Testing contagion through causality : An empirical investigation of five Arab countries

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Abstract: This paper aims to investigate whether the financial turbulence, associated with the political instability after the Arab Spring, spread to other stable countries. For this purpose, we have employed a Granger-causality approach to test if there were causal connections between price indices of five Arab stock markets. Our findings suggest that there was evidence on contagion only from Tunisia to Jordan, and from Egypt to Morocco.

Keywords: Contagion, Granger-causality, Arab Spring.

Jel Classification Codes : G01, G15.

I- Introduction :

In today's highly integrated world where all countries seek to be part of a bigger economic bloc, in order to benefit from all related advantages, it is logical to expect that once a financial crisis occurs in a country, it will undoubtfully spread to other countries in the world. That is why the phenomenon of contagion is usually considered as inevitable consequence of "the new global economy"[1]; and as Moser (2003) expresses that, "Blaming financial crises on contagion has proved to be highly contagious".

Although the term 'contagion' has become standard language in the vocabulary of international economists and policy makers[2]. It was rarely used prior to the East Asian financial crisis. In fact, it has only appeared in few articles discussing the transmission of the Peso crisis in 1994*, and it was until the Thai devaluation in 1997, that the research on contagion has received a great attention[3].

There is a voluminous analytical and empirical literature on the international propagation of shocks (King and Wadhawani, 1990, Kaminsky and Reinhart, 2000, Hernández and Valdés, 2001, Forbes and Rigobon, 2002,…etc)*. These studies aim mainly to understand and to explain the widespread of the 1990s crises, due to their virulence and their far-reaching effects beyond their epicenters[4]. Even though, some economists argue that there has been less contagion during the recent crises (Argentina 2001-2002, Turkey 2001)[5], which may lead to think that a learning effect may have enabled the financial system to mitigate the spread of shocks. The spillover of US subprime turmoil shows that financial contagion still exists.

Contagion is a long-standing concern for both academic community, investors and policymakers. It is commonly viewed as an indispensable result of globalization. Therefore, speaking of financial contagion may seem absurd and unnecessary while everyone knows what it is. So, why bother analyzing such obvious subject ? Researches in this specific area have three important ramifications :

First, international diversifying of financial portfolio relies on measuring markets' cross-correlation and their comovement[6]. According to Markowitz, an investor can reduce portfolio risk simply by holding combinations of instruments that are not perfectly

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positively correlated. However, correlation between assets or market indices is variable according to Longin and Solnik (1995)[7], and all markets tend to be highly volatile and correlated during times of financial turbulence; which may undermine all the benefits of diversification.

Second important contribution of this field of research is related to integration. As mentioned earlier, economic policies are attempting to reach markets' integration. Nevertheless, with the uprising risk of contagion associated with financial globalization, government officials should focus more on measures to take, according to the level of cross-country correlation, in order to minimize the risk of shocks propagation between the members of economic unions. Furthermore, the level of correlation between markets can help as well in predicting growth rates of integrated countries since financial markets are supposed to reflect the true image of their national economies; which is considered as a positive outcome in a long-term perspective[8].

Third, this topic focuses on the role of international institutions and the effectiveness of their intervention and financial assistance packages; this later depends totally on the cross-country linkages. More specifically, if one country is affected by crisis in another country and they have few linkages, then a short-term bailout is more likely to be effective. However, if the two countries are closely linked; this temporarily assistance would only prolong a necessary economic adjustment because the second economy has to respond to changes required by the crisis in the first economy[9].

Our study focuses on investigating this phenomenon specifically inside MENA region. Middle East and North Africa countries were trying for a long time to form an economic union, due to the similarities shared between them. However, the following years since the so-called "Arab Spring", starting from December 2010, had been marked by domestic and regional turmoil. Key sources of instability are security risks affecting an estimated twenty percent (20%) of regional GDP (Iraq, Jordan, Lebanon, Libya, Syrian Arab Republic, and Republic of Yemen). Political transition is affecting another twenty percent (20%) (Egypt, Tunisia)[10]. In addition to the volatile price of oil that is affecting both oil importing and oil exporting countries alike.

