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Correlations in Regional Property Markets Including Spillover Effect of Economic Policy Uncertainty

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ABSTRACT
In regional economic problems, understanding the property market is a momentous task due to its importance in the whole economic industrial chain. The property markets in different regions are interconnected, thus studying the correlations is imperative to the management and investment. It is intuitively known that the property market should be altered by the economic policy uncertainty (EPU), which has spillover among different regions. However, the effect from the spillover of EPU on the property markets has not been considered in previous literatures. Therefore, in this paper, we construct a framework that uses a generalized vector autoregressions model to produce a spillover index of EPU and then interpolates this index matrix to a dynamic conditional correction GARCH model. Using this model, empirical regression on the property indices and EPU indices evidences that the spillover of EPU has significant effect on the correlations of property markets. This analysis indicates that the regional property markets that have large spillover of EPU shows strong comovement, that is, high contagion effect. The findings imply the importance of putting enough vigilance to the spillover of EPU from external economies for the managers and investors of property markets.

Keywords: *Economic policy uncertainty, Spillover, Property market, Correlation effect.*

1. INTRODUCTION

With the progress of society and technology, the economic globalization is becoming more and more in-depth. The development of an economy is not only dependent on its own conditions, but also influenced by other regional economies. The economic development can both take advantage of the favourable factors of the surrounding environment and be affected by its adverse effects. Thus, in analysing the regional economics, the correlation between the markets in different regions has always been an imperative concern. In the economic system, the property market is undoubtedly one of the most important markets. As a substantial evidence, in 2008, the subprime mortgage crisis evolved into a global financial crisis. Therefore, investigating the correlations of global property markets is greatly significant.

The correlation effect has been widely studied in the stock markets [1-4], and recently has been confirmed in the property markets [5]. Previous literatures discussed the correlations of different regional property markets with the inclusion of spatial effects incorporating the geographic adjacency and economic similarity factors. Since the markets are affected by the economic policies, the change of economic policy would result in alterations to the markets. Therefore, the impact of economic policy uncertainty (EPU) on various markets such as stocks [6] and crude oil [7] has attracted a lot of interest.

The EPU is a complicated latent economic variable, thus a quantitative measurement is needed. Toward this end, Baker et al. [8] constructed a proxy index to measure the EPU. The generation process is mainly based on the statistics of the frequency about some relevant keywords such as economic, economy, uncertain, uncertainty, regulation, appeared in the newspapers. This EPU index is a proper indicator for the uncertainty related to economic policies and the occurrence of some big events. Besides, it is a time series, and thus can be conveniently used in empirical researches [6,7]. Recently, Balli et al. [9] found that the effect of EPU in a country can spill to other countries. This suggests that the spillover of EPU probably leads to a change on the correlations of property markets. This question has not been investigated and thus cannot be fully known. Therefore, in this work, we modified the multivariate GARCH model [10] with the dynamic conditional correction containing the spillover matrix of EPU which is obtained using a generated vector autoregression model [11]. It is found that the spillover of EPU has significant effect on the correlations of property markets.

2. METHODOLOGY

In the framework of multivariate GARCH model, the property return is written as

$$y_t = u + \sum_{i=1}^{p} a_i y_{t-i} + \sum_{j=1}^{q} b_i y_{t-i} + \varepsilon_t \quad (1)$$

where y_t is the return vector of N economies, u is a N dimensional vector of unknown parameter, a and b are the coefficient matrices, ε is the vector of residuals. The time-varying variance is defined as

$$\sigma_t^2 = \omega_0 + \omega_1 \varepsilon_{t-1}^2 + \lambda I_t \varepsilon_{t-1}^2 + \omega_2 \sigma_{t-1}^2 + \eta \Delta_t \quad (2)$$

where I_t is a sign vector with one for $\varepsilon_{t-1} < 0$ and zero otherwise. Δ_t is a dummy vector indicating the global financial crisis from February 4, 2007 to December 8, 2008 herein, and the parameter sets of ω_0, ω_1, ω_2, λ, η are unknown coefficients.

