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Abstract

The purpose of this paper is to investigate vulnerability to financial contagion in a set of expanding emerging markets of the Middle East and North Africa, during seven episodes of international financial crisis. Using Fry & Baur (2005) fixed-effect panel approach, we significantly reject the hypothesis of a joint regional contagion. However, using a battery of bivariate contagion tests based on Forbes and Rigobon (2002), Corsetti (2002), and Favero and Giavazzi (2002), we find evidence that each of the investigated markets suffered from contagion at least once out of the seven investigated crises. In conformity with the literature, our results suggest that the probability of being affected by contagion seems to increase as the MENA markets develop in size and liquidity, and become more integrated to the world's markets.

JEL classification: G11;G12;G15
Keywords: Contagion, Emerging Markets, Middle East and North Africa.

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1. Introduction

The joint increased international integration of emerging markets and the repeated incidence of financial crises in recent history have ignited a research agenda into the role of globally integrated capital markets in financial crises. More specifically, the concept of 'contagion' as a conduit for capital market turmoil has become an important focus. Contagion can be defined as the transmission of unanticipated local shocks to another country or market, resulting in an increase in correlation during periods of financial crisis (Masson, 1999; Forbes and Rigobon, 2002). The consequences of contagion can be staggering: for instance, real output losses during the Asian crisis have been estimated at 15% of GNP (IMF, 2001). These crisis episodes have clearly highlighted the risk inherent to capital market integration for emerging market economies.

On the other hand, several studies suggested that global integration is beneficial to growth and employment. Models of international asset pricing under capital market segmentation usually predict that the integration of capital markets decreases the cost of capital as risk is internationally diversified (Stulz, 1999). Empirical work also suggests that liberalizing restrictions on international portfolio flows tends to enhance stock price liquidity, which in turns enhances productivity and ultimately affect economic growth (Levine, 2001; Bekaert and Harvey, 2000; Patro and Wald, 2004). For emerging market economies, the co-existence of gains and risks associated to financial integration is inherent to the relationship uniting market integration and vulnerability to financial contagion. More fundamentally, one might ask whether an optimal degree of financial integration exist, where an emerging market economy can reap the benefits of greater access to foreign capital without enduring the costs of contagion.

The objective of this paper is to answer part of the question by investigating the vulnerability of the emerging markets of the Middle East and North Africa (MENA) to various episodes of financial crisis. As shown in table 1, the area has now overcome Latin America in terms of average market capitalization, liquidity and number of listed firms. However, only since the 1990's have the MENA countries embarked on financial liberalization policies, and with different timings (see FEMISE, 2005). As a consequence, the MENA area actually encompasses markets of various sizes and maturity, from the largely capitalized stock markets of Turkey, Israel and Egypt, to the more thinly traded markets of Morocco, Tunisia and Lebanon.

Previous research in the MENA stock markets has shown that these markets display opportunities for international diversification by displaying evidence for international segmentation and predictability (Lagoarde-Segot&Lucey, 2005(a),(b); Girard ,2004). However, to our knowledge, there is no empirical evidence on the transmission of international financial crisis in these markets. This paper constitutes a first attempt to fill this gap in the literature. The remainder of the paper is structured as follows. Section 2 presents the methodology, the crisis definition and the dataset. Section 3 discusses our findings, and section 4 draws together our conclusions.

INSERT TABLE 1 ABOUT HERE

2. Methodology, Data and Crisis Identification

2.1 Methodology

There is now a reasonably large body of empirical work testing for the existence of contagion during financial crisis. The seminal methodology used to analyze simultaneously falling stock markets over breakdown periods was to compare correlation coefficient with a benchmark (Longin&Solnik, 1995; Karolyi & Stulz, 1996). However, it is now established that results from this approach can be biased. First, the presence of heteroscedasticity in the studied markets makes it impossible to draw robust conclusion from simple correlation coefficients. It has been shown that heteroscedasticity is a typical feature of crisis periods since the latter generally corresponding to an increase in volatility (Forbes&Rigobon, 2002). A second bias is that simple tests based on changes of coefficient can have low power (Dungey & Zhumabekova, 2001). Finally, bi-variate coefficient analysis implies that only pairs of markets can be analyzed, even though markets are part of a larger financial system (Baur&Fry, 2005).

Several models of contagion have been developed over recent years in order to overcome the difficulties cited above (see Dungey, Fry, Gonzalez & Martin, 2004). These methodologies have relative merits and use a variety of econometric techniques. In order to investigate the issue of contagion in the Middle East and North Africa, we build up a battery of econometric tests that encompasses four of these, including the multivariate fixed effect panel approach of Baur&Fry (2005), the endogenous timing structural model approach of Favero&Giavazzi (2002), the Forbes & Rigobon (2002) adjustment of the correlation coefficient and the Corsetti et al. (2002) version of the latter.

2.1.1 The fixed-effect approach

The first technique we employ is a multivariate test of contagion based on a panel data model which controls for common vulnerabilities through the inclusion of a world, regional and emerging equity market index. The framework is a basic regression model of the form:

$$y_{i,t} = \alpha_i + \gamma_t + \beta_{i1}\tau_{regional,t} + \beta_{i2}\tau_{global,t} + \beta_{i3}\tau_{emerging,t} + \varepsilon_{i,t} \quad (1)$$

Where $y_{i,t}$ is the return of country i at time t, and $\tau_{regional,t}$, $\tau_{global,t}$ and $\tau_{emerging,t}$ are regional, global and emerging markets factors, respectively. The model contains a constant, α_i, for each country return vector y_i and a fixed time effect γ_t which is defined for a period a K days through time across all countries. As in Baur&Fry (2005), the fixed time effect is interpreted in comparison to a base period and capture contagion in this model. The error terms are given by $\varepsilon_{i,t}$ and are assumed to be independent and independently distributed with zero mean and unit variance.