All these aspects offer a suitable climate for shocks to spread between MENA countries. Thus, the main problematic of this paper is to answer the following question:

Did financial markets' instability caused by political crises (Arab Spring revolutions) spilled over to other stable countries within the MENA region?

To develop this idea, we divide our problematic into several questions:

1. What contagion does and does not mean ?
2. How can we test for the existence of contagion ?
3. How to apply Granger-causality approach to test for contagion ?
4. Are there any empirical evidence of contagion of political turbulence from some Arab countries to other stable States ?

The remainder of this paper is organized as follows : section II briefly reviews the relevant theoretical and empirical literature on contagion. Section III discusses the data and methodology we pursue to test for contagion within the five Arab countries selected. Section IV presents the empirical results, and Section V concludes.

II- Literature review:

Although the flood of research on contagion, economists do not agree and are often not clear about what they mean exactly when using this term.

Most contemporary authors have been busy producing research on contagion, especially since the series of 1990s crises, after which this word has become a part of standard economic lexicon. If we ask anyone about the big "C" as called by Forbes (2012)*, the answer will definitely be that contagion is "the transmission of crisis from one country to other countries"[13]. So as argued by both Forbes and Claessens (2004), should we call any changes in a second economy as a response to changes (positive or negative) in a first economy a contagion? We will take the two examples cited in the article of Forbes and Claessens (2004) to illustrate this point:

- The transmission of a shock from Russia to Brazil after the 1998 Russian ruble devaluation.
- The transmission of a financial turbulence to Canadian market after the U.S. stock market drops by five percent (5%).

So, which of the two scenarios is considered as a contagion? Most people would agree that only the first case represents contagion, since the crisis has spread between two very different economies that are located in separate geographic regions with no direct linkages between them. For the second, contagion is not the most likely culprit; because the turbulence has propagated between two similar and closely linked economies, which are located in the same geographic region[11].

This small example shows that it is controversial, whether any transmission of country specific shocks should be considered contagion. It indicates also that there is a broader definition of contagion, mostly used by politicians and investors; and a narrow definition used for academic purposes mainly to test and explain this phenomenon, and lately to determine the appropriate measures in order to prevent or to face it.

Forbes and Rigobon present the most famous definition of contagion in their (2002) article[12]. They define "**contagion**" as "a significant increase in cross-market linkages after a shock to one country (or group of countries)[13] . Thus, "if the cross-market co-movement does not increase significantly, then any continued high level of market correlation suggests strong linkages between the two economies that exist in all states of the world"[14] . The appropriate word to describe the second scenario is "**interdependence**". Moser (2003) restricts the use of that term only to crises that are "causally connected"[15]; therefore, he defines it as : "contagion is supposed to describe incidents in which a (suitably defined) financial crisis in one country brings about a crisis in another"[16]. Forbes (2012) modifies the earlier (2002) definition of contagion and adopts in her article a broader meaning that has become commonly used. According to her (2012) article: "contagion is the transmission of an extreme negative shock in one country to another country (or group of countries)"[17]. This definition includes all possible transmission channels that are usually associated with interdependence. This later refers to, according to the same article, "cross-country spillovers in all states of the world"[18]. We notice that the use of this term "contagion" has evolved over time and even the explanations given by the same group of authors (Forbes 2002, 2004, 2012) have changed.

Forbes and Rigobon (2002) elucidate the necessity and advantage of adopting a narrow definition of contagion into two major points :

- To differentiate between contagion and other similar phenomena.

- To be able to test for its existence[19].

II.1. Contagion versus similar phenomena

Shocks can be transmitted through different mechanisms. We will try to sum up the most agreed upon channels, and point out to the ongoing debate on this issue.

