International Journal of Statistical Sciences *ISSN 1683-5603*
Vol. 22(1), 2022, pp 257-274

An Investigation into the Transmission of Global-Economic Disturbances using Hazard Model

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[Received July 29, 2021; Accepted March 7, 2022]

Abstract

Although the determinants of economic crises have been documented extensively since 1990s, however, the evidence about the determinants of the transmission effect across countries is scarce. Therefore, the objective of this study is to identify macroeconomic factors, which transmit global-economic crises across countries. To achieve this objective, we use an approach that combines the event study and survival analysis methodologies. In particular, a global-economic disturbance is seen as a disease that can be spread to different countries through the stock markets. Our results reveal that increases in the level of competitiveness is beneficial to strengthen the economy. By contrast, more flexibility in the exchange rate regime and increases in the level of financial depth are detrimental for the stability of the economy. Finally, developed countries has a less probability of transmission as compared to developing countries.

Keywords: Global-economic disturbance; Transmission; Stock market.

AMS Subject Classification: 91B26.

1. Introduction

Existing evidence about the determinants of economic crisis mainly focuses on modeling the probability of suffer a crisis through a binomial model. For instance, see Frankel and Rose (1996), Reagle and Salvatore (2000), and Beck, Demirgüç-Kunt, and Levine (2006), Baselga-Pascual, Trujillo-Ponce, and Cardone-

Riportella (2015), Holopainen and Sarlin (2017), Boonman, Jacobs, Kuper, and Romero (2019) among others. We take a different perspective by studying a less researched topic in the economic-crisis literature. Specifically, this paper focuses on the factors contributing to the transmission of a global-economic crisis from one country to another (Hernández and Valdés 2001; Haile and Pozo, 2008; Brutti and Sauré, 2015; Zorgati, Lakhal and Zaabi, 2019; Kosmidou, Kousenidis, Ladas, Negkakis, 2019). This is addressed by focusing on events occurred during the two global-economic crises; the US subprime crisis and the European sovereign crisis. Following evidence about contagion between stock markets (e.g. Markwat, Kole, and Van Dijk, 2009; Fang and Bessler, 2018; Zhou, Lin, and Li, 2018; Lyócsa and Horváth, 2018), we use stock-market information to identify macroeconomic determinants (Jordà, Schularick and Taylor, 2011; Reinhart and Rogoff, 2011; Bicaba, Kapp, and Molteni, 2014 among others) of the transmission of global-economic disturbances. An important advantage of using stock-market data is that it involves expectations of agents and then it is equivalent to a forward-looking model (Maltritz and Eichler, 2010).

In order to identify a significant impact of a global-economic disturbance on stock markets, we use an event study approach. In particular, two events are chosen for the Subprime crisis, and four events for the Sovereign crisis to analyze their transmission to different stock markets around the world. Moreover, to identify the main macroeconomic determinants of the transmission effect, a global-economic disturbance is seen as a disease that can spread to different stock markets. Toward this goal, a Hazard specification is used where the dependent variable represents the probability of being infected by a global-economic disturbance. There is an extensive evidence that highlights the advantages of using a Hazard specification (see e.g. Shumway, 2001, Giot and Schwienbacher, 2007, and Duffie, Saita, and Wang, 2007; Fleitas, Fishback and Snowden, 2018; Martinez, Zouaghi, Marco and Robinson, 2019; among others).

Consequences of economic crises can be deep and long lasting; therefore, its study has critical importance to preserve the stability of the economy. Moreover, globalization and the high integration of international markets transmit economic crises across countries quickly. In such an environment, it is important to investigate the factors contributing to the transmission across countries. The objective of this paper is to identify macroeconomic variables which can have a significant effect on the transmission of economic crises across countries. In this

context, the main contribution of this study is to detect macroeconomic factors, which can be used to strengthen the economy to face international disturbances. This study is planned for the time period from 2007 to 2012.

Our results reveal that some macroeconomic variables can be used to enhance the stability of the economy. More flexibility in the exchange rate regime increases the probability of transmission of economic crises, increases in the level of financial depth is detrimental to face international disturbances, and increases in the level of competitiveness increases the strength to face an international economic crisis. Finally, our findings show that developed countries has a less probability of transmission of an international economic crisis as compared to developing economies.

