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Does the US Contagion Risk Affect Foreign Direct Investment Inflows in Emerging Economies?

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Abstract

Contagion has been one of the most widely studied and challenging problems in recent economic research. This study aims to measure the lower-tail dependence of risk contagion between the US economy and emerging countries. Four time-varying copulas, namely Student-t, Clayton, rotated survival Gumbel, and rotated survival Joe are considered to quantify the tail dependence. Overall, the results show the contagion effects of the US economy on 18 emerging economies. The size of contagion effects gradually increases for all countries, except Thailand, the Philippines, Argentina, and Chile. Furthermore, the Granger causality test and regression analysis reveal a temporal and contemporaneous effects of contagion risk on FDI inflows in 8 out of the 18 countries.

Keywords: Contagion risk; Emerging Economies; Foreign Direct Investment; Copula; Tail dependence

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1. Introduction

Foreign direct investment (FDI) is a vital source of economic growth in many emerging countries. Studies reveal that host countries can benefit from the international transfer of technology and financing of various restructuring processes. In addition, the host countries with insufficient capital can still participate in the global production chains due to the FDI. Therefore, FDI becomes a vital source of money for economic development, especially for developing countries (Ucal et al., 2010). However, the literature also shows strong evidence that the economic or financial crisis had a discouraging impact on FDI due to the higher macroeconomic uncertainty that resulted from the crisis and its contagion (Hill & Jongwanich, 2009; Emara & Said, 2021). Economic contagion is known as an economic crisis originating in a country or a market that influences another. The effects can be transmitted to another region because the countries are connected or have interdependence through international trade, monetary, and financial systems. As a result, there has been an interest in the contagion effects between one country and another. Therefore, a series of questions need to be answered to help policymakers formulate superior economic policies. These questions include: How does contagion from a crisis that originated in a country affect other countries? What are the impacts of contagion risks from the economic crisis?

The effects of an economic crisis can be spread in many ways; however, in this study, we focus on the impacts of economic contagion on the international flow of capital or the FDI. The literature has indicated that economic crisis and FDI inflows have some linkage with each other. However, it is found that it has not only a direct effect; a country with a potential for attracting foreign investment could also have a minimal inward FDI flow due to other countries' economic crises or a so-called economic contagion (Pazienza & Vecchione (2009). This finding highlights the relationship between the FDI inflows and economic contagion. Indeed, the economic crisis not only directly affects the economy of the former country, but also affects the economic activities of trading partner countries, such as lower international trade and foreign investment. If the originating country of the economic crisis has a large economy, it will inevitably be associated with a wide range of other countries. Initially, the economic crisis in big countries would reduce the FDI outflow of those countries as well as lower imports of goods. Urata (1999), Ucal et al. (2010), and more recent work, Fan et al. (2020) indicated that the global financial crisis led to increasing uncertainty in macroeconomic performance, which in turn reduced investor confidence and negatively impacted firms' plans for future investment, including the FDI. These will affect trading partner countries or countries that are investment destinations immediately. In addition, once a trading partner has been negatively affected, it can cause a negative economic impact on the next trading partner and cause broader impacts.

Among all economic crises, this study highlights the impact of US Economic contagion on the FDI inflows in emerging countries, which are the main trading partners of the US. One of the recent economic crises was the US financial crisis in 2008. It is found to have the greatest impact on FDI flows compared to past severe crises such as Spain's crisis (1977), Norway's crisis (1987), Finland's crisis (1991), Sweden's crisis (1991), and Japan's crisis (1992) (Dornean, Işan, and

Oanea, 2012). The US financial crisis in 2008 was caused by non-performing loans collateralized by real estate and the profitability of financial institutions through the issuance of new, high-risk financial instruments. An unrealistic decision and a focus on real estate speculation have led to a domino collapse for the parties involved; for example, an unprecedented real estate slump, the stock market falling sharply, people losing their ability to spend, and business bankruptcy. These led to economic contraction and rising unemployment in the US. As the United States is one of the largest economies with considerable world economic power, it dramatically impacts other countries directly and indirectly. US direct investment in countries has declined sharply, and imports from other countries have also declined. This has resulted in a negative impact on the economies of trading partners inevitably. In addition to the direct effect, when the US's major trading partners experience a slowdown, it will have an economic impact on the next trading partner and have a broader impact, which results in FDI flows plunging globally.

Measuring the Degree of Economic Contagion

Previously, we discussed the relationship among economic crises, particularly the US crisis, economic contagion, and FDI. However, the method for measuring economic contagion is still vague. Many previous works have proved the degree of economic linkages between the US and emerging countries (Edwards, 1996; Karolyi, 2003; Calvo & Reinhart, 1996; Dornbusch et al., 2000). These studies revealed the absence of the contagion effect on emerging countries during the US financial crisis. Although the US contagion effects have a pronounced impact on many countries, the impact of this contagion on the FDI inflows in emerging economies is limited. The reason is that a contagion effect is an extreme event and rarely occurred in history; thus, the sample size of empirical studies is limited (Liu et al., 2020). Besides, it is difficult to decompose or quantify the actual degree of a contagion effect and its impacts on the FDI. In the literature, economists have been interested in the contagion effect since the Mexican devaluation in 1994, which brought capital flows or foreign direct investment (FDI) to other Latin American economies and thereby led to a speculative attack on their currencies (Karolyi, 2003). Some works investigated the linkage between contagion and capital flows (Calvo & Reinhart, 1996; Dornbusch et al., 2000; Hernandez et al., 2001; Dornean & Oanea, 2012) and revealed a strong linkage. Hernandez, Mellado, and Valdes (2001) confirmed that contagion played a significant role in the private capital flows to emerging countries during the 1970s to 1990s. Dornean and Oanea (2012) analyzed the effect of the global financial crisis on FDI flows into Central and Eastern European (CEE) countries. They found that the contagion occurred during the economic crisis and significantly contributed to the region's capital flows. However, the sign and magnitude of the impact differed notably depending on the specific characteristics of the CEE countries. However, these works usually used a dummy variable to indicate the economic crisis or contagion effect, which may not reflect the actual degree of contagion or economic crisis's impact on capital flows. Specifically, the previous studies employed a dummy variable that captures the contagion (economic crisis) and takes the value of 1 for the contagion effect period and 0 otherwise. Although it is difficult to identify the financial crisis period and degree of contagion, the measurement based on tail dependence can solve this problem. Some scholars (Rodriguez, 2007;

Nikoloulopoulosa et al., 2012; Cech, 2006; Shamiri et al., 2011; Maneejuk & Yamaka, 2019) suggested that the contagion's degree can be inferred from the extreme co-movement of a pair of random variables as indicated by their lower tail dependence coefficient. In other words, if the lower tail dependence is positive, it signifies the existence of the contagion effect.

Therefore, this study introduces static and dynamic copula models to quantify the degree of the US contagion effect on emerging countries. First, we want to note that the contagion effect refers to the extreme correlation coefficients among different markets. It mainly occurs when the value of correlation coefficients increases during extreme events such as economic crises. (Changqing, Chi, and Yan, 2015; Maneejuk and Yamaka, 2019). As the degree of contagion can be reflected by the lower tail dependence, this study adopts four tail dependence copulas: Student t, Clayton, Rotated Gumbel 180 degrees, and Rotated Joe 180 degrees to estimate the coefficients. Specifically, we consider the lower tail dependence between the US and emerging countries' Gross Domestic Product (GDP) per capita to proxy the degree of contagion effect. In contrast to the related studies (Calvo & Reinhart, 1996; Dornbusch et al., 2000; Hernandez et al., 2001; Dornean & Oanea, 2012) that usually used the dummy variable as the proxy of the contagion effect. Our measures mitigate the drawback of unreliable indicators and significantly increase the sample size of the time and countries. In particular, the set of emerging countries we consider is selected to detect dissimilarities in contagion effects between the US and emerging countries and within a set of countries belonging to the same geographical area. Thus, our study covers 18 countries in North-South America, Asia, Europe, and Africa from 2005 to 2020.

This research has a contribution in two aspects. First is the economic contribution from investigating the US economic crisis's contagion effect on the FDI inflows in 18 emerging countries in North-South America, Asia, Europe, and Africa. This study also utilizes the Vector autoregressive-based Granger causality test to investigate the causal relationship between the degree of contagion effect and FDI inflows in emerging countries. Second is the econometric contribution from measuring contagion using static and dynamic copulas models, as copula is the recent powerful tool for estimating the lower tail dependence. Accordingly, this study suggested four tail dependence copulas: Student t-copula (symmetric tail dependence), Clayton copula (lower tail dependence), rotated survival Gumbel (lower tail dependence), and rotated survival Joe (lower tail dependence) to measure the degree of contagion. To the best of our knowledge, this is the first attempt to measure the degree of contagion using these four copula functions. It is also the first study attempting to investigate the impact of the degree (magnitude) of contagion on the FDI inflows in emerging countries.

This paper is organized as follows: Section 2 reviews the literature. Section 3 describes the econometric methodology. Section 4 defines the variables and provides data descriptions. Section 5 discusses the empirical results, and in Section 6 the conclusion is drawn.

2. Literature Review

This study is motivated by the importance of the US crisis's contagion effects on the FDI inflows of emerging countries. An increasing number of studies examine and study the magnitude of economic crisis and their contagion effects on FDI flows. Based on the literature, there was strong evidence that the economic crisis's contagion had a considerable influence on FDI. Hernandez, Mellado, and Valdes (2001) revealed that contagion plays a vital role in determining the level of capital inflow in emerging countries during the 1970s and the 1990s. Poulsen and Hufbauer (2011) compared the impact of the US economic crisis's contagion and past crisis's contagion on FDI. They revealed that indeed, the US crisis during 2008-2009 was the largest one, and it led to a more significant impact on FDI worldwide, particularly in Emerging countries. Ucal et al. (2010) revealed the finding from their study that the financial crisis had a negative effect on the FDI inflows in 148 emerging countries. Dornean and Oanea (2012) analyzed the impact of the US crisis on FDI in Central and Eastern European (CEE) countries and suggested a significant negative impact on CEE FDI inflows.

On the other hand, Hasli et al., (2017) found that the US financial crisis attracted rather than hindered FDI in emerging countries. They explained that although the crisis led to a sell-off of foreign equity holding in the host country; simultaneously, there was an inward flow of FDI due to the abolishment of restrictive foreign investment policies to attract new investment. Therefore, multinational enterprises reacted to these attractive and liberalized FDI policies by moving their investments into the emerging economies during the crises. According to this empirical literature, the studies on the effect of crisis contagion on the FDI inflows have illustrated mixed results. Recently, many researchers have questioned how to investigate the impact of the economic crisis's contagion on FDI as the indicator of economic crisis's contagion was generally indicated by the dummy variable. We have a concern that the dummy variable may not reflect the actual degree of the contagion of the economic crisis on capital flows. Also, the contagion may not occur only in the crisis periods.

