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Impacts of Free Trade Policies on Dependency of Trades with Copula Approach

Chiu-Lan Chang[a], Bin Hong[b*], Ming Fang[c]

Abstract

The trades between China and Taiwan across the Taiwan Strait has been growing continuously. The Chinese government implements a series of free trade policies which have impacts on the cross-strait's trade integration and economic growth. Fujian Province as one of the communication windows with Taiwan has implemented a series of free trade polices accomplishes with the policies of Chinese central government. This study emphasizes on the investigation of the impacts of free trade policy on dependency of trades across the Taiwan Strait. With the application of copula approach, this study analyzes the situation of imports and exports between Fujian and Taiwan under the free trade policies. The results reveal that under the free trade policies, the dependency of trades has been affected. After the establishment of China (Fujian) Pilot Free Trade Zone, the trade dependency of Fujian and Taiwan using static copula is extremely highly dependent. The dynamic copula is also used to capture the dynamic dependency of trades. The results suggest that the establishment of free trade zone strengthens the trade cooperation between Fujian and Taiwan. The results may provide helpful insights for the policy makers and international investors.

Keywords: copula, free trade policy, dependency of trades, free trade zone, trade cooperation

1. Introduction

Implementing free trade policies has been an important trend in international trades. Scholars have carried out research and discussion on the influence of free trade policies and related economic relationship among countries such as dependency of trades. The declined trade barriers and lessening policies have significantly influenced both economies, especially the free trade policies will directly affect the international trades of these two parties.

In recent years, with the dramatic economic development of China's international trades market, China has started implementing a series of free trade policies to create a decent trade environment for the international investors.

[a]Professor, Department of Finance, Fuzhou University of International Studies and Trade, China
[b]Assistant Professor, Overseas Education College, Xiamen University, China
[c]Associate Professor, Department of Finance, Fuzhou University of International Studies and Trade, China
**Corresponding Author: Bin Hong*
Email: bhong@xmu.edu.cn

Fewer trade barriers on the markets not only enhance the economic activities due to no impediments such as legal restrictions, transaction costs, taxes and tariffs against the trades on international goods, but also provide the opportunity for a better economic development of both parties. Consequently, the relationship of the cross-strait has been also changed due to the sequential China's trade policy opens to Taiwan. This paper intends to examine the dependence of trades between the cross-strait markets due to the China's free trade policy changes. In June 29, 2010, China and Taiwan signed The Cross-Straits Economic Cooperation Framework Agreement (ECFA) which is viewed as one of the most important free trade agreements of both economies.

With the continuous deepening of trade across the Taiwan Strait, Fujian Province as a pilot window of communication near Taiwan, has a great congenital advantage between these two areas. The special relationship between the two areas, which are relatively close and have the same cultural origin, has greatly promoted the economic cooperation and

cultural exchange between Fujian and Taiwan. Fujian Province is one of the earliest provinces with the most intensive investments from Taiwan, and Taiwan is one of the major trade partners of Fujian Province. This study mainly analyzes the current situation of imports and exports between Fujian and Taiwan. China establishes the China (Fujian) Free Trade Pilot Zone (FFTZ) in December 2014. One of the main purposes of FFTZ establishment aims to promote the economic cooperation through the international trades between Fujian and Taiwan. Therefore, this study divides the sample into three periods which are Pre-ECFA, Post-ECFA &Pre-FFTZ and Post-FFTZ to distinguish the impacts of China's free trade policies.

This study applies the copula method instead of traditional linear methodology to capture the dependency. Previously, many studies use Pearson's correlations coefficients as a measure of the strength of dependence between two markets. However, the Pearson's correlation might only provide partial information on the actual dependence since it limits the structure of the relationship in a linear form （Embrechts et al., 2003). Holding correlation fixed is not generally sufficient to capture the whole picture of the dependency. Therefore, using copula allows greater flexibility in modeling the dependency.

The rest of this study is comprised as follows. In Section 2 reviews the literature. In Section 3 describes the empirical methodology. In Section 4 describes the empirical results. Lastly, conclusions are presented.