This paper is organized as follows. Section 2 discusses the main features of the methodological approach. Section 3 presents the data and descriptive statistics of the variables in analysis. The results of this study are presented in sections 4. Finally, section 5 concludes this study.

2. Methodology

Maltritz and Eichler (2010) noted that stock markets involve central information about expectations of the economic performance. Furthermore, there is a documented transmission effect across stock markets around the world, see e.g. Wongswan (2006), Savva, Osborn, and Gill (2009), Markwat et al. (2009), and Ehrmann, Fratzscher, and Rigobon (2011). Therefore, we focus on the main indices of the stock markets of countries in order to capture the transmission of global-economic crises. In particular, the transmission effect studied here is defined as the number of days that a global-economic disturbance takes to impact a stock market. Additionally, a global-economic disturbance is defined as an important event or "news" in the market that occurred during the last two global-economic crises, i.e. the US Subprime crisis in 2008 and the European sovereign crisis in 2010. Specifically, we focus on the two most important events occurred during the US Subprime crisis, i.e. the bankruptcy of the New Century Financial Corporation and the bankruptcy of the Lehman Brothers. In relation to the European sovereign crisis, we focus on the four most important country requests for financial assistance, i.e. Greek, Irish, Portuguese, and Spanish-Cypriot financial help requests. As a consequence, the analysis of the impacts of these six

events on different stock markets around the world allows us to obtain the number of days of transmission.

We use the event-study methodology which allows us to determine the significance of specific announcements or "news" on the stock price returns. In this way, we take advantage of this information to identify the number of days that a global-economic disturbance takes to impact a stock market. Therefore, this methodology allows us to quantify in days the transmission of a global-economic crisis across countries. In particular, the day of occurrence of a specific event corresponds to the starting point and the day associated with a significant impact of a global-economic disturbance is identified by using the event-study methodology. In consequence, the difference between these two dates provides us the number of days that a specific global-economic disturbance takes to impact a specific stock market.

Technically, the method proceeds as follows. The expected return is estimated by following the standard literature of Capital Asset Pricing Model (CAPM). In this case, the stock return is a function of the market return, i.e.

$$R_t = \delta_0 + \delta_1 R_{mt} + \varepsilon_t \tag{1}$$

where ε_t is a stochastic term such that $\varepsilon_t \sim N\left(0, \sigma_\varepsilon^2\right)$, R_t is the stock return, R_{mt} is the market return, and δ_0 and δ_1 are the coefficients of the model. Given that our focus is the stock market of a country, the stock return R_t is based on the main stock index of an economy. Furthermore, the market return R_{mt} is based on the Morgan Stanley Capital International index (MSCII). This index is composed by the stock indices of all developed countries and then it captures the evolution of the main stock markets around the world [1]. Actually, this is the standard benchmark to compare the performance of stock markets. Therefore, the abnormal return is defined by

$$A\hat{R}_t = R_t - \hat{\delta}_0 - \hat{\delta}_1 R_{mt} \tag{2}$$

Under the null hypothesis that the event has no impact on the abnormal return,

[1] A list of the stock indices that compose the MSCII can be found in the website www.msci.com.

$$A\hat{R}_t \sim N\left[0, \sigma^2_{A\hat{R}_t}\right] \tag{3}$$

Following MacKinlay (1997) and Campbell, Cowan, and Salotti (2010), the variance of the abnormal return is estimated as

$$\hat{\sigma}^2_{A\hat{R}_t} = \hat{\sigma}^2_{\varepsilon} + \frac{1}{N}\left[1 + \frac{\left(R_{mt} - \hat{\mu}_m\right)^2}{\hat{\sigma}^2_m}\right] \tag{4}$$

where $\hat{\sigma}^2_{\varepsilon}$ is the estimated variance of the residuals of model in equation (1), N is the sample size, $\hat{\mu}_m$ is the mean of the market return, and $\hat{\sigma}^2_m$ is the variance of the market return. The second term in equation (4) captures the sampling error incorporated in the estimation of the parameters of the model in equation (1). In particular, as N goes to infinity the variance of the abnormal return converges to the variance of the residuals of the model in equation (1).

