricane Katrina in 2005.

The National Response Framework (NRF) includes NVOAD as the organization responsible for coordinating the nonprofit sector organizations response, as opposed to both the Federal Response Plan and National Response Plan which did

⁴ Susan Kim, 2002, What is NVOAD? Disaster News Network.
<http://www.disasternews.net/news/article.php?articleid=2948>

not include NVOAD. Empirical evidence of how NVOAD members have actually responded to disasters is useful in evaluating whether the NRF has worked effectively or not. Rather than focusing on hypothesis testing, this study uses network analysis to examine the role of nonprofit organizations in disaster response and provides policy recommendations to improve emergency and disaster response through more effective involvement of the nonprofit sector.

2. Literature Review and Background Information

Nonprofit organizations play important roles in solving social problems and responding to the needs in the community (Gronbjerg and Paarlberg, 2001). The effectiveness of nonprofit organizations in a community depends on the resource sharing of nonprofit organizations among themselves and among other sectors (Agranoff 2005; Paarlberg and Varda, 2009; Salamon, 1987). Nonprofit organizations' involvement in disaster response requires the collaborative capacity of multiple sectors and jurisdictions. Collaborative capacity building is a difficult task for public and nonprofit managers. Capacity building and effective performance requires fostering relationships and forming creative teams and networks (Galaskiewicz and Rauschenbach, 1988; Kapucu and Van Wart, 2006; Keifer and Montjoy, 2006; Kenis and Provan 2009; Senge et al., 2008). Collaborative and network perspectives using network analysis techniques can help public and nonprofit managers improve the effectiveness of their services (intra-organizational or interorganizational levels) in the following ways: identify points of misalignment and accelerate collaboration in the right places; determine whether certain organizations and functions are achieving the connectivity required for desired results and to identify and track intervention strategies; and identify high performers in a network and determine the reasons for success, and in turn, replicating that success with low performing actors in the network (Cross and Thomas, 2009; Gray, 1989; Provan, Veazie, Staten, and Teufel-Shone, 2005).

In responding to a disaster of extreme magnitude, nonprofit organizations usually have to deal with *"the challenge of channeling the desire to help to the right place at the right time"* (Miller, Jensen, and Moore, 2005, p. 2). First, the pre-disaster training of workers becomes difficult during extreme events, and the amount of unsolicited donations coupled with the number of unaffiliated volunteers pose important challenges for nonprofit organizations in effectively organizing their response to disasters (Miller, Jensen, and Moore, 2005). Pre-disaster training in the effective management of public information, in setting up a Voluntary Coordination Team and Reception Center in collaborating with the Public Information Office of a local Emergency Operation Center, and in maintaining a database of volunteers can help nonprofit organizations better

organize and coordinate their response to emergencies (Miller, Jensen, and Moore, 2005; Zakour and Gillespie, 1998).

In dealing with these problems, nonprofit organizations are increasingly partnering within and across organizational sectors. “[T]he creation of synergy through partnership produces results that partners could not obtain without collaboration” (Brown, 1990; as cited in Lister, 2000, p. 4). Nonprofit collaborations usually operate at the interpersonal level, and these personal relationships are frequently minimized in management theory (Lister, 2000). If one of the goals in disaster management is the incorporation of community-based groups, then interpersonal relationships take on added importance in decision making and in the sharing and maximization of social capital resources and expertise (Wachtendorf and Kendra, 2004).

To understand nonprofit collaboration and partnerships, it is useful to take a look at some definitions and conceptual developments in several theories. “Partnership refers to any intentionally collaborative relationship between two or more organizations from multiple sectors (public, private and nonprofit) which joins resources to identify, and subsequently pursue, a joint approach to solving multiple common problems” (Kapucu, 2006, p. 207). The need for complementary resources is one of the key drivers of inter-organizational cooperation in dynamic environments of disasters. Organizations with responsibilities in disaster response and recovery, that have strong working relationships on a daily basis, will function better in the dynamic environment of disaster. The pervasive threats of man-made and natural disasters create a situation of ‘shared risk’ for the entire society (Grunder, 2004; Kapucu, 2006; Zakour and Gillespie, 1998). The unprecedented demand to respond quickly to disasters and to be part of a recovery effort requires two basic management skills from every organization – collaboration and adaptation to change.

Nonprofit partnerships include operations at three levels: administrative, policy, and institutional. The partnership process encourages collective action and capacity building, more effective decision making and implementation, and more community involvement and commitment to the success of the policies and programs (Gazley and Brudney, 2007; Kenis and Provan 2009). Designing inter-organizational coordination and informed collective action in response to disasters can better serve the immediate need in the society (Hossain and Kuti, 2009; Kapucu, 2006).

In order for the partnerships to be effective, there needs to be viable communication, the capacity for partnering, and a commitment to collaborate. Kapucu (2007) found that there was a need to have previously established

patterns of communication between the disaster response team and local nonprofit organizations. In addition, there needed to be a commitment to supporting and building the organizational capacity of these nonprofits enabling them to successfully partner in the response and recovery process.

In addition to functional and operational arguments for nonprofit partnerships and collaboration, some theoretical arguments exist. Both social choice theory and resource dependence theory posit that organizations, when interacting with the environment, respond to both the opportunities and challenges found there. For example, in a study analyzing emergency managers' strategies in terms of resource and funding provision, McGehee and Andrew (2009) found that managers strive to form strategic and key professional ties with those who have access to, information about, and granting power for the funding sources provided by state or federal governments. Provan and Milward (1991) argue that inter-organizational relations are basically due to the need to reduce environmental uncertainty and increase access to scarce resources. Shen and Shaw (2004) classify such dependencies in three categories: sharing, flow and fit. Accordingly, "*[s]haring dependency occurs when multiple activities need to use the same resources. Flow dependency appears when the output of one activity is the input of another. Finally, fit dependency arises as the outputs of multiple activities need to fit into a single product (resource)*" (Shen and Shaw, 2004, p. 2114). However, not all responses are determined by a rational goalbased assessment of the situation (Aldrich and Pfeffer, 1976; as cited in Hill and Lynn, 2003). Some organizations might be more motivated to seek collaboration with resource-rich organizations during emergencies due to resource dependency. According to Monge and Contractor (2003), both exchange and dependency theories have a role in the study of inter-organizational networks, and several studies utilizing resource dependency theory include an organization's network centrality as part of their assessment (Mizruchi and Galaskiewicz, 1994). These theories then provide the basis for examining an organization's centrality with a specific network and the degree of collaboration that occurs in response to a disaster. In the following section the value of partnerships in response to disasters is expanded.

Figure 1 provides a diagram that explains the ways in which nonprofit partnerships make the disaster response more effective through networks and collaboration. In the pre-disaster phase the clarification of roles is critical along with capacity and network building to establish social capital and commitment to share information and resources during a disaster response. Establishing a local-level database, including information about the suppliers of physical, informational, and human resources, can be useful to increase the collaborative

capacity as well as the awareness and resilience of the community (Gazley and Brudney, 2007; Graddy and Wang, 2009; Troy, Carson, Vanderbeek, and Hutton, 2007). During the disaster response communication, collaboration, coordination, and cooperation are important in the delivery of services and in the recovery phase (see footnote 4). In addition, the sharing of resources and risk are critical to effective response and successful collaboration. This model of partnerships provides benchmarks for assessing the quality of collaborative disaster response.

The next section of the paper discusses the attempt by the National Voluntary Organizations in Disaster (NVOAD) to formalize the networking and collaborative efforts.

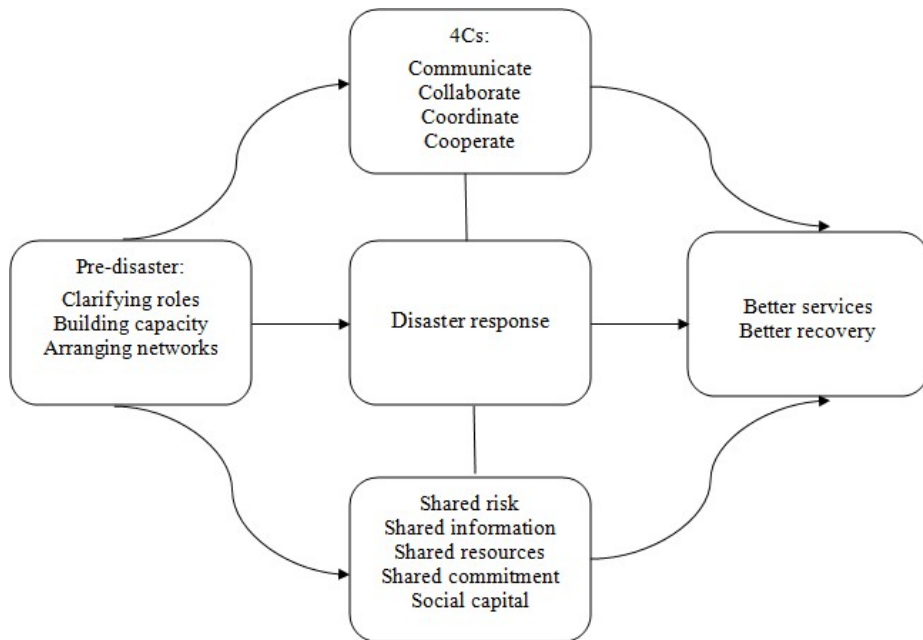


Figure 1. Disaster response diagram of nonprofit partnerships

Notes: 4Cs are coming from the VOAD mission (see footnote 4).

3. Nonprofit Organizations in Disaster Management

Emergency managers need to have clear working relationships with nonprofit organizations involved in disaster management (Sylves, 2009). The leading single

nonprofit organization involved in disaster management is the American Red Cross (ARC). Since its inception, ARC has focused on assisting individuals in times of crisis and in Federal Response Plan functions as a "*federal agency*" helping to coordinate mass care resources in presidentially declared disasters or emergencies. The American Red Cross, as a representative of nonprofit organizations in the Federal Response Plan, provides support in the coordination of disaster management services. These services include providing the disaster-affected population shelter, food, first aid, the distribution of emergency relief items, disaster welfare information, and family reunification services (see footnote 1, p. 102).

Many other smaller nonprofit organizations provide services to disaster-affected populations as part of their mission. However, their roles have been less prominent than the American Red Cross. Many nonprofit organizations have joined the National Voluntary Organizations Active in Disaster (NVOAD), and as stated earlier, it was founded in order to avoid service duplication by sharing information among nonprofit organizations and communicating with the public in a more effective and coordinated manner through regular meetings with the member agencies (footnote 3, Sylves, 2008). In other words, NVOAD is a coalition that provides a platform for its 105 member organizations to communicate, collaborate, coordinate, and cooperate, with the actual services being provided by the member organizations. Because of the increasing need for the contributions of nonprofit organizations in disaster relief, and the growing number, scope and impact of disasters, NVOAD Standing Committees were set up to better deal with issues in a more specialized and continual way (see footnote 4). Some of the topics addressed by these committees are disaster case management, disaster recovery, emotional and spiritual cares, mass care, and volunteer management.

NVOAD's mission to coordinate nonprofit activities has taken on new importance after the failures of inter-organizational communication and coordination in the deadly attacks of September 11th because timely and coordinated action is not only important for fire and police departments but also for nonprofit organizations that fill in the gaps in disaster response. The goals of NVOAD focus on the development of the capacity and competencies of state and local Voluntary Organizations Active in Disaster (VOADs) to make sure that they are well prepared and sufficiently equipped to fulfill their disaster mitigation, response and recovery missions effectively (see footnote 4, Sylves, 2008). NVOAD has several membership criteria including transparency and accountability; the type of service provided, participation requirements, and standards of conduct and service delivery. Moreover, there are some requirements based on the size of

budget, number of staff and volunteers, and years of experience depending on which one of the two tiers the member will operate (see footnote 2).

The role of nonprofit agencies in the National Response Plan (NRP) and National Response Framework (NRF) is to collaborate with first responders and all levels of government in providing disaster relief services that sustain life, address the physical and emotional distress of individuals, and promote the recovery of disaster victims when assistance is not available from other sources. The American Red Cross and NVOAD are the leading nonprofit organizations that respond to disasters by providing leadership in the coordination and integration of the overall Federal efforts in the areas of mass care, housing, and human services. *"For the purposes of the National Response Plan, the American Red Cross functions as an ESF primary organization in coordinating the use of Federal mass care resources in the context of Incidents of National Significance"* (see footnote 1, p. 20).

Although there has never been a study to verify their role in the emergency management process, the actual impact of the American Red Cross and the nonprofit members of NOVAD in coordinating and collaborating in disaster response and recovery has been implied. This study seeks to provide insight into the centrality of the roles played by nonprofit organizations in disaster response and recovery, and the methodology of the study will be covered in the next section of the paper.

4. Methodology

This research focuses on the September 11th, 2001 attacks on the World Trade Center in New York City and Hurricane Katrina in New Orleans in 2005. In order to evaluate the nonprofit organizations' response to these two catastrophic disasters within the Federal Response and the National Response Plan, the authors carefully reviewed several key documents studying the interactions of NVOAD member organizations and tracking changes in their connectivity. The two cases utilize the data from the content analyses of news reports in The New York Times and situation reports from FEMA. Content analyses were used to identify the major organizations that participated in the response operations and in the interactions between organizations in response operations for both of these events (Borgatti, Everett, and Freeman, 2002; Scott, 2000).

Content analysis is a useful method of listing both attribute and relational data regarding organizations that have participated in disaster response in the first three weeks after a disaster has occurred. The Lexis-Nexis program helps to identify newspaper and situation reports published on specific dates by using key

words like “September 11th attacks”, “9/11”, “Hurricane Katrina”, etc. Once the analyses are complete, a matrix of interactions among organizations is created to analyze the network of communications and interactions.

Archival data is preferred for the study for several reasons. First, it can provide network data that would otherwise not be available. Second, potential interviewees might refuse participation to the research. Third, organizations might dissolve or merge with others making them unavailable for study. Finally, archival data can be available for an extended period of time (Knoke and Kuklinski, 1982). This analysis illustrates the patterns of communication among organizations. Data collected from the content analysis was examined by using the UCINET Version 6.0 (Borgatti, Everett, and Freeman, 2002) social network analysis program. UCINET is a comprehensive program for the analysis of social networks. The program contains several network analytic routines (e.g., centrality measures, dyadic cohesion measures, positional analysis algorithms, clique measures, etc.) and general statistical and multivariate analysis tools, such as multidimensional scaling, correspondence analysis, factor analysis, cluster analysis, and multiple regressions (Gould and Fernandez, 1989; Wasserman and Faust, 1994).

The September 11th content analysis data are collected from news reports in The New York Times between the dates of 09/12/2001 – 10/04/2001; and situation reports from the FEMA between the dates of 09/11/2001 – 10/04/2001. The Hurricane Katrina case utilizes the data from the content analyses of news reports in The New York Times between the dates of 08/29/2005 – 09/18/2005; and situation reports from the FEMA between the dates of 09/11/2005 – 10/04/2005. In addition, the following reports are also used: Florida State Emergency Response Team (SERT) Situation Reports; New Orleans City Situation Reports; Louisiana State Situation Reports; Mississippi State Situational Reports; The Federal Response to Hurricane Katrina: Lessons Learned (Townsend, 2006); Hurricane Katrina: A Nation Still Unprepared⁵; and the U.S. House of Representatives⁶ Select Bipartisan Committee to Investigate the Preparation for and Response to Katrina: A Failure of Initiative. Content analysis of the Hurricane Katrina case began with the June 1, 2005 reports because there were no reported storms in June or July of the 2005 hurricane season and ran through February 28, 2006.

⁵ U.S. Senate Committee of Homeland Security and Government Affairs. Report 2006. Hurricane Katrina: A National Still Unprepared. Washington D.C. Government Printing Office. http://hsgac.senate.gov/_files/Katrina/ExecSum.pdf

⁶ U.S. House of Representatives. report 2006. Select Bipartisan Committee to Investigate the Preparation for and Response to Katrina: A Failure of Initiative. Washington D.C.: Government Printing Office. http://katrina.house.gov/full_katrina_report.htm

5. Findings and Discussion

Centrality measures are used to indicate how central an organization's position is in the network (Durland and Fredericks, 2006; Kar and Hatmaker, 2008). There are three types of centrality measures in the tables below. First, degree centrality estimates the actor's centrality in the network in terms of their number of ties (Kapucu, 2006). Second, closeness centrality measures the centrality of network actors by determining how close each actor is to the other actors in terms of the shortest possible path. Third, betweenness centrality measures the position of an actor in the network with respect to its geodesic path between other actors, and it indicates the extent to which it is capable to act as a broker (Hanneman, 2001). Clique analysis demonstrates subgroups within a network in which all members of a subgroup are connected to one another (Belotti, 2009; Hossain and Kuti, 2009). In the section below a visual representation of the network analysis is presented along with several tables that cover all the centrality measures and clique analysis findings.

5.1. Nonprofit Organizations' Network in Response to September 11th Terrorist Attacks

Network analysis provides a visual representation of the interactions between organizations identifying those organizations central to the coordination of the response effort. Figure 2 is a network diagram that illustrates interactions among the various organizations involved in emergency response during and after the September 11th attacks.

involved in the emergency response, they did not reportedly interact with any other organization.

Table 1. Degree centrality measures of organizations in the network

	Organization name	Degree
1	Federal Emergency Management Agency	7.415
2	New York City Mayor	0.791
3	US Department of Health and Human Services	0.491
4	FEMA Disaster Field Office	0.47
5	US Army Corps of Engineers	0.47
...
93	McGuire AFB	0.043
94	Church World Services	0.043
95	New York State Senate	0.043
96	Nassau County Fire Department	0.021
97	US Marine Corps Chemical-Biological Response	0.021
...
177	Equal Rights Officer	0
178	New York State Crime Victims Board	0
179	US Department of State	0
180	United Parcel Service	0
181	US Armed Forces	0
Mean		0.118

In Table 2, the closeness centrality measures of the top, mid, and lowest five organizations in the 9/11 response network are shown. Closeness centrality measures the centrality of network actors by determining how close each actor is to the other actors in terms of the shortest possible path (Hanneman, 2001). Although FEMA has the greatest number of links in the network, it does not score the highest in terms of the closest path to every actor in the network. As seen in Figure 2 (above), some of the actors are scattered farther from the center (FEMA) to the peripheries. Again, there is not a NVOAD member in the top 5, though there are some VOADs in the mid 5 organizations of the analysis.

Table 2. Closeness centrality measures of organizations in the network

	Organization name	Closeness
1	New York State Department of Environmental Protection	0.718
2	New York Stock Exchange	0.718
3	New York State Department of Sanitation	0.717
4	New York City Office of Emergency Management	0.713
5	FEMA Disaster Field Office	0.708
...
93	Shomburg Black Museum	0.698
94	Voluntary Organizations Active in Disasters	0.698
95	National Geographic	0.698
96	Church of Bethlehem	0.698
97	Service Employees International Union	0.698
...
177	Equal Rights Officer	0.552
178	New York State Crime Victims Board	0.552
179	US Department of State	0.552
180	New Jersey Port Authority	0.552
181	The President Bush	0.552
Mean		0.671

Table 3 (above) shows betweenness centrality measures of the organizations in the 9/11 response network. Betweenness centrality measures the position of an actor in the network with respect to its geodesic path between other actors, and it indicates the extent to which it is capable of acting as a broker (Hanneman, 2001). The table shows that FEMA has the highest betweenness score meaning that it had played an important broker role. The American Red Cross, a NVOAD member organization, scored the third highest in its role as a bridge among several organizations in the network. Of course, the Red Cross is one of the approximately 100 congressionally-chartered organizations and the only nonprofit organization with a congressional mandate to provide disaster relief. It has built-in communication structures that enable the organization to frequently coordinate with government agencies that respond to disasters.

Table 3. Betweenness centrality measures of organizations in the network

	Organization name	Betweenness
1	Federal Emergency Management Agency	15.56
2	New York City Fire Department	2.389
3	American Red Cross	1.812
4	Environmental Protection Agency	1.588
5	New York City Mayor	1.521
...
93	Joint Information Center	0
94	Joint Regional Medical Planning Office	0
95	McGuire AFB	0
96	Department of Transportation	0
97	New York City Transit	0
...
177	Turner Construction	0
178	US News and World Report	0
179	Washington Post	0
180	Yomiuri Shimbun	0
181	Transcomm	0
Mean		0.173

In Table 4 the measures of degree, closeness, and betweenness centrality of NVOAD member organizations and some state and local VOADs in disaster response are presented. The American Red Cross has the highest score in degree and betweenness centrality, a high score in closeness, and it is the only organization that has played the role of being the bridge in interactions with other organizations in the network. Although the World Vision had the least amount of ties in the network, it had closer paths to every other actor in the network. This means that although the World Vision does not have many interactions with other organizations in the network, it is still at a good position to obtain information and resources from other actors in the network due to its proximity to other organizations with two or more paths.

