Impact on Property Market from Economic Policy Uncertainty and Its Spillover

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Abstract. The property market plays an important role in the economic system, and it would be greatly affected by the change of economic policies. Understanding the impact of economic policy uncertainty (EPU) is helpful for the investment and management. The EPU of an economy is not only acting on its own property market; the transmission of EPU between different economies, or called as the spillover of EPU, also makes influence on other property markets. However, the impact from the spillover of EPU is not considered previously due to the lack of methods and thus still remains unclear. Therefore, in this work, we combine a generalized VAR model and a DSP-GARCH model to simultaneously take the EPU and its spillover into account. The data of property indices and EPU indices for eight economies are used. Empirical analysis shows that the increased change of EPU has significant negative effect on the property market, and the effect from the spillover of EPU also significantly exist between property markets. The property market with large spillover of EPU yields strong volatility spillover effect.

1. Introduction
Taking a global perspective, all economic markets are affected by the economic and financial policies from home and abroad. In the aftermath of the global financial crisis occurred in 2008, the global economic environment has become increasingly complex, such as the Brexit and the European Debt Crisis. In response to the volatile international markets and in order to stimulate the economies, all countries have adjusted their domestic and foreign economic policies, leading to the increasing uncertainty related to the economic policies, which, in turn, greatly affected the economic markets. The property market is a vital part of the economic system. As the most noted example, the global financial crisis in 2008 is evolved from the Subprime Crisis in the property market of United States. Therefore, investigating the impact of economic policy uncertainty (EPU) on the property market is of great significance.

To quantitatively measure the latent effect of EPU, Baker et al. [1] constructed an index of EPU based on the frequency of the key words related to the policy uncertainty reported in the newspapers. The EPU index does not use complex models in generation and provides a convenient measurement of the uncertainty of economic policies. It has been widely used in studying the causality between the EPU and the market returns or their volatility [2-4]. The important implications from EPU for property market have also been fully demonstrated [5-8]. Nonetheless, Balli et al. [9] have reported that the
EPU has spillover among different countries, indicating that the effect of national EPU of each country is no longer limited to its own. Therefore, investigating the effect of both EPU and its spillover on the property market is imperative.

However, the method simultaneously taking the EPU and its spillover into account is lack, and thus the perception of their impact is limited. To fill the methodological and cognitive gaps, this work constructs a framework incorporating the time-series of EPU as an exogenous explanatory variable and the spillover of EPU as a weight matrix. The cross-economy spillover of EPU is obtained by a generalized vector autoregressions (VAR) model that relies on the decompositions of the forecast error variances of the EPU indices [10], while the time-series regression is implemented by a GARCH approach. Using this framework, empirical research is performed using the data of property indices and EPU indices of eight economies, and the impact of EPU and its spillover on property market is revealed.

2. Methodology

In this section, the models for calculating the directional spillover of EPU and for regressing the time-series are briefly described.

2.1. Generalized VAR model

To measure the spillover of a given economic variable among different economies, its time-series data are used, and the cross-variance share of the forecast error variances can be regarded as the spillover index [10]. In order to decomposing the variances, we first consider a reduced-form VAR(p) model:

\[ Y_{N,t} = \sum_{i=1}^{p} \phi_i Y_{N,t-i} + \epsilon_t, \]  

where \( \epsilon_t \) is independently and identically distributed disturbance. If the VAP(p) process is stable, the moving average representation can be obtained by successive substitution for \( Y_{N,t-i} \) as

\[ Y_{N,t} = \sum_{i=1}^{\infty} A_i \epsilon_{t-i}, \]

where \( A_i \) is a \( N \times N \) coefficient matrix obeying the recursion \( A_i = \phi_i A_{i-1} + \phi_{i-1} A_{i-2} + \cdots + \phi_{i-p} A_{i-p} \). The above transformation to obtain the moving average coefficient is the key step. Parsing the error variances of each variable attributed to different shocks, the share of H-step-ahead error variance \( \theta_{ij}^H \) can be written as

\[ \theta_{ij}^H = \frac{\sigma_{ij}^2 \sum_{k=0}^{H-1} (e_{k}^A \psi e_j)^2}{\sum_{k=0}^{H-1} (e_{k}^A \psi e_j)^2}, \]

where \( \sigma_{jj} \) is the standard deviation of the \( j \)-th equation error terms, \( e_j \) is a selection indicator with one for the \( i \)-th element and otherwise zero, \( \psi \) is the variance matrix of the disturbance. In this generalized VAR model, the correlated shocks are appropriately accounted using the historical distribution of the errors, thus the shock to each variable is not orthogonalized, that is, the row sum of the variance decomposition matrix from equation (3) is not guaranteed equal to one. By normalizing the elements in the matrix with the row sum, the spillover index can be denoted as

\[ \hat{\theta}_{ij}^H = \frac{\theta_{ij}^H}{\sum_{j=1}^{N} \theta_{ij}^H}. \]