Once the variance of the abnormal return is obtained, one can have the following null hypothesis

$$H_0 : AR_t = 0 \tag{5}$$

which is tested using the *t*-statistic, i.e.

$$t = \frac{A\hat{R}_t}{\hat{\sigma}_{A\hat{R}_t}} \tag{6}$$

which asymptotically follows the *t*- distribution with $\left(n-k\right)$ degrees of freedom where n and k are the sample size and the number of coefficients estimated in equation (1), respectively.

The null hypothesis in expression (5) is tested for sequential periods after the occurrence of the event. The first day associated with a significant impact is identified and then the information associated with the number of days of transmission is obtained. If a no significant impact is detected, we use the day associated with the highest value in statistic in equation (6) to identify the days of transmission[2].

[2] This issue does not involve a bias in our approach given the information of insignificant impacts is included in the estimation as censored points, see Cox (1975) for more details.

Once the transmission effect across countries is obtained, we proceed to identify its main determinants by using survival analysis. Survival analysis is a technique highly used in the epidemiology literature to identify determinants of the contagion of a disease. Basically, the dependent variable corresponds to the time period until an individual is infected by a specific disease. This time period is defined as a healthy state and is transformed in the probability of being infected in order to set up an empirical model. Hence, a global-economic crisis is seen as a disease that is spread to different countries through stock markets. In this way, the number of days identified with an event study corresponds to the healthy days of a country before being infected by an economic crisis. Thus, survival analysis allows us to set up a probabilistic model in order to identify macroeconomic variables that have a significant impact on the transmission of global-economic disturbances across countries.

Since the literature about determinants of the transmission of economic crises is scarce, we use macroeconomic variables as channels of this transmission effect, which have been extensively studied as determinants of economic crisis. In particular, we identify four groups of determinants, i.e. variables related to economic policies, public debt, openness, and economic performance (see e.g. Frankel and Rose, 1996, Reagle and Salvatore, 2000, and Beck et al., 2006). Specifically, the ratio of government debt over GDP is used as the proxy for debt. The ratio of fiscal deficit over GDP and the exchange rate regime are used as proxies for economic policies[3]. The ratio of current account over GDP and the economic freedom index are used as proxies for openness. Finally, economic growth, inflation, unemployment rate, per capita GDP, financial depth measured by bank branches, and terms of trade are used as proxies for economic performance.

In order to incorporate these macroeconomic variables as determinants of the probability of transmission, we estimate a Proportional Hazard model (PH model henceforth). Following Cox (1972, 1975) and Breslow (1975), the PH model to study the determinants of the transmission of global-economic crises across countries is defined as follows

[3] Given that there is no a specific literature about the determinants of the transmission effect studied here, these different national accounts are taken into account in order to identify which of them have a significant impact on the probability of transmission.

$$\lambda\left(y_{it}\right)=\lambda_0\left(y_{it}/\alpha\right)\phi\left(\sum_{j=1}^{2}\beta_j x_{jit}+\theta w_{it}+\sum_{j=1}^{2}\phi_j z_{jit}+\sum_{j=1}^{6}\psi_j v_{jit}\right) \quad (7)$$

where y_{it} corresponds to the number of days that a global-economic disturbance takes to impact a stock market. Since $\lambda(.)$ is the Hazard function, $\lambda\left(y_{it}\right)$ represents the probability of being infected by a global-economic crisis, i.e. probability of transmission; x_{jit}, w_{it}, z_{jit}, and v_{jit} are the proxies for economic policies, debt, openness, and economic performance, respectively; β_j, θ, ϕ_j, and ψ_j are the respective parameters of the macroeconomic determinants. $\phi(.)$ is a function that depends on country characteristics. Therefore, this function transforms the macroeconomic determinants studied here into a determinant of the probability of transmission defined by the Hazard function. $\lambda_0(.)$ is the baseline Hazard function that depends on the number of days of transmission, y_{it}, and is conditional on the coefficient α.

An important point here is that different functional forms can be used for $\phi(.)$ and $\lambda_0(.)$ which depends on the distribution assumed for the probability of transmission. Cox (1972, 1975) proposed a semi-parametric model where the exponential function is used for $\phi(.)$ and the baseline Hazard function is not specified (Cox-model henceforth). It has been a recurrent approach given its simplicity and minimum assumptions. However, it assumes a constant rate in the pattern of the Hazard function.