Table 4. Centrality measures of NVOAD members in the 9/11 response network

Degree orders	Organization name	Degree	Closeness	Betweenness
10	American Red Cross	0.342	0.693	1.812
23	New York City VOAD	0.171	0.693	0
24	United Methodist Committee on Relief	0.15	0.698	0
54	Southern Baptist Convention	0.064	0.698	0
68	United Jewish Appeal	0.043	0.698	0
75	United Way	0.043	0.698	0
77	Salvation Army	0.043	0.698	0
83	Voluntary Organizations Active in Disasters	0.043	0.698	0
84	Church of Scientology	0.043	0.552	0
94	Church World Services	0.043	0.698	0
127	Church of the Brethren	0.021	0.697	0
131	Adventist Disaster Services	0.021	0.552	0
140	Southern Baptists Kitchens	0.021	0.552	0
145	New Jersey VOAD	0.021	0.698	0
163	World Vision	0.021	0.698	0

Table 5. Cliques in 9/11 response network with 4 members

1	Federal Emergency Management Agency, US Army Corps of Engineers, Deployable Tactical Operation Center, Environmental Protection Agency
2	Federal Emergency Management Agency, Center for Disease Control, Occupational Services and Health Administration, Environmental Protection Agency
3	Federal Emergency Management Agency, Center for Disease Control, Environmental Protection Agency, New York City Department of Health
4	Federal Emergency Management Agency, Center for Disease Control, US Department of Health and Human Services, New York City Department of Health
5	Federal Emergency Management Agency, US Department of Agriculture, New York City Emergency Operations Center, American Red Cross
6	Federal Emergency Management Agency, Federal Bureau of Investigation, National Communication Service, Verizon Communications
7	Federal Emergency Management Agency, Deployable Tactical Operation Center, National Communication Service, Verizon Communications

In table 5 (above), cliques of organizations in the 9/11 response network are shown. Clique analysis demonstrates subgroups within a network in which all members of a subgroup are connected to one another. There were seven core, overlapping cliques of four organizations in the network, and the only nonprofit organization found was the American Red Cross. Being part of a clique means that those specific organizations in a clique have mutual connections with one another and most of the cliques in the above table include FEMA – a central organization in the network. Therefore, it can be argued that most of the resources flow in those cliques, and there is a higher level of communication due to the interconnectedness of the organizations. Apart from the American Red Cross, no other nonprofit organization seems to take advantage of this level of connectedness.

The analysis of the case of September 11th in the previous section demonstrated the limited network centrality of nonprofit organizations in disaster response beyond that of the American Red Cross. However, the analysis of nonprofit organizations response to Hurricane Katrina in the following section may reveal a different network portrait.

5.2. Nonprofit Organizations Networks in Response to Hurricane Katrina in 2005

Below, Figure 3 depicts the network analysis of the emergency responders' network identified by the data in response to Hurricane Katrina in 2005. The tables in this section provide the results of the analysis of the degree, closeness, and betweenness centrality measures of actors in the Hurricane Katrina response network, the centrality measures of NVOAD members in the network, and the cliques of members.

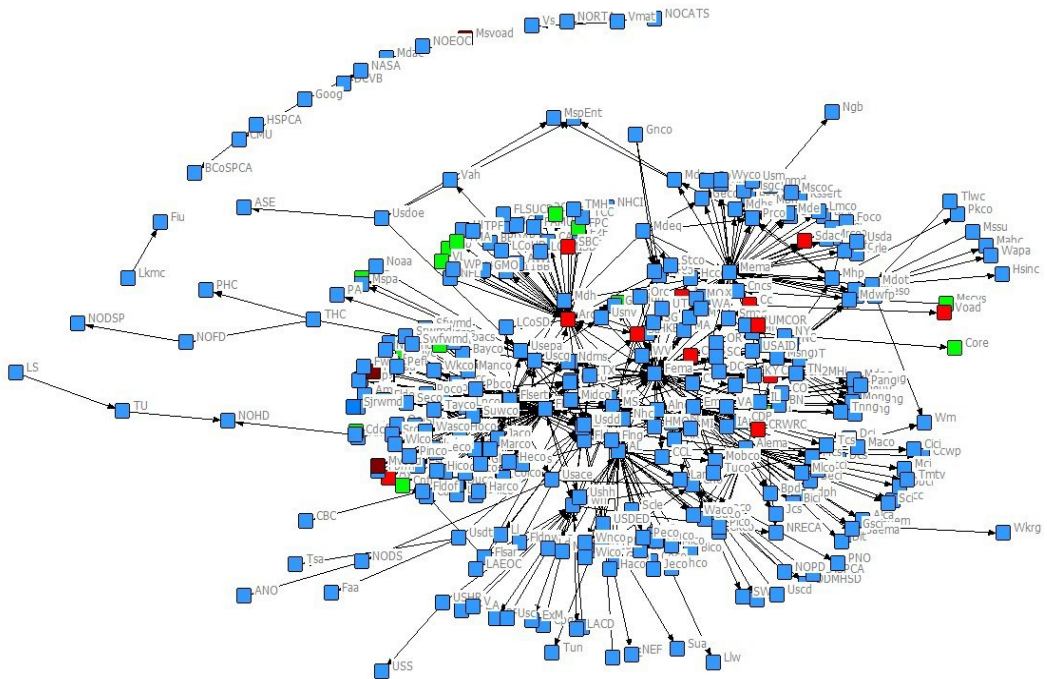


Figure 3. Map of NVOADs and other nonprofit organizations in Hurricane Katrina Emergency Response Network

Legends: Red Squares (NVOAD members), Green Squares (Other Non-profit Organizations), Dark Red Squares (Other VOADs), Blue Squares (Other Organizations)

The above figure illustrates interactions amongst various organizations involved in emergency response during and after Hurricane Katrina. Isolates, meaning organizations that have no reported interaction with others, are not shown in the figure. The network is less dense in the center compared to the 9/11 network and has more and larger cliques across the network. However, NVOAD member organizations (red) occupy positions in several parts of the network, while other VOADs (brown) and nonprofit organizations (green) are similarly located.

Table 6. Degree centrality measures of organizations in the Hurricane Katrina response network

	Organization name	Degree
1	Florida Special Emergency Response Team	14.483
2	Federal Emergency Management Agency	11.552
3	Mississippi Emergency Management Agency	8.793
4	Florida	8.276
5	American Red Cross	7.069
...
293	Gulf Shores City	0.172
294	Local Law Enforcement Agencies (FL)	0.172
295	New Orleans Capital Area Transit System	0.172
296	Mississippi Chamber of Commerce	0.172
297	Perry County (AL)	0.172
...
577	Warren county (MS)	0
578	Lawrence County (MS)	0
579	Wyoming	0
580	Oxfam America	0
581	Yazoo County (MS)	0
Mean		0.314

Table 6 (above) shows the top 5, mid 5, and lowest 5 organizations ordered according to their degree centrality measures. Because the number of organizations in the network is very large, and most of them are public or for-profit organizations, the authors decided to only present the upper, middle, and lower five scores in each network. Degree centrality estimates the actor’s centrality in the network in terms of their number of ties. Here, the Florida State Emergency Response Team (FL SERT) and FEMA scored highest in terms of the number of interactions they had during emergency response. The American Red Cross is the number five organization in the network in terms of its number of ties, which is consistent with the September 11th response analysis. Although samples of the mid and lowest 5 organizations indicate that not one is a NVOAD member, however Table 7 below shows that there are several NVOAD members in the mid and low level centrality measures.

Table 7. Closeness centrality measures of organizations in the Hurricane Katrina response network

	Organization name	Closeness
1	New Orleans Health Department	0.2
2	Hancock County (MS)	0.2
3	Pearl River County (MS)	0.2
4	Forrest County (MS)	0.2
5	Mallette Brothers Construction	0.2
...
293	Veterinary Services	0.172
294	Florida International University	0.172
295	Federal Aviation Administration	0.172
296	Transportation Security Administration	0.172
297	Private Helicopter Companies	0.172
...
577	Warren county (MS)	0.172
578	Lawrence County (MS)	0.172
579	Wyoming	0.172
580	Oxfam America	0.172
581	Yazoo County (MS)	0.172
Mean		0.185

In Table 7 (above), the closeness centrality measures for the top, mid, and lowest five organizations in the Hurricane Katrina response network are presented. Closeness centrality measures the centrality of network actors by determining how close each actor is to the other actors in terms of the shortest possible path (Hanneman, 2001). Although the Florida State Emergency Response Team and FEMA have the greatest number of links in the network (degree of centrality), they do not score highest in terms of the closest path to every actor in the network, because, as it can be seen in Figure 3 (above), some actors are scattered farther from the center to the peripheries in the response to Hurricane Katrina. The New Orleans Health Department and Hancock County (MS) had the closest path to every other actor in the network. Again, there is not a NVOAD member in the top 5, though there are some VOADs in the mid 5 and lowest 5 levels.

Table 8. Betweenness centrality measures of organizations in the Hurricane Katrina response network

	Organization name	Betweenness
1	Federal Emergency Management Agency	2.589
2	Florida Special Emergency Response Team	1.791
3	Mississippi Emergency Management Agency	1.358
4	American Red Cross	1.32
5	Emergency Management Assistance Compact	0.986
...
293	Gulf Shores City	0
294	Leon County Whole Child	0
295	Lake Charles Regional Airport	0
296	Lauderdale County (AL	0
297	Lee County (FL)	0
...
577	Warren county (MS)	0
578	World Vision	0
579	Wyoming	0
580	Wayne County	0
581	Yazoo County (MS)	0
Mean		0.023

The betweenness centrality measures of the organizations in the Hurricane Katrina response network are presented in Table 8. Betweenness centrality measures the position of an actor in the network with respect to its geodesic path between other actors, and it indicates the extent to which it is capable of acting as a broker (Hanneman, 2001). The table shows that FEMA and Florida State Emergency Response Team have the highest betweenness scores, meaning that they had played important broker role in the network. American Red Cross, a NVOAD member organization, has scored the fourth highest in its role acting as a bridge among several organizations in the network.

Table 9. Centrality measures of NVOAD members in the Hurricane Katrina response network

Degree order	Organization name	Degree	Closeness	Betweenness
5	American Red Cross	7.069	0.199	1.320
33	Salvation Army	0.69	0.199	0.008
38	Catholic Charities USA	0.69	0.199	0.024
55	Seventh Day Adventist Church	0.345	0.199	0
58	Miami VOAD	0.345	0.199	0
85	Adventist YES Corps	0.345	0.199	0
115	Adventist Community Services Disaster Response	0.345	0.199	0
155	Church World Service	0.172	0.199	0
161	Convoy of Hope	0.172	0.199	0
170	Florida VOAD	0.172	0.199	0
197	VOAD	0.172	0.199	0
202	Baptist Convention Disaster Relief	0.172	0.199	0
234	Mississippi VOAD	0.172	0.172	0
237	Christian Disaster Response	0.172	0.199	0
283	Southern Baptist Convention	0.172	0.172	0
306	Christian Reformed World Relief Committee	0.172	0.199	0
313	United Methodist Committee on Relief	0.172	0.199	0
337	Faith Presbyterian Church	0.172	0.199	0
465	Southern Baptist Disaster Relief Fund	0	0.172	0

The measures of degree, closeness, and betweenness centrality of NVOAD member organizations and some state and local VOADs are presented in table 9 (above). The American Red Cross has the highest score in all the centrality measures, and Catholic Charities USA is the only other organization that played the role of being a bridge in interactions of other organizations in the network. As a point of clarification, although the Southern Baptist Disaster Relief Fund has a 0.000 degree centrality score, it has a 0.172 betweenness score, which might not make sense. Although scores are normalized to the corresponding network, zero is not absolute.

Table 10. Cliques in Hurricane Katrina response network with 5 members

1	Emergency Management Assistance Compact, Federal Emergency Management Agency, Florida, Florida Special Emergency Response Team, Mississippi
2	American Red Cross, Federal Emergency Management Agency, Florida, Florida Special Emergency Response Team, Mississippi
3	Federal Emergency Management Agency, Florida, Florida Special Emergency Response Team, Mississippi, US Department of Defense
4	Alabama, American Red Cross, Federal Emergency Management Agency, Florida Special Emergency Response Team, Mississippi
5	Alabama, Emergency Management Assistance Compact, Federal Emergency Management Agency, Florida Special Emergency Response Team, Mississippi
6	Alabama, Federal Emergency Management Agency, Florida Special Emergency Response Team, Mississippi, US Department of Defense
7	American Red Cross, Federal Emergency Management Agency, Florida Special Emergency Response Team, Louisiana, Mississippi
8	Federal Emergency Management Agency, Florida Special Emergency Response Team, Louisiana, Mississippi, US Coast Guard
9	Federal Emergency Management Agency, Florida Special Emergency Response Team, Louisiana, Mississippi, US Department of Defense
10	Alabama, Alabama Emergency Management Agency, National Guard (AL), Emergency Management Assistance Compact, Mobile County (AL)
11	Alabama, Alabama Emergency Management Agency, National Guard (AL), Emergency Management Assistance Compact, Mississippi
12	Alabama, Alabama Emergency Management Agency, Emergency Management Assistance Compact, Federal Emergency Management Agency, Mississippi

Tables 10 and 11 (above) show the cliques of organizations in the Hurricane Katrina response network. Clique analysis demonstrates subgroups within a network in which all members of a subgroup are connected to one another. There were 12 core overlapping cliques of five organizations in the network, and the only nonprofit organization represented was the American Red Cross. Also, there were 15 core, overlapping cliques of four organizations in the network with Catholic Charities USA in one clique and the American Red Cross in four other cliques. This indicates that Catholic Charities USA and the American Red Cross have a mutual relationship with all members of the cliques they are involved in. This kind of clique membership is essential for sharing information, resources, and expertise.

The Hurricane Katrina network analysis shows that the NVOAD structure of each network is different, and that NVOAD member organizations have participated in the network. However, except for the American Red Cross, they

scored low in terms of the number of collaborative interactions and brokerage relationships, which is similar to the majority of organizations in the network.

Table 11. Cliques in Hurricane Katrina response network with 4 members

1	Broward County (FL), Federal Emergency Management Agency, Florida, Florida Special Emergency Response Team
2	Federal Emergency Management Agency, Florida, Florida Special Emergency Response Team, Okeechobee County (FL)
3	Broward County (FL), Florida, Florida Special Emergency Response Team, Palm Beach County (FL)
4	US Department of Homeland Security, Florida Special Emergency Response Team, Louisiana, US Coast Guard
5	Alabama, Alabama Emergency Management Agency, National Guard (AL), Baldwin County (AL)
6	Alabama Emergency Management Agency, Federal Emergency Management Agency, Louisiana, Mississippi
7	Alabama Emergency Management Agency, National Guard (AL), Louisiana, Mississippi
8	Alabama Emergency Management Agency, Emergency Management Assistance Compact, Mississippi, National Guard (MS)
9	National Guard (AL), American Red Cross, Louisiana, Mississippi
10	Alabama, National Guard (AL), American Red Cross, Mississippi
11	State Troopers (AL), Emergency Management Assistance Compact, Federal Emergency Management Agency, Mississippi
12	Catholic Charities USA, Corporation for National and Community Services, Federal Emergency Management Agency, Mississippi Emergency Management Agency
13	Federal Emergency Management Agency, Houston Mayor, Texas, US Department of Defense
14	American Red Cross, Federal Emergency Management Agency, Louisiana, Texas
15	Federal Emergency Management Agency, Louisiana, Texas, US Department of Defense

Findings of the study indicate that nearly half of the NVOAD agencies interacted with others in the Emergency Management networks. The NVOAD members are relatively closer to the network center, especially the American Red Cross. In addition, most NVOAD agencies have relatively fewer connections in the network with less potential to bridge other actors and groups. It is believed that investments in developing formal and informal relationships with other actors in the network can help the NVOAD agencies have important collaborative links with regard to the flow of information and resources.

This article reiterates the importance of collaboration among nonprofit organizations and other organizations in the response network in terms of sharing resources, information, and risk. In order to achieve a higher level of collaborative capacity, the American Red Cross can be accepted as a role model in terms of its connectivity with other organizations in the network. It is recommended that NVOAD organizations set up teams and streamline their efforts at achieving connectivity according to the best practices and evaluate their collaborative capacity from time to time according to the benchmarking that the best practices provide. If successful NVOAD members will be better able to accomplish their mission of communication, coordination, collaboration, and cooperation.

There are several limitations for the findings of this paper. First, situation reports might be biased in terms of their interactions because most of these are self-reported. Because most situation reports are created by FEMA and ARC, those two organizations might appear over-represented in both networks. However, it is also expected that FEMA and ARC have important positions in networks because of their legal mandates. Second, the interactions of organizations recorded in news reports might be questionable in terms of their validity. However, they are important source of information with less cost and they do illustrate, albeit within media's perspective, how organizations have interacted during the time period of the study. Finally, social network analysis has inherent limitations too. It depicts relationships among organizations as ties among nodes, but it does not focus much on the attributes of individual organizations. However, the strength of this approach precisely lies in this and this paper have used it to understand how nonprofit organizations are structurally located in the response network and how that explains their effectiveness.

6. Conclusion

Nonprofit organizations have had important roles and responsibilities in disaster relief throughout American history. Nonprofit organizations were the primary first responders during the times when government actors did not carry the burden of saving citizen lives and properties. Governments started getting involved in early 20th century, and the 21st century ushered in unique challenges and complexities, which necessitated a need for the integration of actions of response organizations across political jurisdictions and organizational sectors under the umbrella of a unified national disaster policy. This paper tracks changes in the national disaster policy with regard to the nonprofit sector by looking at the roles ascribed to nonprofit organizations in the Federal Response Plan (FRP), the National Response Plan (NRP), and the National Response Framework (NRF). Also, data collected from major newspapers and organizational reports about inter-

organizational interactions of emergency management agencies during the September 11th attacks and Hurricane Katrina are analyzed by using social network analysis tools. The findings of the study indicate that there has been an increase in the interactions of National Voluntary Organizations Active in Disasters (NVOAD) network member organizations in keeping with changes in the National Response Plan to involve nonprofit organizations in the national disaster planning process.

Nearly half of the NVOAD agencies have reportedly interacted with others in the emergency management networks. Moreover, the NVOAD members relatively close to the network center in both of the cases studied experienced enhanced communication and the acquisition of necessary resources to achieve their missions. In contrast, the NVOAD agencies that had relatively few connections in the network experienced a limited ability to respond to the disaster. It is recommended that the organizations at the center of the network share their best practices of collaboration with the other NVOAD members. Investments by the NVOAD coalition in developing formal and informal relationships with other actors in the network can help NVOAD agencies have important collaborative links with regard to the flow of information and resources. The research can be furthered by surveying the perceptions of NVOAD members about their awareness of the network and their role in national disaster response, as well as the extent to which they are using the NVOAD coalition to coordinate their activities.

Network analysis offers a unique opportunity to study the complex nature of disaster response and the role of nonprofit organizations in the response effort. The next research step is to conduct an in-depth survey of NVOAD member organizations focusing on understanding disaster network formation and sustainability. It is possible that some of the smaller nonprofit organizations that belong to NVOAD are overlooked by the data sources, and researchers should look at these smaller organizations for case analysis. Lastly, future research should focus on conducting an in-depth analysis with some description of network positions and case analysis of the organizations with high scores and the ones with low centrality scores. This analysis would offer the opportunity to discover best practices used by nonprofit organizations to improve emergency management network performance and to identify barriers to enhanced network performance.

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A Study on Regime Type and Globalization in Simultaneous Equation Framework

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Abstract

In this study we build a simultaneous equation model in which the measures of different aspects of globalization (attributable to KOF) and different aspects of democracy (attributable to EIU) are related in seven structural equations. A bi-directional relationship between democracy and globalization is visualized. The model is estimated by the conventional 2-SLS as well as a modified 2-SLS in which Shapley value regression is used at the second stage of 2-SLS. On the basis of our analysis, we document several findings. First, we find that democracy and globalization promote each other and hence there is a bi-directional causality with positive relationships running both ways between democracy and globalization. At a national level, there may be various intermediary conditions that modify the relationship as well as set in motion a complex of positive and/or negative feedbacks to accelerate or retard the pace of globalization and democratization in a country-specific manner. However, when a large number of countries are studied, a clear relationship emerges out. Second, there is a need to estimate the structural coefficients of the model cautiously since the regression equations may be suffering from collinearity among the predictor variables. The Shapley value regression based 2-SLS has performed better than the conventional regression in estimating the structural parameters of the model. Third, the system methods of estimation of the model gives better results than what are obtained by the single equation methods of estimation of structural parameters of the model.

Keywords: *Simultaneous equations model; Two-Stage Least Squares; Instrumental Variables; Collinearity; Shapley Value Regression; Democracy Index; Globalization Index.*

JEL Classification: *C30, C36, C51, C57, C61, C71, F63.*

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1. Introduction

The bearing of regime type (that has democracy and authoritarianism at two opposite poles) on globalization are debatable. On the one hand, there are research findings and arguments that suggest a positive influence of democratic attributes in governance on globalization, while, on the other hand, there are empirical studies as well as consorted line of reasoning that favours authoritarian elements in governance to promoting globalization. Reversing the arrow of causality, some scholars have given the logic along with empirical evidences that globalization promotes democracy while some others have reasons to contend that globalization hurts democracy. Since a political regime has more pervasive, direct and explicit effects, the issue of impacts of globalization on democracy has elicited more attention of the scholars.

Economists such as Schumpeter (1950), Lipset (1959), and Hayek (1960) argue that free trade and capital flows, by enhancing the efficiency of resource allocation lead to economic development which fosters demand for democracy. Schwartzman (1998) identifies class conflict as the social mechanism linking world-system processes to national political dynamics. In this framework, domestic political structures become part of the evolving transnational fabric of economic relations. Consequently, globalization promotes democracy at the national level which in turn facilitates further globalization in the interest of the dominant world economic system.