As in Baur & Fry (2005), the model differentiates between common vulnerabilities and contagion through the relative importance of the global and regional factors compared to the fixed time effects. It is assumed that vulnerabilities exist in both the benchmark and crisis period and capture the systematic relationship between the equity markets of each country and the region, emerging markets and the world. In this framework, the fixed time effect captures time-varying joint positive and negative movements across markets that are unexplained by the loading factors over the period of study. The idea is then that contagion occurs wherever these fixed time effects reach a certain threshold, highlighting the fact that asset prices are determined by a large unexplained common factor. We consider that the threshold is reached if the t-statistic of an estimate of the fixed effect is significant at the 5% level.

According to Baur&Fry, the advantages of this approach lies in that the model can endogenously determine contagion and hence avoid the sample selection bias discussed in Pesaran and Pick (2004). Moreover, the panel model is multivariate and therefore gives evidence of joint contagion through an estimation of global interdependencies. When investigating contagion in a specific region, it thus constitutes a useful complement to the bivariate framework.

2.1.2 The structural model approach

Favero & Giavazzi (2002) have also proposed a methodology which also allows to endogenously define contagion by indentifying many short lived crisis periods associated with extreme returns. The idea is to implement a VAR to control for the interdependence between asset returns, and subsequently used the heteroscedasticity and nonormalities of the residuals from that VAR to identify unexpected shocks transmitted across countries, which are considered as contagion. The first step is to estimate a simple VAR and to consider the distribution of the residuals. Crisis observations are then defined through a set of dummies associated with extreme residuals for each country. Consider the following VAR model:

$$z_t = \phi z_{t-1} + v_t \tag{2}$$

Where z_t are pooled asset returns across the sample period, ϕ contains the $N \times N$ VAR parameters, and v_t are the reduced-form disturbance with zero means and constant covariance matrix with variances given by $E\left[v_i^2\right] = \sigma_i^2$. The dummy variables are then defined as:

$$d_{i,k,t} = \begin{cases} 1 : \left|v_{i,t}\right| > 3\sigma_i^2 \\ 0 : otherwise \end{cases} \tag{3}$$

Where we define one single dummy variable per observation. These dummy variables are then included in the following structural model:

$z_{1,t} = \alpha_{1,2} z_{2,t} + \theta_1 z_{1,t-1} + \gamma_{1,1} d_{1,1,t} + \gamma_{1,2} d_{2,1,t} + \eta_{1,t}$ $z_{2,t} = \alpha_{2,1} z_{1,t} + \theta_2 z_{2,t-1} + \gamma_{2,1} d_{1,1,t} + \gamma_{1,2} d_{2,2,t} + \eta_{2,t}$	(4)

Where θ_1 and θ_2 are the parameters on own lags and $\eta_{i,t}$ are the structural disturbances. In order to correct for simultaneity bias, this model is implemented using an FIML variable estimator where instruments are the dummy variables and each country's own lagged returns. Finally, contagion from country 1 to country 2 is tested by checking the significance of the shock in asset returns in the second country on asset returns in the first country:

$$H_0 : \gamma_{1,2} = 0$$

2.4 Adjusted correlation coefficient

In a seminal paper, Forbes&Rigobon (2002) pointed out that the traditional comparison of correlation coefficient is biased due to heteroscedasticity in market returns during crisis periods. They subsequently proposed a methodology to correct for that bias. Consider the basic conditional correlation coefficient between country 1 and 2:

$p = \frac{\sigma_{1,2}}{\sigma_1 \sigma_2}$	(5)

An adjustment can be done using the following transformation:

$p^* = \frac{p}{\sqrt{1+\delta\left[1-(p)^2\right]}}$	(6)

Where $\delta = \frac{\sigma_{11}^h}{\sigma_{11}^l} - 1$ measures the change in high period volatility against the low period volatility in the crisis country. The null hypothesis of no contagion is then tested as:

$$H_0 : p_h - p_l = 0$$

However, this approach has been criticized by Corsetti et.al(2002) on the basis that it is built on arbitrary and unrealistic restrictions on the variance of country-specific shocks. Whereas the Forbes&Rigobon (2002) methodology identifies tranquil and crisis periods by different levels of asset return volatility, a change in variance might actually be driven by an increase in the variance of a common factor, which then causes unusual volatility in other markets. In this case, the event of a significant change in the magnitude of co-movement between markets does not necessarily require a rise in correlation between these markets; and contagion can be defined as the presence of co-movements in significant excess from what could be expected from an unchanged transmission mechanism. Accordingly, the methodology proposed by Corsetti et.al (2002) consists of testing for structural breaks in the international transmission mechanism.

The model first creates data-generating process in country 1 and country 2, where country 2 is the country where the crisis occur:

$$\begin{cases} \mathrm{r}_1 = \alpha_1 + \gamma_2 f + \varepsilon_1 \\ \mathrm{r}_2 = \alpha_2 + \gamma_2 f + \varepsilon_2 \end{cases} \qquad (7)$$

Where $\alpha' s$ are constants, γ_1 and γ_2 are country-specific factor loading, f is a common factor, ε_i and ε_j are country-specific factors. Correlation coefficients are defined as:

$$\begin{cases} p_c = \dfrac{1}{\left[1 + \dfrac{Var(\varepsilon_1)}{\gamma_1^2 Var(f \mid C)}\right]^{1/2} + \left[1 + \dfrac{Var(\varepsilon_2)}{\gamma_2^2 Var(f)}\right]^{1/2}} \\ p_t = \dfrac{1}{\left[1 + \dfrac{Var(\varepsilon_1)}{\gamma_1^2 Var(f)}\right]^{1/2} + \left[1 + \dfrac{Var(\varepsilon_2)}{\gamma_2^2 Var(f)}\right]^{1/2}} 2 \end{cases} \qquad (8)$$