Thus, various techniques have been developed to capture and measure contagion between countries, for instance, analysis of cross-market correlation coefficients (Forbes and Rigobon, 2001; King and Wadhwani, 1990; Calvo and Reinhart, 1996), DCC-GARCH framework (Engle, 2002), and cointegration (Login and Solnik, 1995). The cross-market correlation coefficient is among the pioneering tools in measuring the contagion effects among markets. It is the most straightforward method that measures the correlation in returns between two markets during a stable period and examines whether there is a significant increase in this correlation coefficient during the crisis or not. If the correlation coefficients increase during the crisis, the contagion exists between markets or countries (Forbes and Rigobon, 2001). Within this context, King and Wadhwani (1990) examined the cross-market correlation coefficients among the US, UK, and Japanese stock markets during the US stock market crash in 1987 and found the correlations among these three markets to significantly increase during this period. Likewise, Lee and Kwang (1993) employed this approach to detect the contagion effect on 12 major stock markets and confirmed this US stock crisis's contagion effect. Calvo and Reinhart (1996) used this approach to test the contagion effect of the Mexican currency crisis in 1994 on Emerging markets. Although this correlation coefficient was successful in detecting the contagion as well as measuring the degree of contagion, Forbes and Rigobon (2002) suggested that the test of contagion based on the constant correlation coefficient is misleading and may not correspond to the dynamic change and structural change of the economic and financial time series. Besides, Engle (2002) argued that the dynamic correlation is more precise in modeling time variation of the time series data. Therefore, he introduced the Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroscedasticity (DCC-GARCH) model to find the time-varying correlation between markets.

The cross-market correlation framework has been further used to estimate the variance-covariance transmission mechanism across countries. For example, Chou et al. (1994), Hamao et al. (1990); and Edwards (1996) applied this method to find the evidence of significant contagion across markets after the US stock market crash in 1987 and the Mexican peso crisis in 1994. Chiang et al. (2007) confirmed that this model could explain the dynamic correlation of nine Asian stock markets from 1990 to 2003 and showed that the degree of correlation increased significantly during the crisis period.

As the econometric methods improve, many studies gradually recognize the drawbacks of the linear correlation measured by the traditional models. Changqing, Chi, Cong, and Yan (2015) and Maneejuk, Yamaka, and Sriboonchitta (2018) mentioned that most of the linear correlations measured by those traditional models have a low ability to capture asymmetry and nonlinear dependence. To deal with these problems, Rodriguez (2007) suggested measuring the tail dependence between a pair of random variables during the crisis period; and this tail dependence can be quantified by the copulas which are defined as "functions that join or couple multivariate distribution functions to their one-dimensional marginal distribution functions" (Nelsen, 1999). Compared to the traditional dependency or correlation measurement, Copula can characterize a nonlinear, asymmetric dependency, and tail dependence. Also, the copula model allows us to assess the degree of contagion risk during crisis periods. Thus, this model is an alternative to correlation in the modeling of contagion risks.

However, some scholars (Patton, 2012; Changqing, Chi, and Yan, 2015; Maneejuk and Yamaka, 2019; Alqaralleh, Awadallah and Al-Ma'aitah, 2019) argued that the static Copula does not consider the structural change in the dependence structure; thus, the dynamic copula model is introduced to find the time-varying tail dependence for full samples to identify the size of "non-crisis" and "crisis" periods through time. Therefore, in this paper, we can quantify the degree of contagion between the US and emerging countries by modeling the dynamic copula model. Our paper is related to Hernandez, Mellado, and Valdes (2001), Poulsen and Hufbauer (2011), Ucal et al. (2010), and Hasli et al., (2017) in that it investigates the impact of the crisis on the FDI inflows in emerging countries. But unlike these previous studies, we replace the dummy variable of crisis with the degree of contagion obtained from the dynamic copula model.

3. Methodologies

3.1 Bivariate Copula and Tail Dependence

In this study, we use bivariate copula to investigate the economic contagion between the US economy and emerging countries because the model also allows us to measure the degree of contagion through the tail dependence. Since Sklar's Theorem (1959) gave the first definition of a copula, it has two critical implications. First, when the margins are continuous, copula is unique. Second, it shows that a copula can be constructed from any distribution function with known marginal distributions. Let $H(GDPG^{US}, GDPG^{Dev,i})$ be the joint bivariate distribution function of the standardized Gross Domestic Product (GDP) growth of the US and emerging country *i*, respectively. The unique copula function C can be presented as

$$H(GDPG^{US}, GDPG^{Dev,i}) = C(F_1(GDPG^{US}), F_2(GDPG^{Dev,i}); \theta), \tag{1}$$

where $F_1(GDPG^{US})$ and $F_2(GDPG^{Dev,i})$ are the empirical cumulative distribution function of the standardized GDP growth of the US and emerging country *i*, respectively; and θ is the copula dependence parameter. Then, we can have a bivariate copula function as

$$C(u^{US}, v^{Dev,i}); \theta) = H(F_1^{-1}(u^{US}), F_2^{-1}(v^{Dev,i})), \tag{2}$$

where $u^{US} = F_1(GDPG^{US})$ and $v^{Dev,i} = F_2(GDPG^{Dev,i})$ are the uniform [0,1] variables; and F_1^{-1} and F_2^{-1} are the inverse empirical cumulative distribution function. In this study, four copula functions, namely Student-t, Clayton, rotated survival Gumbel, and rotated survival Joe are utilized to measure the tail dependence.

Tail dependence is the measurement of the dependence between the random variables in the extreme parts of the bivariate distribution (Joe, 2005). To measure the risk contagion, Chiang et al. (2007) suggested capturing the lower tail dependence, which reflects the contagion effect between countries when negative extreme events or crises occur. Therefore, it is reasonable to use the lower tail dependence to measure the economic risk contagion between the US and emerging countries. The lower tail dependence is defined as follows.

$$\tau^L = \lim_{u \to 0} \Pr[GDPG^{US} < F_1^{-1}(u) \mid GDPG^{Dev,i} < F_2^{-1}(u)] = \lim_{u \to 0} \frac{C(u,u)}{u}, \tag{3}$$

where $\tau^L \in [0,1]$, and u is a threshold value. If τ^L is 0, then the US and emerging country *i* have lower tail independence. Note that the higher value of tail dependence indicates the larger size or degree of the contagion risk between the US and emerging country *i*.

As a contagion does not rely on an ad hoc determination of the crisis period, we can use the time-varying copula to measure the contagion size. We focus on time-varying tail dependence by allowing the lower tail parameters to be time-varying according to the ARMA (1,10) process

(Patton, 2007; Talbi, Peretti, and Belkacem, 2020). Therefore, we can write the time-varying equations of four copulas models as follows:

The bivariate time-varying tail Student-t copula is defined as

$$\tau_t^{L(T)} = 2t_{\mathrm{v}+1}\left(-\sqrt{\mathrm{v}+1}\sqrt{\frac{1-\theta_t^{(T)}}{1+\theta_t^{(T)}}}\right), \tag{4}$$

$$\theta_t^{(T)} = \Delta\left(\omega_0^{(T)} + \omega_1^{(T)}\theta_{t-1}^{(T)} + \omega_2^{(T)}\left(\frac{1}{10}\sum_{j=1}^{10} F_1^{-1}(u_{t-j}^{US})F_2^{-1}(v_{t-j}^{Dev})\right)\right), \tag{5}$$

where $t_{\mathrm{v}+1}$ is the standardized Student-t distribution function with $\mathrm{v}+1$ degrees of freedom. Then, $\omega_0^{(T)}$, $\omega_1^{(T)}$, and $\omega_3^{(T)}$ are the estimated parameters. $\theta_t^{(T)}$ is the Student-t copula dependence parameter at time t. Then, we keep the time-varying dependence parameter within the interval (-1,1) by using the transformation function, $\Delta(a) = (1-e^{-a})/(1+e^{-a})$. For the degrees of freedom v, the time-varying equation is given by

$$\mathrm{v}_t^{(T)} = \tilde{\Delta}\left(\gamma_0^{(T)} + \gamma_1^{(T)}\mathrm{v}_{t-1}^{(T)} + \gamma_2^{(T)}\left(\frac{1}{10}\sum_{j=1}^{10} F_1^{-1}(u_{t-j}^{US})F_2^{-1}(v_{t-j}^{Dev})\right)\right), \tag{6}$$

where $\tilde{\Delta}(a) = 2 + ((e^{a}/(1+e^{-a}))\times 100)$ is the modified transformation for ensuring that $\mathrm{v}_t^{(T)}$ will be within the interval (-1, ∞).

The bivariate time-varying tail Clayton copula is defined as

$$\tau_t^{L(C)} = 2^{-1/\theta_t^{(C)}}, \tag{7}$$

$$\theta_t^{(C)} = \Delta^{C}\left(\omega_0^{(C)} + \omega_1^{(C)}\theta_{t-1}^{(C)} + \omega_2^{(C)}\left(\frac{1}{10}\sum_{j=1}^{10}\left|u_{t-j}^{US} - v_{t-j}^{Dev}\right|\right)\right), \tag{8}$$

where $\Delta^{C}(a) = a^2$ is the modified transformation for ensuring $\theta_t^{(C)}$ to be within the interval (0, ∞). For the cases of survival Gumbel and survival Joe copulas, their bivariate time-varying tail dependence can be given by

$$\tau_t^{L(S)} = 2 - 2^{1/\theta_t^{(S)}}, \tag{9}$$

$$\theta_t^{(S)} = \Delta^{S}\left(\omega_0^{(S)} + \omega_1^{(S)}\theta_{t-1}^{(S)} + \omega_2^{(S)}\left(\frac{1}{10}\sum_{j=1}^{10}\left|u_{t-j}^{US} - v_{t-j}^{Dev}\right|\right)\right), \tag{10}$$

where $\Delta^{S}(a) = 1 + a^2$ is the modified transformation for ensuring $\theta_t^{(S)}$ to be within the interval (1, ∞).

3.2 Specification of Copulas

- *The Student-t Copula*

The Student-t copula is asymmetric dependence model since it has more mass in the tails (Cech, 2006), indicating that it is more likely to produce values far below its mean. The density of the Student-t copula is given by

$$C\left(u_t^{US}, v_t^{Dev,i} \middle| \theta_t^{(T)}, \mathrm{v}_t\right) = \int_{-\infty}^{t_v^{-1}(u_t^{US})} \int_{-\infty}^{t_v^{-1}(v_t^{Dev,i})} \frac{1}{2\pi\sqrt{1-\theta_t^{(T)}}} \left[1 + \frac{x_t^2 + y_t^2 - 2\theta_t^{(T)} x_t y_t}{\mathrm{v}_t (1-\theta_t^{(T)})^2}\right], \tag{11}$$

where t_{v}^{-1} is the inverse of the univariate student-t distribution function with the degrees of freedom v_t. x_t and y_t represent the standardized GDP growth of the US and emerging country *i*, respectively.