Li and Reuveny (2003) study 127 countries for 26 years (1970-1996) and finds that different constituents of globalization affect democracy in different manner not conformal to each other. In their own words: *“Trade openness and portfolio investment inflows negatively affect democracy. The effect of trade openness is constant over time while the negative effect of portfolio investment inflows strengthens. FDI inflows positively affect democracy, but the effect weakens over time. The spread of democratic ideas promotes democracy persistently over time.”*

Sobhan (2003) argues that the process of globalization represents involuntary and often extraneous constraints on the government and the people of a country. Countries with weak democratic institutions and undiversified or externally dependent economies fall prey to the globalization forces. Globalization may favourably help the economies that can diversify and where political institutions are strong enough to protect the interests of the citizens of different sections.

Rudra (2005) covers 59 developing countries for the time period 1972-97 and finds that globalization does not directly and unconditionally promote democracy. Increasing exposure to international export and financial markets does lead to

improvements in democracy only if safety nets are used simultaneously as a strategy for providing stability and building political support.

Eichengreen and Lebang (2006) analyses a long series of historical data (1870-2000) for a large number of countries and finds a bidirectional causality suggesting the existence of positive relationships running both ways between democracy and globalization.

For Acemoglu and Robinson (2006a) the relationship between development and political regime is not a direct one. The political regime type shapes and is also shaped by economic conflict between elites and citizens. Political elites are unlikely to block development when there is a high degree of political competition or when they are highly entrenched. Expected political replacement effect has a direct bearing on the involvement of the elite class in a country in facilitating or discouraging globalization. Acemoglu and Robinson (2006b) also observe that key democratizing forces associated with trade openness depend on country's relative factor endowment.

Milner and Mukherjee (2009) studies 130 developing countries in the period 1975-2002 distributed over different continents. It finds that democracy fosters trade and capital account liberalization, while the effect of economic openness on democracy is positive but weak. Neither trade nor capital account liberalization has any statistically significant effect on democratization.

Turyahikayo (2014) examines the impact of globalization on domestic political structures and processes in established, transitional and non-democratic regimes. It reveals that globalization has been used as a tool by the established democracies with strong economies to exploit transitional governments and non-democracies through expanding the range of exploitative investment to bring poorer countries in the ambit of influence. Such an expansion feeds on cheap labour. The destination countries of such investment also work as dumping ground for the industrial waste.

Steiner (2015) studies macro-level dataset on legislative elections in 23 established democracies over the period 1965-2006 to test the hypothesis that higher levels of economic globalization result in lower turnout (for voting). The results of the study emphatically indicate that economic globalization has negative effects on electoral turnout in established democracies on account of reduced party polarization (low dispersion) with limited option with regard to economic policy that also induces citizens to think of contesting parties as having less influence on the economy. In view of this, globalization may have a negative effect on public participation in the political domain.

Nayyar (2015) observes that the relationship between democracy and globalization is dialectical rather than linear or unidirectional. The causation runs in both directions in different spheres whose interaction shapes the outcome.

Stein (2016) investigates into the question whether a sovereign state system, democratic governments, and an integrated global marketplace can coexist. It assesses analytic materialist arguments for their incompatibility and the key assumptions on which they rest. It *“describes the extant pressures operating to limit each of the three: how sovereignty and democracy work to constrain globalization, how globalization and sovereignty generate a democratic deficit, and how globalization and democracy lead to limitations upon, and even the transcendence of, sovereignty.”*

Haffoudhi and Bellakhal (2016) finds that the impact of globalization on democracy is demographic-regime specific. Countries that overlooked Malthusian constraints fostered democracy, whereas countries with late demographic transitions, suffering yet of Malthusian constraints, famines and chronic under-nutrition or failed to invest in human capital and consequently have had inefficient resource allocation, also fail to promote democracy.

Kollias and Paleologou (2016) studies the relationship between KOF¹ globalization indices and Polity measures of democracy in 110 countries of different income levels (high, medium and low) for the period 1970-2011 and finds a positive impact of globalization on democracy, but this is not universally true across all income groups since any effect exerted by globalization on democracy may differ depending on a country's attributes.

This brief review of research suggests that the relationship between globalization and democracy (or the political regime of whatever type) may not be direct. It is mediated by the country-specific institutions, class interests, resource endowments, institutional structure, demographic characteristics, involvement and effectiveness of the national government in proper management of the economy and the polity and so on. Depending on mediating forces globalization and democratization may have mutually reinforcing or mutually conflicting relationship. However, irrespective of the country-specific scenarios, a canonical correlation analysis of the measures of democracy and the measures of globalization of a large number of countries indicates that democracy and globalization are conformal to each other.

¹ KOF [Konjunkturforschungsstelle or Economic Research Centre of ETH Zurich]. 2017 Index of globalization. http://globalization.kof.ethz.ch/media/filer_public/2017/04/19/rankings_2017.pdf

2. The Present Study

The investigation at hand acknowledges bi-directional causality between globalization and democracy (or the political regime that has full democracy at the one end and authoritarianism at the other). It holds that the regime type affects the extent of globalization and also that globalization affects the regime type tending to favour democratization.

To capture the bi-directional causality mentioned above, this study constructs a simultaneous equation model in which five measures (detailed out below) of different aspects of a regime, ranging between the two poles of full democracy and authoritarianism, aim at explaining six indicators of globalization (detailed out below). Additionally, some of the indicators of globalization influence the overall index of democracy. The globalization indicators as well as the overall index of democracy are, thus, the endogenous variables in the model while the indicators of political regime are predetermined (exogenous) variables.

The Economist Intelligence Unit (EIU), a British business within the Economist Group has published the Democracy Index for 2006, 2008 and 2011 and for every year afterwards up to 2016. The index is based on 60 indicators grouped in five different categories or dimensions of regime ranging from democracy to authoritarianism. These categories are: Electoral process and pluralism (*EPP*), Functioning of government (*FOG*), Political participation (*PPN*), Political culture (*PCL*) and Civil liberties (*CVL*), each one measured by an index.

The five measures of different aspects of democracy (*EPP*, *FOG*, *PPN*, *PCL* and *CVL*) mentioned above pertaining to any particular year may be suitably weighted and aggregated to yield an overall index (*DI*, or the Index of Democracy with the score value in the range of zero to ten). On the basis of the score value (*DI*) the political systems of different countries may be classified into Full democracies (score value in 8-10 range), Flawed democracies (score value in 6 to below-8 range), Hybrid regimes (score value in 4 to below-6 range) and authoritarian regimes (score value below 4).

The KOF² visualizes three aspects of globalization: economic, social and political. The economic aspect of globalization is measured by two indices, the social aspect of globalization is measured by three indices and the political aspect has only one measure. The indices of globalization are, thus, six in number. They are: (1) *E1* - actual economic flows such as trans-border trade, direct investment and portfolio investment, (2) *E2* - relaxation of restrictions on trans-border trade

² KOF [Konjunkturforschungsstelle or Economic Research Centre of ETH Zurich]. 2017 Index of globalization. http://globalization.kof.ethz.ch/media/filer_public/2017/04/19/rankings_2017.pdf

as well as capital movement by means of taxation, tariff, etc., (3) *S1* - trans-border personal contacts such as degree of tourism, telecom traffic, postal interactions, etc., (4) *S2* - flow of information, (5) *S3* - cultural proximity, and (6) *P* - the measure of trans-national political set up. All the six (*E1* through *P*), by a scheme of linear combination, are used to arrive at the overall composite index of globalization (say, Γ) as described in Dreher (2006) and Dreher et al. (2008). Mishra (2017) uses Almost Equi-Marginal Contribution (AEMC) principle for making a linear combination of globalization aspect indicators *E* through *P*. Unlike the KOF index of globalization (based on linear aggregation through the Principal Component Analysis), the AEMC index of globalization is based on the linear aggregation such that the expected mean marginal contributions (Shapley value shares) of all constituent variables to the synthetic index are as close to each other as possible. The composite index of globalization based on AEMC principle may be denoted by *G*.

Table 1. Summary for Data Abbreviation and Description

Abbreviation	Description
EPP	Electoral process and pluralism;
FOG	Functioning of government;
PPN	Political participation;
PCL	Political culture;
CVL	Civil liberties;
DI	Index of Democracy with score value range between 0-10;
E1	Actual economic flows such as trans-border trade, direct investment and portfolio investment;
E2	Relaxation of restrictions on trans-border trade as well as capital movement by means of taxation, tariff, etc.;
S1	Trans-border personal contacts such as degree of tourism, telecom traffic, postal interactions, etc.;
S2	Flow of information;
S3	Cultural proximity;
P	The measure of trans-national political set up.

3. A Simultaneous Equation Model of Globalization and Regime Type

Since our study visualizes a bi-directional causal relationship between democracy (political regime type) and globalization, the measures of different aspects (economic, social and political) of globalization are endogenous variables that directly or indirectly influence each other. The overall democracy index at a later date (DI_{16} for the year 2016) also is one of the endogenous variables influenced by the globalization indices of the earlier date (during 2006-2014). The measures of different aspects of democracy (for the year 2006) are the predetermined (exogenous) variables. Our simultaneous equation model is given in the schematic form as under. We have made a comparative study of two scenarios that we describe in the next section. In the model below, t is denoting pessimistic or optimistic vector pertaining to the two scenarios. All the relationships in the model characterize following linear equations (abbreviations in table 1).

$$E1_t = f(E2_t, S1_t, FOG_{06}, PCL_{06}, CVL_{06}) \quad eq. (01)$$

$$E2_t = f(S2_t, S3_t, P_t, EPP_{06}, PPN_{06}) \quad eq. (02)$$

$$S1_t = f(E1_t, S3_t, FOG_{06}, PCL_{06}, CVL_{06}) \quad eq. (03)$$

$$S2_t = f(E2_t, FOG_{06}, PPN_{06}, PCL_{06}, CVL_{06}) \quad eq. (04)$$

$$S3_t = f(P_t, EPP_{06}, FOG_{06}, PPN_{06}, PCL_{06}) \quad eq. (05)$$

$$P_t = f(E1_t, E2_t, S1_t, S2_t, S3_t) \quad eq. (06)$$

$$DI_{16} = f(E2_t, S1_t, S2_t, S3_t, P_t) \quad eq. (07)$$

4. Data on the Measures of Democracy and Globalization

Under our study there are 116 countries distributed over the continents, viz. Africa, the Americas, Asia, Australia, Europe and Oceania. These countries together represent all types of political regime (full democracy to authoritarian) and all levels of globalization (very low, medium and high). The data used by us are presented in the appended tables: Table A1, Table A2 and Table A3.

In table A1 we present five measures for democracy (EPP_{i06} , FOG_{i06} , PPN_{i06} , PCL_{i06} and CVL_{i06} ; $i=1$ through 116) for the year 2006 as well as the overall measure of democracy for 2016. The measures of democracy for 2006 make our exogenous variables while the overall measure of democracy for 2016 (DI_{i16} $i=1,2,\dots, 116$) is one of our endogenous variables.

As to the measures of different aspects of globalization, we have used the KOF indices³ for the period 2006-2014. However, we have not used a time series data for any country under study for the entire period 2006-2014. From the available time series over the years (for all countries under study), we have formed two scenarios. For any particular i^{th} country (among 116 countries considered in the study at hand) we have G for 9 years, 2006-2014 that we denote by $G_{ij}; j=2006$ through 2014 and $i=1$ through 116.

For every G_{ij} we have the associated sub-indices [$E1_{ij}$, $E2_{ij}$, $S1_{ij}$, $S2_{ij}$, $S3_{ij}$ and P_{ij} ; $j=2006$ through 2014 and $i=1$ through 116]. We have constructed two vectors:

$$(1) \quad [E1_i^{min}, E2_i^{min}, S1_i^{min}, S2_i^{min}, S3_i^{min}, P_i^{min}]$$

which is associated with

$$G_i^{min} = \min(G_{ij}; j \in [2006, 2014]) \quad \text{where } i = 1, 2, 3, \dots, 116$$

that gives us the set of values associated with the lowest extent of globalization experienced by any country during 2006-2014.

Similarly,

$$(2) \quad [E1_i^{max}, E2_i^{max}, S1_i^{max}, S2_i^{max}, S3_i^{max}, P_i^{max}]$$

which is associated with

$$G_i^{max} = \max(G_{ij}; j \in [2006, 2014]) \quad \text{where } i = 1, 2, 3, \dots, 116$$

that gives us the set of values associated with the highest extent of globalization experienced by any country during 2006-2014. We may call them pessimistic (associated with G^{min}) and optimistic (associated with G^{max}) vectors of globalization. We have these two vectors as our endogenous variables for estimating the model for pessimistic effects of the indicators of the political regime and optimistic effects of the indicators of the political regime.

5. Estimation of the Model

There are several methods to estimate a simultaneous equation model that may be primarily classified into two groups: (1) single equation methods, and (2) system methods. The single equation methods are easy to apply and free from the undesirable effects of misspecification of other equations in the model, but they are susceptible to the detrimental effects of disturbances correlated across the

³ KOF [Konjunkturforschungsstelle or Economic Research Centre of ETH Zurich]. 2017 Index of globalization. http://globalization.kof.ethz.ch/media/filer_public/2017/04/19/rankings_2017.pdf

equations. The system methods are cumbersome and susceptible to the problems of misspecification of equations in the model, but they perform well even if the disturbances across the equations are correlated. Between the single equation and the system methods of estimation, thus, there is a trade-off between deleterious effects of '*misspecification*' and '*correlated residuals across the equations*' in the model. Since little is known about correct specification of different equations in our model, we have favoured the single equation method of estimation for ease in computation as well as for avoiding the possible risk in proceeding to the system method of estimation under the circumstances of misspecification. We also do not have reasons to assume the disturbances in the equations to be normally distributed. Under these circumstances we have chosen the Two-Stage Least Squares (2-SLS) method of estimation since it handles instrumental variables in a very natural manner.

5.1. The Two-Stage Least Squares for structural Equations

If an econometric model is specified as $YA + XB + U = 0$ (where Y are current endogenous and X are predetermined variables), the 2-SLS method first obtains the Ordinary Least Squares (OLS) based expected values of Y by the relationship $\hat{Y} = XC$ (where C is the matrix of reduced form coefficients) and in order to proceed to the second stage substitute the estimated \hat{y} for observed y in the equation wherever it is a regressor variable (and not the regressand variable). Thus, among the regressor variables \hat{y} would be used as an instrumental variable (Reiersol, 1945) representing y , while x is its own instrument. This approach renders the use of OLS at the second stage free from the stochastic regressor problem.

5.2. Possible Collinearity among Regressors at the 2nd Stage and its Treatment

However, since at the second stage, the 2-SLS uses the estimated values of some endogenous variables together with some predetermined variables as regressors, collinearity among the regressor variables may arise. This is because the estimated values of endogenous variables are the linear functions of the predetermined variables in the model. Collinearity may affect standard errors of the estimated parameters. Signs of the estimated parameters also may be wrong (Smith and Brainard, 1976). In view of this, we have also used the Shapley value regression at the second stage of 2-SLS and compared the results of this choice with the conventional method that uses OLS at the second stage.

5.3. The Shapley Value Regression

Shapley value regression significantly ameliorates the deleterious effects of collinearity on the estimated parameters of a regression equation. The concept of Shapley value was introduced in (cooperative collusive) game theory where agents form collusion and cooperate with each other to raise the value of a game in their favour and later divide it among themselves. Distribution of the value of the game according to Shapley decomposition has been shown to have many desirable properties (Roth, 1988, pp.1-10) including linearity, unanimity, marginalism, etc. Following this theory of sharing of the value of a game, the Shapley value regression decomposes the R^2 of a conventional regression (which is considered as the value of the collusive cooperative game) such that the mean expected marginal contribution of every predictor variable (agents in collusion to explain the variation in y , the dependent variable) sums up to R^2 .

The scheme of Shapley value regression is simple. Suppose z is the dependent variable and $x_1, x_2, \dots, x_k \in X$ are the predictor variables, which may have strong collinearity. Let $Y_i \subset X$ in which $x_i \in X$ is not there or $x_i \notin Y_i$. Thus, Y_i will have only $k-1$ variables. We draw r ($r=0, 1, 2, \dots, k-1$) variables from Y_i and let this collection of variables so drawn be called P_r such that $P_r \subseteq Y_i$. Also, $Y_i = Y_i \cup \emptyset$. Now, P_r can be drawn in $L=kCr$ ways. Also, let $Q_r = P_r \cup x_i$. Regress (least squares) z on Q_r to find $R^2_{q_r}$. Regress (least squares) z on P_r to obtain $R^2_{p_r}$. The difference between the two R-squares is $D_r = R^2_{q_r} - R^2_{p_r}$, which is the marginal contribution of x_i to z . This is done for all L combinations for a given r and arithmetic mean of D_r (over the sum of all L values of D_r) is computed. Once it is obtained for each r , its arithmetic mean is computed. Note that P_r is null for $r=0$, and thus Q_r contains a single variable, namely x_i . Further, when P_r is null, its R^2 is zero. The result is the arithmetic average of the mean (or expected) marginal contributions of x_i to z . This is done for all x_i ; $i=1, k$ to obtain the Shapley value (S_i) of x_i ; $i=1, k$. In the regression model $z=Xb+u$, the OLS gives a value of R^2 . The sum of all S_i ; $i=1,2, \dots, k$ is equal to R^2 . Thus, OLS R^2 has been decomposed. Once all Shapley value shares are known, one may retrieve the coefficients (with original scale and origin) by solving an optimization problem suggested by Lipovetsky (2006) using any appropriate optimization method. A simple algorithm and computer program is available in Mishra (2016).

6. Empirical Findings

As pointed out earlier, we have used two alternative vectors of globalization measures, the one related to G^{\min} and the other related to G^{\max} . Therefore, we

have two parallel findings, the one for a pessimistic view and the other for an optimistic view of globalization.

The reduced form coefficients matrices C (based on OLS) are given in table 2 for pessimistic and optimistic views of globalization at Panel A and Panel B respectively. Their standard errors are not presented because the coefficients are used only to obtain the expected values of endogenous variables.

Table 2. Estimated Reduced Form Coefficients Matrix (Transposed C)

Equation Number	Regressand Variable	Reduced Form Coefficients of Predictor Variables (All Predetermined) Relating to Political Regime						R ²
		<i>EPP</i>	<i>FOG</i>	<i>PPN</i>	<i>PCL</i>	<i>CVL</i>	<i>CONST</i>	
Panel A: Pessimistic Scenario of Globalization								
1	E1	-0.09669	0.24146	0.24643	0.18092	0.08821	23.34796	0.3753
2	E2	0.09687	0.28829	-0.00578	0.20171	0.00678	23.07078	0.5184
3	S1	-0.14461	0.08996	0.21068	0.53211	0.30117	-12.02201	0.5231
4	S2	-0.04587	0.05542	0.20342	0.31348	0.22407	21.23889	0.5171
5	S3	-0.01793	0.42558	0.21272	0.55329	0.07899	-33.44582	0.4838
6	P	0.00492	0.00730	0.19940	0.15338	0.09913	46.08075	0.2507
7	DI	0.07114	0.20676	0.09848	0.23259	0.32429	3.07933	0.8982
Panel B: Optimistic Scenario of Globalization								
1	E1	0.12400	0.10555	0.07432	0.20298	-0.06958	42.89204	0.2417
2	E2	0.09679	0.23024	-0.02864	0.24574	0.05692	26.76866	0.5184
3	S1	-0.16699	0.12057	0.22784	0.48374	0.30252	-8.67294	0.5180
4	S2	-0.07373	0.08948	0.19270	0.30243	0.20114	25.23083	0.5035
5	S3	-0.06626	0.45089	0.36109	0.43824	0.11419	-30.03597	0.4843
6	P	0.06859	0.01120	0.17536	0.21128	-0.04321	52.97000	0.2898
7	DI	0.07114	0.20676	0.09848	0.23259	0.32429	3.07933	0.8982

Notes: Numbers in the table are coefficients of predictor variables estimated by OLS technique. Panel A pertains to globalization with pessimistic scenario, while panel B displays estimation with optimistic scenario. For descriptions of abbreviated variables see table 1. Equation numbers correspond to equations 1-7 explained in section 3.

At the second stage, we estimate the structural parameters (A and B) by OLS (i.e. conventional 2-SLS) and present them in table 3 where Panel A and Panel B correspond to pessimistic and optimistic views respectively. As the proposed alternative at the second stage, we also estimate the structural parameters by Shapley value regression and present them in table 4 (pessimistic and optimistic views at Panel A and B respectively). It may be noted that obtaining the coefficients of the Shapley value regression we have to use an efficient

optimization method (Lipovetsky, 2006; Mishra, 2016). In the present study, this is done by the Host-Parasite Co-Evolutionary algorithm, which is a powerful biologically inspired population method of global optimization (Mishra, 2013). In table 3 and table 4, the current endogenous parameters matrix (A) has in the principal diagonal cells minus unity which pertains to the dependent endogenous variable in the equation concerned. A zero in an off-diagonal cell denotes that the endogenous variable is not included in the particular equation. Similarly, in B matrix, a zero in a cell denotes that the particular predetermined variable is not included in the equation concerned.