Simultaneous crises can be a result of coincidence. In other words, "**independent shocks**" hit countries at about the same time with no connection between the different crises"[20]. This case shows clearly that the simultaneous occurrence of financial crises is not a sufficient condition, because contagion requires a causal connection according to Moser (2003) [21].

Simultaneity may also happen due to a "**common shock**", that is, "global or regional external shocks (other than a financial crisis) adversely affect economic fundamentals in a number of countries simultaneously, potentially triggering crises in some of them"[22]. Masson (1999b) calls this "monsoonal effects"[23]. These adverse shocks can be a change in global (US) interest rates, exchange rates between major currencies, commodity prices, or recessions in major industrial countries.

Crises spread through other normal mechanisms, generally known as "**interdependence**" (Forbes and Rigobon, 2002), "transmission" (Bordo et al, 1998), "spillovers" (Masson, 1999b), fundamental-based contagion" (Kaminsky and Reinhart, 2000). All these different names refer to shock transmission through the existing channels that link economic fundamentals of countries. The most important channel is trade. Trade links encompasses two transmission mechanisms: direct bilateral trade, according to which a major trading partner of a crisis country could experience declining in asset prices and large capital outflows or could become the target of speculative attacks. This country will suffer eventually from a deterioration in the trade account[24]. The second effect of trade is competitive devaluation[*] ; if a crisis in one country causes its currency to be devalued, this can reduce the relative export competitiveness of other countries that compete in third markets, and can put a pressure on them to depreciate their currency[25]. Another transmission channel is **financial links**. financial crisis in one country can directly cause reductions in trade credits, foreign direct investment, and other capital flows abroad[26] leading to a sharp increase in borrowing costs and liquidity problems, especially for countries heavily reliant on financial leverage[27]. Moreover, banks and lending institutions are considered as an important financial channel of shock propagation due to their extensive interconnections[28], or as it is also called 'common creditor' effect. When a number of countries rely mainly on the same creditor (as for East Asian countries depend on Japan or Latin American countries on USA); a crisis in one country within the same cluster is more likely going to affect other countries.

After discussing all these potential transmission mechanisms, we have to say that in literature, there is a little convergence on what of the previous channels are responsible for contagion. A number of authors agree on calling contagion only shocks transmission that cannot be explained by the above-mentioned mechanisms or by economic fundamentals. A crisis in a country lead to a general change in investors' behavior or sentiment. Portfolio investors can change their risk perception; therefore, they will behave differently[*], irrationally, which may trigger a crisis in other countries. If this change affects only similar countries to the ground-zero country (the crisis country)[*], it is a **discriminating**

contagion[29]. If there are no visible similarities, then it is a "**pure**" or "**shift* contagion**"[30]. Figure (1) shows a simple classification of normal and contagion channels.

II.2. Testing for contagion

Generally, empirical tests of contagion are divided into two categories : testing for contagion itself without trying to explain the underlying transmission mechanisms, which can be a complex and difficult task, due to unavailability of high frequency data of economic fundamentals. Alternatively, testing for contagion specific transmission channel. Studies in this category avoid going through the debate about contagion. However, other comprehensive studies try to use both approaches, that is to say, testing first for the existence of a pure contagion; then identifying its transmission mechanisms.

We focus on the first category, in which five general strategies are used : probability analysis, VAR models, latent factors/ GARCH models, extreme value analysis, and the widely used approach of cross-market correlations analysis[31]. This latter was initially established by Forbes and Rigobon (2002). These authors argue that during crises, increased volatility lead the correlation coefficients to be biased upward due to heteroscedasticity. After adjusting for this bias, there were no evidence of contagion during the 1990s crises. Although, their findings were later criticized by Corsetti et al (2001); this analysis is still used even recently to test for the spillover* of the US meltdown to other countries.