- *Clayton Copula*

Clayton copula is an implicit copula that exhibits asymmetric dependence for most parameter values. The lower tail is more dependent than the upper tail, so it is appropriate for modeling the effect during the crisis (Shamiri et al., 2011). The density of the Clayton copula is as follows:

$$C\left(u_t^{US}, v_t^{Dev,i} \middle| \theta_t^{(C)}\right) = \left((u_t^{US})^{-\theta_t^{(C)}} + (u_t^{Dev,i})^{-\theta_t^{(C)}} - 1\right)^{1/\theta_t^{(C)}}. \tag{12}$$

This Copula has the dependence structure with a range between the independence copula (when $\theta_t^{(C)} = 0$) and as $\theta_t^{(C)} = \infty$ it approaches a two-dimensional comonotonicity copula. In other words, it has a lower tail dependence between variables and is better for joining adverse events than positive events.

- *Rotated Copulas*

Many copulas cannot display negative tail dependence, for instance, the Gumbel and Joe copulas. Once the bivariate random variable has negative dependence, we can rotate these copulas to capture a negative tail dependence. Cech (2006) derived the rotated Copula by defining $\overline{u} = 1 - u$ and $\overline{v} = 1 - v$, then the 180° rotated Copula is as follows:

$$C^{180^\circ}(u, v) = u + v - 1 + C(1-u, 1-v). \tag{13}$$

Thus, we can derive our 180° rotated Gumbel copula $C(u_t^{US}, v_t^{Dev,i} \middle| \theta_t^{(SG)})$, and 180° rotated Joe Copula $C(u_t^{US}, v_t^{Dev,i} \middle| \theta_t^{(SJ)})$ as follows:

$$C(u_t^{US}, v_t^{Dev,i} \middle| \theta_t^{(SG)}) = (1-u_t^{US}) + (1-u_t^{Dev,i}) - 1 + (\exp(-((1+\ln u_t^{US})^{\theta_t^{(SG)}} + (1+\ln u_t^{US})^{\theta_t^{(SG)}}))^{1/\theta_t^{(SG)}}, \tag{14}$$

$$C(u_t^{US}, v_t^{Dev,i} \middle| \theta_t^{(SJ)}) = (1-u_t^{US}) + (1-u_t^{Dev,i}) - 1 + (1-((-u_t^{US})^{\theta_t^{(SJ)}} + (-u_t^{US})^{\theta_t^{(SJ)}} - (-u_t^{US})^{\theta_t^{(SJ)}}(-u_t^{US})^{\theta_t^{(SJ)}})^{1/\theta_t^{(SJ)}}), \tag{15}$$

where θ^{SG}, θ^{SJ} are dependence parameters of survival Gumbel (or 180° rotated Gumbel) copula and survival Joe (or 180° rotated Joe) copula respectively.

3.3 Regression Model

This study aims to investigate the impact of the US contagion risk on the FDI inflows in emerging countries using multiple linear regression as a predictive analysis. Thus, our empirical model can be written as

$$\begin{aligned}\Delta \ln FDI_{i,t} = \beta_{0,i} + \beta_{1,i}\Delta \ln Con_{i,t} + \beta_{2,i} GDPG_{i,t}^{Dev} + \beta_{3,i}\Delta \ln Open_{i,t} \\ + \beta_{4,i}\Delta \ln REER_{i,t} + \beta_{5,i}\Delta \ln CPI_{i,t} + \varepsilon_t,\end{aligned} \tag{16}$$

where $FDI_{i,t}$ is the foreign direct investment, net inflows, as a percentage of GDP of emerging country *i* at time *t*. $Con_{i,t}$ is the estimated degree of contagion between the US and emerging country *i* at time *t*. We note that the contagion value is represented by lower tail dependence; thus, $Con_{i,t} = \tau_{i,t}^{L}$. Also, we consider additional control variables to avoid the omitted variable problem. We apply the following control variables according to the recommendations from the related literature (Cohen, 2007; Campos and Kinoshita, 2008; Calderon and Didier, 2009; Hasli et al., 2017; Jaiblai and Shenai, 2019). These control variables include real GDP growth of emerging country $i\,(GDPG_{i,t}^{Dev})$, trade openness measured by the ratio of imports + exports to GDP between the US and emerging country i $(Open_{i,t})$, exchange rate US dollar to emerging country's currency $i\,(REER_{i,t})$, and consumer price index of emerging country i $(CPI_{i,t})$. The parameters $\beta_{0,i}, \beta_{1,i}, \ldots, \beta_{5,i}$ are the estimated coefficients of emerging country *i*. All data is transformed into log differences $\Delta \ln(\cdot)$ to achieve stationary properties.

3.4 Vector Autoregressive-based Granger Causality Test

Finally, it is worth testing the causal relationship between contagion and FDI. Thus, we use the vector autoregressive-based Granger causality test of Rossi (2005), which is the extension of traditional Granger causality test of Granger (1969). Rossi (2005) mentioned that this method is potentially important to allow for changes over and it provides more reliable results in the presence of instabilities when compared to the traditional Granger causality test. In a bivariate framework, the first variable is said to cause the second one in the Granger sense if the forecast for the second variable changes according to the lagged values for the first variable. The specific equation is as follows:

$$\Delta \ln FDI_t = \sum_{p=1}^{P} \alpha_{1p}\Delta \ln Con_{t-p} + \sum_{p=1}^{P} \beta_{1p}\Delta \ln FDI_{t-p} + \varepsilon_{1t}, \tag{17}$$

$$\Delta \ln Con_t = \sum_{1=1}^{P} \alpha_{2p}\Delta \ln Con_{t-p} + \sum_{p=1}^{P} \beta_{2p}\Delta \ln FDI_{t-p} + \varepsilon_{2t}, \tag{18}$$

The null hypothesis of no-granger causality is given by $H_0:\alpha_{1p}=0, H_0:\beta_{1p}=0$ and the corresponding alternative hypothesis is $H_a:\alpha_{1p}\neq 0, H_a:\beta_{1p}\neq 0$. In other words, the null hypothesis states the non-existence of causal relationship between the risk contagion and FDI. If this null is rejected, there is evidence of Granger causality. To test the above hypothesis, an F-test statistic is employed.

4. Definition of Variables and Data Description

4.1 Variables and Data Description

In this paper, we generate tail dependence using the time-varying bivariate copula model between the real GDP growth of the US and the real GDP growth of each emerging country. Then, we investigate the impact of the contagion risk and other determinants on FDI inflows in emerging countries, which consist of real GDP growth, trade openness, exchange rate, and inflation. All the data presented in this study is obtained from www.ceicdata.com and the World Bank – World Development Indicator. The selected emerging countries include 18 countries, namely China, India, Indonesia, Thailand, and the Philippines from the Asian region, Russia, Poland, Hungary, Romania, and Bulgaria from the Europe region, Brazil, Mexico, Argentina, Chile, and Colombia from the North-South American area, and South Africa, Egypt, and Morocco from the African region, and the US as an origin of the crisis. The paper covers the period from 2005-2020, and the frequency of the data is quarterly, covering 64 observations. Although our sample size is small, the results obtained from maximum likelihood estimation (MLE) for our models (bivariate copula, Granger causality, and linear regression) are still valid, as the sample size remains more extensive than the number of parameter estimates. Lee and Song (2004) and Maneejuk, Yamaka, and Sriboonchitta (2020) revealed that MLE for structural equation and regression models are still efficient when the ratio of parameters: sample size is 1:5. Also, Zhang, Czado, and Min (2011) suggested that MLE for low dimension copula model is still valid and efficient for small sample size. Table 1 presents the descriptions of all variables considered in this study.

Table 1. Definition of variables

Variable	Description
Con	Degree of economic contagion between the US and emerging country that is generated by the time-varying tail dependence.
$GDPG^{Dev}$	Growth rate of real GDP of emerging country
$GDPG^{US}$	Growth rate of real GDP of the US
Open	Trade openness measured by the ratio of imports + exports to GDP between the US and emerging country
REER	Real effective exchange rate (local currency/USD) of emerging country
CPI	The consumer price index of emerging country
FDI	Foreign Direct Investment, net inflows (% of GDP) of emerging country

4.2 Descriptive Statistics

This section presents the summary descriptive statistics of real GDP growth of selected countries in Table 2. We can observe that the mean GDP growth is significantly different from zero for all countries. The mean of China's GDP growth is higher than in other emerging countries. Not surprisingly, China has become the center of the global supply chain network over the past decade. Considering the GDP growth in each region, Bulgaria has the largest GDP growth compared to other European countries. Argentina and Egypt perform the highest GDP growth in North-South American and African areas, respectively.

The minimum, maximum, and standard deviation values indicate a notable time-series variation in all variables. For example, Bulgaria shows experienced the highest and the lowest GDP growth of 0.0228 and -0.0236, respectively, among all our sample countries. Compared to other emerging countries, Bulgaria also has the highest standard deviation of GDP growth (0.0174), indicating a high fluctuation in the economy. Conversely, Thailand is a minor risky economy since it presents the lowest standard deviation among all our sample countries.

Moreover, most countries (except India, Indonesia, and Chile) show a negative skewness value. This implies that most emerging countries' economic growth has a long left-tail distribution, while India, Indonesia, and Chile have a long right-tail distribution. In addition, it is observed that the kurtosis is higher than 3 for all countries, except for Bulgaria and Hungary, indicating that the distribution of economic growth is leptokurtic.

Table 2. Descriptive statistics for the real GDP growth

	Mean	**Maximum**	**Minimum**	**Std. Dev.**	**Skewness**	**Kurtosis**
Argentina	0.0016	0.0174	-0.0240	0.0079	-0.5035	4.4530
Brazil	0.0011	0.0136	-0.0236	0.0053	-1.5417	10.0611
Bulgaria	0.0021	0.0228	-0.0377	0.0174	-0.7522	2.2870
Chili	0.0014	0.0180	-0.0167	0.0070	0.1132	3.3132
China	0.0028	0.0122	-0.0130	0.0075	-1.0107	4.4738
Columbia	0.0013	0.0114	-0.0173	0.0053	-0.9238	4.7650
Egypt	0.0023	0.0252	-0.0406	0.0111	-0.5518	5.5057
Hungary	0.0009	0.0169	-0.0302	0.0118	-0.7903	2.6368
India	0.0017	0.0132	-0.0090	0.0050	0.2774	3.1818
Indonesia	0.0017	0.0132	-0.0090	0.0050	0.2774	3.1818
Mexico	0.0006	0.0083	-0.0205	0.0043	-2.2602	11.6930
Morocco	0.0012	0.0099	-0.0122	0.0035	-0.6776	5.2840
Philippines	0.0024	0.0207	-0.0138	0.0098	-0.0237	5.6870
Poland	0.0012	0.0208	-0.0252	0.0097	-0.4817	3.8526
Romania	0.0016	0.0111	-0.0234	0.0062	-1.4906	6.7158
Russia	0.0015	0.0185	-0.0359	0.0111	-1.5183	5.5273
South Africa	0.0005	0.0148	-0.0212	0.0055	-0.7109	6.1287
Thailand	0.0016	0.0090	-0.0100	0.0034	-0.7348	4.6870
USA	0.0026	0.0118	-0.0242	0.0059	-2.0443	9.5837

Note that the summary descriptive statistics of other variables including FDI, CPI, REER, and trade openness are provided in the Appendices 1A-1D respectively.