Moreover, we also report standard errors of estimate of the coefficients corresponding to the Shapley value based 2-SLS structural coefficients reported in table 4 using Jackknife resampling technique. For both (Panel A and B) the *t-value* for all endogenous (but none of the predetermined) predictors are statistically significant at 1% level.

Table 3. Estimated Structural Parameters Based on Conventional 2-SLS Estimation

Eqs. No.	Endogenous Variables (Transposed A Matrix)							Predetermined Variables (Transposed B Matrix)						R ²
	E1	E2	S1	S2	S3	P	DI	EPP	FOG	PPN	PCL	CVL	CONST	
Panel A: Pessimistic Scenario of Globalization														
1	-1	0.7800	1.1911	0	0	0	0	0	-0.0910	0	-0.6100	-0.2760	19.6726	0.3753
2	0	-1	0	1.4254	0.5535	-3.5950	0	0.1899	0	0.3030	0	0	176.946	0.5184
3	1.6709	0	-1	0	-0.9450	0	0	0	0.0888	0	0.7528	0.2284	-82.6508	0.5231
4	0	-0.4740	0	-1	0	0	0	0	0.1919	0.2010	0.4090	0.2273	32.1631	0.5171
5	0	0	0	0	-1	0.7969	0	-0.0220	0.4198	0.0540	0.4311	0	-70.1672	0.4838
6	-0.2110	-0.6580	-0.8960	1.5482	0.5704	-1	0	0	0	0	0	0	41.6162	0.2507
7	0	0.2382	-2.363	6.0177	0.096	-3.2440	-1	0	0	0	0	0	-5.9572	0.8982
Panel B: Optimistic Scenario of Globalization														
1	-1	2.3547	0.6222	0	0	0	0	0	-0.5116	0	-0.6766	-0.3918	-14.7428	0.2417
2	0	-1	0	0.0160	0.5052	0.0923	0	0.1251	0	-0.2303	0	0	36.6456	0.5184
3	-0.9095	0	-1	0	0.8182	0	0	0	-0.1523	0	0.3098	0.1458	54.9108	0.5180
4	0	-0.7618	0	-1	0	0	0	0	0.2649	0.1709	0.4896	0.2445	45.6232	0.5035
5	0	0	0	0	-1	-2.6429	0	0.1150	0.4805	0.8245	0.9966	0	109.9563	0.4843
6	1.2483	-0.6065	-0.0036	0.4164	-0.0394	-1	0	0	0	0	0	0	3.9434	0.2898
7	0	0.8967	-2.2264	4.6889	-0.3119	-0.9095	-1	0	0	0	0	0	-119.7295	0.8982

Notes: Numbers in the table are coefficients of predictor variables estimated by conventional 2-OLS technique. Panel A presents estimation of globalization with pessimistic scenario, while panel B displays estimation with optimistic scenario. For descriptions of abbreviated variables see table 1. Equation numbers corresponds to equations 1-7 explained in section 3.

Table 4. Estimated Structural Parameters Based on Shapley-Value Regression 2-SLS Estimation

Eqs.	Endogenous Variables: Transposed A Matrix							Predetermined Variables: Transposed B Matrix						R ²
	E1	E2	S1	S2	S3	P	DI	EPP	FOG	PPN	PCL	CVL	CONST	
Panel A: Pessimistic view														
1	-	0.2246*** (0.0346) [6.4913]	0.1801*** (0.0265) [6.7962]	-	-	-	-	-	0.1058 (0.2062) [0.5131]	-	0.1413 (0.1769) [0.7988]	0.0857 (0.1334) [0.6424]	-41.2332 (5.6861) [-7.2516]	0.3618
2	-	-	-	0.1921*** (0.0200) [9.605]	0.1235*** (0.0173) [7.1387]	0.2956*** (0.0316) [9.3544]	-	0.0669 (0.1249) [0.5356]	-	0.1025 (0.1418) [0.7228]	-	-	-47.4994 (4.8967) [-9.7003]	0.4803
3	0.3173*** (0.0245) [12.951]	-	-	-	0.1711*** (0.0141) [12.1348]	-	-	-	0.1374 (0.1407) [0.9765]	-	0.2075 (0.1916) [1.0830]	0.1146 (0.1970) [0.5817]	-52.7262 (4.9762) [-10.5957]	0.5040
4	-	0.2622*** (0.0265) [9.8943]	-	-	-	-	-	-	0.1158 (0.1414) [0.8190]	0.1397 (0.2119) [0.6593]	0.1682 (0.2010) [0.8368]	0.1077 (0.1581) [0.6812]	-45.3551 (3.7463) [-12.1066]	0.5058
5	-	-	-	-	-	0.6622*** (0.0872) [7.594]	-	0.1198 (0.2107) [0.5686]	0.2281 (0.3092) [0.7377]	0.2233 (0.3342) [0.6682]	0.2903 (0.3822) [0.7595]	-	-95.9363 (10.7596) [-8.9163]	0.4653
6	0.1334*** (0.0224) [5.9554]	0.1300*** (0.0245) [5.3061]	0.0993*** (0.0173) [5.7399]	0.1444*** (0.0316) [4.5696]	0.0706*** (0.0141) [5.0071]	-	-	-	-	-	-	-	-31.8045 (5.2208) [-6.0919]	0.2392
7	-	0.3241*** (0.0141) [22.9858]	0.2197*** (0.0100) [21.9700]	0.2931*** (0.0100) [29.3100]	0.1585*** (0.0058) [27.3276]	0.4340*** (0.0173) [25.0867]	-	-	-	-	-	-	-84.8041 (3.1439) [-26.9742]	0.8480
Panel B: Optimistic view														
1	-	0.1783*** (0.0363) [4.9118]	0.1106*** (0.0239) [4.6276]	-	-	-	-	-	0.0740 (0.1470) [0.5034]	-	0.0929 (0.1685) [0.5513]	0.0614 (0.1193) [0.5147]	-30.2465 (5.1579) [-5.8641]	0.2295
2	-	-	-	0.2071*** (0.0197) [10.5127]	0.1157*** (0.0126) [9.1825]	0.3142*** (0.0339) [9.2684]	-	0.0693 (0.1516) [0.4571]	-	0.1051 (0.1204) [0.8729]	-	-	-51.7940 (5.0830) [-10.1897]	0.4816
3	0.4186*** (0.0386) [10.8446]	-	-	-	0.1708*** (0.0141) [12.1135]	-	-	-	0.1327 (0.1497) [0.8864]	-	0.2071 (0.2334) [0.8873]	0.1117 (0.2075) [0.5383]	-62.6993 (6.1482) [-10.198]	0.4950
4	-	0.2502*** (0.0240) [10.425]	-	-	-	-	-	-	0.1087 (0.1337) [0.8130]	0.1289 (0.2028) [0.6356]	0.1635 (0.1855) [0.8814]	0.0969 (0.1367) [0.7089]	-44.1332 (3.7357) [-11.8139]	0.4922
5	-	-	-	-	-	0.7641*** (0.0753) [10.1474]	-	0.1297 (0.2202) [0.5890]	0.2512 (0.3311) [0.7587]	0.2468 (0.3410) [0.7238]	0.2919 (0.3301) [0.8843]	-	-109.4473 (10.224) [-10.7049]	0.4720
6	0.1968*** (0.0405) [4.8593]	0.1237*** (0.0178) [6.9494]	0.0862*** (0.0156) [5.5256]	0.1179*** (0.0210) [5.6143]	0.0599*** (0.0100) [5.9900]	-	-	-	-	-	-	-	-35.4534 (5.3336) [-6.6472]	0.2735
7	-	0.3319*** (0.0136) [24.4044]	0.2273*** (0.0115) [19.7652]	0.3195*** (0.0160) [19.9688]	0.1487*** (0.0058) [25.6379]	0.4421*** (0.0209) [21.1531]	-	-	-	-	-	-	-92.4873 (3.3760) [-27.3955]	0.8358

Notes: Numbers in the table are coefficients of predictor variables estimated by Shapley Value Regression 2-SLS technique; their standard errors and t-statistics are presented in parentheses and brackets respectively. The standard errors are derived by Jackknife resampling technique. Panel A presents estimation of globalization with pessimistic scenario, while panel B displays estimation with optimistic scenario. For descriptions of abbreviated variables see table 1. Equation number corresponds to equations 1-7 explained in section 3.

In the last column of tables 2-4, the R^2 values are reported corresponding to each equation. We observe that conventional 2-SLS at the second stage gives the R^2 values that are identical to those obtained for the reduced form equations. However, the R^2 values for the proposed 2-SLS (in which OLS is replaced by the Shapley value regression) are a little smaller than those given by the conventional 2-SLS based on OLS. This cost has to be paid for treating the collinearity problem that has devastating effects on the coefficients of the structural equations.

7. Interpretation

In table 5 we present the Shapley value shares of the predictor variables (in R^2) in different equations of the model for pessimistic and optimistic scenarios, respectively. Their percentage shares in the respective R^2 also are reported. A zero value in a cell(i,j) indicates that the j^{th} predictor variable is absent in the i^{th} equation. The symbol (-) in the principal diagonal cells is the cell for the i^{th} dependent endogenous variable appearing in the i^{th} equation.

As to the significance of the Shapley share of a particular predictor in R^2 , the statistical tests (reported in table 4, though) are not yet well established. Nevertheless, as a thumb rule (which could be very robust) we may state that if R^2 is statistically significant (at, say, 1 percent level and the appropriate degrees of freedom) and there are k predictors, then $100/k$ is the most reasonable share (percentage) that could be attributed to any particular predictor when we have no knowledge of its factual contribution. This is based on the Principle of Insufficient Reason or the Principle of Indifference (Keynes, 1921, pp. 44-70), when no reason is known to distribute the shares differently. On this logic, whenever the share of a predictor variable (5 in number in each equation) is 20 percent or more, it is surely significant. It may be noted that R^2 for all equations are significant at 1 percent. We use this thumb rule and accordingly we have underlined (in table 5) the percentage contribution of those predictors that are not less than 20 percent.

A simple analysis is presented in table 6. Equation-wise, we present the list of predictor variables that have Shapley value shares 20% or more within square brackets [.), those having Shapley value shares not less than 19 percent but less than 20 percent in curly brackets {.) and those having Shapley value shares not less than 18 percent but less than 19 percent in round brackets (.). We do not consider below 18 percent contribution. The symbol U stands for the 'union' set operator. Accordingly, we may assign the importance of the predictor variable. The lists are not identical in the two scenarios. But in any case, the bi-directional causality between democracy and globalization is established. The globalization variables $E2$ (relaxation of restrictions on trans-border trade as well as capital

movement by means of taxation, tariff, etc.) and S2 (flow of information) surely affect democratization (DI_{16}). Among the exogenous (predetermined) variables, CVL (Civil liberties) is a weak and EPP (Electoral process and pluralism) is a very weak predictor.

Table 5. Shapley-Value Shares of Predictors in R^2 and their Percentage

Eqs. No.	Endogenous Variables (Transposed A Matrix)							Predetermined Variables (Transposed B Matrix)					
	E1	E2	S1	S2	S3	P	DI	EPP	FOG	PPN	PCL	CVL	CONST
Panel A: Pessimistic Scenario of Globalization													
1	-	0.0836 (<u>22.26%</u>)	0.0949 (<u>25.28%</u>)	-	-	-	-	-	0.0768 (<u>20.46%</u>)	-	0.0663 (17.65%)	0.0538 (14.35%)	0.3753 (100%)
2	-	-	-	0.1135 (<u>21.89%</u>)	0.1317 (<u>25.40%</u>)	0.1081 (<u>20.85%</u>)	-	0.0849 (16.38%)	-	0.0802 (15.47%)	-	-	0.5184 (100%)
3	0.1233 (<u>23.58%</u>)	-	-	-	0.1253 (<u>23.96%</u>)	-	-	-	0.0894 (17.09%)	-	0.1113 (<u>21.29%</u>)	0.0737 (14.09%)	0.5231 (100%)
4	-	0.1190 (<u>23.01%</u>)	-	-	-	-	-	-	0.0955 (18.46%)	0.1076 (<u>20.81%</u>)	0.1017 (19.67%)	0.0933 (18.04%)	0.5171 (100%)
5	-	-	-	-	-	0.1180 (<u>24.38%</u>)	-	0.0590 (12.20%)	0.1174 (<u>24.26%</u>)	0.0860 (17.77%)	0.1035 (<u>21.38%</u>)	-	0.4838 (100%)
6	0.0486 (19.38%)	0.0458 (18.25%)	0.0493 (19.67%)	0.0595 (23.73%)	0.0476 (18.97%)	-	-	-	-	-	-	-	0.2508 (100%)
7	-	0.1952 (<u>21.73%</u>)	0.1661 (18.50%)	0.1880 (<u>20.93%</u>)	0.1697 (18.89%)	0.1792 (19.95%)	-	-	-	-	-	-	0.8982 (100%)
Panel B: Optimistic Scenario of Globalization													
1	-	0.0632 (<u>26.14%</u>)	0.0513 (<u>21.21%</u>)	-	-	-	-	-	0.0490 (<u>20.25%</u>)	-	0.0401 (16.58%)	0.0382 (15.82%)	0.2417 (100%)
2	-	-	-	0.1171 (<u>22.59%</u>)	0.1282 (<u>24.74%</u>)	0.1023 (19.73%)	-	0.0895 (17.27%)	-	0.0813 (15.68%)	-	-	0.5184 (100%)
3	0.1096 (<u>21.16%</u>)	-	-	-	0.1334 (<u>25.76%</u>)	-	-	-	0.0899 (17.35%)	-	0.1120 (<u>21.63%</u>)	0.073 (14.1%)	0.5180 (100%)
4	-	0.1187 (23.57%)	-	-	-	-	-	-	0.0946 (18.80%)	0.1012 (<u>20.10%</u>)	0.1060 (<u>21.05%</u>)	0.083 (16.48%)	0.5035 (100%)
5	-	-	-	-	-	0.1155 (<u>23.86%</u>)	-	0.0619 (12.79%)	0.1219 (<u>25.18%</u>)	0.0934 (19.28%)	0.0915 (18.89%)	-	0.4843 (100%)
6	0.0667 (<u>23.00%</u>)	0.0548 (18.92%)	0.0547 (18.86%)	0.0576 (19.89%)	0.0560 (19.32%)	-	-	-	-	-	-	-	0.2898 (100%)
7	-	0.2041 (<u>22.72%</u>)	0.1729 (19.25%)	0.1922 (<u>21.40%</u>)	0.1731 (19.27%)	0.1559 (17.36%)	-	-	-	-	-	-	0.8982 (100%)

Notes: The numbers in the table are shares of predictor variables (estimated by Shapley Value decomposition) in 2-SLS R^2 , while their percentage weights are given in the parentheses. We have distinguished the ones whose percentage contribution in R^2 is more than 20% by underlining them. Panel A presents estimation of globalization with pessimistic scenario, while panel B displays estimation with optimistic scenario. For descriptions of abbreviated variables see table 1. Equation numbers corresponds to equations 1-7 explained in section 3.

Table 6. Equation-wise Strength of Predictor Variables According to the Shapley Value Shares

Equations	Pessimistic Scenario	Optimistic Scenario
1	$E1=f([E2, S1, FOG] \cup \{\text{null}\} \cup (\text{null}))$	$E1=f([E2, S1, FOG] \cup \{\text{null}\} \cup (\text{null}))$
2	$E2=f([S2, S3, P] \cup \{\text{null}\} \cup (\text{null}))$	$E2=f([S2, S3] \cup \{P\} \cup (\text{null}))$
3	$S1=f([E1, S3, PCL] \cup \{\text{null}\} \cup (\text{null}))$	$S1=f([E1, S3, PCL] \cup \{\text{null}\} \cup (\text{null}))$
4	$S2=f([E2, PPN] \cup \{PCL\} \cup (FOG, CVL))$	$S2=f([E2, PPN, PCL] \cup \{FOG\} \cup (\text{null}))$
5	$S3=f([P, FOG, PCL] \cup \{\text{null}\} \cup (\text{null}))$	$S3=f([P, FOG] \cup \{PPN\} \cup (PCL))$
6	$P=f([S2] \cup \{E1, S1\} \cup (E2, S3))$	$P=f([E1] \cup \{S2, S3\} \cup (E2, S1))$
7	$DI_{16} =f([E2, S2] \cup \{P\} \cup (S1, S3))$	$DI_{16} =f([E2, S2] \cup \{S1, S3\} \cup (\text{null}))$

Notes: $[.] > 20\%$; $19\% < \{.\} < 20\%$; $18\% < (.) < 19\%$; we do not consider below 18% contribution. The symbol \cup stands for the “union” set operator. Equation numbers corresponds to equations 1-7 explained in section 3.

In table 7 we present the list of predictor variables (equation-wise) that have negatively signed structural coefficients estimated by the conventional 2-SLS. In the first equation (for $E1$) the democracy measures FOG (Functioning of Government), PCL (political Culture) and CVL (Civil Liberties) have negative sign. This is for both pessimistic and optimistic views of globalization. In the second equation P (political measure of globalization) or PPN (Political Participation) adversely affect $E2$ (relaxation of constraints on trans-border flow of goods, services and finance). In equation #3 trans-border personal contacts ($S1$) are adversely affected by cultural proximity ($S3$), trans-border flow of goods, services and finance ($E1$) or the Functioning of the Government (FOG). In equation #4, follow of information ($S2$) is adversely affected by relaxation of restrictions on trans-border trade and flow of finance ($E2$). In equation #4, cultural proximity ($S3$) is adversely affected by electoral process and pluralism (EPP) or political set up for enhancing globalization (P). In equation #6, the political set up for enhancing globalization is adversely affected by trans-border flow of goods, services and finance ($E1$), relaxation for restrictions on trans-border trade etc. ($E2$), trans-border personal contacts and movement of people ($S1$) or trans-border cultural proximity ($S3$). It may be noted that most of these (negative) relationships are unexpected and misleading. They also indicate that different measures of globalization are not in concordance with each other. As to the final equation (#7 for DI_{16}), trans-border personal contacts and movement of people ($S1$), political set up for promoting globalization (P) and/or cultural proximity ($S3$) adversely affect democratization.

Table 7. Predictor Variables that obtain Negatively Signed Structural Coefficients Estimated by the Conventional 2-SLS

Equations	Endogenous (Dependent) Variable	Pessimistic Scenario of Globalization		Optimistic Scenario of Globalization	
		Predictor Variables		Predictor Variables	
		<i>Endogenous</i>	<i>Predetermined</i>	<i>Endogenous</i>	<i>Predetermined</i>
1	E1	-	FOG, PCI, CVL	-	FOG, PCI, CVL
2	E2	P	-	-	PPN
3	S1	S3	-	E1	FOG
4	S2	E2	-	E2	-
5	S3	-	EPP	P	-
6	P	E1, E2, S1	-	E2, S1, S3	-
7	DI ₁₆	S1, P	-	S1, S3, P	-

Notes: Panel A presents estimation of globalization with pessimistic scenario, while panel B displays estimation with optimistic scenario. For descriptions of abbreviated variables see table 1. Equation numbers corresponds to equations 1-7 explained in section 3.

In contrast, a perusal of table 4 (the structural coefficient matrices A' and B' obtained by the proposed Shapley value regression at the second stage) suggests that the coefficients associated with endogenous as well as predetermined variables (except constant terms) are all positive. They suggest that globalization measures are concordant with each other and the democratic regimes promote globalization. We also find that DI_{16} is positively affected by all predictor variables included in equation #7, indicating that globalization promotes democratization.

The contrasting results obtained by the conventional 2-SLS and the proposed Shapley value based 2-SLS indicate that neither data nor the specification in our model were responsible for the unexpected results provided by the conventional 2-SLS, but the problem was created by collinearity at the second stage of the 2-SLS. A treatment of the problem of collinearity by using the Shapley value regression at the second stage of 2-SLS has rendered the results that are conformal to our expectation based on reasoned and realistic ground.

In table 8 we present the correlation matrices of disturbances across the equations. A larger magnitude of correlation in an off-diagonal cell indicates cross correlation of residuals that may affect the efficiency of an equation method of estimation and prompt to seek for an application of any system method of estimation such as 3-SLS or FIML. A perusal of the elements of correlation matrices reveals that while for DI_{16} the cross correlations are often very small (irrespective of the view of globalization - pessimistic or optimistic, and the

method of estimation - conventional or Shapley value regression based), this is only partially (but dominantly) true of *P* (the political dimension of globalization). However, this is not so for the economic (*E1* and *E2*) and social (*S1*, *S2* and *S3*) indicators of globalization in which most of the correlation coefficients are significantly large in magnitude.