2. Literature Review

2.1 Trade Dependency and Trade Policies

Many related researches focus on trade dependency and trade policies. The trade dependence of two economies has been influenced by the trade policies of both parties (Richardson and Kegley, 1980, Manger and Shadlen, 2014). Osakwe, et al. (2018) explore the relationship between trade, trade liberalization, and exports diversification in developing and Sub-Saharan African (SSA) countries. Choi (2020) discusses the financial development and international trades.

Li, et al. (2016) summarize a literature review of China's foreign trade policy. Lin (2018) examines the trade dependence within greater China and discusses the economy and trade between Mainland China, Taiwan and Hong Kong. Kahn-Nisser (2019) examines at the linkages between export to the European Union (EU), export to China from the policy perspective. Shovkun (2020) investigates the international trade dependence of Ukrainian economy from the prospects of free trade with China.

The growing trade dependence between China and Taiwan is of great significance. With the trend of international economic development, Fujian Province and Taiwan have in-depth contacts in economic, cultural and other fields. Economic and financial activities across the Taiwan Straits have become grown increasingly. The trade cooperation has become an irreplaceable and necessary component of economic and trade exchanges between Fujian and Taiwan.

From the literature review, this study uses the data of exports, imports and international trades of Fujian and Taiwan to verify the relationship between imports and exports and economic growth of Fujian and Taiwan.

2.2 Dependency and Copula

Copula has been used to measure conditional dependency between time series
each driven by complicated marginal distributions. Recent applications of copulas and discussions on the use of copulas can be found in Embrechts et al. (2003) and Cherubini, et al. (2004). Hoesli and Reka (2011) analyze the dependency between securitized real estate and common stock markets of the matured countries. Chang and Hsueh (2013) examine the dynamics of dependence between real estate and stock markets of emerging countries in Asia. Wang, et al. (2015) investigate dependency of real estate and stock market in China with dynamic copula. Fang, et al. (2017) discusses the financial dependency of equity markets of China and Taiwan under the ECFA framework.

Though, there are many researches using copula to examine the dependency of two economies or the dependency of two different financial markets. However, there is still few related researches to discuss the trade dependency with the application of copula.

Therefore, this study attempts to use copula approach to discuss the trade dependency which may make up for the deficiencies in the literature.

3. Methodology

Copula analysis is a technique for understanding the dependency of variables. Our empirical model is constructed based on the results of Sklar's theorem (Sklar, 1959), where the joint CDF of two random variables can be expressed as a function of its own marginal distributions, and the function binding the two marginals together is called

the copula. Let *X* and *Y* be two random variables with CDF (cumulative distribution function) F_X and F_Y, and *F* be their joint CDF. The Sklar's theorem suggests $F(x,\ y;\theta)=C\left(F_X(x;\theta_x),F_Y(y;\theta_y);\theta_c\right)$, where $C(\cdot)$ is the copula function, θ_x and θ_y denote the vectors of parameters in the marginal CDFs of *X* and *Y*, θ_c denotes the vector of copula parameters. Let $\theta=(\theta_x^{\mathrm{T}},\theta_y^{\mathrm{T}},\theta_c^{\mathrm{T}})^{\mathrm{T}}$ denote the parameters in the joint CDF. The copula function is unique if $F_X(x)$ and $F_Y(y)$ are all continuous. Since the CDF is always bounded between [0,1], the copula function can be viewed as a bivariate distribution of uniform random variables with the dependence parameter θ_c. More details of the copula may be referred to the work of Joe (1997), Nelsen (2006), and Cherubini et al. (2004). Patton (2006) finds that the conditional joint density can be written as