Testing contagion through causality is related to the analysis of asset price correlation. This test is used in many studies; among them, we refer to the study of Sander and Kleimeir (2003); in which they explore changes in the existence and the direction of causality by applying Granger-causality methodology on sovereign bond spreads during both the Asian and Russian crises[32]. In their study, they investigated contagion after dividing the whole period (from 19/12/1996 to 16/03/2000) into four sub-periods : tranquil, crisis, transition, and post crisis period. After applying Granger test on these periods, they find out that the Asian crisis established new causality patterns on a regional level that were not present before the crisis. These changes appeared later with the Russian crisis on international base affecting other emerging non-Asian economies in the sample.

III. Data and methodology:

In our study, we adopt the definition of contagion provided by Moser (2003). In which contagion requires causal connections[33]. Following Sander and Kleimeir (2003) testing methodology, we apply Granger-causality test on time series of five Arab stock markets' indices during the turmoil period of political crises called "Arab Spring". This period was marked by revolutionary wave of demonstrations and protests that started with the Tunisian revolution on December 17, 2010 in Sidi Bouzid; followed by the Egyptian revolution on January 25, 2011. This wave of uprising reached other Arab States such as : Algeria, Jordan, Libya, Bahrain,…etc in different periods. Most of these revolutions faded by mid-2012. Thus for the choice of our study period, We have selected December 17, 2010 as the starting date and May 01, 2012 as the ending date. The logic behind this choice is already justified by the timeline of Arab Spring events. We define the sub-periods as follows : a pre-crisis period that starts on April 30, 2010 and ends on December 16, 2010; a crisis period from December 17, 2010 to April 29,2011; a transition period from May 02, 2011 to December 30, 2011; a post-crisis period that starts from January 02, 2012 and ends on May 01, 2012. The study sample encompasses five Arab Countries, two of them were

the starting points of political disturbance. It includes : Morocco, Tunisia, Egypt, Kuwait, and Jordan. We apply Granger-causation on daily observations of stock exchange price indices : MASIIDX, TUNINDEX, EGX30, KSE-IXP (parallel market*), AMMAN SE.

Table (1) provides descriptive statistics over the different sub-periods. Comparing the mean over the four periods, this table reveals that price indices fall, as expected when the crisis period starts, with MASIIDX and AMMAN SE as exceptions. The biggest change is observed in TUNINDEX and EGX30. For both AMMAN SE and MASIIDX, the response is observed later during the transition and the post-crisis period as well, which may indicates that these two markets were not immediately affected by the turbulence as it was the case for the rest of the sample. For the KSE-IXP, there is no dramatic change in prices. TUNINDEX and EGX30 witnessed the highest changes from the pre-crisis to the crisis period; and even in the post-crisis period, prices didn't go back to their initial levels observed in the pre-crisis period. As for the volatility, the table shows that the standard deviations increase significantly for all countries when the crisis starts, with the biggest change is observed for EGX30 (from 308,2977 to 732,1598). This change is also observed for the full period, which can be justified by the high volatility of stock markets associated with the political instability. These changes can also be seen on the figure (2) that captures the sudden changes of all indices when the events start.

We proceed now with the causality test. Granger causality has been widely utilized for the investigation of the direct interactions. Before applying this test, we should examine the basic properties of the variables; because the standard Granger test is only valid when time series are stationary. If the variables are non-stationary or/and co-integrated, then the test will be misspecified. Thus, we follow these steps :

1- We test for stationarity using Dicky-Fuller (DF) unit root test.
2- If the series are stationary, we apply Granger-causality test.

IV. Empirical results:

After applying unit root analysis over the four sub-periods[37], the results reveal that all series are stationary, which indicates that a standard Granger-causality test can be applied. Table (2) summarizes all the results of causation testing between each pair of countries.