5. Empirical Results and Discussion

This section will present the empirical results starting from the unit root test results for all the variables. Then, the degree of contagion will be shown in the next subsection, followed by the test results of vector autoregressive-based Granger causality. Finally, the impacts of contagion and other determinants on FDI will be discussed in the last subsection.

5.1 Unit Root Test

Stationarity is the essential requirement for time-series analysis, in which the unit root test is the most effective method for testing the stationarity of a time series. Therefore, we use the Augmented Dickey-Fuller (ADF) with intercept and trend test to examine the stationarity of all the variables. The null hypothesis is that an observable series is stationary (the existence of unit root). Therefore, according to the ADF test results reported in Table 3, the examined series are stationary at the level.

Table 3. Unit Root Test

Country	$\Delta \ln FDI$	$GDPG$	$\Delta \ln Open$	$\Delta \ln REER$	$\Delta \ln CPI$
Argentina	-6.1761***	-3.4038**	-4.2294***	-4.8897***	-5.2225***
Brazil	-4.4557***	-5.5886***	-5.5620***	-5.5603***	-5.0513***
Bulgaria	-3.4568**	-2.6188*	-3.0860**	-5.8374***	-3.1764**
Chili	-2.8136**	-3.4559**	-3.7670***	-4.9905***	-2.5545*
China	-5.1465***	-2.2212*	-4.1289***	-5.5478***	-4.4136***
Columbia	-4.8532***	-5.5249***	-4.8687***	-5.7841***	-1.7821
Egypt	-6.6363***	-2.4087*	-3.0832**	-4.9364***	-5.0002***
Hungary	-5.2229***	-3.1048**	-4.8984***	-5.9189***	-2.6112*
India	-4.3674***	-2.9457**	-2.8274**	-4.7345***	-2.6418*
Indonesia	-4.8558***	-2.9457**	-3.6365***	-5.2158***	-5.8090***
Mexico	-6.2830***	-5.6129***	-3.7025***	-5.6368***	-2.6060*
Morocco	-4.2186***	-5.2953***	-4.5832***	-5.7988***	-5.7445***
Philippines	-4.5965***	-5.2953*	-4.5832***	-5.7988***	-5.7445***
Poland	-5.0173***	-3.0119**	-3.9774***	-5.3997***	-1.7769***
Romania	-3.8397***	-5.3349***	-4.1205***	-5.0965***	-2.6095*
Russia	-3.8870***	-2.4474*	-5.5558***	-3.4544**	-2.4253*
South Africa	-7.3934***	-5.5619***	-4.4333***	-6.1168***	-3.0955**
Thailand	-5.5904***	-4.1589***	-4.7394***	-3.9255***	-7.5076***

Note: ***, ** and * indicate the rejection of the null hypothesis at 1%, 5%, and 10% significance level, respectively

5.2 Measurement of the Degree of Contagion Effects

This section aims to assess the size of contagion effects between the US and emerging countries. Thus, four copula models are employed to measure the lower tail dependence between the US and each emerging country. Both bivariate static and dynamic copulas are applied to the US and each emerging country's standardized GDP growth. To find the best fit static and dynamic copulas, we employ the Akaike Information Criterion (AIC), and the lowest value of AIC will correspond to the best copula model. The model comparison results of static and dynamic copulas are provided in Tables 4 and 6, respectively.

Considering the static copulas comparison in Table 4, we can observe that the Student-t copula is selected as the best copula model for virtually all pairs, except for Morocco and South Africa. This indicates that there exists a symmetric tail dependence between the US and emerging countries (except for Morocco and South Africa). For the case of Morocco and South Africa, it is evident that Survival Gumbel is the best copula function.

The results of the best fit static copula models are also presented in Table 5. The estimated dependence parameters and their corresponding Kendall's tau are provided. We find that the correlation values are positive in all economic pairs. Overall, we find that the correlations between the US and emerging countries range from 0.63 to 0.91. The positive correlation between the US and Indonesia is the lowest with a value of 0.63, while the US and South Africa pair is the highest with a value of 0.91. Our empirical study is of great interest, given that the results of tail dependence and Kendall's tau are consistent. This indicates that the higher degree of economic integration brings a higher degree of contagion effect. Chen, Hao, and Li (2020) mentioned that the contagion effect comes from a closer link among the markets, countries, regions, and industries across the world, and this connectivity has become more prominent since the 2008 financial crisis.

As shown in the last column of Table 5 and Figure 1, the lower tail dependence results show that the degree of contagion between the US and South Africa is the highest, with a value of 0.93, while the degree of contagion in the US-Indonesia pair is the lowest with the value of 0.11. This finding indicates a high impact of the US crisis on South Africa's economic growth. Our result is consistent with the study of Rena and Msoni (2014) that revealed a significant severe impact of the US crisis on South Africa during 2008/09. They also found that South Africa entered the recession in 2008/09 for the first time in 19 years, and the unemployment rate remained high at 25 percent.

The US is one of the most important trading partners of South Africa, and many US multinational corporations (MNCs) have entered South African markets through both FDI and Non-FDI modes since 1990. Owhoso et al. (2002) mentioned that in the 1990s, many African nations' governments recognized the potential for benefits from foreign investment and changed policies to encourage market entry. Due to this close nexus between South Africa and US' FDI and Non-FDI modes, the economic conditions and their crisis would significantly impact South African countries in various dimensions, particularly the investment and export sectors. According to the World bank (2009), the global financial crisis originated in the US had impacted the South African economy in various ways. The most significant is the decline in export prices and volumes. Due to falling prices and demand for their commodities, South Africa has experienced sharp drops in primary commodity exports by around 40 percent. As a result, according to African Development Bank (AfDB), real GDP growth is expected to slow to 4.6 percent in 2009 from 6.2 percent in 2007. As a result, South Africa will be hit the hardest, with its forecast growth rate slowing to 4.0 percent in 2009 compared to other African countries.

Regarding capital inflows, South Africa has been dependent on aid funds for the last two decades, for example, the President's Emergency Plan for AIDS Relief (PEPFAR). However, these funds were found to be contractions during the crisis in 2008-2009 (Joshua, Adedoyin, and Sarkodie, 2020). In addition to aid funds, FDI-related infrastructures (such as good roads, adequate electricity supply, effective communication, and basic information technology) were also dropped during the crisis. Recently, many trade agreements, such Trade and Investment Framework Agreement (TIFA) and Trade, Investment, and Development Cooperative Agreement (TIDCA), have been introduced to aid South Africa's economy and health.

According to the above, we can see that the relationship between South Africa and the US is strong in various dimensions. Therefore, the fluctuation of the US economy can inevitably influence the variation in the South African economy.

Table 4. Model comparison and tail dependence

Country	Student-t			Clayton		
	Upper	Lower	AIC	Upper	Lower	AIC
Argentina	0.29	0.29	**-65.26**	0	0.86	-49.11
Brazil	0.28	0.28	**-66.95**	0	0.87	-59.32
Bulgaria	0.32	0.32	**-71.07**	0	0.87	-56.87
Chile	0.38	0.38	**-84.12**	0	0.88	-66.88
China	0.38	0.38	**-84.12**	0	0.89	-67.75
Colombia	0.41	0.41	**-90.21**	0	0.90	-75.85
Egypt	0.29	0.29	**-64.47**	0	0.86	-50.34
Hungary	0.41	0.41	**-90.54**	0	0.89	-75.77
India	0.33	0.33	**-60.25**	0	0.78	-22.43
Indonesia	0.11	0.11	**-28.78**	0	0.73	-18.57
Mexico	0.55	0.55	**-129.35**	0	0.93	-114.30
Morocco	0.19	0.19	-38.53	0	0.82	-40.98
Philippines	0.35	0.35	**-78.09**	0	0.88	-61.61
Poland	0.36	0.36	**-80.65**	0	0.88	-66.24
Romania	0.30	0.30	**-66.27**	0	0.86	-52.56
Russia	0.38	0.38	**-83.32**	0	0.89	-69.24
South Africa	0.69	0.69	-177.46	0	0.96	-171.42
Thailand	0.35	0.35	**-54.67**	0	0.79	-25.33
Country	**Survival Gumbel**			**Survival Joe**		
	Upper	**Lower**	**AIC**	**Upper**	**Lower**	**AIC**
Argentina	0	0.80	-59.19	0	0.86	-47.82
Brazil	0	0.80	-65.2	0	0.87	-58.35
Bulgaria	0	0.81	-65.87	0	0.87	-55.79
Chile	0	0.83	-77.78	0	0.88	-65.91
China	0	0.84	-78.45	0	0.89	-67.04
Colombia	0	0.85	-85.38	0	0.90	-75.19
Egypt	0	0.74	-60.4	0	0.86	-49.36
Hungary	0	0.84	-85.14	0	0.90	-75.07
India	0	0.72	-30.41	0	0.79	-20.92
Indonesia	0	0.67	-24.21	0	0.73	-17.10
Mexico	0	0.89	-125.25	0	0.93	-114.05
Morocco	0	0.73	**-42.79**	0	0.82	-41.03
Philippines	0	0.82	-72.08	0	0.88	-60.68
Poland	0	0.83	-75.78	0	0.89	-65.42
Romania	0	0.80	-61.35	0	0.87	-51.41
Russia	0	0.83	-78.25	0	0.89	-68.39
South Africa	0	0.93	**-177.73**	0	0.96	-171.39
Thailand	0	0.73	-33.03	0	0.80	-23.79

Note: Numbers in the bold present the best static copula.