The conditional correlation matrix can be extended in the recursion form of

$$R_t = \alpha R + \beta R_t + \gamma \Psi_{t-1} + \delta W \Psi_{t-1} \quad (3)$$

Table 1. Estimation results of mean and variance equations.

	u	a	b	ω_0	ω_1	ω_2	λ	η	R^2	ML
USA	0.047*** (0.014)	-0.014 (0.013)	0.972*** (0.004)	0.010*** (0.004)	0.048*** (0.010)	0.886*** (0.013)	0.034*** (0.010)	0.066*** (0.013)	0.382	-4607
CAN	0.046*** (0.011)	0.079*** (0.015)	0.990*** (0.002)	0.005*** (0.000)	0.039*** (0.007)	0.919*** (0.009)	0.008*** (0.003)	0.060*** (0.0100	0.549	-3504
AUS	0.035** (0.014)	0.029* (0.015)	0.995*** (0.001)	0.007*** (0.001)	0.027*** (0.007)	0.924*** (0.009)	0.020*** (0.006)	0.053*** (0.011)	0.521	-4562
UKD	0.043*** (0.014)	0.029 (0.022)	0.993*** (0.001)	0.009*** (0.002)	0.072*** (0.011)	0.880*** (0.011)	0.025** (0.010)	0.060*** (0.016)	0.523	-4833
FRA	0.068*** (0.013)	0.002 (0.015)	0.993*** (0.001)	0.010*** (0.002)	0.041*** (0.008)	0.879*** (0.014)	0.025*** (0.007)	0.092*** (0.014)	0.507	-4283
GER	0.052*** (0.015)	0.039*** (0.015)	0.970*** (0.003)	0.006*** (0.001)	0.041*** (0.007)	0.915*** (0.007)	0.015*** (0.006)	0.060*** (0.009)	0.492	-5025
HKC	0.041** (0.018)	0.019 (0.014)	0.992*** (0.002)	0.004*** (0.000)	0.026*** (0.005)	0.946*** (0.005)	0.003 (0.002)	0040*** (0.007)	0.503	-5579
JAP	0.018 (0.014)	0.019 (0.015)	0.998*** (0.000)	0.003*** (0.000)	0054*** (0.007)	0.930*** (0.006)	0.008* (0.004)	0.027*** (0.009)	0.507	-5923

Note: The values in parentheses correspond to the standard errors. R^2 and ML are the goodness of fit and the value of maximum likelihood respectively. *, ** and *** denote significance at 10%, 5% and 1% level respectively.

where $R = cc' + D$ with $c = (c_1, \cdots, c_N)$ being a vector with N elements and D being a diagonal matrix with the diagonal elements of $1 - c_i^2$. Ψ is a matrix determined by the residuals. W is the $N \times N$ matrix denoting the spillover index of EPU, which can be obtained from the variance decompositions using a generalized vector autoregression model [11]. Briefly, considering the moving average presentation of $y_t = \sum_{i=1}^{p} \phi_i y_{t-i} + \varepsilon_t$, the return is expressed by the disturbance, as

$$y_t = \sum_{i=1}^{\infty} A_i \varepsilon_{t-1} \quad (4)$$

where A_i is the $N \times N$ coefficient matrix. The variance decompositions are obtained by

$$\theta_{ij} = \frac{s_{jj}^{-1} \sum_{h=1}^{H-1} \left(e_i' A_h \Lambda e_j\right)^2}{\sum_{h=1}^{H-1} \left(e_i' A_h \Lambda A_h' e_i\right)} \quad (5)$$

where s and Λ are the standard deviation and variance matrix of errors, respectively, e_i is selection indictor with one for i element and zero otherwise. The spillover index is denoted by the normalized variance shares, as

$$W_{ij} = \frac{\theta_{ij}}{\sum_{j=1}^{N} \theta_{ij}} \quad (6)$$

3. RESULTS AND DISCUSSION

For empirical analyses, the property indices collected from Global Property Research database and EPU indices obtained from Economic Policy Uncertainty website were used. Herein, there are eight economies are considered, namely, United States (USA), Canada (CAN), Australia (AUS), United Kingdom (UKD), France (FRA), Germany (GER), Hong Kong of China (HKC), and Japan (JAP). The period of data covers from January, 2000 to December, 2019. As usual, the difference of the natural logarithm of two consecutive values of the property index and EPU index is employed to represent the property return and EPU change, respectively. The coefficients in the mean and variance equations are first fitted, as listed in Table 1. As shown in Equation (2), depending on whether the shock ε_{t-1} is negative or positive, the variance is different, thus the λ is an implication of the leverage effect in the property market. The statistically significant positive values of λ evidence the existence of leverage effect again [5].