As expected, turmoil in Tunisia appeared to be Granger-causing the turbulence in three (03) out of four (04) countries during the crisis period. The test results may confirm the hypothesis derived from the figure (02) observations; that figure shows that all indices responded to the events in Tunisia. For Morocco- the only negative result- causality didn't appear until transition and post-crisis period; which may lead to think that the interconnections between the two markets arrived later comparing to other countries, despite the fact that they are located within the same geographic region. Results about TUNINDX show that there was no contagion from Tunisia to Egypt and Kuwait since the causality patterns were the same before and during the crisis period. For Jordan, the change in the results may indicate the existence of contagion between the two markets; the crisis in Tunisia may be the cause of turbulence in Jordan. Contagion between Tunisia and Morocco appeared later, as mentioned above, in the transition period; which may be justified by the fact that the disturbance in other Arab countries especially in Egypt enforced the initial turbulence caused by the events in Tunisia. Thus, the Moroccan markets has become more sensitive to the negative events in Tunisia.

Causality tests for EGX30 reveal that the crisis in Egypt was not causing anything, except for the turbulence in Morocco. This may be justified by the fact that the turbulence in both Tunisia and Jordan have started before the Egyptian revolution unlike Morocco, in which the crisis emerged after the events in Egypt.

The interesting results were observed during the pre-crisis period; where MASIIDX was causing all other indices except for AMMAN, which may reflect interdependence between all markets in tranquil periods. During both the transition and the post-crisis period, test results are mostly negative. For both KSE-IXP and Amman, causality patterns didn't change remarkably during the four sub-periods.

V. Conclusion :

This study has attempted to investigate for the existence of contagion, after the turbulence caused by political instability, between five Arab countries. For this purpose, we have employed a specific approach used by Sander and Kleimeir (2003). We have applied Granger-causality test on times series of stock markets price indices over four sub-periods. The results show that causality appeared suddenly, after the crisis, only in few cases (between Tunisia and Jordan; Egypt and Morocco). For the rest of results, the existence of causality was a continuation from the pre-crisis period, or it appeared later after the events in Egypt. This may suggest that the turmoil in Tunisia was not sufficient alone to cause negative changes in other markets, until the disturbance appeared in other Arab countries, especially in Egypt.

This study, however, could be reconducted and extended in many different ways. Further studies may apply the same testing methodology on all MENA countries during the same period to form an overall picture of all stock markets behavior, since other Arab countries- not included in our sample- may have contributed in the turbulence of the studied countries, such as : Libya, Syria, Yemen…etc. Other studies may focus on using other strategies to test for contagion, or even attempt to identify the transmission mechanisms that allow the shocks to spread between MENA countries. This line of research can also be extended to investigate the possibility to form an integrated region with minimum risk of contagion.

- Appendices:

Figure (1) : Shocks transmission mechanisms

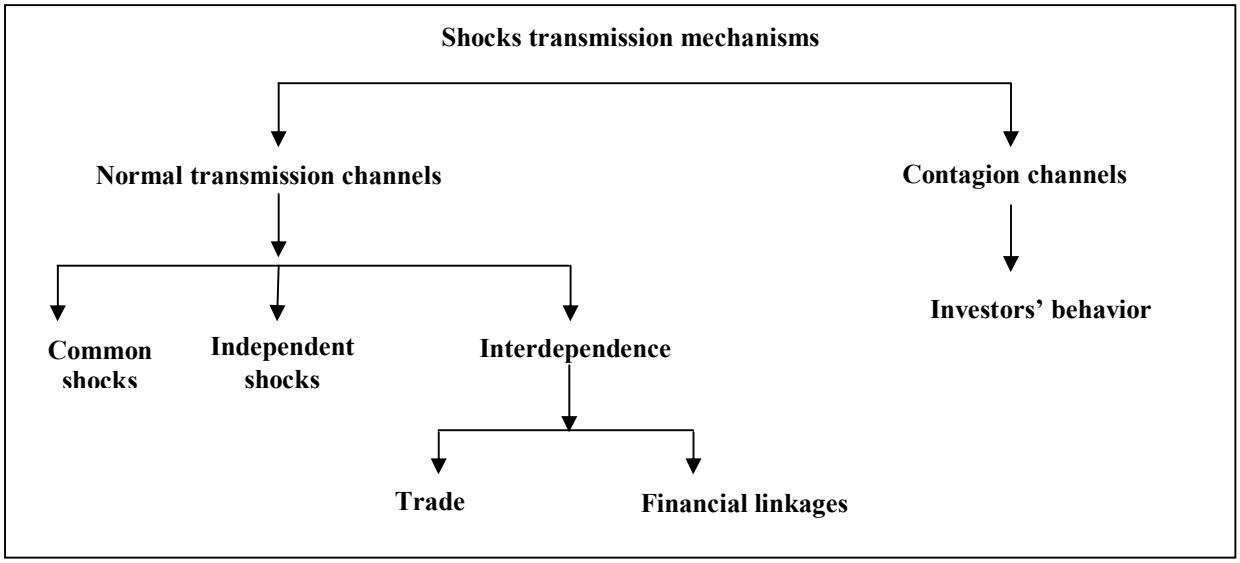

Table (1) : Descriptive Statistics

	MASIIDX	TUNINDEX	EGX30	KSE-IXP	AMMAN SE
Mean					
Full period	**11761,76**	**4759,725**	**5490,264**	**6380,620**	**4887,044**
Pre-crisis period	12016,80	5176,913	6547,980	6808,761	5063,444
Crisis period	12573,16	4525,791	5915,907	6489,197	5179,973
Transition period	11446,83	4470,635	4643,780	6026,156	4718,127
Post-crisis period	11016,21	4808,140	4717,271	6051,475	4569,036
Median					
Full period	**11741,51**	**4717,480**	**5425,980**	**6338,700**	**4905,260**
Pre-crisis period	12014,97	5171,360	6547,130	6810,300	5059,900
Crisis period	12644,14	4436,500	5646,500	6491,150	5098,200
Transition period	11393,84	4500,500	4639,640	5910,200	4695,770
Post-crisis period	11091,60	4750,210	4907,360	6120,000	4602,310
Standard deviation std.deve					
Full period	**625,4035**	**383,2421**	**1006,140**	**422,3324**	**280,2022**
Pre-crisis period	291,7849	221,4629	308,2977	207,3448	138,5443
Crisis period	415,5998	330,4932	732,1598	278,9642	233,6048
Transition period	355,2520	210,8376	582,9785	232,7937	160,2268
Post-crisis period	376,4596	141,1473	521,7786	198,7836	130,1085