Table 5. The selected static copula dependence, Kendall's Tau, upper and lower tail dependences between the US and emerging countries

Country	Selected Copula	Dependence Parameter	Kendall's Tau	Upper tail	Lower tail
Argentina	Student-t	0.93	0.76	0.29	**0.29**
Brazil	Student-t	0.93	0.75	0.28	**0.28**
Bulgaria	Student-t	0.94	0.77	0.32	**0.32**
Chile	Student-t	0.95	0.80	0.38	**0.38**
China	Student-t	0.95	0.80	0.38	**0.38**
Colombia	Student-t	0.96	0.81	0.41	**0.41**
Egypt	Student-t	0.93	0.76	0.29	**0.29**
Hungary	Student-t	0.96	0.81	0.41	**0.41**
India	Student-t	0.92	0.77	0.33	**0.33**
Indonesia	Student-t	0.84	0.63	0.11	**0.11**
Mexico	Student-t	0.98	0.86	0.55	**0.55**
Morocco	Survival Gumbel	2.90	0.65	0	**0.73**
Philippines	Student-t	0.94	0.79	0.35	**0.35**
Poland	Student-t	0.95	0.79	0.36	**0.36**
Romania	Student-t	0.93	0.76	0.30	**0.30**
Russia	Student-t	0.95	0.80	0.38	**0.38**
South Africa	Survival Gumbel	10.74	0.91	0	**0.93**
Thailand	Student-t	0.91	0.76	0.35	**0.35**

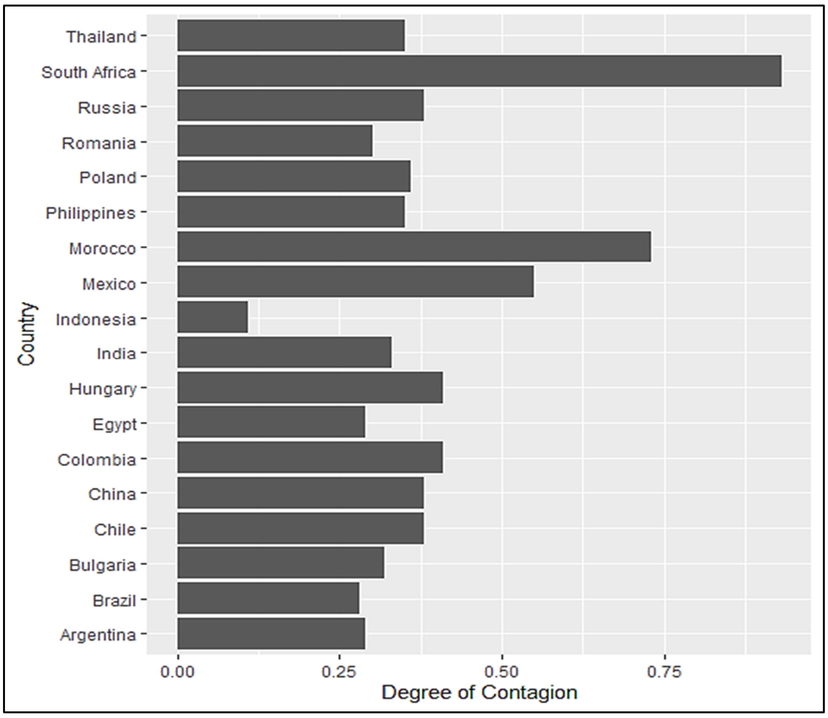

Figure 1. Static economic contagion in 18 emerging economies

5.3 US Dynamic Contagion in 18 Emerging Economies

Regarding the time-varying copulas, it is interesting to quantify the degree of contagion over time. Thus, it is advantageous to allow the time-varying copula's tail dependence to interpret the degree of contagion between the US economy and emerging countries throughout the sample. Again, four time-varying copulas are considered and compared by the AIC. The comparison results are shown in Table 6. The AIC results suggest that Student-t copula is selected for Argentina, Bulgaria, China, Mexico, Chile, Egypt, Hungary, India, Russia, and Thailand. On the other hand, the Clayton copula is the best choice for Brazil, Colombia, Indonesia, and the Philippines. At the same time, Survival Joe is appropriated for Poland and Romania, and Survival Gumbel is the best for Morocco and South Africa. This means that the US - emerging economy dependence seems to occur most of the time during extreme market events and that the US and emerging economies tend to boom or crash together for these countries. Furthermore, there exists the presence of asymmetric tail dependence between the economy of the US and the economies of Brazil, China, Colombia, India, Indonesia, Philippines, Poland and Romania, Morocco, and South Africa. This implies that the economic dependence structure between the US and these countries is not the same in boom and crash.

Table 6. Model comparison and average time-varying tail dependence.

Country	Student t		Clayton		Survival Gumbel		Survival Joe	
	Average **tail**	**AIC**	Average **tail**	**AIC**	Average **tail**	**AIC**	Average **tail**	**AIC**
Argentina	0.28	**-178.98**	0.34	-188.23	0.44	-63.99	0.33	-50.13
Brazil	0.52	-54.87	0.45	**-89.32**	0.29	-73.24	0.78	-61.02
Bulgaria	0.81	**-83.76**	0.78	-65.45	0.77	-70.34	0.87	-62.44
Chile	0.61	**-129.84**	0.62	-121.43	0.43	-100.23	0.45	-70.23
China	0.92	**-102.78**	0.88	-67.75	0.87	-84.54	0.78	-75.52
Colombia	0.81	-121.67	0.85	**-114.98**	0.91	-93.56	0.70	-76.02
Egypt	0.30	**-69.09**	0.45	-63.55	0.40	-65.45	0.43	-62.35
Hungary	0.93	**-100.54**	0.91	-75.77	0.81	-83.26	0.88	-88.24
India	0.53	**-82.53**	0.27	-22.43	0.31	-43.93	0.30	-32.92
Indonesia	0.25	-33.12	0.33	**-36.94**	0.43	-30.11	0.32	-22.23
Mexico	0.83	**-186.09**	0.70	-190.34	0.65	-153.33	0.79	-149.03
Morocco	0.59	-54.87	0.53	-41.04	0.53	**-66.34**	0.49	-41.03
Philippines	0.71	-81.45	0.74	**-102.32**	0.53	-80.32	0.42	-65.94
Poland	0.75	-95.87	0.77	-57.34	0.61	-80.34	0.76	**-104.21**
Romania	0.65	-79.09	0.67	-89.34	0.81	-68.94	0.77	**-93.02**
Russia	0.88	**-98.76**	0.79	-73.23	0.70	-80.23	0.81	-70.35
South Africa	0.83	-178.90	0.82	-171.42	0.82	**-179.73**	0.80	-150.93
Thailand	0.30	**-54.67**	0.25	-25.33	0.20	-39.02	0.23	-51.32

Note: Numbers in the bold present the best dynamic copula result. Average tail is the average tail dependence (Reported in Figure 1.)

The estimation results of the best-fitting time-varying Copula are reported in Table 7. We note that ω_0 indicates the mean of the dependence, ω_1 indicates autoregressive parameter or degree of persistence, and ω_2 captures the dependence process adjustment (Pastpipatkul et al., 2016; Maneejuk and Yamaka, 2019). We can see that the autoregressive parameter ω_1 in the time-varying Copula is significant and less than 0.40, suggesting that there is not a high degree of persistence about the dependence structure between the US and emerging economies. The parameter ω_2 is also strongly significant for all countries except for Hungary, indicating substantial variations over time in the dependence between the US and emerging economies. Besides, this parameter's positive values suggest that the previous information on the growth of the US and emerging countries is useful for investigating the dynamic dependence between them. Nevertheless, it is a fact the value of the parameter ω_2 is relatively larger compared to the persistence parameter ω_1 for all countries. This means that there is a weak dynamic persistence effect. According to these significant results, we can conclude that the static copula model may not be appropriate to describe the dependence structure between the US and emerging countries' economic growth.

Table 7. The selected dynamic Copulas for contagion between the US and emerging countries

Country	Selected Copula	ω_0	ω_1	ω_2	Average lower tail dependence
Argentina	Student-t	0.124 (0.021)***	0.364 (0.056)***	0.635 (0.021)***	0.28
Brazil	Clayton	0.211 (0.101)**	0.320 (0.023)***	0.679 (0.073)***	0.45
Bulgaria	Student-t	1.229 (0.631)*	0.132 (0.039)***	0.282 (0.121)**	0.81
Chile	Student-t	0.321 (0.111)***	0.321 (0.101)***	0.678 (0.032)***	0.61
China	Student-t	1.501 (0.320)***	0.110 (0.011)***	0.990 (0.021)***	0.92
Colombia	Clayton	1.456 (0.522)***	0.110 (0.011)***	0.990 (0.056)***	0.85
Egypt	Student-t	0.230 (0.024)***	0.323 (0.011)***	0.676 (0.000)***	0.30
Hungary	Student-t	2.256 (1.428)*	0.056 (0.031)*	0.294 (0.273)	0.93
India	Student-t	1.021 (0.240)***	0.424 (0.020)***	0.575 (0.121)***	0.53
Indonesia	Clayton	0.012 (0.005)**	0.316 (0.037)***	0.683 (0.069)***	0.33
Mexico	Student-t	0.515 (0.211)***	0.315 (0.021)***	0.684 (0.094)***	0.83
Morocco	Survival Gumbel	8.693 (0.212)***	0.316 (0.010)***	0.683 (0.000)***	0.53

Country	Selected Copula	ω_0	ω_1	ω_2	Average lower tail dependence
Philippines	Clayton	0.045 (0.010)***	0.330 (0.021)***	0.669 (0.091)***	0.74
Poland	Survival Joe	1.289 (0.244)***	0.044 (0.041)	0.768 (0.075)***	0.76
Romania	Survival Joe	1.2445 (0.242)***	0.154 (0.051)***	0.443 (0.135)***	0.77
Russia	Student-t	2.546 (1.021)***	0.210 (0.025)*	0.990 (0.054)***	0.88
South Africa	Survival Gumbel	3.789 (0.230)***	0.352 (0.024)***	0.647 (0.000)***	0.82
Thailand	Student-t	0.001 (0.000)***	0.426 (0.022)***	0.573 (0.043)***	0.30

Note: ***, ** and * indicate the rejection of the null hypothesis at 1%, 5%, and 10% significance level, respectively. The parentheses () present the standard error.

The average tail dependence or degree of contagion is also reported in Table 7 (the rightest column). We can notice that the average tail dependence is generally strong (values close to one) in many countries. The highest mean tail dependence with a value of 0.93 is obtained for Hungary, followed by China (0.92), Russia (0.88), Colombia (0.85), and Mexico (0.83); while the lowest mean tail dependence, with a value of 0.28, is found in Argentina. This result indicates that the economic growth of Hungary, China, Russia, Colombia, and Mexico are primarily affected by the US contagion risk.

To better understand the degree of contagion risk over time, we illustrate the time-varying lower-tail dependence between the US and 18 emerging economies generated from the best-fit copula models (Table 7). The graphical results of time-varying lower-tail dependencies are illustrated in Figure 2, in which several observations can be made and summarized as follows. (1) The degree of contagion, as reflected by the tail dependence plots for all emerging countries, is not stable and varies over time, confirming the appropriateness of the time-varying copulas' implementation rather than the static copulas. (2) After the official ending of the US crisis in 2009, the degree of contagion gradually increased for virtually all countries except Thailand, the Philippines, Argentina, Brazil, and Chile. This indicates the growing contagion risk of the US in the post-crisis period, which is possibly explained by what Pastpipatkul et al. (2015) have convinced regarding the increasing integration between the US and emerging economies following the implementation of the Quantitative easing (QE) policy by the Federal Reserve (Fed). In 2008, the Fed announced the first QE to escape the severe crisis. This policy was employed during 2008-2014, leading the Fed's balance sheet to increase from less than $1 trillion in 2008 to $4.4 trillion in 2014. Furthermore, Çepni et al. (2020) mentioned that a significant surge in capital flows to emerging countries occurred after the global financial crisis in 2008 due to the low savings rate in the US. Thus, these large capital inflows may lead to real exchange rate appreciation and inflation pressure in emerging economies, which in turn cause significant instability in their financial markets and economies. (3) Among the emerging countries, the degree of contagion between the US and Hungary exhibits the highest values, with the time-varying dependence reaching a low of 0.90 and a high of 0.94. In contrast, the US-Indonesia contagion exhibits the lowest values, with the time-varying dependence ranging from 0.06 to 0.52. This finding reveals that the Hungarian economy is substantially affected by the external contagion risk from the US economy most of the time from 2005 to 2019. Our finding is consistent with Egedy (2012) on the influence of the global financial crisis on Europe, which indicates that Hungary is one of the biggest losers of the crisis in Europe as it is a small country with an open economy and has a weak fiscal policy stance. Since 2009, the Hungarian currency has depreciated by 17 percent compared to the EUR; thus, it has ruined the country's export sector and many industries. Andor (2009) pointed out that Hungary has shown such vulnerability to global developments and has been forced to obtain external support from the IMF. At the end of 2009, the number of housing loans in Hungary was 3,920 billion HUF (i.e., 15 percent of the GDP), of which 63 percent was the ratio of foreign currency-based housing loans. (4) Interestingly, the lower-tail dependence correlation is relatively high in Europe countries (the average tail dependence above 0.77 for all European countries), indicating that the crisis affected the Europe region more than other regions.