To interpret the estimates of the model in equation (7), we estimate the Hazard Ratio (*HR* henceforth). The *HR* is the ratio between the estimated Hazard functions associated with a unit increase in a specific macroeconomic variable. The advantage of using the *HR* is that it only depends on the coefficients associated with the variables in analysis. Given that the *HR* is the ratio between two probabilities, the interpretation is in relation to one. Specifically, $HR>1$ implies that an increase in a unit value of a macroeconomic determinant increases the probability of transmission of a global-economic disturbance and the economy becomes more unstable. On the other hand, $0<HR<1$ implies that an increase in

this unit value decreases the probability of transmission of a global-economic disturbance and the economy becomes more stable.

3. Data and Descriptive Statistics

Two economic crises, i.e. Subprime crisis in the US and the European Sovereign crisis, are analyzed here by focusing on important events that ignited these crises and how these crises were transmitted to different stock markets of Asian and European countries. On the one hand, the Subprime crisis is addressed by the main subprime lenders collapse in 2007. During that year, the most important event occurred on April 2, 2007 with the bankruptcy of one of the largest subprime mortgage lender, New Century Financial Corporation. Later the second most important event was the bankruptcy of the Lehman Brothers on September 15, 2008, one of the fourth largest investment banks in the US. On the other hand, four events are taken into account for the European sovereign crisis. Specifically, the Greek financial help request on April 23, 2010, the Irish financial help request on November 21, 2010, the Portuguese financial help request on April 6, 2011, and the Spanish-Cypriot financial help request on June 27, 2012.

The data to identify the number of days that a global-economic disturbance takes to impact a stock market corresponds to daily frequency and is obtained from the Bloomberg data base for the main stock indices of 64 countries[4]. The market index is proxied by the MSCI index that considers the evolution of the most important stock markets around the world. The source of this index also corresponds to the Bloomberg data base. The time period to identify the days of transmission covers at least 120 days before each event which is the standard sample to analyze daily data in the event study methodology. As a result, our sample constitutes a panel with six temporal periods (the six event in analysis) and 64 countries which implies a total of 384 observations. Note that the sample to estimate the impact of macroeconomic variables on the probability of transmission is composed of annual data, but the events occurred during the years from 2007 to 2012[5].

[4] The selection of countries is based on the availability of the data.
[5] In 2010 there were two events one in April and another one in November. Given there is no event on 2009, the first one is considered as the one in 2009.

The stock market return is the excess return over a risk-free return. Particularly, it is obtained as

$$R_t = \ln\left(\frac{z_t}{z_{t-1}}\right) - \frac{1}{30}\ln\left(1+i_{t-1}\right) \tag{8}$$

where, z_t is the country-stock index and i_{t-1} is the monthly risk-free interest rate that is proxied by the Eurodollar deposit rate and is obtained from the Federal Reserve Bank of Saint Louis.

Next, we discuss the dependent variable in equation (7), i.e. the number of days of transmission. The sample size for estimating the model in equation (7) is 120 days before the occurrence of the event, which does not take into account the 10 days previous to the event. In this way, the event window considers 10 days before and 10 days after the event in order to investigate the significance on the abnormal return. This is a standard approach followed in the event study methodology; see e.g. MacKinlay (1997) among others. In addition, the first period that shows a significant impact on the abnormal return determines the number of days that a global-economic disturbance affects a specific stock-country index. The days of transmission for each country in analysis are presented in Table 1 and discussed below.

All the countries in our sample present a significant impact of at least one global-economic disturbance. This reveals the importance of the global-economic disturbances considered here. European nations, present the most number of significant impacts. This result is expected given the last two global-economic crises have mostly affected developed countries and, in particular, the latest one had its root in Europe. An important effect is also revealed for Asian nations given 14 out of 22 countries present at least 4 significant impacts from the global-economic disturbances. South Korea, Israel, and Saudi Arabia are exceptions here given they present only two significant impacts. Among the countries studied here, Bulgaria, Japan, Netherlands, Russia, and Turkey seems to be the most sensitive nations to international disturbances given all events in analysis present a significant impact on these economies. Finally, among the six global-economic disturbances, the Greek financial help request and the bankruptcy of the Lehman Brothers are the most important events, since these significantly impact 48 and 53

countries (out of 64), respectively. In fact, these disturbances are considered the key events occurred in the last two global-economic crises, which is highlighted by our findings.