Where p_c and p_t are coefficients for the crisis and tranquil period, respectively. If the transmission mechanism is left unchanged between the tranquil and crisis period, γ_1, γ_2, $Var(\varepsilon_1)$ and $Cov(\varepsilon_1 \varepsilon_2)$ will be constant and the correlation coefficient between asset returns becomes:

$\phi(\lambda_1, \lambda_2^C, \delta, p) \equiv p\left[\left(\frac{1+\lambda_2}{1+\lambda_2^C}\right)^2 \frac{1+\delta}{1+p^2\left[(1+\delta)(\frac{1+\lambda_2}{1+\lambda_2^C})-1\right](1+\lambda_2)}\right]^{1/2}$	(9)

Where $\lambda_2 = \frac{Var(\varepsilon_2)}{\gamma_2^2 Var(f)}$ and $\lambda_2^C = \frac{Var(\varepsilon_2 \mid C)}{\gamma_2^C Var(f \mid C)}$.

Testing the null hypothesis of interdependence versus contagion amounts to measuring whether p^C is significantly higher than ϕ, which represents the theoretical measure of interdependence:

$$H_0 : p^C \leq \phi$$

In implementing the correlation-based methodology, we draw on two test-statistics to measure the significance of the difference between coefficients. Following Forbes & Rigobon (2002) we begin with a test based on the Fisher transformation. However, this approach makes the assumption of normality, and might suffer from a lack of robustness in the case of skewed stock market returns. In an attempt to improve the finite sample properties of the statistic we therefore complement the analysis with an exact t-test based on actual sample correlation coefficients (as suggested in Collins&Biekpe, 2003)[3]:

$t = (p_x - p_y)\sqrt{\frac{n_1 + n_2 - 4}{1-(p_x - p_y)^2}}$	(10)

Where $t(0.05, n_1 + n_2 - 4)$.

2.2 Data and Identification of crises

[3] Corsetti et al. (2002) also suggest calculating the test based on threshold values derived from the variance ratios. However, this framework requires that studied market display high correlation levels (>0.32) during the crisis period, otherwise threshold values tend to infinity and the null hypothesis cannot be rejected at all. Results are available on request.

We investigate the impact of each of last decade's majour financial crisis on the emerging markets of the Middle East and North Africa. Our analysis thus begins with the 1997-1998 Asian crisis, the 1998 Russian financial turmoil and its extension to Brazil the same year. We then turn to the 2001 Turkish crisis and the Argentinean insolvency crisis in 2002. Following Mishkin and White (2002), who found that the US turmoil in the aftermath of the 9/11 terrorist attacks was among the fifteen biggest crash of the century, we also include these terrorists attacks in the crisis timeline. Finally, we also look at the effect of the American financial turmoil that followed the Enron and WorldCom accounting scandals. Serwa and Bohl (2004) highlighted the magnitude of the latter by suggesting that it corresponded to a fall of 20% in the US index.

INSERT TABLE 2 ABOUT HERE

The preliminary step to the investigation of contagion is the accurate identification of the crisis interval. This requires to divide the dataset into a stable and a turmoil period. Our starting dates are based on the literature, and the length of the turmoil are chosen to be one or two months depending on crisis development. Following Rigobon(2001), we assume that the breakout of the East Asian crisis can be identified with the dramatic increase of short term interest rates in Hong Kong on October 23, 1997. The dates for the Russian crisis and its Brazilian sequel are based on the results from Rigobon(2001) and Baig and Goldfajn(2001). According to this timeline, the initial shock to the Russian bond market took place on August 6, 1998. The stock market reacted one week later and the turmoil persisted until the end of September. The Brazilian crisis, which was often associated with contagion from the Russian crisis, lasted from the end of November 1998 to January 1999. Following Mishkin and White (2002), the starting dates of the two american market crashes are taken from daily newspaper. Terrorists acts in New York and Washington took place on September 11, 2001, and WorldCom revealed its accounting fraud on June 25, 2002. Dates for the Turkish crisis were selected following Alper(2001) and Yeldan(2002), and the duration of the Argentinean crisis is identified following Serwa and Bohl(2004).

We used daily dollar stock market returns for Morocco, Egypt, Tunisia, Lebanon, Jordan, Turkey and Israel, as well as for each of the crisis markets. We also use a MENA, a composite emerging market and a world benchmark. Data are taken from the S&P/IFCG emerging markets database. For the US market we used the MSCI database. The time series ranged from September 1997 to September 2002. In order to neutralize the possible impact of different trading days, all series are smoothed using a two-day moving average filter.

3. Results and Analysis

We begin our investigation by asking whether the MENA markets are subject to common vulnerabilities, making them susceptible to shocks from neighbouring countries. Results of the estimation of the fixed time effect are shown in table 2, which reports an R^2 of 21.47% and an F-statistic of 37.98 for this model.

INSERT TABLE 3 ABOUT HERE

The world index which captures global vulnerability, and the MENA benchmark which captures regional vulnerabilities are significant with t-values of 2.8 and 8.14 respectively. However, the parameter estimate is sensibly higher for the regional benchmark (0.24) than for the global benchmark (0,09). According to Fry&Baur (2005) this finding can be explained by the fact that in the case of weakly traded markets, regional linkages are more important than world linkages due to the relative importance of regional trade linkages as compared to world linkages, which probably emphasize financial rather than economic linkages. The emerging market index is unsignificant, which reflects both the weak share of the MENA markets in emerging markets total capitalization and their segmentation with the world markets. The time series of the fixed time effect over the whole sample period, including the seven investigated crisis is presented in figure 1. The first panel of the figure presents coefficients estimates and the second panel presents the t-values associated with critical values at the 5% significance level. Inspection of this figure shows the absence of joint contagion over the period of study, which suggests that the MENA financial markets are not vulnerable to regional realllocation of international portfolios in the event of a international financial crisis. Moreover, turning to bivariate results in the event of specific crisis, coefficients obtained from the fisher transformation reject the hypothesis of contagion, for each methodology. However, this result suffers from a statistical bias as the test relies on the assumption of normality.