According to the above discussion, we can validate our tail dependence as the degree of contagion over time. The tail dependence in many countries performs well in reflecting the high degree of contagion after the advent of the economic crisis in 2008. This picture is apparent in the case of China, Columbia, Hungary, Indonesia, Morroco, Poland, Russia, South Africa, Romania, Egypt, Bulgaria, and Mexico. We could observe the gradual increase in the contagion degree after the financial crisis, confirming the accuracy of the predicted tail dependence as the contagion proposed in our study.

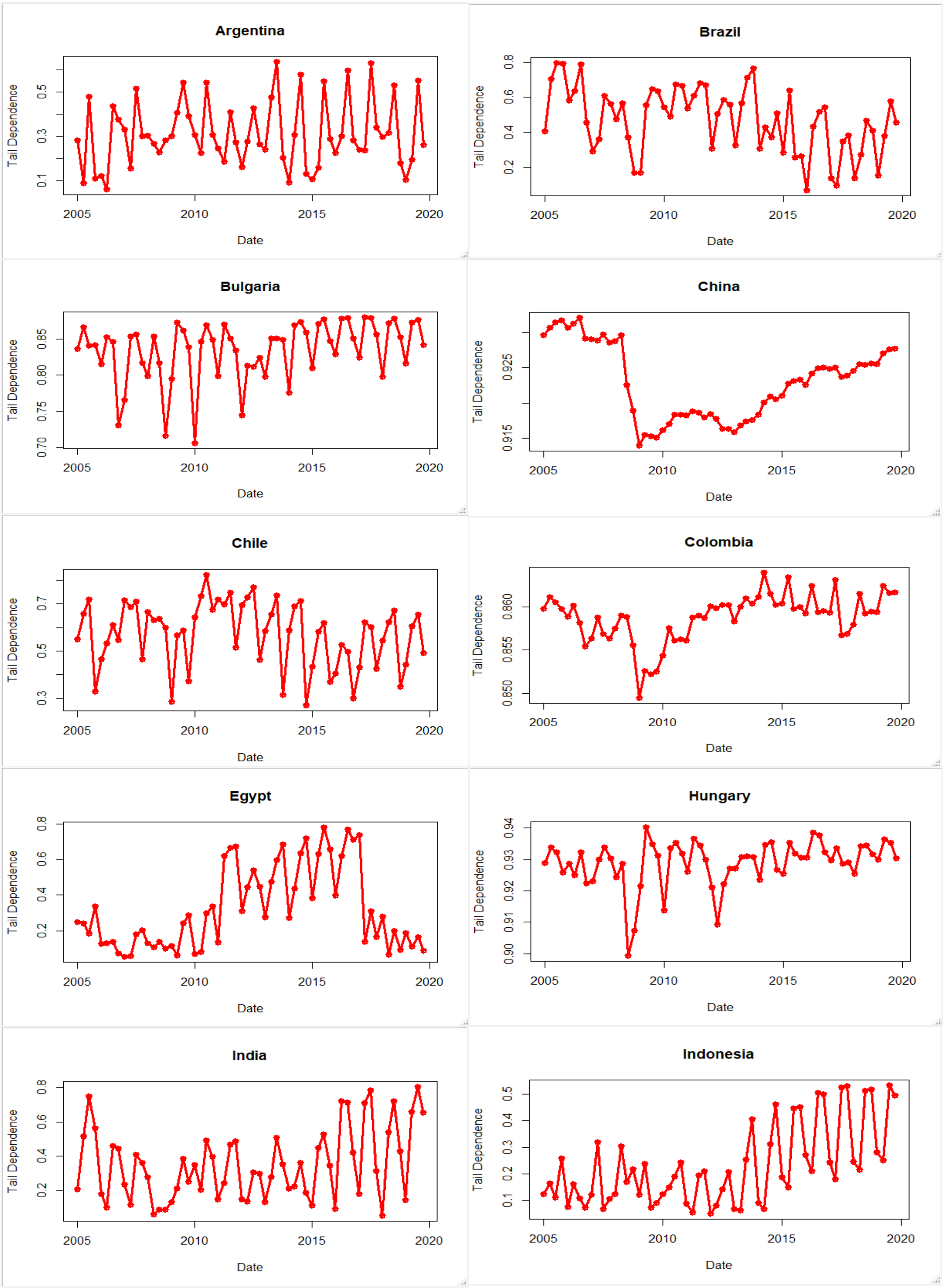

Figure 2: Time-varying lower-tail dependence (Contagion risk) between the US and each emerging country.

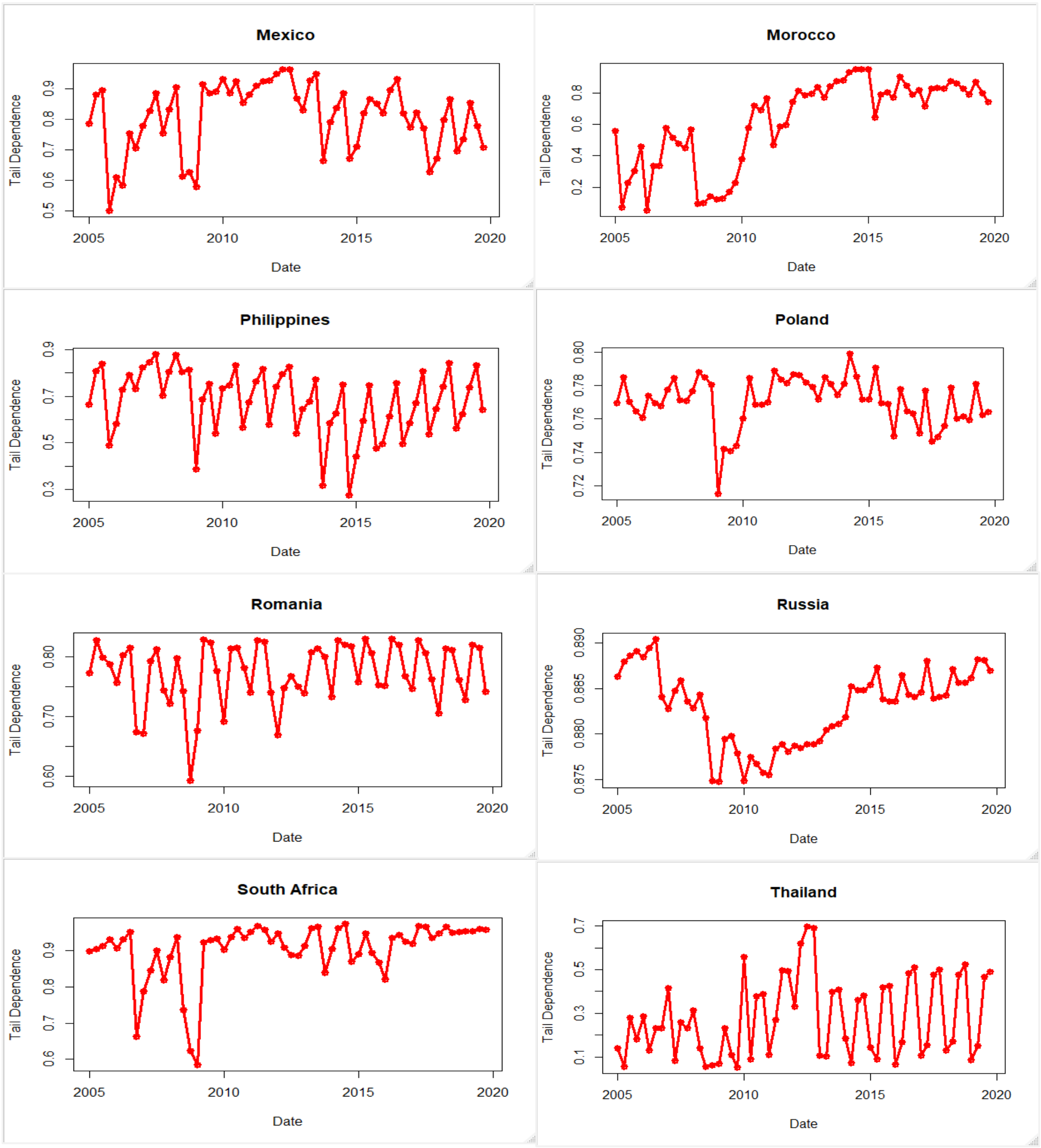

Figure 2: Time-varying lower-tail dependence (Contagion risk) between the US and each emerging country. (Cont.)

5.4 Vector Autoregressive-based Granger Causality Test Results

The contagion effect between the US and various emerging countries is captured by the time-varying copulas' tail dependence and presented in the previous section. We then proceed to examine the causality between the US contagion effect and FDI flows to emerging countries. Granger causality tests are applied based on the vector autoregression (VAR) model presented in Section 3.4. Table 8 reports the p-values for Granger causality between the lower-tail dependence as a contagion effect and FDI inflows at various lags in the 18 countries.

Table 8. Granger causality test for lags 1-3 (t-statistic test)

Country	FDI→Contagion			Contagion→FDI		
	p=1	*p* =2	*p* =3	*p* =1	*p* =2	*p* =3
Argentina	0.3107	0.2699	1.4719	0.1606	0.1439	0.9681
Brazil	1.3769	0.9123	0.4983	0.3508	0.8135	0.5025
Bulgaria	4.1139**	4.6332 **	3.2283**	0.1977	1.4251	1.0065
Chile	1.7411	6.9746 ***	5.2557***	3.9477*	0.1993	0.4257
China	0.6281	0.8796	0.6449	5.3808**	3.9931**	3.7520**
Colombia	7.4796***	3.9657**	2.4044*	0.5538	0.3769	0.4483
Egypt	5.6925**	2.9058*	2.344*	3.4067*	0.6571	2.2800*
Hungary	1.4604	0.8182	0.4474	4.3403 **	1.1707	1.2185
India	0.1641	0.6084	0.4270	1.2172	0.2632	0.4151
Indonesia	1.1480	0.8111	0.5182	0.3891	0.4861	0.4943
Mexico	0.2916	0.8634	0.6253	0.8557	0.4133	0.3532
Morocco	1.2401	0.0531	0.0564	0.7824	1.0372	0.8307
Philippines	3.0568*	2.3505	1.7870	0.0474	1.2331	0.8382
Poland	0.5130	0.1509	0.1144	1.7416	1.1332	0.8912
Romania	1.3345	4.5310**	2.1743	6.3311**	1.4152	1.2072
Russia	5.1171**	2.2771	2.9827**	0.6898	0.2809	0.3713
South Africa	1.0185	0.8565	1.6776	0.4223	0.3079	0.1816
Thailand	0.1609	0.4955	0.3654	0.7647	1.9196	2.0380

Note: ***, **, and * indicate the rejection of the null hypothesis at 1%, 5%, and 10% significance level, respectively.