Table 8. Correlation Among Residuals at Stage-2 of Conventional and Shapley Value Based 2-SLS

Eqs. No.	End. Var.	Conventional 2-SLS							Shapley Value based 2-SLS						
		<i>E1</i>	<i>E2</i>	<i>S1</i>	<i>S2</i>	<i>S3</i>	<i>P</i>	<i>DI₁₆</i>	<i>E1</i>	<i>E2</i>	<i>S1</i>	<i>S2</i>	<i>S3</i>	<i>P</i>	<i>DI₁₆</i>
Panel A: Pessimistic Scenario of Globalization															
1	<i>E1</i>	1	0.387	0.575	0.560	0.280	-0.186	0.066	1	0.354	0.564	0.551	0.274	-0.180	0.008
2	<i>E2</i>	0.387	1	0.517	0.563	0.472	-0.021	0.072	0.354	1	0.458	0.509	0.479	-0.050	0.073
3	<i>S1</i>	0.575	0.517	1	0.660	0.466	-0.199	0.038	0.564	0.458	1	0.669	0.456	-0.189	-0.041
4	<i>S2</i>	0.560	0.563	0.660	1	0.543	0.098	-0.056	0.551	0.509	0.669	1	0.529	0.103	-0.087
5	<i>S3</i>	0.280	0.472	0.466	0.543	1	0.390	-0.047	0.274	0.479	0.456	0.529	1	0.359	-0.102
6	<i>P</i>	-0.186	-0.021	-0.199	0.098	0.390	1	0.078	-0.180	-0.050	-0.189	0.103	0.359	1	0.085
7	<i>DI₁₆</i>	0.066	0.072	0.038	-0.056	-0.047	0.078	1	0.008	0.073	-0.041	-0.087	-0.102	0.085	1
Panel B: Optimistic Scenario of Globalization															
1	<i>E1</i>	1	0.347	0.553	0.509	0.205	-0.224	0.139	1	0.315	0.526	0.494	0.187	-0.204	0.097
2	<i>E2</i>	0.347	1	0.528	0.599	0.479	-0.016	0.071	0.315	1	0.476	0.556	0.475	-0.048	0.093
3	<i>S1</i>	0.553	0.528	1	0.696	0.512	-0.141	0.004	0.526	0.476	1	0.704	0.509	-0.130	-0.081
4	<i>S2</i>	0.509	0.599	0.696	1	0.586	0.107	-0.005	0.494	0.556	0.704	1	0.582	0.111	-0.068
5	<i>S3</i>	0.205	0.479	0.512	0.586	1	0.319	-0.053	0.187	0.475	0.509	0.582	1	0.297	-0.077
6	<i>P</i>	-0.224	-0.016	-0.141	0.107	0.319	1	0.134	-0.204	-0.048	-0.130	0.111	0.297	1	0.066
7	<i>DI₁₆</i>	0.139	0.071	0.004	-0.005	-0.053	0.134	1	0.097	0.093	-0.081	-0.068	-0.077	0.066	1

Notes: Numbers in the table are correlation coefficients among residuals of conventional 2-SLS vis-à-vis Shapley Value 2-SLS. For descriptions of abbreviated variables see table 1. Equation numbers corresponds to equations 1-7 explained in section 3.

In table 9 we present the difference between the cross-equation correlation coefficients obtained by the conventional and the Shapley value based 2-SLS. This is for both views of globalization, pessimistic and optimistic. A positive value in the off-diagonal cell indicates that the cross-equation correlation of disturbances obtained by the conventional 2-SLS is stronger than the one obtained by the Shapley value regression based 2-SLS (while the negative value conveys the opposite). For the pessimistic view of globalization, in the upper diagonal cells of the difference matrix 21 ($=7 \times (7-1)/2$) elements are there. Out of them only 7 are

negative. It conveys that in two-third of cases the Shapley value based 2-SLS may be more efficient than the conventional 2-SLS. For the optimistic view of globalization, there are only 5 negative values in the upper diagonal cells of the difference matrix. It conveys that in (a little over) three-fourth of cases, the Shapley value based 2-SLS may be more efficient than the conventional 2-SLS. This also is one of the reasons why we consider that the Shapley value based 2-SLS has given better results than the conventional 2-SLS.

Table 9. Difference between Correlation Among Residuals of Conventional versus Shapley Value Based 2-SLS

Eqs. No.	End. Var.	Pessimistic Scenario of Globalization							Optimistic Scenario of Globalization							
		E1	E2	S1	S2	S3	P	DI ₁₆	E1	E2	S1	S2	S3	P	DI ₁₆	
Panel A: Pessimistic Scenario of Globalization																
1	E1	0	0.033	0.011	0.009	0.006	-0.006	0.058	0	0.032	0.027	0.015	0.018	-0.02	0.042	
2	E2	0.033	0	0.059	0.054	-0.007	0.029	-0.001	0.032	0	0.052	0.043	0.004	0.032	-0.022	
3	S1	0.011	0.059	0	-0.009	0.01	-0.01	0.079	0.027	0.052	0	-0.008	0.003	-0.011	0.085	
4	S2	0.009	0.054	-0.009	0	0.014	-0.005	0.031	0.015	0.043	-0.008	0	0.004	-0.004	0.063	
5	S3	0.006	-0.007	0.01	0.014	0	0.031	0.055	0.018	0.004	0.003	0.004	0	0.022	0.024	
6	P	-0.006	0.029	-0.01	-0.005	0.031	0	-0.007	-0.02	0.032	-0.011	-0.004	0.022	0	0.068	
7	DI ₁₆	0.058	-0.001	0.079	0.031	0.055	-0.007	0	0.042	-0.022	0.085	0.063	0.024	0.068	0	

Notes: Numbers in the table are difference of correlation coefficients among residuals of conventional and Shapley Value 2-SLS. For descriptions of abbreviated variables see table 1. Equation numbers corresponds to equations 1-7 explained in section 3.

8. Concluding Remarks

On the basis of our analysis that models the relationship between democracy and globalization in a simultaneous equations framework, we conclude the following counts. First, democracy and globalization promote each other and hence there is a bi-directional causality with positive relationships running both ways between democracy and globalization as envisaged by Eichengreen and Leblang (2006). At a national level, there may be various intermediary conditions (such as institutional and historical factors, relative factor abundance, demographic reasons, influence and the self-interests of the elite class, safety nets for stability and building political support by the national government, etc.) that modify the relationship as well as set in motion a complex of positive and/or negative feedbacks to accelerate or retard the pace of globalization and democratization in a country-specific manner. However, when a large number of countries are studied a clear relationship emerges out.

Second, there is a need to estimate the structural coefficients of the model cautiously since the regression equations may be suffering from collinearity among the predictor variables. The Shapley value regression based 2-SLS has performed better than the conventional regression in estimating the structural parameters of the model.

Third, it is expected that the system methods of estimation of the model would give better results than what are obtained by the single equation methods of estimation of structural parameters of the model.

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Appendix

Table A1. Scores Obtained by Countries on the Measures in Different Dimensions of Democracy

	Country	Dimensions of Democracy – 2006					Democracy Index 2016 (DI ₁₆)
		EPP	FOG	PPN	PCL	CVL	
1	Albania	7.33	5.07	4.44	5.63	7.06	5.91
2	Algeria	2.25	2.21	2.22	5.63	3.53	3.56
3	Argentina	8.75	5	5.56	5.63	8.24	6.96
4	Australia	10	8.93	7.78	8.75	10	9.01
5	Austria	9.58	8.21	7.78	8.75	9.12	8.41
6	Azerbaijan	3.08	0.79	3.33	3.75	5.59	2.65
7	Belgium	9.58	8.21	6.67	6.88	9.41	7.77
8	Benin	6.83	6.43	3.89	6.88	6.76	5.67
9	Bhutan	0.08	4.64	1.11	3.75	3.53	4.93
10	Bolivia	8.33	5.71	4.44	3.75	7.65	5.63
11	Botswana	9.17	7.86	5	6.88	9.12	7.87
12	Brazil	9.58	7.86	4.44	5.63	9.41	6.9
13	Bulgaria	9.58	5.71	6.67	5	8.53	7.01
14	Burkina Faso	4	1.79	2.78	5.63	4.41	4.7
15	Burundi	4.42	3.29	3.89	6.25	4.71	2.4
16	C.Africa Rep.	0.42	1.43	1.67	1.88	2.65	1.61
17	Cambodia	5.58	6.07	2.78	5	4.41	4.27
18	Cameroon	0.92	3.21	2.78	5.63	3.82	3.46
19	Canada	9.17	9.64	7.78	8.75	10	9.15
20	Chad	0	0	0	5	3.24	1.5
21	Chile	9.58	8.93	5	6.25	9.71	7.78
22	China	0	4.64	2.78	6.25	1.18	3.14
23	Colombia	9.17	4.36	5	4.38	9.12	6.67
24	Congo D. Rep.	4.58	0.36	2.78	3.75	2.35	1.93
25	Congo Rep.	4.58	0.36	2.78	3.75	2.35	2.91
26	Costa Rica	9.58	8.21	6.11	6.88	9.41	7.88
27	Cyprus	9.17	6.79	6.67	6.25	9.12	7.65
28	Denmark	10	9.64	8.89	9.38	9.71	9.2
29	Dominic Rep.	9.17	4.29	3.33	5.63	8.24	6.67
30	Ecuador	7.83	4.29	5	3.13	7.94	5.81
31	Egypt	2.67	3.64	2.78	6.88	3.53	3.31
32	El Salvador	9.17	5.43	3.89	4.38	8.24	6.64
33	Ethiopia	4	3.93	5	6.25	4.41	3.6
34	Fiji	6.5	5.21	3.33	5	8.24	5.64
35	Finland	10	10	7.78	8.75	9.71	9.03
36	France	9.58	7.5	6.67	7.5	9.12	7.92
37	Gabon	0.5	3.21	2.22	5.63	2.06	3.74
38	Gambia	4	4.64	4.44	5.63	3.24	2.91
39	Germany	9.58	8.57	7.78	8.75	9.41	8.63
40	Ghana	7.42	4.64	4.44	4.38	5.88	6.75
41	Greece	9.58	7.5	6.67	7.5	9.41	7.23
42	Guatemala	8.75	6.79	2.78	4.38	7.65	5.92
43	Guinea	1	0.79	2.22	3.75	2.35	3.14
44	Guyana	8.33	5.36	4.44	4.38	8.24	6.25

45	Haiti	5.58	3.64	2.78	2.5	6.47	4.02
46	Honduras	8.33	6.43	4.44	5	7.06	5.92
47	Hungary	9.58	6.79	5	6.88	9.41	6.72
48	Iceland	10	9.64	8.89	10	10	9.5
49	India	9.58	8.21	5.56	5.63	9.41	7.81
50	Indonesia	6.92	7.14	5	6.25	6.76	6.97
51	Ireland	9.58	8.93	7.78	8.75	10	9.15
52	Israel	9.17	6.64	7.78	7.5	5.29	7.85
53	Italy	9.17	6.43	6.11	8.13	8.82	7.98
54	Ivory Coast	1.25	2.86	3.33	5.63	3.82	3.81
55	Jamaica	9.17	7.14	5	6.25	9.12	7.39
56	Japan	9.17	7.86	5.56	8.75	9.41	7.99
57	Jordan	3.08	3.79	3.89	5	3.82	3.96
58	Kenya	4.33	4.29	5.56	6.25	5	5.33
59	Kuwait	1.33	4.14	1.11	5.63	3.24	3.85
60	Lebanon	7.92	2.36	6.11	6.25	6.47	4.86
61	Lesotho	7.92	6.43	4.44	6.25	7.35	6.59
62	Luxembourg	10	9.29	7.78	8.75	9.71	8.81
63	Madagascar	5.67	5.71	5.56	6.88	5.29	5.07
64	Malawi	6	5	3.89	4.38	5.59	5.55
65	Malaysia	6.08	5.71	4.44	7.5	6.18	6.54
66	Mali	8.25	5.71	3.89	5.63	6.47	5.7
67	Malta	9.17	8.21	6.11	8.75	9.71	8.39
68	Mauritania	1.83	4.29	2.22	3.13	4.12	3.96
69	Mauritius	9.17	8.21	5	8.13	9.71	8.28
70	Mexico	8.75	6.07	5	5	8.53	6.47
71	Moldova	9.17	4.29	6.11	5	7.94	6.01
72	Mongolia	9.17	6.07	3.89	5.63	8.24	6.62
73	Montenegro	9.17	5.71	5	5.63	7.35	5.72
74	Morocco	3.5	3.79	2.78	5.63	3.82	4.77
75	Myanmar	0	1.79	0.56	5.63	0.88	4.2
76	Nepal	0.08	3.57	2.22	5.63	5.59	4.86
77	Netherlands	9.58	9.29	9.44	10	10	8.8
78	New Zealand	10	8.57	8.33	8.13	10	9.26
79	Nicaragua	8.25	5.71	3.33	3.75	7.35	4.81
80	Niger	5.25	1.14	1.67	3.75	5.88	3.96
81	Nigeria	3.08	1.86	4.44	4.38	3.82	4.5
82	Norway	10	9.64	10	8.13	10	9.93
83	Pakistan	4.33	5.36	0.56	4.38	5	4.33
84	Panama	9.58	7.14	5.56	5.63	8.82	7.13
85	Paraguay	7.92	5	5	4.38	8.53	6.27
86	Peru	8.75	3.29	5.56	5	7.94	6.65
87	Philippines	9.17	5.36	5	3.75	9.12	6.94
88	Poland	9.58	6.07	6.11	5.63	9.12	6.83
89	Portugal	9.58	8.21	6.11	7.5	9.41	7.86
90	Romania	9.58	6.07	6.11	5	8.53	6.62
91	Rwanda	3	3.57	2.22	5	5.29	3.07
92	Saudi Arabia	0	2.36	1.11	4.38	1.76	1.93
93	Senegal	7	5	3.33	5.63	5.88	6.21
94	Sierra Leone	5.25	2.21	2.22	3.75	4.41	4.55
95	Singapore	4.33	7.5	2.78	7.5	7.35	6.38
96	South Africa	8.75	7.86	7.22	6.88	8.82	7.41

97	South Korea	9.58	7.14	7.22	7.5	7.94	7.92
98	Spain	9.58	7.86	6.11	8.75	9.41	8.3
99	Swaziland	1.75	2.86	2.22	3.13	4.71	3.03
100	Sweden	10	10	10	9.38	10	9.39
101	Switzerland	9.58	9.29	7.78	8.75	9.71	9.09
102	Syria	0	1.79	1.67	6.88	1.47	1.43
103	Tanzania	6	3.93	5.06	5.63	5.29	5.76
104	Thailand	4.83	6.43	5	5.63	6.47	4.92
105	Togo	0	0.79	0.56	5.63	1.76	3.32
106	Trinidad & Tobago	9.17	6.79	6.11	5.63	8.24	7.1
107	Tunisia	0	2.36	2.22	6.88	3.82	6.4
108	Turkey	7.92	6.79	4.44	3.75	5.59	5.04
109	Uganda	4.33	3.93	4.44	6.25	6.76	5.26
110	United Kingdom	9.58	8.57	5	8.13	9.12	8.36
111	United States	8.75	7.86	7.22	8.75	8.53	7.98
112	Uruguay	10	8.21	5	6.88	9.71	8.17
113	Venezuela	7	3.64	5.56	5	5.88	4.68
114	Vietnam	0.83	4.29	2.78	4.38	1.47	3.38
115	Yemen	2.67	2.71	2.78	4.38	2.35	2.07
116	Zambia	5.25	4.64	3.33	6.25	6.76	5.99

Table A2. Economic, Social and Political Dimensions and Overall Indices of Globalization in Different Countries

	Country	Year-H	E1	E2	S1	S2	S3	P	KOF	AEMC
1	Albania	2009	56.57	73	52.55	73.9	2.42	80.69	61.6	61.61
2	Algeria	2006	55.36	52.55	32.39	64.92	1.93	80.65	54	53.32
3	Argentina	2008	45.92	39.11	43.3	71.5	41.47	92.07	59.95	59.19
4	Australia	2007	74.79	81.24	73.4	87.55	94.03	89.71	83.8	84.03
5	Austria	2007	89.34	86.56	87.06	92.06	95.54	96.86	91.87	93.95
6	Azerbaijan	2007	67.38	63.7	37.92	77.61	34.96	54.01	57.02	54.69
7	Belgium	2007	96.71	82.81	81.94	96.39	91.22	97.67	92.41	93.75
8	Benin	2014	53.79	42.92	28.55	39.46	2.48	75.17	46.67	48.99
9	Bhutan	2014	60.64	56.77	46.83	45.54	6.87	38.85	43.58	47.07
10	Bolivia	2006	62.03	59.79	39.52	51.01	3.78	75.69	54.42	56.38
11	Botswana	2008	77.58	59.64	59.54	57.17	5.88	59.28	55.5	60.64
12	Brazil	2014	51.77	52.82	24.46	70.5	39.58	94.3	61.4	58.16
13	Bulgaria	2013	80.04	72.93	51.55	77.71	85.3	84.96	76.98	76.34
14	Burkina Faso	2014	59.67	46.84	19.43	44.62	2.17	76.88	48.69	49.12
15	Burundi	2014	23.53	33.37	21.02	37.22	3.1	62.17	35.04	34.79
16	C. Africa Rep.	2014	49.56	28.29	13.44	40.71	2.24	58.39	36.34	37.27
17	Cambodia	2014	85.86	50.76	29.52	48.48	1.31	62.36	50.69	54.22
18	Cameroon	2014	44.96	38.31	16.91	52.02	2.24	73.16	44.2	42.75
19	Canada	2007	76.2	82.03	80.78	94.74	96.09	92.91	87.15	87.51
20	Chad	2006	55.49	27.21	23.94	32.35	2.91	60.04	38.37	41.7
21	Chile	2007	82.68	87.08	41.25	77.69	41.18	87.67	74.31	72.77
22	China	2014	43.49	62.19	18.71	65.65	78.37	84.26	62.02	56.85

23	Colombia	2013	58.32	57.38	33.46	69.69	38.12	79.65	60.15	58.23
24	Congo D. Rep.	2013	69.13	37.26	6.23	43.38	1	62.03	41.67	42.31
25	Congo Rep.	2014	96.24	41.58	35.45	43.93	1.25	63.67	51.83	57.31
26	Costa Rica	2007	64.79	73.3	60.37	78.75	45.65	58.63	63.66	63.45
27	Cyprus	2008	93.5	84.06	88.1	95.69	93.84	78.36	87.32	89.36
28	Denmark	2007	87.8	89.09	83.64	89.59	93.06	93.75	90.01	91.9
29	Dominic Rep.	2014	64.15	59.56	53.7	64.97	79.14	73.31	66.45	67.2
30	Ecuador	2006	55.97	46	36.82	65.37	38.22	79.01	57.39	56.77
31	Egypt	2013	42.96	48.68	27.64	66.78	77.77	93.01	63.1	59.62
32	El Salvador	2007	61.06	72.79	49.35	64.68	40.8	75.4	63.79	64.02
33	Ethiopia	2014	24.93	28.39	19.32	33.17	2.85	82.51	39.33	39.87
34	Fiji	2014	74.43	25.7	56.98	57.2	43.56	69.68	57.56	61.3
35	Finland	2007	85.16	87.39	72.07	90.6	91.67	91.64	87.22	87.36
36	France	2007	76.99	87.19	80.56	88.36	91.79	97.96	88.23	89.36
37	Gabon	2014	75.55	42.75	52.22	63.44	2.36	72.3	55.96	59.46
38	Gambia	2006	70.76	49.68	45.63	57.79	6.31	61.86	51.78	54.92
39	Germany	2007	81.36	84.49	76.35	87.52	92.57	92.43	86.48	87.44
40	Ghana	2014	62.3	54.48	27.85	45.77	3.96	85.72	54.17	55.67
41	Greece	2007	68.15	83.53	76.51	83.41	85.44	92.38	82.59	83.44
42	Guatemala	2014	48	74.96	26.23	57.23	42.95	83.01	60.42	57.71
43	Guinea	2014	57.21	31.29	21.72	41.38	2.73	76.19	44.4	46.82
44	Guyana	2006	80.52	62.07	56.43	55.51	44.1	43.34	56.44	59.99
45	Haiti	2010	34.21	62.93	28.71	50.84	1	45.88	39.36	38.47
46	Honduras	2014	74.61	71.19	28.45	58.46	39.51	71.84	61.42	60.57
47	Hungary	2009	92.14	85.86	65.93	89.31	89.62	91.47	86.99	87.02
48	Iceland	2008	89.32	64.89	81.47	80.36	91.88	70.11	77.86	81.39
49	India	2014	43.78	44.93	14.1	45.12	32.98	91.23	52.38	50.87
50	Indonesia	2014	56.25	71.79	20.4	49.92	33.89	86.83	59.65	57.96
51	Ireland	2014	99.52	89.78	89.37	91.72	91.88	90.47	92.15	95.2
52	Israel	2010	71.59	83.51	75.06	67.25	90.37	80.29	78.15	80.79
53	Italy	2007	68.17	83.24	70.46	78.72	86.52	97.92	82.85	83.57
54	Ivory Coast	2007	63.35	40.17	41.85	52.15	2.85	70.72	49.83	53.08
55	Jamaica	2007	80.64	70	63.13	69.52	7.11	68.56	62.72	66.57
56	Japan	2014	50.41	76.54	43.39	75.59	87.91	88.1	72.26	68.81
57	Jordan	2006	79.36	59.47	67.97	71.54	41.11	84.27	70.31	73.94
58	Kenya	2007	27.19	46.79	29.61	46.02	3.72	82.92	46.46	45.8
59	Kuwait	2008	61.31	75.01	78.96	76.28	90.41	59.54	70.76	72.18
60	Lebanon	2006	86.92	62.3	70.38	81.04	43.26	74.55	70.5	74.2
61	Lesotho	2014	80.48	41.22	25.58	48.74	6.87	54.09	45.94	48.77
62	Luxembourg	2007	100	88.46	96.09	97.51	48.25	80.06	85.62	89.59
63	Madagascar	2014	62.47	36.71	11.21	48.02	2.73	65.1	42.9	42.98
64	Malawi	2013	49.9	52.47	26.25	41.95	6.99	64.35	45.4	46.09
65	Malaysia	2010	89.03	69.62	64.71	75.92	87.52	83.17	79.12	81.07
66	Mali	2014	50.97	41.67	22.46	44.1	1.12	75.98	46.07	46.72
67	Malta	2009	99.76	87.06	83.18	96.04	49.74	52.58	76.16	78.24