$F(x_t,y_t\mid\phi_t;\theta)=C\left(F_X(x_t\mid\phi_t;\theta_x),F_Y(y_t\mid\phi_t;\theta_y);\theta_c\right)$.By taking the derivative with respect to *X* and *Y*, we can obtain the conditional joint PDF of X and Y $f(x_t,y_t\mid\phi_t;\theta)=c\left(F_X(x_t\mid\phi_t;\theta_x),F_Y(y_t\mid\phi_t;\theta_x);\theta_c\right)\cdot f_X(x_t\mid\phi_t;\theta_x)\cdot f_Y(y_t\mid\phi_t;\theta_y)$, where $f(\cdot)$ denotes the joint PDF and $c(u_t,v_t\mid\phi_t;\theta_c)=\partial C(\cdot)/\partial u_t\partial v_t$ is the copula density function. Given the sample (y_t, x_t), t = 1,…,t, the log-likelihood function may be constructed and the ML estimator can be defined as $\hat{\theta}=\arg\max\sum_{t=1}^{T}\ln f(x_t,y_t\mid\phi_t;\theta)$. This study applies Gaussian copula to model dependence. The Gaussian copula in the form of $C(u,v)=\int_{-\infty}^{\Phi^{-1}(u)}dx\int_{-\infty}^{\Phi^{-1}(v)}dy\,\frac{1}{2\pi\sqrt{1-\delta^2}}\exp\left\{-\frac{x^2-2\delta xy+y^2}{2\left(1-\delta^2\right)}\right\}$ allows for equal degrees of positive and negative tail dependence and the δ is the copula parameter as the correlation coefficient ($-1<\delta<1$). It has the property of asymptotic independence, that is extreme events occur independently in each margin, no matter how high is δ.

4. Empirical Analysis

The monthly exports, imports and total international trades of Fujian and Taiwan are selected. The samples are from January 1995 to December 2019. The data sources are from Fujian Provincial Bureau of Statistics and Bureau of Statistics of Taiwan.

The data are divided in three sample period to verify the impacts of free trade policy. The three periods are Period I: Pre-ECFA （1995.1~2010.6), Period II: Post-ECFA & Pre-FFTZ (2010.7~2014.12) and Period III: Post-FFTZ (2015.1~2019.12) to distinguish the impacts of China's free trade policies. Table 1 summarizes the international trades of Fujian and Taiwan. Obviously, the international trades of both areas have been gradually increasing under the free trade policies.

The Gaussian copula can capture the trade dependence between Fujian and Taiwan very well both under the constant and time-varying conditions. Table 2 summarizes the empirical results of Gaussian copula. Under the static Gaussian copula in Panel A of Table 2, the trade dependency of Fujian and Taiwan is extremely highly dependent in Period I and Period III. The static trade dependency of international trades of Fujian and Taiwan in these three periods are 0.973, 0.531 and 1.000, respectively. The static trade dependency of exports of Fujian and imports of Taiwan in these three periods are 0.972, 0.633 and 1.000, respectively. The static trade dependency of imports of Fujian and exports of Taiwan in these three periods are 0.969, 0.334 and 1.000, respectively. Several interesting results are found. First, before the implementation of ECFA of China and Taiwan, the trade dependency of Fujian and Taiwan are highly dependent. Second, during the first couple years after the implementation of ECFA since July, 2010, the trade dependency is not as high as pervious period. However, it can be found that in Period III, after the establishment of FFTZ, the trade dependency of Fujian and Taiwan is close to one indicates the trade dependency of both areas are extremely high. The results suggest that the establishment of FFTZ is a successful trade policy to increase the trade dependency of Fujian and Taiwan which will enhance the trade cooperation of these two areas.

In Panel B of Table 2 reports the mean of dynamic dependency under the dynamic Gaussian copula with a time-varying of 12 periods. The results suggest that the trade dependency is dynamic changing. Compared with the static Gaussian copula, the mean of dynamic Gaussian copula show that trade

dependency is not constantly highly dependent. The mean of dynamic trade dependency of international trades of Fujian and Taiwan in these three periods are0.561, 0.545 and 0.492, respectively. The mean of dynamic dependency of exports of Fujian and imports of Taiwan in these three periods are 00.525, 0.617 and 0.477, respectively. The s mean of dynamic dependency of imports of Fujian and exports of Taiwan in these three periods are 0.573, 0.390 and 0.615, respectively. It can be found that in period I, before the implementation of ECFA, the trade dependency of imports of Fujian and exports of Taiwan takes the most important role of the cross-strait trades. In period II, after the implementation of ECFA and before the implementation of FFTZ, the trade dependency of exports of Fujian and imports of Taiwan takes the most important role of the cross-strait trades. Meanwhile, after the implementation of FFTZ, the trade dependency of imports of Fujian and exports of Taiwan takes the most important role of the cross-strait trades.