Source : Calculated by the author using Eviews8

Figure (2) : Stock markets price indices

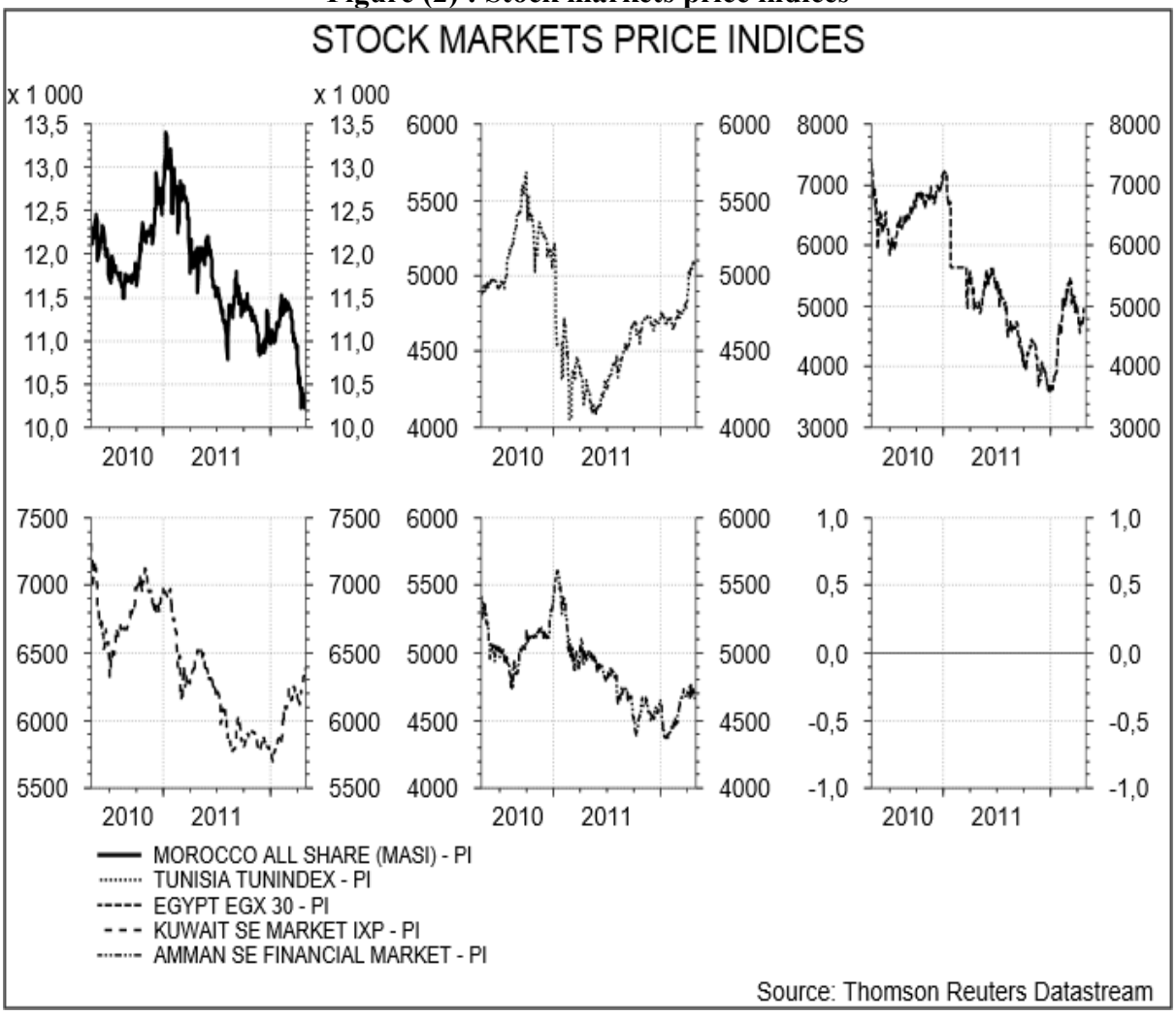

Table (2) : Results of Granger-causality test

	Pre-crisis period	Crisis period	Transition period	Post-crisis period
MASI ⇨ TUNI	YES	NO	NO	NO
MASI ⇨ EGX	YES	NO	NO	NO
MASI ⇨ KSE	NO	NO	YES	NO
MASI ⇨ AMMAN	NO	NO	NO	NO
TUNI ⇨ MASI	NO	NO	YES	YES
TUNI ⇨ EGX	YES	YES	YES	NO
TUNI ⇨ KSE	YES	YES	NO	NO
TUNI ⇨ AMMAN	NO	YES	YES	NO
EGX ⇨ MASI	NO	YES	NO	NO
EGX ⇨ TUNI	NO	NO	NO	NO
EGX ⇨ KSE	NO	NO	NO	NO
EGX ⇨ AMMAN	NO	NO	YES	YES
KSE ⇨ MASI	NO	NO	NO	NO
KSE ⇨ TUNI	NO	NO	NO	NO
KSE ⇨ EGX	NO	NO	NO	NO
KSE ⇨ AMMAN	YES	NO	NO	YES
AMMAN ⇨ MASI	YES	NO	NO	YES
AMMAN ⇨ TUNI	NO	YES	NO	NO
AMMAN ⇨ EGX	NO	NO	NO	NO
AMMAN ⇨ KSE	NO	NO	NO	NO

Source : Calculated by the author using Eviews8

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