68	Mauritania	2014	79.3	58.16	19.77	51.82	1.37	66.99	51.45	52.55
69	Mauritius	2014	91.12	84.89	58.78	82.06	42.61	45.32	66.61	66.81
70	Mexico	2014	63.45	68.45	44.3	68.92	40.12	71.72	62.29	61.61
71	Moldova	2007	67.96	69.67	44.9	84.17	39.27	67.22	64.04	61.7
72	Mongolia	2014	84.88	65.73	16.76	59.4	1.43	71.89	56.91	55.63
73	Montenegro	2010	81.65	79.55	72.69	94.41	5.08	56.33	65.48	66.92
74	Morocco	2014	60.71	53.68	45.87	83.86	37.71	89.5	65.95	64.33
75	Myanmar	2014	56.93	56.33	11.89	42.07	1	44.74	39.03	38.4
76	Nepal	2013	13.26	39.95	24.97	44.85	2.79	70.69	38.18	36.7
77	Netherlands	2014	97.64	88.48	85.98	93.26	92.75	95.41	92.84	95.24
78	New Zealand	2008	76.62	90.04	79.32	91.46	50.44	80.05	79.17	80.12
79	Nicaragua	2012	61.15	61.69	34.97	56.57	40.24	57.38	53.99	53.56
80	Niger	2014	54.67	50.44	32.41	35.3	1.74	74.33	47.92	50.86
81	Nigeria	2009	65.1	47.51	12.39	52.93	3.47	89.37	54.36	52.53
82	Norway	2013	80.32	72.93	81.74	85.52	91.68	92.27	84.48	86.83
83	Pakistan	2007	40.85	43.25	23.4	44.12	32.38	87.55	51.83	51.16
84	Panama	2009	89.59	71.32	50.84	81.17	47.74	60.74	67.7	67.56
85	Paraguay	2012	62.44	56.59	36.33	65.09	39.86	77.61	60.13	59.39
86	Peru	2011	69.02	82.53	32.33	58.27	36.87	84.74	66.14	65.24
87	Philippines	2006	65.22	52.73	30.26	49.7	39.96	81.96	58.39	59.19
88	Poland	2014	77.73	76.38	57.4	92.23	89.22	88.82	81.32	79.32
89	Portugal	2007	82.71	87.1	76.48	91.1	88.73	93.85	87.61	88.21
90	Romania	2014	60.67	83.22	48.07	82.02	82.39	89.82	76.51	73.36
91	Rwanda	2014	34.81	63.91	17.27	39.87	7.05	71.53	45.56	43.83
92	Saudi Arabia	2009	62.95	76.19	69	71.18	83.25	60.43	68.43	69.75
93	Senegal	2012	57.58	47.32	29.33	58.91	3.53	87.9	54.64	54.59
94	Sierra Leone	2011	69.7	46.89	19.84	38.92	3.16	65.1	45.9	48.29
95	Singapore	2009	99.01	95.35	92.18	88.25	96.12	71.77	88.27	91.52
96	South Africa	2014	72.64	65.18	41.53	61.39	41.93	88.04	66.72	67.54
97	South Korea	2014	62.52	63.76	43.81	73.55	42.42	89.58	67.03	66.05
98	Spain	2007	78.33	81.36	74.93	87.72	90.22	95.93	85.92	86.71
99	Swaziland	2014	77.83	43.61	59.31	60.2	6.37	36.55	47.48	51.92
100	Sweden	2007	88.33	86.26	80.84	84.38	94.73	96.03	89.41	91.73
101	Switzerland	2014	95.02	70.51	91.77	87.57	94.47	93.4	88.79	93.18
102	Syria	2011	53.48	55.43	51.94	65.49	1	52.73	48.93	50.02
103	Tanzania	2007	35.61	53.2	16.78	31.93	3.04	55.74	37.71	37.42
104	Thailand	2012	83.87	59.54	42.9	72.93	80.93	81.22	72.06	71.71
105	Togo	2014	78.62	46.54	25.04	57.99	3.72	73.38	53.7	54.25
106	Trinidad & Tobago	2012	86.13	68.86	58.65	67.24	41.73	53.54	63.09	65.62
107	Tunisia	2008	70.83	48.71	41.68	76.78	2.67	86.29	60.45	60.63
108	Turkey	2014	51.09	66.13	50.76	72.49	81.59	91.88	71.33	69.88
109	Uganda	2013	44.01	58.02	21.59	37.01	4.52	70.23	45.48	45.69
110	United Kingdom	2006	81.91	89.75	79.57	90.54	93.3	94.9	89.06	89.91
111	United States	2007	65.17	85.34	67.13	82.45	91.9	92.1	81.8	81.15
112	Uruguay	2008	65.66	68.87	51.35	65.92	42.1	85.45	67.23	68.14

113	Venezuela	2006	62.32	47.83	38.48	68.43	41.65	65.68	56.17	55.45
114	Vietnam	2014	80.26	49.28	16.43	63.78	31.92	71.13	56.69	54.98
115	Yemen	2008	53.37	63.83	23.57	41.91	1.68	62.24	46.51	46.66
116	Zambia	2007	64.24	63.96	27.92	45.69	4.09	73.93	52.96	54.04

E1, E2, S1, S2, S3, P and KOF are for the Year-H when the overall index AEMC attained **maximum** (Gmax) during 2006-2014. AEMC Indices are computed by the author.

Table A3. Economic, Social and Political Dimensions and Overall Indices of Globalization in Different Countries

	Country	Year-L	E1	E2	S1	S2	S3	P	KOF	AEMC
1	Albania	2006	35.89	58.68	52.56	69.39	2.24	67.63	51.18	50.86
2	Algeria	2007	49.62	47.76	33.94	64.81	2.05	48.49	43.47	42.36
3	Argentina	2012	41.13	30.68	43.54	72.69	40.54	92.83	57.89	57.09
4	Australia	2013	68.41	78.01	73.79	85.8	92.9	90.42	81.97	82.24
5	Austria	2013	85.52	76.5	86.51	91.31	95.46	96.36	89.09	91.36
6	Azerbaijan	2009	59.96	57.99	38.9	78.95	34.51	55.51	55.35	52.78
7	Belgium	2013	95.51	73.19	84.04	96.99	91.01	96.51	90.7	92.32
8	Benin	2006	28.32	40.26	28.88	35.4	2.54	71.83	40.22	41.61
9	Bhutan	2007	34.97	56.4	46.37	41.28	5.32	21.18	33.12	35.44
10	Bolivia	2011	56.44	50.56	37.79	58.44	2.91	76.81	52.76	53.62
11	Botswana	2012	60.07	53.5	56.45	55.16	4.95	39.77	45.21	49.05
12	Brazil	2008	48.27	53.34	20.26	68.5	38.23	92.27	59.38	55.59
13	Bulgaria	2010	71.76	74.41	50.21	82.83	40.81	83.13	70.59	69.36
14	Burkina Faso	2006	16.39	50.78	32.95	36.9	3.9	71.57	40.68	41.27
15	Burundi	2006	24.06	35.17	16.96	35.39	4.15	36.97	27.89	26.92
16	C. Africa Rep.	2007	40.14	22.02	15.27	32.43	2.24	57.98	32.8	34.45
17	Cambodia	2011	70.4	50.86	26.14	44.44	2.17	59.93	46.83	49.02
18	Cameroon	2010	35.79	41.44	16.83	51.95	2.73	70.25	42.67	40.16
19	Canada	2013	74.03	77.68	81.23	92.24	94.97	92.94	85.6	86.39
20	Chad	2011	50.22	28.12	19.94	36.74	2.91	58.55	37.11	39.14
21	Chile	2013	77.71	75.92	38.21	76.16	40.69	88.74	71.11	69.54
22	China	2012	41.21	56.27	16.75	65.54	78.02	84.8	60.42	55.12
23	Colombia	2008	54.98	42.87	30.73	70.8	38.22	78.48	56.48	54.44
24	Congo D. Rep.	2006	19.87	28.69	8.76	34.02	1	44.96	26.11	24.95
25	Congo Rep.	2008	91.35	37.23	31.94	40.9	1.74	39.88	42.91	47.78
26	Costa Rica	2013	62.9	66.25	55.31	81.31	45.89	59.43	62.05	61.03
27	Cyprus	2006	91.53	84.62	86.55	95.34	47.57	59.05	76.11	78.44
28	Denmark	2013	84.52	80.7	81.47	88.35	93.53	91.65	86.99	88.85
29	Dominic Rep.	2009	54.07	57.06	53.37	67.39	36.62	56.88	55	55.44
30	Ecuador	2014	40.55	36.53	34.14	62.25	38.21	80.97	52.78	51.64
31	Egypt	2012	41.62	46.07	22.45	66.66	35.94	93.45	56.99	53.67
32	El Salvador	2011	57.17	63.11	35.53	66.64	41.19	78.63	60.89	59.25
33	Ethiopia	2011	28.98	21.94	10.54	29.29	2.17	81.88	36.82	37.47

34	Fiji	2009	64.73	25.64	56.01	50.18	43.87	66.56	53.75	57.81
35	Finland	2009	77.81	86.19	72.26	88.86	91.36	90.25	85.08	85.04
36	France	2013	73.58	78.12	81.13	89.14	92.48	97.29	86.09	87.32
37	Gabon	2011	75.77	31.78	51.97	61.25	2.36	51.11	47.92	51.79
38	Gambia	2009	50.86	50.47	45.99	61.95	5.38	64.8	50.18	51.12
39	Germany	2013	75.94	73.34	79.32	85.4	92.01	91.93	83.41	85.16
40	Ghana	2008	36.37	51.83	35.82	43.8	4.52	83.98	49.19	50.64
41	Greece	2012	61.28	77.37	75.14	84.24	84.42	91.33	79.82	80.21
42	Guatemala	2010	46.46	68.4	27.08	56.03	43.98	82.47	58.89	56.59
43	Guinea	2010	35.7	31.29	21.36	39.92	4.15	71.9	39.38	40.45
44	Guyana	2013	61.74	58.98	48.79	58.06	5.76	44.66	47.6	49.78
45	Haiti	2014	35.21	68.47	6.41	51.82	1	48.28	38.81	34.53
46	Honduras	2010	63.36	65.1	30.16	60.23	39.72	70.29	58.38	57.05
47	Hungary	2011	91.22	81.45	66.67	89.18	90.33	90.93	86.05	86.3
48	Iceland	2013	89.48	59.8	80.56	78.37	50.11	54.09	67.32	71.77
49	India	2006	35.28	43.76	13.64	46.46	32.53	89.37	50.22	47.98
50	Indonesia	2008	49.64	69.02	17.85	47.95	33.79	84.05	56.64	54.53
51	Ireland	2008	97.8	88.49	91.12	92.11	48.1	87.41	85.93	89.89
52	Israel	2011	69.88	76.98	75.38	66.87	90.37	65.01	72.46	75.13
53	Italy	2013	64.98	75.44	70.42	78.44	88.21	97.52	80.94	81.77
54	Ivory Coast	2013	56.86	36.44	29.24	53.69	2.61	74.19	47.92	48.82
55	Jamaica	2014	73.94	51.72	57	67.13	6.93	72.58	58.43	62.05
56	Japan	2011	43.92	65.57	42.19	76.22	87.85	88.66	69.25	65.61
57	Jordan	2013	72.22	61.91	52.07	69.51	42.37	86.09	67.93	69.18
58	Kenya	2012	25.69	44.87	19.21	48.47	3.59	82.94	45.16	42.55
59	Kuwait	2013	53.45	65.47	70.68	73.63	89.69	60.31	66.44	67.03
60	Lebanon	2011	77.07	56.8	70.26	90.02	45.95	60.76	65.7	67.36
61	Lesotho	2006	59.43	37.57	24.7	45.45	6.68	33.39	35.69	36.96
62	Luxembourg	2006	99.72	87.43	96.37	96.87	48.06	60.97	80.05	83.89
63	Madagascar	2011	56.71	28.24	8.15	49.42	2.67	63.64	39.71	39.25
64	Malawi	2009	32.32	44.3	27.07	39.17	6.74	61.73	39.76	40.16
65	Malaysia	2014	88.91	66.95	57.96	77.28	87.65	83.69	78.14	79.14
66	Mali	2007	44.08	41.64	20.96	36.32	2.17	73.6	43.06	44.06
67	Malta	2006	97.19	87.13	83.62	96.07	50.17	47.77	74.5	76.39
68	Mauritania	2006	72.75	40.6	25.64	43.51	1.37	45.02	40.79	43.65
69	Mauritius	2006	57.62	70.87	59.49	85.06	40.57	57.79	61.85	60.47
70	Mexico	2008	55.23	60.32	42.67	70.3	41.09	70.95	59.27	57.99
71	Moldova	2014	60.52	63.4	40.67	84.06	37.77	69	61.39	58.36
72	Mongolia	2006	54.54	60.02	19.54	57.15	2.05	65.31	48.72	46.41
73	Montenegro	2006	52.52	76.75	73.23	94.86	6.25	46.57	57.31	56.97
74	Morocco	2006	49.22	40.66	35.46	67.4	37.2	87.73	57.63	56.51
75	Myanmar	2009	47.2	49.84	9.82	27.94	1	36	31.86	32.04
76	Nepal	2008	11.4	31.69	25.16	37.96	3.35	68.1	34.85	34.44
77	Netherlands	2009	95.28	88.51	84.91	90.53	92.9	93.23	91.35	93.78
78	New Zealand	2013	72.83	85.72	78.84	89.57	50.42	80.03	77.41	78.48

79	Nicaragua	2008	53.72	63.14	35.68	56.5	39.11	55.74	52.42	51.57
80	Niger	2007	24.17	37.19	32.59	30.52	1.68	71.94	38.88	41.05
81	Nigeria	2014	46.48	52.49	9.46	46.64	1.43	90.79	50.24	48.17
82	Norway	2006	81.16	70.67	79.65	83.91	91.99	88.88	82.87	85.24
83	Pakistan	2014	33.87	45.27	19.22	48.01	32.32	87.3	51.02	48.64
84	Panama	2006	91.07	65.78	50.23	73.96	47.74	56.13	64.69	65.63
85	Paraguay	2008	53.18	57.92	36.26	60.83	37.09	75.13	57.14	56.32
86	Peru	2006	66.78	67.15	32.7	54.46	37.01	84.09	62.39	62.5
87	Philippines	2014	58.47	49.32	24.22	54.23	41.28	82.83	56.84	55.98
88	Poland	2011	72.22	68.03	56.29	91.86	87.36	89.58	78.67	76.61
89	Portugal	2013	79.89	82.09	68.63	91.19	89.7	88.98	84.05	83.54
90	Romania	2006	60.44	60.73	44.18	78.72	38.69	89.91	66.5	64.99
91	Rwanda	2006	19.54	34.11	23.81	38.03	4.27	60.31	34.49	34.22
92	Saudi Arabia	2006	52.82	76.19	70.24	69.12	82.06	57.24	65.22	66.57
93	Senegal	2006	40.99	38.14	40.6	58.22	4.09	86.13	50.65	51.75
94	Sierra Leone	2009	30.15	41.28	19.63	33.56	3.22	61.16	36.2	36.81
95	Singapore	2014	99.01	96.53	93.2	85.75	96.53	54.77	83.64	87.04
96	South Africa	2011	67.26	63.98	39.51	61.09	40.86	86.2	64.64	64.93
97	South Korea	2006	54.55	65.58	39.06	76.1	41.38	83.59	63.92	61.36
98	Spain	2013	75.24	74.68	73.88	86.21	89.6	95.51	83.68	84.6
99	Swaziland	2007	63.2	36.36	61.97	54.71	6.37	33.68	42.4	47.23
100	Sweden	2013	85.48	75.35	81.3	81.02	93.46	94.65	86.05	89.13
101	Switzerland	2011	94.7	60.22	91.35	89.06	94.96	92.44	86.84	91.37
102	Syria	2007	49.06	38.95	43.38	63.66	1	54.93	44.26	45.17
103	Tanzania	2006	27.06	50.59	17.16	33.54	2.61	55.17	35.78	34.91
104	Thailand	2008	74.06	55.41	39.67	68.67	37.94	78.48	62.87	62.95
105	Togo	2008	53.5	37.49	28.74	54.91	3.53	71.19	46.93	47.25
106	Trinidad & Tobago	2007	79.71	71.95	61.64	66.92	5.76	47.01	56.82	59.84
107	Tunisia	2011	68.94	42.49	40.06	78.34	2.48	83.92	58.35	58.22
108	Turkey	2006	46.77	69.54	40.93	72.69	78.12	89.96	69.07	65.92
109	Uganda	2006	35.99	52.16	24.19	35.24	3.53	67.77	42.31	42.8
110	United Kingdom	2014	80.71	85.27	76.35	87.66	93.64	94.67	87.26	88.15
111	United States	2009	59.05	78.48	66.91	81.46	91.77	91.43	79.14	78.47
112	Uruguay	2012	60.28	67.75	52.98	69.97	42.11	84.09	66.43	66.74
113	Venezuela	2010	40.82	37.04	38.46	70.34	40.3	66.51	50.75	48.92
114	Vietnam	2006	70.58	39.35	17.13	59.33	3.04	50.33	43.21	42.59
115	Yemen	2014	35.99	54.18	26.38	44.1	1.12	65.01	42.99	42.64
116	Zambia	2012	50.36	55.83	16.51	43.66	3.78	73.04	47.36	46.41

E1, E2, S1, S2, S3, P and KOF are for the Year-L when the overall index AEMC attained **minimum** (Gmin) during 2006-2014. AEMC Indices are computed by the author.



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Does it take two to tango: Interaction between Credit Default Swaps and National Stock Indices

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Abstract

This paper investigates both short and long-run interaction between BIST-100 index and CDS prices over January 2008 to May 2015 using ARDL technique. The paper documents several findings. First, ARDL analysis shows that 1 TL increase in CDS shrinks BIST-100 index by 22.5 TL in short-run and 85.5 TL in long-run. Second, 1000 TL increase in BIST index price causes 25 TL and 44 TL reduction in Turkey's CDS prices in short- and long-run respectively. Third, a percentage increase in interest rate shrinks BIST index by 359 TL and a percentage increase in inflation rate scales CDS prices up to 13.34 TL both in long-run. In case of short-run, these impacts are limited with 231 TL and 5.73 TL respectively. Fourth, a kurush increase in TL/USD exchange rate leads 24.5 TL (short-run) and 78 TL (long-run) reductions in BIST, while it augments CDS prices by 2.5 TL (short-run) and 3 TL (long-run) respectively. Fifth, each negative political events decreases BIST by 237 TL in short-run and 538 TL in long-run, while it increases CDS prices by 33 TL in short-run and 89 TL in long-run. These findings imply the highly dollar indebted capital structure of Turkish firms, and overly sensitivity of financial markets to the uncertainties in political sphere. Finally, the paper provides evidence for that BIST and CDS with control variables drift too far apart, and converge to a long-run equilibrium at a moderate monthly speed.

Keywords: Credit Default Swaps (CDS); BIST-100 index; Cointegration; ARDL.

JEL Classification: E00, E44.

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1. Introduction

Doubtlessly the last global financial crisis has put a spotlight on Credit Default Swaps (CDS), a contract between parties where buyer transfers the risk of default to the seller of swap, which has been utilized as primary hedging technique for both corporate and sovereign credit risks since early 1990s. Since its introduction in 1994 by JP Morgan, it rapidly has integrated into the daily life of many traders, regulators, and financial economists. These swaps can be used for several purposes. For instance, risk managers might use them to manage and hedge specific credit risks, while investors might utilize them to earn higher returns by buying out additional risks. Traders might also use them to make profit from bid-offer spreads, while some other agents might wish to get the advantage of tax arbitrage with these derivatives.

The CDS market has been experiencing rapid growth since mid 1990s (the date when the first transactions were facilitated) reaching the market size of 900 billion USD in the eve of 2000. Further by the end of 2005 it scaled up to 14 trillion USD, and continued its rapid growth (hitting about 60 trillion USD level) until recent sub-prime crisis in 2007-2008. Henceforth the market size experienced continuous decreases. Just in the first year of the crisis, it shrank almost by 30% melting down to the level of 41 trillion USD, and the following years it continued to decrease but at a slower rate (see figure 1). Today, the size of credit derivatives market is about 14.5 trillion USD, and we all have learned inevitable role of these swaps by experiencing its (direct and indirect) macro- and micro-economic impacts. Yet, although thousands of studies discuss these economic roles of CDS, some key issues are still hotly debated and remain controversial.