Table 1: Numbers of days that a global-economic disturbance takes to impact a stock market

Country	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Argentina	8*	5**	9**	2	1	10
Australia	2	5**	4*	9*	9***	5*
Austria	8**	3**	3**	8	1	9*
Bahrain	7*	6*	3*	3***	9*	2
Belgium	8	3*	3*	6**	6*	9**
Brazil	9	1	2*	3*	2	6
Bulgaria	8*	3***	6**	9*	6**	6**
Canada	6	9*	9**	9	3**	2*
Chile	10	4***	5	3	4	8
China	5**	5**	4	8	9**	8***
Colombia	2	1**	10**	3	6	1*
Costa Rica	1***	8	6**	1***	5***	8
Cyprus	10***	3	9*	7	2*	3
Czech Republic	8**	1*	8***	8**	4*	3
Estonia	8***	3***	3	6**	9**	5**
Finland	8	3**	5*	6	6*	9
France	6	3**	9**	6**	6	9
Germany	9	3	9**	6**	9*	9**
Greece	7*	2*	9*	8	8*	5*
Hong Kong	7*	4	5*	6**	9***	8*
Hungary	7	1	3**	4	9	1*
Iceland	7**	5***	2***	2*	1	1*
India	9	9	3**	1	4*	9*
Indonesia	1**	2	8***	7**	8**	8*
Ireland	2	3**	6*	5	10	5*
Israel	2**	1**	8	7	1	3
Italy	8	3**	3**	6*	10*	8
Japan	5*	3*	3*	7*	9*	1**
Jordan	1**	2*	3	9*	5	6
Korea	2**	2	10	7	5*	8
Kuwait	6***	6	8*	2*	10	3
Latvia	1**	1**	3*	3**	7	9*
Lebanon	9	5*	10*	4**	7***	10**
Luxembourg	8*	3**	9**	5	10*	7*
Malaysia	5***	1*	5**	9	4	7
Malta	8	3***	6**	6	6***	1***

Mexico	10	3**	2**	3***	1	8
Netherlands	8*	3**	10**	6**	6*	9***
New Zealand	7	3***	8**	1*	9**	3
Norway	8**	1***	3*	5	6**	9***
Oman	5*	2*	7	5	1	10**
Pakistan	3*	3	10***	9**	9*	3***
Peru	6**	3**	7**	4*	5***	3*
Philippines	8**	3**	8***	9*	8	8*
Poland	8	1*	1*	8	2*	1*
Portugal	8*	3***	1**	6*	6*	3
Qatar	1*	2*	8	10***	3*	4*
Rumania	8**	1**	8***	1	1	5***
Russia	9*	1***	10**	7*	10*	1*
Saudi Arabia	9	2	1	2***	7	4**
Serbia	8*	1***	5	6***	9**	3*
Singapore	8**	8	3**	2**	9**	8**
Slovakia	2	2***	7***	3	9***	8
Spain	8*	4	3*	1	6**	6
Sri Lanka	7	3***	5*	7***	4**	2
Sweden	2	4	8*	4*	7*	9
Switzerland	8	1*	9**	10**	1	4**
Thailand	2	1*	7	6**	4**	9**
Taiwan	9**	1*	8**	8*	9**	8
Turkey	3**	4*	10***	6**	2**	7*
UK	9	1*	6**	6**	6	3*
Ukraine	1***	1***	10***	4**	9	4***
USA	6*	1	6*	8*	2**	10
Venezuela	7**	8***	3*	10**	7	4

***, **, and * denotes the significance at 1%, 5%, and 10% level, respectively. Events 1 to 6 correspond to the bankruptcy of New Century Financial Corp., bankruptcy Lehman Brothers, and Greek, Irish, Portuguese, and Spanish-Cypriot financial help request, respectively.

4. Results

In spite of the fact that there is an extensive literature related to the determinants of economic crises, e.g. Frankel and Rose (1996), Reagle and Salvatore (2000), Beck et al. (2006), and Bicaba et al. (2014) among others, the investigation of determinants of the transmission of economic crises is scarce. To the best of our knowledge, this is the first study dealing with this issue by using this innovative approach. For this reason, we use a stepwise method to identify macroeconomic determinants of the probability of transmission. Specifically, we initially include

all macroeconomic variables in the model in equation (7) and start to eliminate one at a time in concordance with the lowest insignificance identified. This procedure is repeated until getting all variables significant at the conventional levels[6].