2.2. DSJ-GARCH model

To explore the relationship between different variables, the time-series regression approaches such as multivariate GARCH model are widely employed. Herein, in order to consider the effect of the spillover of EPU, a DSP-GARCH model [11] is defined as follows:
\[
Y_{N,t} = \phi Y_{N,t-1} + \rho W_N Y_{N,t} + \lambda W_N Y_{N,t-1} + \beta X_{t,t} + u_N + v_t + e_{N,t}.
\]  
\[
e_{N,t} = \delta W_N e_{N,t} + \varepsilon_{N,t}.
\]  
\[
\sigma_{N,t}^2 = \omega_0 + \omega_1 e_{N,t-1}^2 + \eta W_N e_{N,t-1}^2 + \omega_2 \sigma_{N,t-1}^2.
\]

Here, the definition of \(Y_{N,t}\) is the same as that in the generalized VAR model. \(Y_{N,t-1}\) denotes the one-period lagged return, along with the corresponding coefficient \(\phi\). \(W_N\) is a normalized \(N \times N\) weight matrix with the sum of the row elements being equal to one. Note that, the spillover index matrix from equation (4) satisfies the mathematical requirement of \(W_N\), and thus can be used in equations (5-6). Then, \(W_N Y_{N,t}\) and \(W_N Y_{N,t-1}\) measure the correlation with current and lagged returns including the effect of spillover of EPU, respectively, with the coefficients of \(\rho\) and \(\lambda\) implying return comovements and interdependences. \(X_{t,t}\) is the exogenous explanatory variable with coefficient of \(\beta\); herein, \(X_{t,t}\) is the change of EPU index. \(u_N\) and \(v_t\) represent the individual-specific and time-specific fixed effects, respectively. \(e_{N,t}\) is the vector of disturbances. \(\varepsilon_{N,t}\) is the vector of error terms, \(\sigma_{N,t}^2\) is the conditional variances. \(W_N e_{N,t-1}^2\) denotes the influence from the lagged shocks combined with the spillover of EPU, and \(\eta\) is the coefficient for volatility interdependence.

3. Date description

The empirical study is based on the property indices and EPU indices of eight economies, namely United States (US), Canada (CA), Australia (AU), United Kingdom (UK), France (FR), Germany (GE), Hong Kong (HK), and Japan (JA). The period of samples is ranged from January, 2000 to December, 2019. The GPR 250 indices are used for the property markets, which are collected from the Global Property Research database (http://www.globalpropertyresearch.com). As usual, the property return is calculated by the first-order difference of the natural logarithm of property indices as \(Y_{t} = 100 \cdot (\ln P_{i,t} - \ln P_{i,t-1})\) where \(P_{i,t}\) is the property index value of \(i\)-th economy in period \(t\). The EPU indices are obtained from the economic policy uncertainty index database (http://www.policyuncertainty.com). In accordance to the property variable, the EPU index is also log-differenced for the natural logarithm of two consecutive values, that is, the change of EPU for \(X_{t,t}\).

The descriptive statistics for property return and EPU change are listed in Table 1. It can be seen that the means of property returns and EPU changes are much smaller than the unconditional standard deviations, indicating a high volatility especially for the EPU change. The skewness values are not zero, thus the distribution is not subject to normal distribution, meanwhile, the kurtosis values are larger three, suggesting sharply leptokurtic distribution. Besides, the ADF test, which is significantly different from zero, indicates that there is no unit root and the time-series of property returns and EPU changes are stationary.

**Table 1.** Descriptive statistics for the property return and EPU change of eight economies.

|                | Property return | EPU change |
|----------------|-----------------|------------|
|                | Mean | Std. | Skew. | Kurt. | ADF  | Mean | Std. | Skew. | Kurt. | ADF  |
| US             | 0.86 | 5.14 | -1.07 | 8.38  | -12.24*** | 0.32 | 28.22 | 0.52  | 4.64  | -19.62*** |
| CA             | 1.05 | 4.61 | -1.48 | 9.68  | -11.42*** | 0.80 | 27.60 | 0.32  | 3.42  | -19.80*** |
| AU             | 0.66 | 5.04 | -1.65 | 9.88  | -11.75*** | 0.26 | 39.11 | -0.10 | 4.14  | -20.98*** |
| UK             | 0.39 | 5.70 | -0.42 | 7.14  | -11.03*** | 1.09 | 29.63 | -0.06 | 3.02  | -20.92*** |
| FR             | 0.98 | 4.88 | -0.57 | 5.47  | -11.37*** | 1.08 | 38.47 | 0.21  | 3.83  | -23.02*** |
| GE             | 0.29 | 6.27 | -1.76 | 13.48 | -10.56*** | 0.44 | 38.13 | 0.28  | 3.21  | -21.54*** |
| HK             | 0.73 | 5.94 | -0.49 | 4.65  | -10.56*** | 0.75 | 48.52 | 0.22  | 3.13  | -20.58*** |
| JA             | 0.57 | 6.09 | -0.16 | 3.92  | -12.07*** | 0.13 | 19.59 | -0.24 | 3.66  | -18.65*** |