INSERT FIGURE 1 ABOUT HERE

Using our refined t-statistic not only provides a more robust testing framework, but also uncovers a different story. Taking different methodologies altogether, there is suspicion for contagion for every single MENA market in at least one out of the seven crisis episodes. However, results are contrasted among countries. Israel and Turkey are the only two markets that we can suspect to have endured contagion during the Asian crisis, with the Corsetti framework. Moreover, looking at crisis episodes altogether, they also seem to be sample's most vulnerable markets: besides contagion from the Asian crisis, Israel was quite significantly affected by the Turkish crisis, while Turkey seems to have endured contagion during each american crisis ((in both correlation-based approaches). Considering that Turkey and Israel are the oldest, largest and most developed markets in the MENA, this finding can be explained by the fact that contagion requires a high participation of international investors in the afflicted markets.

On the other hand, we find very little evidence of contagion during the Russian, Brazilian, and Argentinean crisis. Along with the relative smaller impact of these crisis on the world's markets, the relative small size of the MENA markets and the prevalence of regional trade linkages might explain the absence of contagion, as it suggests that the sample countries were immune from balance of payment deficits and from the massive capital flights that were implied by the restructuring of international portfolios.

However, we can suspect that Egypt was affected by the Russian crisis (in the structural model approach); while Tunisia seems to have been quite significantly affected by the Brazilian crisis (in both the Forbes-Rigobon and Favero-Giavazzi approaches). These results might appear uncanny a first glance, especially given the small size of the Tunisian market. However, using daily indices in local currencies and a simple Johansen-Juselius methodology, we detect a cointegrating vector between each of these markets and our world benchmark. The EMU being these two countries' main trade partner, evidence in favour of interrnational financial integration suggests that contagion did not occur due to commercial deficits, but rather through a common creditor effect, or as the result of herding behaviours within the framework of pure contagion.

Finally, another striking fact is that evidence of contagion in the MENA seems to increase over time: dropping the Argentinean crisis out of the analysis due to its local impact, and looking at the number of contagion relationships per crisis, we yield two relationships during the 1997 Asian crisis, four during the 2001 Turkish crisis, and our results culminate with five relationships during the 2002 Enron crisis. Turkey and Israel appear early in the analysis, during the Asian crisis. They are followed by Egypt and Tunisia during the Russian - Brazilian episode. With the outbreak of the Turkish crisis, Morocco and Lebanon join the contagion group, while Jordan is suspected of contagion for the first time during the first American crisis. As we move forward in time and new crises occur, additional countries are thus suspected of contagion. The decade of study being a period of significant developments in the MENA markets, the increase in contagion relationships and the appearance of new recipient markets as we move trough time suggest that along with improved resource allocation benefits, the risks of contagion tend to increase as emerging markets reach higher levels liquidity and capitalization.

4. Conclusion

The objective of this paper was to investigate vulnerability to financial contagion in a set of rapidly expanding emerging markets of the Middle East and North Africa, during seven episodes of international financial crisis. Using Fry & Baur (2005) fixed-effect panel approach, we significantly rejected the hypothesis of joint regional contagion, which can be explained by the low levels of regional financial integration. However, using a battery of bivariate contagion tests based on Forbes and Rigobon (2002), Corsetti (2002), and Favero and Giavazzi (2002), we suspect the presence of contagion for Israel and Turkey during the Asian crisis, Egypt and Tunisia during the Russian crisis and its Brazilian sequel; Israel, Morocco and Lebanon during the Turkish crisis; Tunisia, Turkey and

Jordan during the 9/11/2001 breakdown and Morocco, Turkey, Jordan and Lebanon during the Enron scandals. In conformity with the literature, the time-increasing number of countries suggests that the probability of being affected by contagion grows as markets develop in size and liquidity, and become more integrated to the world's markets.

INSERT TABLE 4 TO 10 ABOUT HERE

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Table 1 Comparative Indicators for emerging markets (2003)

Area	Market Capitalisation /GDP	Liquidity	Listed Companies
Asia			
India	46.80%	31.97%	5644
China	25.50%	71.08%	780
Malaysia	156.00%	32.45%	902
Hong-Kong	456.10%	41.44%	1037
Korea	48.50%	156.20%	684
Philippines	29.20%	11.52%	236
Taiwan	132.53%	156.10%	674
Average	**127.80%**	**71.50%**	**1422**
Latin America			
Argentina	27.00%	8.80%	110
Brazil	45.90%	29.35%	391
Mexico	19.50%	21.11%	237
Chile	11.97%	7.70%	240
Colombia	18.10%	5.65%	108
Peru	19.90%	10.00%	227
Average	**23.70%**	**13.80%**	**218**
MENA			
Egypt	33.79%	15.61%	967
Morocco	29.32%	18.72%	52
Tunisia	10.03%	7.73%	45
Jordan	110.73%	23.78%	161
Lebanon	7.91%	8.72%	14
Israel	67.23%	27.74%	577
Turkey	29.36%	143.55	285
Average	**41.20%**	**35.12%**	**300**

Source: Federation Internationale des Bourses de Valeur, 2005
Note: Market Capitalization/GDP is the market capitalization at the end of each year divided by GDP for the year

Liquidity corresponds to total value traded for the year divided by market capitalization
Listed Companies are the number of listed companies at the end of the year