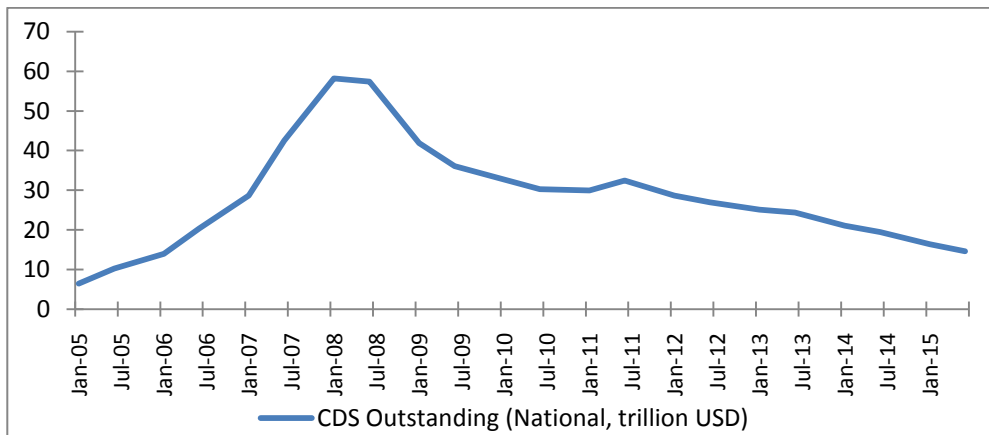


Figure 3. CDS Outstanding (National, trillion USD)

With this motivation, we examine how CDS prices and BIST-100 stock index interact in short- and long-run over January 2008 to May 2015 using the largest available data set of Turkey's sovereign CDS spreads. Our findings show that the impact running from monthly changes in BIST-100 index to fluctuations in CDS is higher than the vice versa impact. Plus, we also document that both BIST and CDS are severe responsive to changes in TL/USD exchange rate and political instability both in short- and long-run. These findings address to the highly dollar indebted capital structure of Turkish firms, and overly sensitivity of financial markets to the uncertainties in political sphere. We also observe limited impact running from interest and inflation rate on to BIST and CDS separately.

The remainder of this paper is structured as following. Next section briefly reviews related literature. Third section covers data description and methodology. Fourth section provides key findings with their interpretations, and the final section concludes.

2. Literature Review

A sizeable literature exists on determinants of CDS spreads such as Longstaff et al. (2003), Galil et al. (2014), and Norden and Weber (2004). These studies explore the association between CDS spreads and stock returns, bond yields, credit ratings, interest rates and other financial indicators. Galil et al. (2014) present three variables to explain changes in CDS spreads: stock return, the change in stock return volatility and the change in the median CDS spread in the rating class. They use dataset of 718 US firms during the period from 2002 to 2013 and obtain parallel results with Blanco et al. (2005) and Trutwein et al. (2011). They also observe that the last Global Financial Crisis caused a structural change in CDS spreads.

More specifically, Longstaff et al. (2003) consider a VAR model for explaining the lead-lag relationships between stock returns, CDS, and bond spreads with weekly data in US, and report that stock returns and CDS spreads lead to the bond spreads. Norden and Weber (2009) also state that stock price indices in prior can predict the CDS and bond spreads. Similarly, Zhu (2006) examines how CDS spreads associated with bond markets, and finds that CDS spreads provide more accurate measurement of default risk than bond spreads. In addition to this, there are some studies which argue that there is a negative relationship among interest rate variables and CDS spreads such as Fama (1984) and Estrella and Hardouvelis (1991).

The relationships between Credit Default Swaps and Credit Ratings are analyzed in various studies. CDSs create more sensitive impression than Credit

Ratings do. It can react to the development on the market more quickly and stimulate the markets in advance as supported by the results that were concluded from previous studies. And of course, here, the operation of the mechanism of Credit Rating measurement and CDS are crucial. Whilst CDSs are announced continuously and daily, rating changes are made in the longer term. Besides, rating scale is not sensitive because it does not include wide range as CDS. Coronado et al. (2011) analyze relationship between stock returns and sovereign CDS spreads by sampling 8 European countries between the periods of 1st January 2007 to 30th July 2010. They show that CDS spread changes are negative correlated with stock returns over the sample countries. However, the significance of correlations is more severe in Italy, Greece, Spain, and Portugal. They point out that these countries have higher risk premiums. Furthermore, they conduct a VAR model to explain the lead-lag link among sovereign CDS spreads and stock returns, and find that changes in stock returns lead sovereign CDS spreads changes between January 2007 to December 2009 periods, and vice versa for during the period of January 2010 to July 2010. They partly disagree with Fung et al. (2008) and Narayan et al. (2014) who bind bidirectional interaction of stock prices and CDS to few conditions. Briefly, Fung et al. (2008) report that stock price affects CDS spreads of firms that have investment grade rating, and vice versa impact is valid only for firms with high payment capacity. On the other hand, Narayan et al. (2014) examine bidirectional interaction of stock prices and CDS concentrating on firms' industries, and find that the interaction exists only in energy, finance, materials, consumer discretion, health care, and industrials sectors.

On the other hand, extant literature (Norden and Weber, 2004; Hull et al., 2004; Finnerty et al., 2013) shows that Credit Ratings are another chief determinant of CDS prices. Hull et al. (2004) assert that review for downgrade ratings forecasts majority of changes in CDS in advance. Norden and Weber (2004) find this time lag (between rating downgrades and changes in CDS spreads) as 60-90 days. Similarly, Ismailescu and Kazemi (2010) report that CDS spreads are significantly sensitive to the rating downgrades. They observe that negative information about credit ratings, i.e. rating downgrades, predicts 42.6% of CDS spreads, however, positive information (rating upgrades) has a limited impact.

3. Data and Methodology

To our knowledge, the literature about interaction between Turkey's CDS and stocks is limited. To resolve this insufficiency we investigate their bi-directional over the period of 2008-2015 both with daily and monthly data. In our daily analysis, following Coronado et al. (2011) we establish VAR model as below.

$$VAR(p) = \Delta BIST_t = \alpha_0 + \sum_{i=1}^p \alpha_i \Delta BIST_{t-i} + \sum_{i=1}^p \beta_i \Delta CDS_{t-i} + e_{1t} \quad (1a)$$

$$VAR(p) = \Delta CDS_t = \beta_0 + \sum_{i=1}^p \beta_i \Delta CDS_{t-i} + \sum_{i=1}^p \alpha_i \Delta BIST_{t-i} + e_{2t} \quad (1b)$$

where p is optimal lag length; $\Delta BIST_t$ is a return of BIST-100 index, and ΔCDS_t is a change credit default swap rate at day t .

On the other hand, in monthly analysis, we consider those two variables (BIST and CDS) in their raw money units, and augment the model by adding control variables such as inflation (CPI), exchange (EX), and interest rates (INT). Besides we also introduce a dummy ($DPOL$), which equates to 1 for the month when significant political events, that distress the financial markets, are occurred, and turns back to zero for other months, to capture the affects of political instability as below.

$$BIST_t = \alpha_0 + \sum_{i=1}^p \alpha_i BIST_{t-i} + \sum_{i=1}^p \beta_i CDS_{t-i} + \sum_{i=1}^{4,p} \theta_{it} \psi_{it} + \omega_{1t} \quad (2a)$$

$$CDS_t = \beta_0 + \sum_{i=1}^p \beta_i CDS_{t-i} + \sum_{i=1}^p \alpha_i BIST_{t-i} + \sum_{i=1}^{4,p} \theta_{it} \psi_{it} + \omega_{2t} \quad (2b)$$

where $BIST_t$ is a price of BIST-100 index in units of Turkish Lira (TL), and CDS_t is a price of credit default swaps in units of TL at month t . The “ ψ ” stands for aforementioned controls, where inflation and interest rates are proxied by consumer price index levels (CPI) and short-term lending rates of Turkish Central Bank respectively. Besides the dummy ($DPOL$) accounts the most significant political crisis alongside with five electoral events during January 2008 and May 2015 which are referred in Appendix-A.

More specifically, the table 1 displays descriptive statistics of input variables where data for $BIST$, CDS , and CPI are gathered from Eikon datastream of Thomson Reuters, meanwhile interest and exchange rates are obtained from OECD and OANDA databases respectively.

Table 1. Descriptive Analysis

	<i>BIST</i>	<i>CDS</i>	<i>EX</i>	<i>CPI</i>	<i>INT</i>	<i>DPOL</i>
<i>Mean</i>	60.27	225.31	1.74	8.12	7.24	0.06
<i>Median</i>	62.36	195.76	1.76	8.17	6.50	0.00
<i>Maximum</i>	88.95	487.65	2.65	12.06	16.75	1.00
<i>Minimum</i>	24.03	119.66	1.17	3.99	1.50	0.00
<i>Std. Dev.</i>	17.09	85.58	0.33	1.85	4.22	0.23
<i>Skewness</i>	-0.36	1.58	0.53	-0.11	1.01	3.83
<i>Kurtosis</i>	2.30	4.93	2.96	2.53	3.20	15.66
<i>Jarque-Bera stat.</i>	3.69	50.42	4.05	1.00	15.04	802.72
<i>Probability</i>	0.16	0.00	0.13	0.61	0.00	0.00
<i>Observations</i>	88	88	88	88	88	88

Notes: *BIST* is a price of BIST-100 index in thousands of Turkish Lira (TL); *CDS* is a price of credit default swaps in TL; *EX* is a TL/USD exchange rate; *CPI* is a consumer price index level; *INT* is a short-term lending rate announced by Turkish Central Bank; *DPOL* stands for significant political events that distress the Turkish financial market.

3.1. Model Specification

Initially we analyze the characteristics of all series under Augmented Dickey-Fuller (ADF) test, formulated as below, lest they violate the stationarity assumption of OLS.

$$\Delta\Omega_t = \theta_0 + \theta_1 T + \rho\Omega_{t-1} + \sum_{i=2}^k \theta_i \Delta\Omega_{t-1} + \varepsilon_t$$

where $\Delta\Omega_t$ is the first difference of a variable Ω ; T is a trend, and θ_1 is its multiplier; k is a optimal lag length; and ε_t is White Noise residual term. Here, ADF hypothesizes H_0 ($\rho=0$) against alternative ($\rho\neq 0$). The rejection of null hypothesis indicates that the variable satisfies the stationarity assumption of OLS.

The table 2 presents results of ADF test where all series except *DPOL* appear non-stationary at level. But they can be converted to a stationary through differencing methodology. As a result, we conclude that only *DPOL* is an $I(0)$ variable, while others are $I(1)$. As a result the input series are not integrated at same degree, therefore we adjust our (2) VAR model into an Autoregressive Distributed Lag (ARDL) model as in (2.1) that tests long-run relationship (cointegration) of $I(0)$ and $I(1)$ series.

$$\Delta BIST_t = \delta_0 + \sum_{i=1}^p \delta_i \Delta BIST_{t-i} + \sum_{i=0}^q \theta_i \Delta CDS_{t-i} + \sum_{j=1}^4 \sum_{i=0}^{k,l,m,n} \eta_{ji} \Delta \psi_{jt-i} + \varphi_1 BIST_{t-1} + \varphi_2 CDS_{t-1} + \sum_{j=1}^4 \varphi_{3j} \psi_{jt-1} + \mu_{1t} \quad (2.1a)$$

$$\Delta CDS_t = \theta_0 + \sum_{i=1}^{p'} \theta_i \Delta CDS_{t-i} + \sum_{i=0}^{q'} \delta_i \Delta BIST_{t-i} + \sum_{j=1}^4 \sum_{i=0}^{k',l',m',n'} \eta_{ji} \Delta \psi_{jt-i} + \varphi_1 CDS_{t-1} + \varphi_2 BIST_{t-1} + \sum_{j=1}^4 \varphi_{3j} \psi_{jt-1} + \mu_{2t} \quad (2.1b)$$

Here, p, q, k, l, m, n and their primes are optimal lag lengths for related variables in the model that are determined by Schwarz Information Criterion (SIC), and μ_t and μ_t are White noise stationary residual terms. Indeed, this methodology is also known as bound testing approach that is pioneered by Pesaran et al. (2001), where the null hypothesis of $\varphi_i=0$ is tested against $\varphi_i \neq 0$ with Wald test considering critical lower and upper bound values. The case, where Wald F-statistics is below lower bound, indicates that series are not cointegrated and there is no any long-run relationship between them. In fact this association exists only if the Wald F-statistics exceeds the critical upper bound, and in case it falls between bounds then the cointegration is inconclusive.

Table 2. Output of ADF Analysis

Variables	Level			1 st Difference		
	Prob.	Lag	DW	Prob.	Lag	DW
BIST	0.7502	0	1.9201	0.0000	0	1.9554
CDS	0.2139	0	1.7684	0.0000	0	2.0209
EX	0.9941	1	1.9308	0.0000	0	1.9316
CPI	0.0531	0	1.5998	0.0000	0	2.0088
INT	0.2716	1	2.0723	0.0000	0	2.0662
DPOL	0.0000	0	2.0079	0.0000	1	1.9687

Notes: DW is Durbin-Watson statistics. The lag is automatically determined by Schwarz Information Criterion (SIC) with maximum 8 lags.

Detection of long-run cointegration in (2.1) equation emerge possibility of following short-run interaction alongside with vector error-correction model (VECM) that can be formulated as below.

$$\Delta BIST_t = \delta_0 + \sum_{i=1}^p \delta_i \Delta BIST_{t-i} + \sum_{i=0}^q \theta_i \Delta CDS_{t-i} + \sum_{j=1}^4 \sum_{i=0}^{k,l,m,n} \eta_{ji} \Delta \psi_{jt-i} + \lambda_1 ECT_{1,t-1} + v_{1t} \tag{2.2a}$$

$$\Delta CDS_t = \theta_0 + \sum_{i=1}^{p'} \theta_i \Delta CDS_{t-i} + \sum_{i=0}^{q'} \delta_i \Delta BIST_{t-i} + \sum_{j=1}^4 \sum_{i=0}^{k',l',m',n'} \eta_{ji} \Delta \psi_{jt-i} + \lambda_2 ECT_{2,t-1} + v_{2t} \tag{2.2b}$$

where ECT_1 (ω_1) and ECT_2 (ω_2) are stationary residual of (2a) and (2b) respectively, and λ_1 and λ_2 are their multiplier that are expected to be significant and between -1 and 0 for robustness of VECM model.

4. Analysis and Findings

4.1. Examination with daily data

Recalling (1), we examine daily interaction between return of BIST-100 index and change in *CDS*, both series are stationary at level, by employing Granger (1969) causality test. Here the optimal lag length “ p ” is determined with information criterion tests as shown in table 3.

Table 3. Lag Length Selection Test

Lag	LR	FPE	AIC	SC	HQ
0	NA	2.26e-07	-9.628784	-9.622192	-9.626339
1	48.21678	2.20e-07	-9.653375	-9.633600*	-9.646041*
2	5.636000	2.20e-07	-9.651943	-9.618985	-9.639720
3	12.73105	2.20e-07*	-9.654863*	-9.608722	-9.637750
4	5.898214	2.20e-07	-9.653601	-9.594276	-9.631598
5	1.080703	2.21e-07	-9.649383	-9.576876	-9.622491
6	15.49522*	2.20e-07	-9.654032	-9.568341	-9.622251

Notes: The lag length criteria test shows comparative outcome of selection criteria. LR is sequential modified LR test statistic (each test at 5% level); FPE is Final prediction error; AIC is Akaike information criterion; SC is Schwarz information criterion; and HQ is Hannan-Quinn information criterion. The asterisks (*) indicates lag order selected by the criterion.

The results show that FPE and AIC point the lag 3 as optimal lengths while SIC and HQ suggest the lag 1. In this case, we decide to employ the Granger (1969) causality test both with lag 1 and 3 separately as in table 4 where the both cases find that there is bi-directional causality between $\Delta BIST$ and *CDS*.

Table 4. Lag Length Selection Test

Model	Null Hypothesis	F-Stat.	Prob.	Observation
VAR(1)	ΔCDS does not Granger cause $\Delta BIST$	7.3300	0.0069	1644
	$\Delta BIST$ does not Granger cause ΔCDS	3.1344	0.0194	
VAR(3)	ΔCDS does not Granger cause $\Delta BIST$	2.7865	0.0395	1642
	$\Delta BIST$ does not Granger cause ΔCDS	6.7360	0.0002	

The Granger causality results reveal that *BIST* and *CDS* are tightly associated with each other. More specifically, the result of VAR(1) model, in table 5, refers that a unit increase in today's ΔCDS , indeed, leads tomorrow's $\Delta BIST$ decrease by -0.04 units. The VAR(1) model where $\Delta BIST_t$ is dependent variable suffers from heteroscedasticity problem in residuals. By assigning White heteroscedasticity consistent coefficient covariance we fix it. As a result we get slightly different standard errors (which we can trust), and asymptotically standard normal distributed t-statistics where significance of ΔCDS_{t-1} has decreased from 1% to 5% level.

On the other hand, VAR(1) model, where ΔCDS is dependent, appears perfectly healthy. It estimates -0.1669 units impact from $\Delta BIST$ to ΔCDS which is actually triple of $\Delta CDS-\Delta BIST$ (-0.0369). Hereby, we conclude that a unit increase in today's $\Delta BIST$ shrinks ΔCDS by 0.17% in following day.

The right-hand side of the table 5 displays results of VAR(3) where both $\Delta BIST$ and ΔCDS dependent models suffer from serial correlated and heteroscedastic residuals. We could cure them, only, by removing third lags of dependent variables from the models. Meantime, we assign White heteroscedasticity consistent coefficient covariance, and get new robust models ($\Delta BIST''$ and $\Delta CDS''$) that estimate quite similar coefficient as VAR(1), -0.03 units impact from ΔCDS to $\Delta BIST$ and -0.17 units impact from $\Delta BIST$ to ΔCDS .

Table 5. Results of VAR Analysis

Variable	VAR(1)			VAR(3)			
	$\Delta BIST_t$	$\Delta BIST_t'$	ΔCDS_t	$\Delta BIST_t$	$\Delta BIST_t''$	ΔCDS_t	$\Delta CDS_t''$
$\Delta BIST_{t-1}$	0.1252*** (0.0155)	-0.1252** (0.0128)	-0.0769*** (0.0074)	0.1216*** (0.0171)	0.1266*** (0.0185)	-0.0426*** (0.0057)	-0.0408*** (0.0051)
$\Delta BIST_{t-2}$	-	-	-	0.0758* (0.0426)	0.0719** (0.0364)	-0.0138* (0.0075)	-0.0142* (0.0081)
$\Delta BIST_{t-3}$	-	-	-	0.0163** (0.0080)	-	-0.0106*** (0.0026)	-0.0173** (0.0082)
ΔCDS_{t-1}	-0.2369*** (0.0499)	-0.2369** (0.0584)	0.3776*** (0.0307)	-0.2158*** (0.0392)	-0.2230*** (0.0473)	0.3532*** (0.0313)	0.3654*** (0.0385)
ΔCDS_{t-2}	-	-	-	-0.1154** (0.0562)	-0.1042** (0.0495)	0.1221*** (0.0278)	0.1309*** (0.0255)
ΔCDS_{t-3}	-	-	-	-0.0449* (0.0260)	-0.0135 (0.0088)	0.0386** (0.0192)	-
C	0.0008* (0.0005)	0.0008* (0.0005)	0.0004 (0.0003)	0.0008** (0.0004)	0.0008** (0.0004)	0.0005 (0.0004)	0.0004 (0.0004)
R ²	0.4062	0.3658	0.3875	0.5931	0.5358	0.6474	0.6161
DW	1.9897	1.9897	1.9853	1.1979	2.0170	1.1390	1.9977
BG LM	0.6131	0.6131	0.9873	0.0001	0.6973	0.0001	0.4695
BPG Test	0.0197	-	0.8517	0.0000	-	0.0000	-

Notes: The numbers in upper part of the table are coefficients estimated by VAR analysis technique where significance levels follows as *:10%, **:5%, and ***:1%. The bottom part of the table shows diagnostics of the VAR models. BG LM is Breusch-Godfrey Serial Correlation LM test with H_0 : residuals of the model are not serially correlated. BPG is Breusch-Pagan-Godfrey heteroscedasticity test with H_0 : residuals of the model are homoskedastic. Both tests reports chi-square probabilities. DW is Durbin-Watson statistics.

4.2. Monthly Analysis

Further, we investigate both short-run and long-run interaction of *BIST* and *CDS* holding *EX*, *CPI*, *INT*, and *DPOL* as control variables. Initially, we present raw regression analysis results in the table 6, where all variables are in first-differenced form (as they are not stationary at level) except *DPOL*. Besides, table 6 shows cross series correlation of all input variables. Although correlation coefficients seem to be low to question presence of collinearity problem, one might think that the correlation of -0.5339 among inflation and interest rate imply collinearity. Lest this potential collinearity motivated by correlation between inflation rate (*CPI*) and interest rate (*INT*), we do not include these two variables in same model simultaneously. Instead, we test their contribution separately.