We use three test statistics to check the robustness of our estimates. First, the overall significance is tested by Wald test. Second, the heteroscedasticity is tested by the Link test. This test looks for a significant pattern in the residuals of the Hazard model. Specifically, it corresponds to a regression between the residuals of the model in equation (7) and the predicted dependent variable and its squared value. A significant coefficient implies that the errors follow a significant pattern in which case we use robust standard errors. Finally, the main assumption for the Cox-model is that the Hazard rate is constant. Therefore, the probability of transmission of one country is proportional to the probability of transmission of any other country in the sample. This assumption implies that the macroeconomic variables must be time-invariant with respect to the number of days of transmission. The standard approach to test this assumption is to evaluate the correlation between the residuals of the model in equation (7) and the log of number of days of transmission for each macroeconomic variable in the study. Therefore, it is necessary to test whether all of these correlations are zero under the null hypothesis (PH test). A significant correlation implies a violation of this assumption (see Cox, 1972 and Cox, 1975 for details about this method and its assumptions). In addition, we capture the heterogeneity of countries in our sample by introducing a dummy variable taking the value one for developed countries and zero otherwise.

Table 2: Results

Variable	Hazard Ratio	S.E.
Economic growth	0.96	0.04
Unemployment rate	1.06	0.04
Inflation Rate	1.02	0.03
GDP per capita	0.99	1.6E-5
Fiscal Deficit	0.99	0.02
Debt	1.01	3.8E-3
Exchange rate regime	1.42***	0.19
Terms of Trade	0.99*	0.01

[6] A forward stepwise procedure was performed as well without a change in the selection of the variables in the final specification.

Economic Freedom	0.99	0.01
Financial Depth	1.01**	0.01
Current Account	0.98	0.02
Developed Countries[a]	0.54*	0.19
Statistic tests		
Wald test	10.40**	
Link test 1	1.58	
Link test 2	0.29	
PH test	0.09	

***,**, and * denotes the significance at the 1%, 5%, and 10% level. S.E. stands for standard errors. Insignificant estimates correspond to the iteration of the stepwise method in which the coefficient was excluded of the specification. Wald test corresponds to the overall significance. Link test 1 and Link test 2 corresponds to the significance of the predicted value and squared predicted value, respectively. PH test checks whether the macroeconomic variables are time-invariant with respect to the number of days of transmission. [a] This variable corresponds to a dummy variable.

The results are reported in Table 2. Our estimates show that the null hypothesis of the Wald test is rejected at the 5% level of significance and the PH and Link tests fails to reject the null hypothesis. The stepwise method identifies three macroeconomic determinants. Improvements in competitiveness (captured by the terms of trade) seems to be useful to strength the economy. An increase of one-unit in the terms of trade index decreases the probability of transmission by 1%. On the contrary, a more flexible exchange rate regime and more financial depth are detrimental for the stability of the economy. An increase of one-branch per 100,000 adults and one-unit in the exchange regime index increases the probability of transmission by 1% and 42%, respectively. The dummy variable for developed countries is significant at the conventional levels, which implies that developed countries have a less probability of transmission compared to developing economies.

Our analysis is based on the identification of significant abnormal returns after the occurrence of one of the six global-economic disturbances. In this way, we are implicitly assuming that the distribution of the abnormal returns follows a different pattern given the presence of these global-economic disturbances. In fact, it seems a logical thought that unexpected episodes have an important effect on stock markets, especially if they are strongly related to the stability of the global economy. Another relevant issue is that the impact of the different global-economic disturbances can be internalized in a prior period given the forward-looking expectations involved in the stock markets. Therefore, one can argue that

the impacts captured by our approach are not due to the presence of the global-economic disturbances analyzed here. In fact, our results could be misleading if the abnormal returns associated with the events in analysis follow the same distribution than the ones in a random period. In order to deal with this issue, we perform the following experiment.