According to the t-statistic test results in Table 8, the dynamic bi-directional causality exists between the contagion and FDI inflows since the null of non-causality is rejected in the cases of Chile, Egypt, and Romania. It can also be observed that unidirectional causality occurs between contagion and FDI inflows for China, the Philippines, Colombia, Russia, Hungary, and Bulgaria. The results provide evidence of unidirectional causality running from the contagion to the FDIs of China and Hungary. On the other hand, there is unidirectional causality from FDIs of the Philippines, Colombia, Russia, and Bulgaria to the degree of contagion. However, there is no causality between contagion and FDI inflows in other emerging countries.

Our granger causality results indicate a linkage between the contagion risk and FDI inflows in some emerging countries, which means that policymakers can rely on the lagged values of the contagion risk inflows as an indicator to forecast the FDI inflows to some emerging countries (e.g., China). These results confirm the transmission of shocks from the US crisis to some emerging countries. On the other hand, we also observe an interesting result that FDI inflows can be used as the indicator to forecast the contagion between the US and the Philippines, Colombia, Russia, and Bulgaria. Therefore, these countries' policymakers can predict the contagion effect by considering the FDI inflows in their countries to prevent the spread of the crisis in the future.

Interestingly, we find weak evidence of the impact of contagion on FDI inflows across countries. We note that the granger causality considers the lagged effect of the contagion. Thus, there would be very little contagion impact on FDI inflows in emerging countries. With quarterly data used in this study, including the time lag that represents a considerable amount of time, the effect of contagion on FDI inflows could proceed together within a quarter. Hence, there might exist a contemporaneous impact of contagion on FDI inflows.

5.5 The Impact of the US Contagion on the FDI Inflows in Emerging Economies

The previous section examines the causality relationship between the contagion and FDI inflows using the statistical method without controlling for other determinants of FDI inflows. Also, it neglects the contemporaneous effect of contagion on FDI inflows. Thus, we finally complement the analysis by investigating the contemporaneous impact of contagion and economic determinants on FDI inflows within the regression framework.

The regression results for all countries are reported in Table 9. Considering our degree of contagion variable, we find a significant effect of contagion risk on FDI inflows in 8 of the 18 emerging countries: Bulgaria, China, Colombia, Indonesia, Morocco, Philippines, South Africa, and Thailand. As expected, the sign of this variable is mainly negative in the case of Bulgaria, Colombia, Indonesia, and South Africa, indicating that the US contagion risk has made substantial negative contributions to the FDI inflows of these countries. This result is consistent with Urata's (1999) explanation and Ucal et al. (2010). Urata (1999) mentioned that the financial crisis had a discouraging impact on FDI inflow as the macroeconomic performance became more uncertain. Ucal et al. (2010) revealed that the financial crisis affects the future foreign investment plan of the US firm and thereby decelerating the FDI outflows to other countries.

However, in the case of China and Morocco, the Philippines, and Thailand, the US contagion shows a significant positive influence on the FDI inflows. This result is consistent with the theory and approach of Thu (1988), Krungman (2000), and the findings of Hasli et al. (2017). Krugman (2000) stated that fire-sale transactions (extremely discounted prices) might occur during a crisis. Although there was simultaneously a flight of short-term capital outflows and sell-offs of foreign portfolios during the crisis, there was an inward flow of foreign direct investment due to the local government's reform of the foreign investment policy. He also mentioned that the reform of policy led to the abolishment of old policies, which deterred FDI, and the desperation for cash by local firms encouraged FDI. Thus, Multinational firms could respond to the attractive and liberalized FDI policies by acquiring companies and assets at fire-sale prices in emerging economies during crises. Moreover, Thu (1988) explained that the crisis or contagion risk might provide the economic prospect to the emerging countries as it may force the government to reform the economic policy to attract more FDI to prevent the crisis.

Table 9. Estimation results of the contagion effect on FDI inflows in emerging countries

Country	*Intercept*	Δ ln *Con*	Δ ln *GDPG*	Δ ln *Open*	Δ ln *REER*	Δ ln *CPI*
Argentina	0.0025 (0.0016)	-0.0014 (0.0013)	0.1152*** (0.0332)	0.1583*** (0.0126)	-0.1088** (0.0467)	0.0001 (0.0001)
Brazil	0.0011** (0.0004)	0.0003 (0.0005)	0.1679* (0.0998)	0.0643* (0.0341)	-0.0129** (0.0048)	-0.0005** (0.0002)
Bulgaria	-0.0018** (0.0007)	-0.0043* (0.0022)	0.0123*** (0.0031)	0.6255*** (0.1291)	-0.0157*** (0.0006)	-0.3153*** (0.1243)
Chile	-0.0003*** (0.0001)	-0.0002 (0.0007)	0.0463** (0.0261)	0.2600*** (0.0085)	0.0407 (0.0666)	-0.0254 (0.0008)
China	-0.0003 (0.0004)	0.0393*** (0.0141)	0.0644*** (0.0213)	0.0002*** (0.0001)	-0.0456*** (0.0134)	-6.2671*** (0.9269)
Colombia	-0.0013*** (0.0002)	-0.0071*** (0.0024)	0.0465*** (0.0113)	0.3095*** (0.0999)	0.0243** (0.0111)	-0.1041 (0.2383)
Egypt	0.1846 *** (0.0234)	-0.0067 (0.0098)	-0.3558 (1.245)	-0.1026 (0.1317)	0.7459 (1.7734)	-0.2235 (0.3492)
Hungary	-0.0105*** (0.0015)	0.0105 (0.0204)	0.6251*** (0.2327)	1.3551*** (0.3434)	0.4829*** (0.2142)	-0.1918 (1.0863)
India	0.0024 *** (0.0011)	-0.0013 (0.0021)	0.3304* (0.1534)	-0.1865 (0.2344)	-0.1191* (0.0674)	-1.6995 *** (0.5870)
Indonesia	0.0012 (0.0009)	-0.0013* (0.0006)	0.1166*** (0.0190)	0.6106*** (0.1346)	-0.0073 (0.0242)	-0.0472 (0.0733)
Mexico	-.00011* (0.0005)	-0.0001 (0.0004)	0.2441* (0.1298)	0.2014 *** (0.0543)	-0.0153 (0.3156)	-0.0015 (0.0009)
Morocco	0.0023*** (0.0011)	0.0023* (0.012)	-0.0301 (0.2225)	0.3003** (0.1271)	-0.0324 (0.0505)	0.0432 (0.2364)
Philippines	0.0010 ** (0.0005)	0.0004* (0.0002)	-0.0053 (0.0711)	0.2336 *** (0.0123)	0.2565*** (0.0805)	-0.0585*** (0.0132)
Poland	0.0002** (0.0001)	-0.0205 (0.0289)	0.1173*** (0.0249)	0.5077 (0.6904)	0.0106 (0.0352)	-0.8980*** (0.2335)
Romania	0.0002 * (0.0001)	-0.0006 (0.0012)	0.2400* (0.1315)	-0.0354*** (0.0086)	0.0036*** (0.0011)	-0.3096*** (0.1373)
Russia	0.0015 (0.0021)	-0.0216 (0.0608)	0.1831*** (0.0521)	-1.1731*** (0.3598)	-0.0592 (0.0578)	-0.3174 (0.4249)
South Africa	-0.0051** (0.0028)	-0.0043** (0.0022)	0.2015 (0.6133)	0.2203*** (0.1034)	0.1199 (0.1076)	1.3934 (1.0761)
Thailand	-0.0005*** (0.0002)	0.0025*** (0.0001)	-0.5326 (0.6711)	-0.8639** (0.4135)	-0.7087*** (0.3112)	-1.0763* (0.5551)

Note: ***, **, and * indicate the rejection of the null hypothesis at 1%, 5%, and 10% significance level, respectively. The parentheses () present the standard error.

Before closing the regression results discussion, it is worth highlighting the findings regarding the control variables included in the regressions. The estimated coefficients differ across countries. The GDP coefficient shows a positive significance in explaining the FDI inflows in all countries (except for Egypt, Morocco, Philippines, South Africa, and Thailand). The insignificance of the estimated coefficient of the GDP growth variable of these countries agrees with the findings of Asiedu (2002). A possible reason is that the impact on growth depending on the host country's income (Choe, 2003) and the productivity-enhancing benefits of FDI holds only when a sufficient absorptive capability for advanced technologies is available to the host country (Borensztein et al., 1998). Therefore, FDI inflows to these countries (which has low technologies) are not an important driver to transfer technologies and support economic growth. Ndikumana and Sarr (2019) confirmed that the overall gains from FDI inflows in employment and welfare were limited in low technology country, in particular Africa region.

We find supporting evidence that the higher trade openness has a positive effect on FDI inflows in Argentina, Brazil, Bulgaria, Chile, China, Colombia, Hungary, Indonesia, Mexico, Morocco, Philippines, and South Africa, suggesting that the higher openness can attract more FDI in these countries. These arguments are supported by the research of Omri (2014), Hasli et al. (2017), and Jaiblai and Shenai (2019). However, the trade openness coefficient turns out to be negative and significant in Romania, Russia, and Thailand. These results indicate that, although openness is a source of FDI attractiveness in some emerging countries, the marginal benefit from improved openness is somewhat negative for some countries. Liargovas and Skandalis (2012) mentioned that the impact of trade openness and FDI inflows are very complex, depending on each country's characteristics. Thus, the interpretation needs careful explanation. Raff (2004) explained that a trade openness policy might not attract FDI as the external equilibrium tariffs are too low to induce FDI. Also, there are multiple equilibria, and countries are stuck in one that does not support FDI. For the real effective exchange rate (REER), we find a negative coefficient for this variable for Argentina, Brazil, Bulgaria, China, India, and Thailand; and positive coefficients for Colombia, Hungary, Philippines, and Romania, while the coefficients are insignificant in other countries. This implies that an appreciation (depreciation) of the host country's currency led to a decrease (increase) in FDI inflows since it increases (decreases) the cost of capital investment. However, the effect of the exchange rate on FDI is still uncertain as the positive impact of the exchange rate is observed in some countries. Lily et al. (2014) suggested that if the purpose of FDI is to serve the domestic market, then the FDI and trade are substitutes; thus, the host currency's appreciation could induce more FDI inflows due to the higher purchasing power of the host country consumers. Finally, regarding the inflation rate measured by the growth rate of CPI, an increase in this variable brings about a significant FDI decrease in Brazil, Bulgaria, China, India, Philippines, Poland, Romania, and Thailand.