Table 2: Crisis Timeline

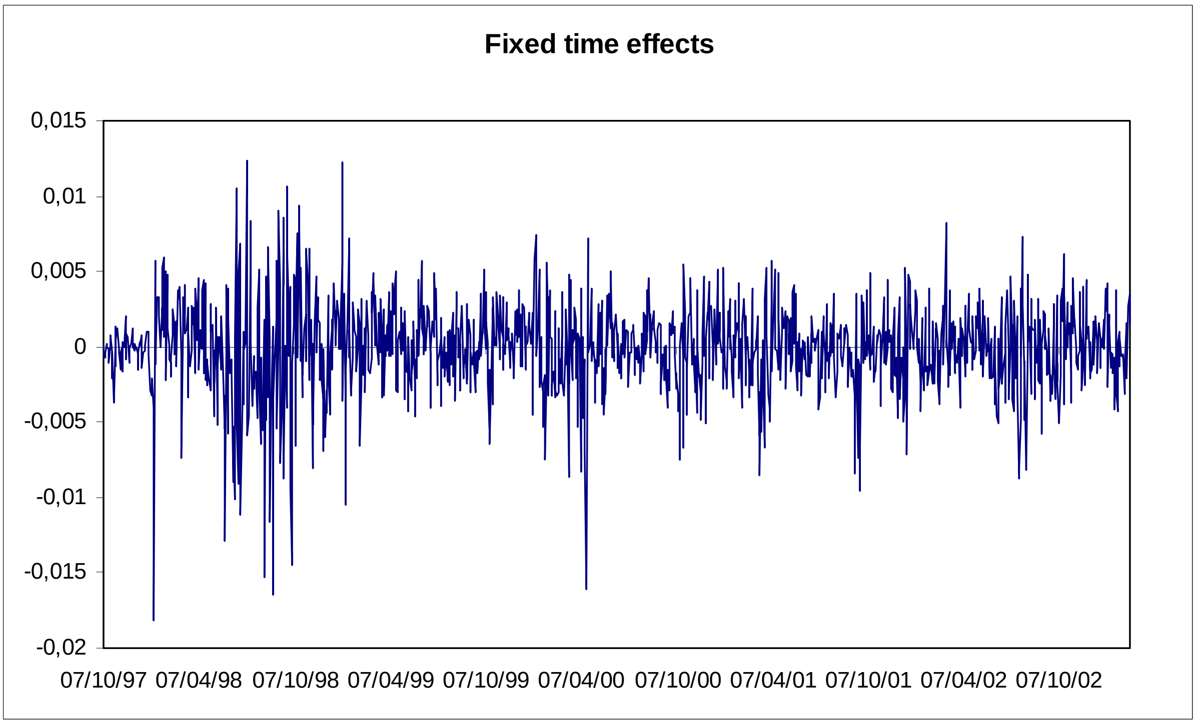
Crisis name	Crisis country	Stable periods	Crisis periods
Asian "Flu"	Hong Kong	1997:10:1–1997:10:22	1997:10:23–1997:11:22
Russian "Virus"	Russia	1998:6:6–1998:8:5	1998:8:6–1998:10:5
Brazilian crisis	Brazil	1998:11:1–1998:12:31	1999:1:1–1999:3:1
Turkish collapse	Turkey	2000:12:5–2001:2:14	2001:2:15–2001:3:13
Terrorist acts and economic slowdown	U.S.	2001:6:27–2001:8:26	2001:9:14–2001:10:13
Argentinean crisis	Argentina	2001:10:13–2001:12:12	2001:12:27–2002:2:26
Accounting scandals	U.S.	2002:4:25–2002:6:24	2002:6:25–2002:7:24

Table 3: Estimation Results of equation (1): regional and global vulnerabilities

Indep. Variable	Coefficients	t	P>T
world_benchmark	0,09	2,8*	0,005
mena_benchmark	0,24	8,14*	0,000
rcompo	0,00	0,11	0,911
_cons	0,00	-0,40	0,69
R square	***0,21***		
F(3,9783)	***37,98***		

Note: (*) indicates significance at the 5% level.

Figure 1: Estimates of the fixed time effects in equation (1), corresponding t-values and 95% critical values