Table 2 presents the estimation results of conditional correlations. All of the estimates are at 1% significance level. The estimated coefficient of β is large, implying a fairly strong autoregressive component in the conditional correlations. The most important coefficient for this work is the value of δ, which indicates whether the spillover of EPU has impact on the correlations of property markets. It can be seen that the estimated value is statistically significant at 1% level. This demonstrates the influence from the spillover of EPU. The economies that have large spillover of EPU correspond to strong correlations between property markets. A plausible interpretation is that the high spillover of EPU suggests strong economic and political ties, thus the linkage of property market is also tight.

Actually, as known from the models, the conditional correlations of property markets for different economies are time dependent. Here, the time-varying trend is not given, instead, the averaged conditional correlations matrix is reported in Table 3 for more intuitive insight. Different from previous studies with spatial factor, the correlation matrix is no longer strictly symmetric with respect to the diagonal but with slight discrepancy. This is because the spillover matrix of EPU is directional [11], which means that it is not as symmetric as the spatial matrix [5,12]. It can be seen that the correction values between the United States and Canada (0.435), the United Kingdom and France (0.509), the United Kingdom and Germany (0.402), the France and Germany (0.459) are relatively larger than that of other economies. These pairs happen to be the countries that generally have close economic and political ties in the world. By contrast, their correlations with Hong Kong and Japan are relatively weak. But it is noticed that the correlation value between Hong Kong and Japan is larger than that with other countries.

Table 2. Estimation results of conditional correlations.

Coefficients	Estimates	Standard errors
α	0.012^{***}	0.001
β	0.967^{***}	0.001
γ	0.019^{**}	0.001
δ	0.002^{***}	0.000
c_1	0.594^{***}	0.026
c_2	0.637^{***}	0.024
c_3	0.522^{***}	0.028
c_4	0.712^{***}	0.020
c_5	0.752^{***}	0.021
c_6	0.604^{***}	0.023
c_7	0.478^{***}	0.030
c_8	0.354^{***}	0.032
ML	4467	

Note: ML is the value of maximum likelihood. *** denotes significance at 1% level.

4. CONCLUSIONS

In summary, the work aims to confirm whether the spillover of EPU has effect on the correlations of the property markets in different regions. For this purpose, the multivariate GARCH model is extended to including the spillover index of EPU in the dynamic conditional correlations. The matrix describing the spillover of EPU is obtained from a variance decompositions approach. The empirical results indicate that the corrections of property markets have strong autoregressive component. Nonetheless, there is a robust evidence that the correlations of property markets are relevant to the spillover of EPU, verified by a statistically significant coefficient. The averaged time-varying correlations matrix shows that the countries with close economic and political ties indeed has strong corrections in the property markets.

Table 3. Averaged conditional correlations of the property markets.

	USA	CAN	AUS	UKD	FRA	GER	HKC	JAP
USA	1.000	0.435	0.224	0.347	0.279	0.260	0.237	0.144
CAN	0.435	1.000	0.290	0.365	0.303	0.269	0.267	0.174
AUS	0.224	0.290	1.001	0.296	0.248	0.204	0.299	0.227
UKD	0.347	0.365	0.296	1.003	0.509	0.402	0.277	0.185
FRA	0.279	0.303	0.248	0.509	1.001	0.459	0.225	0.143
GER	0.260	0.270	0.204	0.402	0.459	1.001	0.189	0.126
HKC	0.237	0.267	0.299	0.278	0.225	0.190	1.009	0.260
JAP	0.144	0.174	0.227	0.185	0.143	0.125	0.260	1.009

AUTHORS’ CONTRIBUTIONS

Y. Zhang: conceptualization, investigation, software, writing. H. Gu: software.

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