We randomly select a period of time in our sample and proceed the same way as we did here in order to obtain the abnormal returns associated with the six disturbances. Specifically, we estimate the CAPM specification, forecast the expected return, and then obtain the abnormal returns. Given that we have six global-economic disturbances we repeat this procedure six times. Once the whole series of abnormal returns is obtained, the mean of this distribution is estimated. We repeat this procedure 1000 times in order to obtain a robust distribution of the mean of the abnormal returns in a random period[7].

Figure 2 shows the graph of the mean of the abnormal returns based on the six disturbances in analysis and the mean associated with the simulation experiment. They seems to follow a similar pattern, however, the mean associated with the global-economic disturbances is clearly more volatile. This reveals an important change in the statistical distribution of the abnormal returns due to the presence of the global-economic disturbances analyzed in this paper. In order to statistically compare both series, we use the test proposed by Diebold and Mariano (1995) that determines the significance of the difference between two series. Specifically, the mean of the difference between the two series is tested to be zero through the following statistic

$$k = \frac{\bar{d}}{\sqrt{T^{-1}2\pi\hat{f}_d(0)}} \tag{9}$$

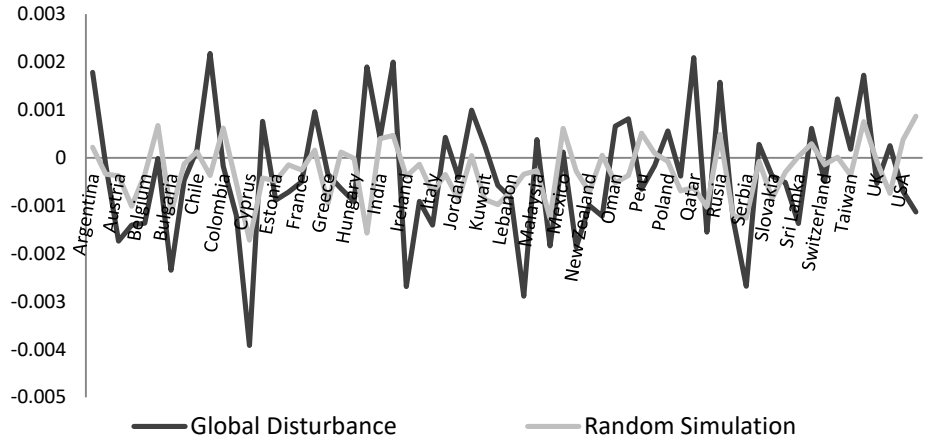
where the statistic k follows the *t*-distribution, $\bar{d}$ is the mean of the difference between the two series based on a loss function[8], T is the sample size, and $\hat{f}_d(0)$ is the consistent estimator of the spectral density of d_t at zero frequency.

[7] Different numbers of replications were used without significant changes in the results.

[8] It corresponds to the quadratic error.

The test statistics is 5.01, which is significant at the 1% level and thus the null hypothesis of zero mean is rejected. This implies that the two series presented in the Figure 1 are significantly different and then our selection of global-economic disturbances provides significant different abnormal returns compared to a random period. Therefore, this analysis supports that our methodology is not capturing information associated with a random period in the stock market.

Figure 1: Mean distribution of abnormal returns



5. Conclusion

A global-economic crisis is of remarkable importance since it causes serious impacts in a society. It is for this reason that the analysis of its determinants is crucial to strengthen the economy. This paper focuses on the transmission effect of an economic crisis across countries. Specifically, this study combines the event study and survival analysis methodologies to identify determinants of the probability of transmission of global-economic disturbances across stock markets. In this way, we identify three macroeconomic variables that can improve the stability of the economy to face the transmission effect of international shocks. A more flexible exchange rate regime increases the fragility of countries. Moreover, higher level of financial depth, measured by the number of branches per 100,000 adults, increases the probability of transmission of economic crises. By contrast, improvements in competitiveness, measured by the terms of trade, is beneficial to

improve economic stability. These findings are useful to monitor specific macroeconomic variables to preserve the stability of the economy or, alternatively, focusing macroeconomic policies to strength the economy to face international economic disturbances. For instance, policies focused on improving competitiveness are recommended by this study. Moreover, economies with flexible exchange rate regimes and high levels of financial depth should be monitored to detect negative effects on the economy at the proper time. Finally, our results show that developing countries are more exposed to suffer the consequences of international economic crises. For future work, this study will be worth exploring with updated data.

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