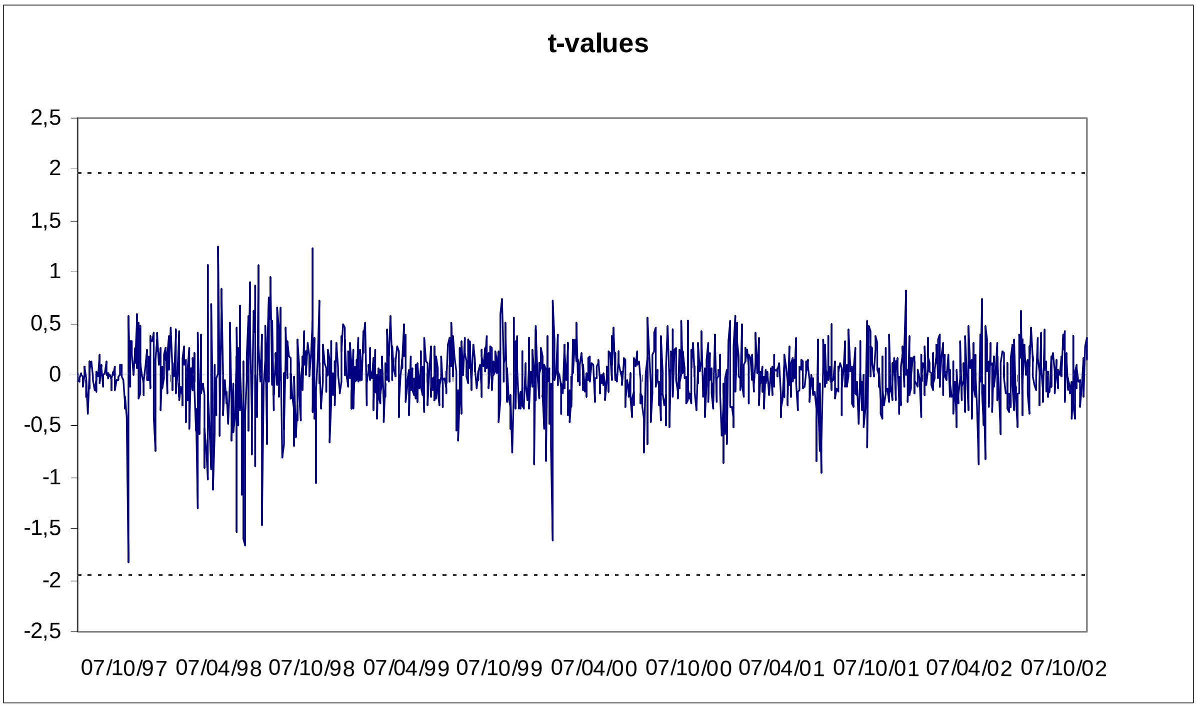


Table 4 to 10: Results Forbes & Rigobon correlation analysis

Table 4 Asian Crisis

Unadjusted Correlation Coefficients	Tranquil Period	Crisis Period	Fstat	Contagion?	t-stat collins	Contagion?
Egypt	0,25	0,49	0,28	**N**	1,81	**Y**
Israel	0,44	0,64	0,29	**N**	1,55	**N**
Morocco	0,11	-0,57	0,29	**N**	-7,06	**N**
Jordan	0,18	0,03	-0,76	**N**	-1,15	**N**
Tunisia	0,53	0,25	-0,34	**N**	-2,23	**N**
Lebanon	-0,21	0,08	-0,15	**N**	2,20	**Y**
Turkey	0,29	0,28	-0,02	**N**	-0,09	**N**
Adjusted Correlation Coefficients						
Egypt	0,19	0,37	0,19	**N**	1,35	**N**
Israel	0,35	0,51	0,20	**N**	1,22	**N**
Morocco	0,09	-0,44	0,20	**N**	-4,68	**N**
Jordan	0,13	0,02	-0,56	**N**	-0,81	**N**
Tunisia	0,38	0,18	-0,22	**N**	-1,57	**N**
Lebanon	-0,15	0,05	-0,11	**N**	1,53	**N**
Turkey	0,21	0,20	-0,01	**N**	-0,06	**N**

Table 5 Russian Crisis

Unadjusted Correlation Coefficients	Tranquil Period	Crisis Period	Fstat	Contagion?	t-stat collins	Contagion?
Egypt	-0,24	0,10	0,34	**N**	3,26	**Y**
Israel	0,21	0,22	0,01	**N**	0,13	**N**
Morocco	0,38	-0,24	0,02	**N**	-7,28	**N**
Jordan	0,01	-0,17	-0,65	**N**	-1,67	**N**
Tunisia	0,44	0,17	-0,30	**N**	-2,53	**N**
Lebanon	0,03	0,0523	-0,18	**N**	0,17	**N**
Turkey	0,36	0,27	-0,09	**N**	-0,76	**N**
Adjusted Correlation Coefficients						
Egypt	-0,17	0,07	0,24	**N**	2,24	**Y**
Israel	0,15	0,16	0,01	**N**	0,09	**N**
Morocco	0,28	-0,17	0,01	**N**	-4,56	**N**
Jordan	0,01	-0,12	-0,46	**N**	-1,18	**N**
Tunisia	0,31	0,12	-0,20	**N**	-1,77	**N**
Lebanon	0,02	0,04	-0,13	**N**	0,12	**N**
Turkey	0,26	0,20	-0,06	**N**	-0,55	**N**

Table 6 Brazilian crisis

Unadjusted Correlation Coefficients	Tranquil Period	Crisis Period	Fstat	Contagion?	t-stat collins	Contagion?
Egypt	0,22	-0,08	-0,31	**N**	-2,43	**N**
Israel	-0,06	-0,04	0,02	**N**	0,17	**N**
Morocco	0,03	-0,25	-0,53	**N**	-2,22	**N**
Jordan	0,08	-0,06	-0,29	**N**	-1,04	**N**
Tunisia	-0,26	0,06	0,32	**N**	2,48	**Y**
Lebanon	0,20	-0,31	-0,14	**N**	-4,52	**N**
Turkey	0,10	0,11	0,01	**N**	0,07	**N**
Adjusted Correlation Coefficients						
Egypt	0,16	-0,06	-0,22	**N**	-1,68	**N**
Israel	-0,04	-0,03	0,02	**N**	0,12	**N**
Morocco	0,02	-0,18	-0,38	**N**	-1,56	**N**
Jordan	0,06	-0,04	-0,21	**N**	-0,73	**N**
Tunisia	-0,18	0,04	0,22	**N**	1,71	**Y**
Lebanon	0,15	-0,23	-0,10	**N**	-3,03	**N**
Turkey	0,07	0,08	0,01	**N**	0,05	**N**

Table 7 Turkish Crisis

Unadjusted Correlation Coefficients	Tranquil Period	Crisis Period	Fstat	Contagion?	t-stat collins	Contagion?
Egypt	0,01	0,13	0,12	**N**	0,97	**N**
Israel	0,12	0,42	0,33	**N**	2,58	**Y**
Morocco	-0,29	0,02	0,17	**N**	2,68	**Y**
Jordan	0,19	0,15	0,32	**N**	-0,28	**N**
Tunisia	0,27	0,10	-0,18	**N**	-0,47	**N**
Lebanon	-0,15	0,0134	-0,04	**N**	-1,47	**N**
Adjusted Correlation Coefficients						
Egypt	0,01	0,09	0,08	**N**	0,69	**N**
Israel	0,09	0,31	0,23	**N**	1,87	**Y**
Morocco	-0,21	0,01	0,12	**N**	1,85	**Y**
Jordan	0,13	0,11	0,22	**N**	-0,20	**N**
Tunisia	0,19	0,07	-0,13	**N**	-1,04	**N**
Lebanon	-0,11	0,01	-0,02	**N**	0,96	**N**