In summary, the implementation of free trade policies affects the trade dependency of Fujian and Taiwan. The trade dependency is time-varying. However, the establishment of FFTZ really takes a big progress of the international trade cooperation of Fujian and Taiwan.

5. Conclusions

This study applies the copula approach to examine the trade dependency. To examine the impacts of free trade policies of China, the samples are divided into three periods.

The empirical results show that the free trade policies have impacts on trade dependency. The implementation of ECFA from 2010 to 2015, though the total trades of both areas are increasing, however, the trade dependency of Fujian and Taiwan are not highly dependent. Meanwhile, after the implementation of FFTZ since 2015 increases the trade dependency of Fujian and Taiwan.

This study focuses on the impacts of free trade policies on trade dependency. The contribution of this study is the first study using the copula approach to analyze the trade dependency. The findings essentially provide useful points of views for the international trade policy makers and international investors. The major contribution of this study is to provide the ability to estimate the effects to free trade policies that are attributed to the international trade markets. This has important implications for international investors since the trade dependency should be noticed in international trades.

Table 1 Descriptive Statistics of Trades in US Million Dollars

Period I: Pre-ECFA （1995.1~2010.6)						
	Fujian			Taiwan		
	Trades	Exports	Imports	Trades	Exports	Imports
Mean	3462	2208	1254	3324	2179	1145
Maximum	2585	1517	1014	1751	1088	718
Minimum	9252	6229	3164	10923	7644	3279
Std. Dev.	598	360	238	218	12	188
Skewness	0.727	0.758	0.695	0.639	0.637	0.668
Kurtosis	2.249	2.236	2.408	2.004	2.011	2.050
Period II: Post-ECFA & Pre-FFTZ (2010.7~2014.12)						
	Fujian			Taiwan		
	Trades	Exports	Imports	Trades	Exports	Imports
Mean	13061	8324	4737	10623	6960	3663
Maximum	17208	11286	6143	12075	7814	4602
Minimum	6829	4040	2720	7468	5130	2338
Std. Dev.	2339	1634	839	984	564	496
Skewness	-0.580	-0.542	-0.559	-0.935	-1.137	-0.434

Kurtosis	2.708	3.072	2.699	3.966	4.641	3.117
Period III: Post-FFTZ (2015.1~2019.12)						
		Fujian			Taiwan	
	Trades	Exports	Imports	Trades	Exports	Imports
Mean	324362	191302	133060	241621	148184	93437
Maximum	18602429	10931697	7670732	13836587	8475474	5361113
Minimum	9095	5586	2950	6445	4172	2273
Std. Dev.	2399684	1410081	989603	1784851	1093270	691581
Skewness	7.551	7.551	7.551	7.551	7.551	7.551
Kurtosis	58.017	58.017	58.017	58.017	58.017	58.017

Table 2 Dependency of Trades- Gaussian Copula

Panel A: Static Gaussian Copula			
	Fujian Trades and Taiwan Trades	**Fujian Exports and Taiwan Imports**	**Fujian Imports and Taiwan Exports**
Period I (1995.1~2010.6)	0.973 (57.171)	0.972 (55.822)	0.969 (52.929)
Period II (2010.7~2014.12)	0.531 (4.520)	0.633 (5.889)	0.334 (2.568)
Period III (2015.1~2019.12)	1.000 (1.476.821)	1.000 (9455.461)	1.000 (10865.27)
Panel B: Mean of Dynamic Gaussian Copula			
	Fujian Trades and Taiwan Trades	**Fujian Exports and Taiwan Imports**	**Fujian Imports and Taiwan Exports**
Period I (1995.1~2010.6)	0.561	0.525	0.573
Period II (2010.7~2014.12)	0.545	0.617	0.390
Period III (2015.1~2019.12)	0.492	0.477	0.615

Note: Numbers in parentheses are t-statistics.