6. Conclusions

The FDI plays an essential role in the global economy, particularly for emerging economies. Consequently, investigating its determinants is vital to attract more FDI inflows. One of the most exciting and effective determinants is crisis contagion. Therefore, this paper aims to capture the significant impact of contagion risk of the US on FDI inflows in 18 emerging countries. Despite the extensive existing literature about the aspects of contagion risk and FDI, the size of the contagion has not been investigated thoroughly and precisely. Specifically, the previous studies usually employed a dummy variable to capture the contagion (economic crisis) and takes 1 for the contagion effect period and 0 otherwise. However, our study aims to fill this gap by examining the impact of the US contagion risk on emerging countries using the time-varying tail-dependence copula approach, which allows us to quantify the size of contagion effects during the economic crisis periods correctly. Then, the obtained degree of the US contagion effects is further used as the factor affecting the FDI inflows to emerging countries. This paper covers 15 years (2005-2019) and includes the global financial crisis in 2008-09, as well as other phases of the crisis. Our results can provide meaningful implications for policymakers and authorities of emerging countries to reinforce their economies and reduce their vulnerability to external shocks.

To measure the tail dependence as a degree of a contagion effect, we utilize the four time-varying copulas: Student-t copula, Clayton copula, rotated survival Gumbel copula and rotated survival Joe copula. The AIC is then used as the copula comparison criteria. Of our four copula functions, the time-varying Student-t copula provides the best overall fit above all our other copula functions in many cases. It implies a strong upper tail and lower tail dependences between the US and emerging countries. More specifically, the US economy is more likely to symmetric correlate with Argentina, Bulgaria, China, Mexico, Chile, Egypt, Hungary, India, Russia, and Thailand. Simultaneously, there is only the lower tail dependence for other countries (Clayton, Survival Gumbel, and Survival Joe are selected). Therefore, we suggest that the dependency between the US and emerging countries is more symmetric than asymmetric, indicating a strong integration between the US and emerging economies in both boom and recession periods. The time-varying copula results show marginal fluctuations of tail dependence over a wide range of the study period, confirming the presence of dynamic contagion effects between the US and emerging countries. We acquire some interesting results about the degree of a contagion effect in both pre-and post-US crises. It is evident that the contagion size gradually increases for all countries except Thailand, the Philippines, Argentina, Brazil, and Chile. This indicates that the contagion risk of the US increased after the crisis period. As revealed by Patipaskul et al. (2015) and Çepni et al. (2020), they found that the US and emerging economies have become more integrated after the implementation of the QE policy and the low saving interest rate in the US. Therefore, there were substantial capital flows from the US to many emerging countries.

Besides, we further investigate the impact of the US contagion risk on the FDI inflows to emerging countries using the Granger causality test and linear regression model. We conclude that there is a heterogeneity of causal relationships between the US contagion and FDI inflows to emerging countries. Both unidirectional and bi-directional relationships between contagion risk and FDI inflows are found in the Granger causality tests. However, the results only indicate a two-way relationship between FDI and contagion in three countries: Chile, Egypt, and Romania. Furthermore, contagion Granger-cause FDI in two countries, whereas FDI Granger-cause contagion was found in 4 countries. A possible reason for this heterogeneity results is the variations within countries or short-run interactions between the contagion-FDI nexus. In addition, our estimation provided a weak, lagged contagion effect. Thus, there might exist the contemporaneous impact of contagion on FDI inflows. Furthermore, the fact about FDI Granger-cause contagion in four countries (the Philippines, Colombia, Russia, and Bulgaria) is meant as a policy implication for these countries to predict the contagion effect by considering their FDI inflows.

To disentangle the contemporaneous effect, we use linear regression analysis. The results show a significant effect of contagion risk on FDI inflows in 8 of the 18 emerging countries, including Bulgaria, China, Colombia, Indonesia, Morocco, Philippines, South Africa, and Thailand. This suggests a contemporaneous effect of contagion risk on FDI inflows to some emerging countries; thus, the policymaker and government should be aware of the contagion risk right after it appears. On the other hand, we also observe an insignificant impact of contagion risk on FDI inflows in the other ten countries. The findings provide implications for these countries' policymakers in such a way that their countries have been immune to the crisis and are not hit hardest by the crisis or severe global turmoil. This suggests that policymakers of these countries need to remain using the current foreign investment policy and enhance their immunization, which could lead to the realization of sustainable FDI development.

Lastly, we identify implications for both policymakers and authorities in emerging countries. Our results could help them determine whether countries achieve sustainable development in their foreign direct investment and whether the US contagion risk contributes more problems to the stability of the FDI. Furthermore, according to the control variables' results, the economic growth or market size and trade openness significantly impact the FDI attractiveness of a host country; that is why a host country with a higher growth rate of GDP and lower trade restrictions will attract more FDI. However, despite all the empirical developments in this study, some limitations remain. Indeed, in analyzing the impact of contagion risk on FDI inflows in emerging countries, we did not consider the social components, infrastructures, and technologies. Thus, these variables are also suggested for consideration to determine the factors affecting the FDI inflows extensively. Moreover, further study may consider using the Markov Switching time-varying copula (Rodriguez, 2007) to measure the tail dependence as this model allows us to investigate the structural change in the contagion risk.

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Appendices

Table 1A. Descriptive statistics for the FDI

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Argentina	1.89	4.26	-1.03	1.00	-0.16	3.51
Brazil	3.14	5.76	0.27	1.25	0.06	2.45
Bulgaria	5.63	31.02	-2.48	7.20	2.09	6.96
Chili	6.42	19.79	-2.38	4.61	0.38	3.16
China	2.78	6.94	0.72	1.28	0.64	3.28
Columbia	4.09	16.83	1.17	1.93	4.20	28.99
Egypt	3.11	12.54	-1.22	2.67	1.52	5.72
Hungary	18.53	109.39	-40.18	65.13	3.20	21.67
India	1.94	4.27	0.41	0.84	0.88	3.56
Indonesia	1.93	5.33	-3.87	1.04	-1.99	16.38
Mexico	2.76	7.02	0.77	1.45	0.86	3.26
Morocco	1.01	4.76	-0.32	1.27	1.03	3.24
Philippines	1.83	5.15	-0.33	1.09	0.47	3.28
Poland	3.47	11.33	-1.83	2.55	0.66	3.89
Romania	3.55	13.05	-1.38	2.61	1.19	4.77
Russia	2.28	7.46	-3.41	1.93	0.08	3.85
South Africa	1.82	35.71	-1.92	4.39	6.80	52.81
Thailand	2.38	6.47	-7.99	2.40	-1.69	8.04

Table 1B. Descriptive statistics for the CPI

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Argentina	295.98	1316.69	65.00	347.43	1.91	5.67
Brazil	125.46	187.12	79.54	35.01	0.26	1.70
Bulgaria	102.15	120.17	72.73	13.10	-0.96	3.09
Chili	111.45	142.08	83.73	17.74	0.11	1.89
China	109.11	129.37	86.51	13.75	-0.17	1.85
Columbia	112.95	149.56	79.67	22.03	0.19	1.83
Egypt	158.80	319.94	57.76	89.36	0.63	1.96
Hungary	105.99	132.11	76.92	15.69	-0.37	2.29
India	126.58	192.38	66.04	41.59	-0.04	1.67
Indonesia	117.16	156.48	68.68	28.49	-0.13	1.73
Mexico	113.44	154.68	80.50	22.83	0.24	1.94
Morocco	103.28	113.42	89.71	7.03	-0.33	2.11
Philippines	109.01	137.94	78.67	17.83	-0.14	2.00
Poland	104.68	123.93	86.88	10.52	-0.22	2.27
Romania	106.30	133.46	74.09	17.23	-0.44	2.20
Russia	128.05	199.37	61.45	44.95	0.06	1.66
South Africa	119.91	171.60	74.26	31.64	0.12	1.75
Thailand	104.68	113.69	86.57	8.87	-0.74	2.15

Table 1C. Descriptive statistics for the Real Effective Exchange Rate

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Argentina	107.34	165.72	78.17	22.84	0.50	2.16
Brazil	94.76	104.66	75.98	8.23	-0.93	2.42
Bulgaria	95.85	104.66	77.53	7.46	-1.06	2.76
Chili	94.92	111.36	77.50	6.28	-0.01	3.08
China	105.78	129.33	82.49	14.62	-0.03	1.57
Columbia	85.32	106.16	62.41	11.44	0.09	1.80
Egypt	88.61	123.55	61.72	17.02	0.12	1.85
Hungary	94.34	110.45	86.80	5.94	0.68	2.57
India	95.17	110.69	80.50	9.70	-0.02	1.57
Indonesia	90.25	101.86	75.27	6.32	-0.24	2.48
Mexico	98.17	120.16	74.36	11.57	-0.32	2.11
Morocco	100.30	108.91	94.66	3.85	0.38	1.94
Philippines	97.80	116.30	73.60	12.00	-0.61	2.22
Poland	95.35	117.85	82.34	6.65	1.05	4.91
Romania	97.66	115.47	79.64	7.79	-0.61	3.58
Russia	88.19	109.57	64.79	12.73	-0.16	1.87
South Africa	88.04	113.83	63.70	13.02	0.18	1.89
Thailand	97.97	115.38	82.76	8.19	-0.44	2.35

Table 1D. Descriptive statistics for the Trade Openness

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Argentina	32.66	40.95	22.49	5.65	0.05	2.09
Brazil	26.81	39.18	22.11	4.09	1.78	6.08
Bulgaria	119.03	130.29	92.69	11.58	-1.02	2.79
Chili	65.96	80.68	56.03	7.62	0.27	2.01
China	46.62	64.48	34.59	10.06	0.52	1.95
Columbia	37.35	40.58	33.90	1.93	-0.23	2.14
Egypt	46.81	71.68	30.25	12.62	0.52	2.13
Hungary	158.62	168.34	127.78	10.23	-1.78	5.90
India	46.14	55.79	37.81	5.77	0.43	1.93
Indonesia	46.80	63.99	32.98	8.36	0.35	2.41
Mexico	67.15	82.36	53.94	9.72	0.18	1.55
Morocco	79.75	87.98	67.91	6.25	-0.65	2.40
Philippines	65.69	83.85	55.82	8.21	0.85	2.80
Poland	92.02	117.62	70.53	13.31	0.19	2.03
Romania	76.29	87.36	58.47	10.54	-0.62	1.76
Russia	49.78	56.71	45.96	3.17	0.68	2.48
South Africa	54.99	65.97	47.43	4.28	0.61	3.97
Thailand	125.93	140.44	97.82	11.45	-0.77	3.22

Note: Trade openness measured by the ratio of imports + exports to GDP between the US and emerging country.

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