Table 8 WTC Attacks

Unadjusted Correlation Coefficients	Tranquil Period	Crisis Period	Fstat	Contagion?	t-stat collins	Contagion?
Egypt	0,00	0,12	0,12	**N**	0,74	**N**
Israel	0,54	0,67	0,21	**N**	0,83	**N**
Morocco	-0,34	-0,14	0,22	**N**	1,30	**N**
Jordan	-0,14	0,30	0,45	**N**	3,11	**Y**
Tunisia	-0,11	0,33	0,46	**N**	3,15	**Y**
Lebanon	-0,01	0,18	0,19	**N**	1,19	**N**
Turkey	0,19	0,52	0,39	**N**	2,23	**Y**
Adjusted Correlation Coefficients						
Egypt	0,00	0,08	0,08	**N**	0,52	**N**
Israel	0,44	0,54	0,14	**N**	0,67	**N**
Morocco	-0,24	-0,10	0,15	**N**	0,92	**N**
Jordan	-0,10	0,22	0,32	**N**	2,13	**Y**
Tunisia	-0,08	0,24	0,33	**N**	2,17	**Y**
Lebanon	0,00	0,13	0,13	**N**	0,84	**N**
Turkey	0,14	0,40	0,28	**N**	1,65	**N**

Table 9 Argentinean Crisis

Unadjusted Correlation Coefficients	Tranquil Period	Crisis Period	Fstat	Contagion?	t-stat collins	Contagion?
Egypt	0,21	0,05	-0,17	**N**	-1,51	**N**
Israel	0,17	0,07	-0,11	**N**	-0,96	**N**
Morocco	-0,27	-0,23	0,26	**N**	0,36	**N**
Jordan	-0,13	-0,42	0,04	**N**	-2,69	**N**
Tunisia	-0,10	0,02	0,12	**N**	1,05	**N**
Lebanon	-0,40	-0,17	-0,31	**N**	2,17	**Y**
Turkey	0,32	-0,11	-0,44	**N**	-4,27	**N**
Adjusted Correlation Coefficients						
Egypt	0,15	0,03	-0,12	**N**	-1,06	**N**
Israel	0,12	0,05	-0,08	**N**	-0,68	**N**
Morocco	-0,19	-0,16	0,17	**N**	0,26	**N**
Jordan	-0,10	-0,31	0,03	**N**	-1,95	**N**
Tunisia	-0,07	0,01	0,08	**N**	0,74	**N**
Lebanon	-0,29	-0,12	-0,22	**N**	1,52	**N**
Turkey	0,22	-0,08	-0,31	**N**	-2,87	**N**

Table 10 Accounting scandals

Unadjusted Correlation Coefficients	Tranquil Period	Crisis Period	Fstat	Contagion?	t-stat collins	Contagion?
Egypt	-0,02	0,12	0,14	**N**	1,10	**N**
Israel	0,54	0,39	-0,19	**N**	-1,14	**N**
Morocco	-0,26	0,10	0,36	**N**	2,96	**Y**
Jordan	0,10	0,36	0,28	**N**	2,11	**Y**
Tunisia	0,01	-0,14	-0,14	**N**	-1,10	**N**
Lebanon	-0,22	0,38	0,63	**N**	5,89	**Y**
Turkey	-0,02	0,36	0,40	**N**	3,23	**Y**
Adjusted Correlation Coefficients						
Egypt	-0,01	0,09	0,10	**N**	0,78	**N**
Israel	0,39	0,29	-0,12	**N**	-0,84	**N**
Morocco	-0,18	0,07	0,26	**N**	2,03	**Y**
Jordan	0,07	0,27	0,20	**N**	1,51	**N**
Tunisia	0,00	-0,10	-0,10	**N**	-0,78	**N**
Lebanon	-0,16	0,28	0,45	**N**	3,85	**Y**
Turkey	-0,02	0,26	0,29	**N**	2,27	**Y**

Table 11 to 16 : Results from the Favero-Giavazzi analysis

Table 11 Asian Crisis

Country	Coefficient	Z	P	Contagion?
Egypt	0,000	-0,28	0,78	**N**
Israel	-0,001	-0,67	0,51	**N**
Morocco	0,001	1,25	0,21	**N**
Jordan	-0,001	-1,43	0,15	**N**
Tunisia	-0,001	-0,26	0,80	**N**
Lebanon	0,001	0,95	0,34	**N**
Turkey	0,000	-0,14	0,89	**N**

Table 12 Russian Crisis

Country	Coefficient	Z	P	Contagion?
Egypt	-0,001	-1,25	0,21	**N**
Israel	0,000	-0,69	0,49	**N**
Morocco	0,000	-1,12	0,26	**N**
Jordan	0,000	0,79	0,43	**N**
Tunisia	-0,006	-1,77	0,08	**N**
Lebanon	0,001	1,62	0,11	**N**
Turkey	-0,002	-1,39	0,17	**N**

Table 13 Brazilian Crisis

Country	Coef	Z	P	Contagion?
Egypt	0,000	-1,07	0,29	**N**
Israel	0,000	-0,41	0,68	**N**
Morocco	0,000	-1,55	0,12	**N**
Jordan	0,000	0,30	0,76	**N**
Tunisia	0,000	0,00	0,00	**Y**
Lebanon	0,000	0,70	0,48	**N**
Turkey	-0,002	-1,19	0,23	**N**

Table 14 Turkish Crisis

Country	Coef	Z	P	Contagion?
Egypt	0,000	0,36	0,72	**N**
Israel	0,000	0,34	0,74	**N**
Morocco	0,000	-1,15	0,25	**N**
Jordan	0,000	-0,01	1,00	**N**
Tunisia	-0,001	-0,19	0,85	**N**
Lebanon	-0,002	-3,08	0,00	**Y**