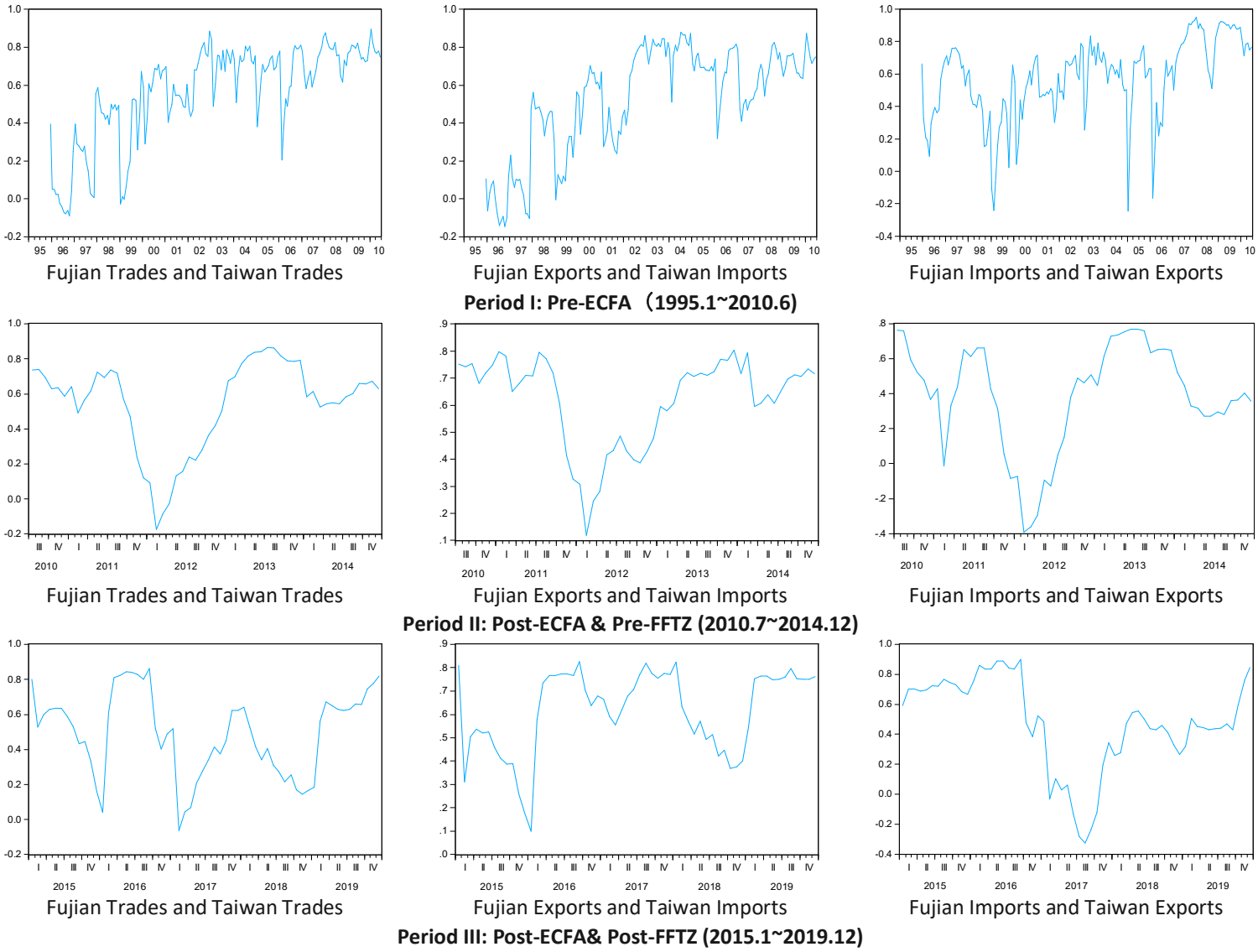

Figure 1 Dynamic Dependency of Trades- Gaussian Copula

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