Table 6. Correlatin among Series

	BIST	CDS	EX	CPI	INT	DPOL
<i>BIST</i>	1	-0.3952	0.6961	-0.1928	-0.6519	0.0192
<i>CDS</i>	-0.3952	1	0.2781	0.4001	0.4717	0.2643
<i>EX</i>	0.6961	0.2781	1	-0.0504	-0.3745	0.1702
<i>CPI</i>	-0.1928	0.4001	-0.0504	1	0.5339	0.0979
<i>INT</i>	-0.6519	0.4717	-0.3745	0.5339	1	0.0592
<i>DPOL</i>	0.0192	0.2643	0.1702	0.0979	0.0592	1

Table 7 reports OLS estimations of $\Delta BIST$ -dependent and ΔCDS -dependent models in each column. The $\Delta BIST$ -dependent model estimates a significant negative short-run impact from ΔCDS to $\Delta BIST$ (-0.02) at 1% significance level. It indicates that 1 TL increase in ΔCDS price causes BIST drop by 17.3 TL. Exchange rate and interest rate seem to have negatively related with BIST as well. A “kurush” (1% of TL) increase in exchange rate shrinks BIST by 56 TL at 1% significance level, while 1 bps increase interest rate leads 312 TL reduction in BIST at 10% significance level. More importantly, dummy variable *DPOL* also derives statistically significant negative estimate of -0.25 at 1% level. However, this model violates non-serially correlated and homoscedastic residuals assumption of OLS. By dropping intercept term and assigning White heteroscedasticity consistent coefficient covariance we fix this problem for the sake of slight decrease in significance of ΔCDS (from 1% to 5%) and slight changes in other variables magnitudes, i.e. ΔCDS and ΔINT increase (in absolute value) to -0.0220 and -0.3388 respectively, while ΔEX and *DPOL* shrinks to -5.04 and -0.2416 respectively. When we replace interest rates with inflation rates, the model derive fairly similar estimates, however, newly included inflation fail to be statistically significant. This clearly shows ΔINT - ΔCPI trade-off is in favor of ΔINT as role of inflation over $\Delta BIST$ is insignificant.

On the other hand, ΔCDS dependent model appears perfectly healthy. By accounting 58.53% variations in ΔCDS , the model predicts significant negative impact running from $\Delta BIST$ to ΔCDS (-35.73 in ΔINT case and -36.93 in ΔCPI case) at 1% significance level. This indicates that 1000 TL increase in BIST index reduces ΔCDS price by 37 TL. Besides, a strong positive impact running from exchange rate to CDS is also documented at 1% significance level, indicating a kurush (1/100 TL) increase in exchange rate scales ΔCDS up by 2.93 TL (in ΔINT case) or 3.09 TL (in ΔCPI case). Interestingly, inflation becomes a significant explanatory variable of ΔCDS that contribute by additional 5% of R^2 value, while interest rate fails to be statistically significant. 1 bps increase in ΔCPI causes ΔCDS increase by 4.57 TL.

Plus, the coefficient of *DPOL* is predicted as -36 at 1% significance level. It indicates that each political uncertainty scales the CDS prices up by 36 TL.

Table 7. Results of OLS Analysis

Variable	(1)	(2)	(3)	(4)	(5)
	Δ BIST	Δ BIST'	Δ BIST	Δ CDS	Δ CDS
Δ CDS	-0.0173*** (0.0044)	-0.0220** (0.0111)	-0.0178*** (0.0051)	-	-
Δ BIST	-	-	-	-35.7381*** (8.5139)	-36.9325*** (8.5495)
Δ EX	-5.6057*** (1.2033)	-5.0388*** (1.1206)	-5.1926*** (1.2122)	292.84*** (81.0982)	308.93*** (83.7342)
Δ CPI	-	-	-0.0831 (0.4365)	-	4.5738** (2.2560)
Δ INT	-0.3120* (0.1661)	-0.3388* (0.1835)	-	6.7281 (6.6600)	-
<i>DPOL</i>	-0.2472*** (0.0762)	-0.2416*** (0.0805)	-0.2423*** (0.2969)	35.6275*** (6.0651)	35.8889*** (6.1202)
C	5.3268*** (1.4732)	-	1.3676*** (0.3613)	-9.0147*** (2.3064)	-9.9546*** (2.5137)
R^2	0.5512	0.5127	0.5485	0.5511	0.5853
DW	2.5937	2.0267	2.0584	2.0912	2.0675
BG LM	0.0114	0.9238	0.2155	0.3524	0.3128
BPG	0.0024	-	0.1372	0.1569	0.1974
White	0.0000	-	0.1190	0.2680	0.2680

Notes: The numbers in upper part of the table are coefficients estimated by OLS analysis technique where significance levels follows as *:10%, **:5%, and ***:1%. Note that BIST is in thousands TL unit (000 TL); CDS is in TL; CPI and INT are in percentage; EX is in raw currency rate. The bottom part of the table shows diagnostics of the OLS models. BG LM is Breusch-Godfrey Serial Correlation LM test with H_0 : residuals of the model are not serially correlated. BPG is Breusch-Pagan-Godfrey heteroscedasticity test with H_0 : residuals of the model are homoskedastic. Both tests reports chi-square probabilities. DW is Durbin-Watson statistics.

Subsequently we estimate the long-run tango of BIST and CDS by recalling (2). Initially, we determine p, q, k, l, m, n and their primes by employing optimal lag length selection tests in Eviews 9.0 software. The figure 2 displays the output

of this analysis where, following minimum AIC value, lag lengths are specified as $p=2, q=1, k=1, l=0, m=0$, and $n=0$ for ARDL model (2.1a). In case of (2.1b), both AIC and SIC finds the lag lengths as $p'=1, q'=1, k'=1, l'=1, m'=0$, and $n'=0$.

Further, we check diagnostics of our selected ARDL models for BIST and CDS separately. We use HAC-robust standard error to fix potential serial correlation and heteroscedasticity problems. Plus, we check check stability of these models with Cumulative Sum of the Recursive Residuals (CUSUM) test to make sure that they do not involve any structural breaks. We show results of diagnostic analysis in figure 3 where we document that both models are stable over time as their CUSUM (blue) lines remains between $\pm 5\%$ significance (two red) lines.

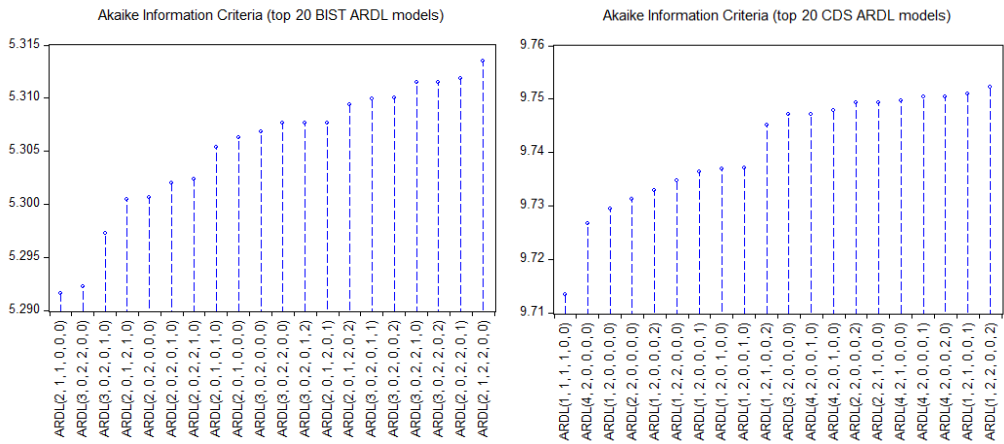


Figure 2. ARDL Lag Specification for BIST and CDS models.

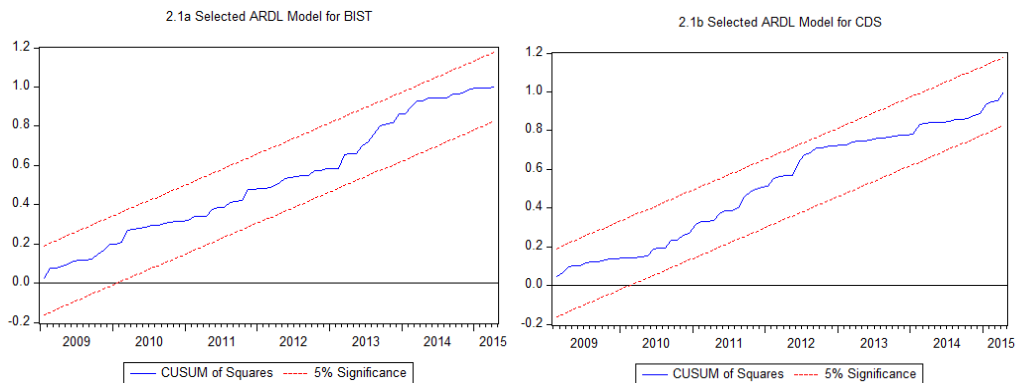


Figure 3. Stability of Selected BIST and CDS ARDL Models

Further, we derive estimates for these ARDL models in table 8 (Panel A) where first column presents estimates for equation 2.1a accounting 45.49% variations in $\Delta BIST$. We hypothesize $\varphi_i=0$ statement for both models utilizing Wald test. Its result is reported at the bottom part of the table 8 where model 2.1a derives t-value of 4.39 which highly exceeds Pesaran et al. critical value 1% significance level, indicating existence of long-run cointegration between series. We dear critical values of Case I that are presented in Pesaran et al (2001) at table CI. Because, case I is specified for models that do not comprise intercept value and any kind of trends, and so both of our models do not include intercept and trend factors as they appear statistically insignificant.

The negative ratio of coefficients to dependent variable ($-\varphi_i/\varphi_6$) shall show the direction and magnitude of their long-run relationship. Panel B of table 8 shows long-run multiplier derived by Panel A estimation. On this basis, the $\Delta BIST$ -dependent model implies that 1 TL increase in CDS prices leads BIST-100 index to decrease by 85 TL at 1% significance level in long-run. Equally, the model also forecasts that a kurush (1% of TL) value lose of TL against USD, leads an average of 78 TL decrease in BIST-100 index value in long-run. It might be addressed to the highly dollar indebtedness structure of Turkish firms, so that the risk of going default increases with the increase of debt that is triggered by appreciation of dollar against TL. More interestingly, 1 base point increase in interest rate causes BIST-100 index decrease by 359 TL in long-run, while each stressful political event shrinks BIST-100 index by roughly 538 TL in long-run, which makes sense, as uncertainties in regulative power negatively affect the financial markets.

The second column of panel A displays estimates of equation 2.1b where ΔCDS is dependent variable. The model's long-run multipliers in panel B indicate that 1000 TL increase in BIST index value causes 44 TL reduction in CDS prices in long-run. Likewise, a kurush increase in exchange rate (TL/USD) augments CDS prices nearly by 3 TL at 1% significance level in long-run. One percentage point increase in *CPI* will enhance CDS prices by 13.34 TL, while each political tensions add 89 TL into CDS prices in long-run at 1% significance level.

Table 8. Results of Bound Test and Long-run Multipliers

PANEL A	(2.1a) ΔBIST	(2.1b) ΔCDS	PANEL B	Long-run ΔBIST	Long-run ΔCDS
ΔBIST _t	-	-6.0800*** (1.5238)	-	-	-
ΔBIST _{t-1}	-0.2951*** (0.0941)	-3.5304** (1.6235)	-	-	-
ΔEX _t	-5.9528*** (4.2677)	309.4381** (145.7939)	-	-	-
ΔCPI _t	0.1788 (0.4334)	-	-	-	-
ΔCPI _{t-1}	-0.0879** (0.0438)	-	-	-	-
CDS _{t-1} (φ ₁)	-0.0140** (0.0066)	-0.4072*** (0.1025)	CDS	-0.0855*** (0.0195)	-
EX _{t-1} (φ ₂)	-1.2780*** (0.3312)	117.2774*** (42.6652)	EX	-7.7974*** (1.8202)	288.0093*** (62.4297)
CPI _{t-1} (φ ₃)	-0.2261* (0.1356)	5.4331 (3.6444)	CPI	-1.3817 (0.9428)	13.3426** (6.2251)
INT _{t-1} (φ ₄)	-0.0584* (0.0302)	3.2827* (1.9357)	INT	-0.3586* (0.1898)	8.0616 (7.3502)
DPOL _{t-1} (φ ₅)	-0.0882*** (0.0251)	36.4096*** (11.1957)	DPOL	-0.5380*** (0.1427)	89.4153*** (15.4522)
BIST _{t-1} (φ ₆)	-0.1639*** (0.0641)	-1.8820*** (0.5203)	BIST	-	-44.0604*** (11.2710)
R-Square	0.4539	0.5059			
Walt test φ _i =0	4.3927***	4.2055**			
Critical Value Case I	<u>Lower Bound</u>	<u>Upper Bound</u>			
10% significance	1.81	2.93			
5% significance	2.14	3.34			
1% significance	2.82	4.21			

Notes: The numbers in the table are coefficients estimated by ARDL analysis technique where significance levels follows as *:10%, **:5%, and ***:1%. Critical values for bound test is retrieved from Pesaran et al (2001) Table CI at Case I with k=5.

Further, we investigate short-run dynamics of BIST and CDS using restricted error-correction model defined at equation 2.2a and 2.2b respectively. This technique also provides evidence for how quickly cointegrated series converge to their long-run equilibrium.

The table 9 demonstrates results obtained from this analysis, where coefficients of independent variables imply their short-run causality on dependent one, and coefficient of ECT_{t-1} indicates the speed of error correction. The table shows that both ECTs are negative (between -1 and 0) and statistically significant. This implies that both models do not have instability problems caused by structural break in data. The ECT_{t-1} implies that (2.2a) model corrects 20.18% of its previous month disequilibrium in current month. Meantime, the diagnostic tests confirm that the model is flawless. The estimated results also reveal that 1 TL increase in CDS prices causes 22.5 TL reduction in BIST-100 index in short-run at 1% significance level. Likewise, a kurush increase in TL/USD exchange rate shrinks BIST-100 index by 24.5 TL in short-run. Apparently, current periods CPI seems to be statistically insignificant, however, its first lag (previous period CPI) is statistically significant at 5% level. A percentage increase in lagged inflation rate and current interest rate diminishes BIST-100 index price by 166 TL and 258 TL respectively in short-run. Plus, each negative political event causes BIST-100 index by 237 TL in short-run at 1% significance level.

On the other hand the model 2.2b also predicts plausible results. It estimates that 1000 TL increase in current and lagged BIST-100 index causes jointly 38 TL reduction in current CDS prices in short-run at 1% significance level. Besides, a kurush increase in current TL/USD exchange rate motivates CDS prices by 2.5 TL in short-run, while a percentage increase in inflation rate increases CDS prices by 6 TL at 10% significance level. The interest rates appear to be statistically insignificant factor in explaining short-run dynamics of CDS prices. In addition, $DPOL$ derives positive coefficient of 33.36 at 1% significance level, indicating 33 TL increment in response to each negative political events in short-run. This model has adjustment speed of 37.31%, indicating that it corrects 37.31% of its previous month disequilibrium on current month.

Table 8. Results of Bound Test

	$\Delta BIST_t$	ΔCDS_t
$\Delta BIST_t$	-	-24.6944*** (5.5101)
$\Delta BIST_{t-1}$	-0.3221*** (0.096)	-13.4232*** (3.4080)
ΔCDS_t	-0.0225*** (0.0059)	-
ΔEX_t	-2.4591*** (0.6788)	248.43** (135.3055)
ΔCPI_t	0.2577 (0.3953)	5.7362* (3.3420)
ΔCPI_{t-1}	-0.1661** (0.0779)	-
ΔINT_t	-0.2309* (0.1335)	2.7155 (1.8906)
$\Delta DPOL_t$	-0.2374*** (0.0702)	33.3645*** (11.9873)
ECT_{t-1}	-0.2018*** (0.0530)	-0.3731*** (0.0915)

Notes: The numbers in the table are coefficients estimated by restrictive error correction ARDL technique where significance levels follows as *:10%, **:5%, and ***:1%. ECT is lagged residual of long-run models of written in equation 2a and 2b. It shows speed of adjustment of previous period disequilibrium on current period.

5. Conclusion

The paper studies both short and long-run interaction between BIST-100 index and CDS prices with daily and monthly periods over January 2008 to May 2015. In daily analysis, both BIST and CDS series are stationarilized by taking their first differences ($\Delta BIST$ and ΔCDS respectively), and subsequently we employ Granger causality test. The results reveal bi-directional causality at 1% significance level, where a percentage increase in today's ΔCDS shrinks tomorrow's $\Delta BIST$ by -0.24%. The inverse impact (running from $\Delta BIST$ to ΔCDS) is 1/3 times, indicating a percentage increase in today's $\Delta BIST$ leads -0.08% reduction in ΔCDS in the following day.

In case of monthly analysis, preliminary regression output indicates that 51.27% variations in $\Delta BIST$ is accounted by CDS prices and four control variables such as TL/USD exchange rate, inflation rate, interest rate, and $DPOL$ (dummy for

negative political events). Estimates show that CDS, exchange rate, interest rate, and *DPOL* appear statistically significant factor in explaining BIST index price. The estimates indicate that 1 TL increase in CDS shrinks BIST index price by 22 TL, while a kurush increase in exchange rate of TL/USD causes 50.4 TL reduction in BIST index price. Likewise, we find that a percentage increase in interest rate decreases BIST index price by 338 TL at 10% significance level. Plus, each negative political event reduces BIST index price by 242 TL at 1% significance level.

In ΔCDS -dependent model, BIST and the four control variables accounts 58.53% variations in CDS. This model predicts significant negative impact running from $\Delta BIST$ to ΔCDS (-35.73 in ΔINT case and -36.93 in ΔCPI case) at 1% significance level. This indicates that 1000 TL increase in BIST index reduces ΔCDS price by 37 TL. Besides, a kurush (1/100 TL) increase in exchange rate scales ΔCDS up by 2.93 TL (in ΔINT case) or 3.09 TL (in ΔCPI case). Interestingly, inflation becomes a significant explanatory variable of ΔCDS that contribute by additional 5% of R^2 value, while interest rate fails to be statistically significant. 1 bps increase in ΔCPI causes ΔCDS increase by 4.57 TL. Plus, the coefficient of *DPOL* is predicted as -36 at 1% significance level. It indicates that each political uncertainty scales the CDS prices up by 36 TL. These findings reveal that both BIST-100 index and Turkey's CDS prices are severe responsive to the changes in exchange rates and political instability.

Besides, the paper proceeds an ARDL approach to examine both short-run and long-run interaction of these series considering, on one hand, $\Delta BIST$ -dependent (2.1a) model where 45.39% of its variation is captured, and on the other hand, ΔCDS -dependent (2.1b) model with 50.59% explanatory power. More specifically, the results of ARDL analysis generate several findings. First, it finds a significant and inverse long-run causality running from ΔCDS to $\Delta BIST$ with impact magnitude of -0.0855 which indicates 1 TL increase in CDS prices pulls down BIST-100 index price by 85.5 TL in long-run at 1% significance level. The restrictive error-correction model shows that this impact is limited with 22.5 TL in short-run.

The system also predicts inverse impact that runs from BIST to CDS as -44.06 in long-run and as -24.69 in short-run. This indicates that 1000 TL increase in BIST index price causes 25 TL and 44 TL reduction in Turkey's CDS prices in short- and long-run respectively. Interestingly, interest rate appears to be significant factor in explaining BIST-100 index, while inflation rate is significant factor for CDS prices, but not vice-versa. This indicate that a percentage increase in interest rate shrinks BIST index by 359 TL and a percentage increase in inflation rate scales CDS prices up to 13.34 TL both in long-run. In case of short-run, these impacts are limited with 231 TL and 5.74 TL respectively.

More importantly, estimates of *DPOL* indicate that each negative political event causes 538 TL reduction in BIST-100 index price and 89 TL increase in CDS prices in long-run at 1% significance level. Restrictive error-correction model implies that these impacts are limited with 237 TL and 33 TL respectively at 1% significance level. This clearly provides strong evidence for severe sensitivity of financial markets to uncertainties in political environment. Plus, both error-correction systems seem to work properly. The $\Delta BIST$ -dependent (2.2a) model corrects 20.18% of its previous month disequilibrium on current month at 1% significance level, while this adjustment speed is 37.31% in ΔCDS -dependent (2.2b) model. The results indicate that the series in (2.2a) and (2.2b) models cannot drift too far apart, and converge to a long-run equilibrium at a moderate monthly speed.

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APPENDIX-A

Month-Date	Events with Huge Negative Politic Impact
January 2008	Ergenekon Operations: Initial Waves
February 2008	Ergenekon Operations: Initial Waves continues
March 2008	Ergenekon Operations: Initial Waves continues
July 2008	Closure Trial of AKP (running government)
January 2009	Ergenekon Operations: Latest Waves
February 2009	Ergenekon Operations: Latest Waves continues
March 2009	Local Elections
June 2010	Gaza Aid Flotilla (Mavi Marmara) raid
September 2010	Constitutional Referendum
June 2011	General Elections
August 2011	The Oath Crisis
December 2011	The Roboski (Uludere) airstrike
February 2012	MIT Crisis
May 2013	The Gezi Uprising
June 2013	The Gezi Uprising
July 2013	The Gezi Uprising
August 2013	The Gezi Uprising
November 2013	The Civil Protests
December 2013	The 17-25 December Events
January 2014	The Civil Protests
March 2014	Local Elections
August 2014	Presidential Elections
September 2014	Assault on Kobane (Kurdish Protests)
December 2014	Assault on Kobane (Kurdish Protests)
February 2015	The Civil Protests
March 2015	The Prosecutor Hostage Crisis (Death of Mehmet Selim Kiraz)

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