Table 15 US Crisis

Country	Coef	Z	P	Contagion?
Egypt	0,000	-0,57	0,57	**N**
Israel	0,000	-1,27	0,2	**N**
Morocco	0,000	0,05	0,96	**N**
Jordan	0,000	-0,94	0,35	**N**
Tunisia	-0,001	-0,12	0,9	**N**
Lebanon	0,000	-1,45	0,15	**N**
Turkey	0,000	1,45	0,15	**N**

Table 16 Argentinean Crisis

Country	Coef	Z	P	Contagion?
Egypt	0,000	-0,48	0,63	**N**
Israel	-0,002	-1,83	0,07	**N**
Morocco	0,000	-0,29	0,77	**N**
Jordan	0,000	-0,57	0,57	**N**
Tunisia	0,001	0,00	0,19	**N**
Lebanon	-0,001	-0,88	0,38	**N**
Turkey	0,001	0,59	0,56	**N**

Table 17 to 23: Results from the Corsetti methodology

Table 17 Asian Crisis

Country	Tranquil Period	Crisis Period	F stat	Contagion?	t-statistic	Contagion?
Egypt	0,05	0,09	0,05	**N**	0,36	**N**
Israel	0,16	0,41	0,28	**N**	1,97	**Y**
Morocco	0,03	0,17	0,14	**N**	1,08	**N**
Jordan	0,10	0,01	-0,08	**N**	-0,57	**N**
Tunisia	0,02	0,06	0,03	**N**	0,24	**N**
Lebanon	0,20	0,19	0,01	**N**	0,04	**N**
Turkey	0,02	0,37	0,37	**N**	2,85	**Y**

Tableau 18 Russian Crisis

Country	Tranquil Period	Crisis Period	F stat	Contagion?	t-statistic	Contagion?
Egypt	0,05	0,09	0,03	**N**	0,26	**N**
Israel	0,23	0,378487	0,11	**N**	0,87	**N**
Morocco	0,07	0,22	0,13	**N**	1,20	**N**
Jordan	0,12	0,08	-0,06	**N**	-0,54	**N**
Tunisia	0,01	0,02	0,00	**N**	-0,01	**N**
Lebanon	0,07	0,06	-0,03	**N**	-0,29	**N**
Turkey	0,35	0,34	-0,10	**N**	-0,75	**N**

Table 19 Brazilian Crisis

Country	Tranquil Period	Crisis Period	F stat	Contagion?	t-statistic	Contagion?
Egypt	0,00	0,13	0,13	**N**	1,18	**N**
Israel	0,10	0,17	0,16	**N**	1,41	**N**
Morocco	0,02	0,11	0,11	**N**	0,97	**N**
Jordan	0,00	0,11	0,11	**N**	0,96	**N**
Tunisia	0,00	0,01	0,01	**N**	0,06	**N**
Lebanon	0,04	0,00	0,00	**N**	-0,02	**N**
Turkey	0,09	0,01	0,00	**N**	-0,01	**N**

Table 20 Turkish Crisis

Country	Tranquil Period	Crisis Period	F stat	Contagion?	t-statistic	Contagion?
Egypt	0,01	0,07	0,07	**N**	0,60	**N**
Israel	0,02	0,26	0,26	**N**	2,19	**Y**
Morocco	0,00	0,19	0,19	**N**	1,56	**N**
Jordan	0,01	0,11	0,11	**N**	0,94	**N**
Tunisia	0,00	0,12	0,12	**N**	0,98	**N**
Lebanon	0,01	0,07	0,44	**N**	0,57	**N**

Table 21 WTC Attacks

Country	Tranquil Period	Crisis Period	F stat	Contagion?	t-statistic	Contagion?
Egypt	0,10	0,07	-0,05	**N**	-0,34	**N**
Israel	0,22	0,41	0,16	**N**	0,93	**N**
Morocco	0,24	0,14	-0,15	**N**	-0,93	**N**
Jordan	0,07	0,36	0,29	**N**	1,83	**Y**
Tunisia	0,03	0,11	0,07	**N**	0,44	**N**
Lebanon	0,10	0,27	0,16	**N**	0,95	**N**
Turkey	0,02	0,40	0,40	**N**	2,59	**Y**

Table 22 Argentinean Crisis

Country	Tranquil Period	Crisis Period	F stat	Contagion?	t-statistic	Contagion?
Egypt	0,07	0,07	0,00	**N**	-0,02	**N**
Israel	0,26	0,24	-0,02	**N**	-0,18	**N**
Morocco	0,09	0,03	-0,06	**N**	-0,54	**N**
Jordan	0,06	0,12	0,06	**N**	0,51	**N**
Tunisia	0,01	0,01	0,00	**N**	-0,03	**N**
Lebanon	0,19	0,05	-0,14	**N**	-1,26	**N**
Turkey	0,26	0,21	-0,05	**N**	-0,42	**N**

Table 23 Enron Crisis

Country	Tranquil Period	Crisis Period	F stat	Contagion?	t-statistic	Contagion?
Egypt	0,01	0,05	0,04	**N**	0,29	**N**
Israel	0,42	0,36	-0,08	**N**	-0,55	**N**
Morocco	0,11	0,10	-0,02	**N**	-0,13	**N**
Jordan	0,01	0,31	0,31	**N**	2,43	**Y**
Tunisia	0,00	0,03	0,03	**N**	0,23	**N**
Lebanon	0,16	0,29	0,13	**N**	0,99	**N**
Turkey	0,02	0,34	0,33	**N**	2,60	**Y**

Table 24 Cointegrating relationships

Vector	Trace Statistic
Egypt-World	65.292**
Tunisia-World	131.457**

Note : (**) indicates rejection of the hypothesis of no cointegration at the 5% level

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