Note: The statistics include the mean (Mean), standard deviation (Std.), skewness (Skew.), kurtosis (Kurt.), and Augmented Dickey Fuller unit root test (ADF). The superscripts *** *, **, and * denote statistical significance at levels of 1%, 5% and 10%, respectively.
4. Empirical results

Table 2 provides the spillovers of EPU between the eight economies herein. The row indicates the share of each economy received from another economy, while the column represents the share of each economy transmitted to the other one. The total transmission of each economy to other economies as well as the total reception from other economies are also given in the last row and the last column respectively. As expected, the diagonal elements are always the largest. This can be understood from the fact that the effect of EPU cannot fully spill out to other economies, generally, it should have stronger influence on its own market rather than that of others. Nevertheless, if considering the total contribution, the spillover from other economies could be larger than itself. For US, CA, AU, UK, FR, and GE, the contribution from other economies is larger than half percentage, whereas it is smaller than half percentage for HK and JA. A plausible reason lies the closer economic political ties between the western countries than that with HK and JA. Likewise, the contribution to other economies is small in HK and JA, especially for HK which is the smallest economy among these objects.

|       | US   | CA   | AU   | UK   | FR   | GE   | HK   | JA   | From others |
|-------|------|------|------|------|------|------|------|------|-------------|
| US    | 0.4165 | 0.0896 | 0.1039 | 0.1111 | 0.0718 | 0.1075 | 0.0533 | 0.0467 | 0.5835       |
| CA    | 0.0879 | 0.4321 | 0.1088 | 0.1002 | 0.1000 | 0.0862 | 0.0349 | 0.0499 | 0.5679       |
| AU    | 0.1073 | 0.0954 | 0.4423 | 0.04   | 0.0626 | 0.1027 | 0.0536 | 0.0522 | 0.5577       |
| UK    | 0.0931 | 0.0916 | 0.0742 | 0.4987 | 0.0890 | 0.0943 | 0.0101 | 0.049   | 0.5013       |
| FR    | 0.0971 | 0.0848 | 0.0743 | 0.1000 | 0.4533 | 0.0970 | 0.0327 | 0.0607 | 0.5467       |
| GE    | 0.0993 | 0.0866 | 0.1007 | 0.0838 | 0.0845 | 0.4509 | 0.0180 | 0.0763 | 0.5491       |
| HK    | 0.0330 | 0.0640 | 0.0536 | 0.0610 | 0.0618 | 0.0345 | 0.6440 | 0.0482 | 0.3560       |
| JA    | 0.0635 | 0.0522 | 0.0719 | 0.0456 | 0.0526 | 0.0630 | 0.0233 | 0.6280 | 0.3720       |
| To others | 0.5812 | 0.5652 | 0.5874 | 0.5857 | 0.5222 | 0.5848 | 0.2258 | 0.3830 |

Once the spillovers of EPU among the economies is obtained, the regression of DSJ-GARCH model can be performed by setting the spillover matrix of EPU to be the weight matrix. Table 3 shows the estimation results. The regression has a relatively high fitting degree, with the goodness of fit \( R^2 \) as high as 0.865 and the value of maximum likelihood function \( ML \) as large as 5232.6. All estimates of the coefficients are significant. Specifically, the \( \beta \) is negatively correlated with property return, implying that the increase of EPU change leads to the decrease of property return. The instability of economic policies may undermine investors’ confidence in the market, resulting in the reduction of returns. The serial autocorrelation coefficient \( \varphi \) is significant at a level of 1% with a value of 0.227, suggesting quite “sticky” in property return, that is, previous property return has a relatively strong influence on the next period’s return. The coefficients \( \rho \) and \( \lambda \), considering the effect of spillover of EPU, are also statistically significant. This demonstrates the importance of the spillover of EPU in studying the comovement and interdependence of property market. The absolute value of \( \rho \) is much than that of \( \lambda \), indicating stronger comovement than interdependence in property return. The volatility spillover effect also exist among these property markets, as evidenced by the statistically significant coefficient \( \eta \). The positive sign indicates that the property markets that have strong spillover of EPU would also exist high volatility spillover.

The conditional variance \( \sigma^2_{t+1} \) of the property returns for different economies can be obtained. As a representative, Figure 1 plots the property index and the conditional variance of US and UK. It can be seen that the property indices follow an overall trend of increase, except for a conspicuous decrease around 2008 corresponding to the outbreak of the global financial crisis. Since this crisis is started from the property market of US, the decrease in US is stronger, and the volatility is higher than that of HK, as evidenced by the time-dependent conditional variance. There is an obvious volatile period
before the crisis in HK, implying a boom period of the property market of HK. The trends for CA, AU, UK, FR, GE are similar to that of US, which also shows an increase of conditional variance around 2008. On the contrary, like in HK, the corresponding volatility during crisis period in JA is also weak.

Table 3. Coefficient estimation results of DSJ-GARCH model.

| Coefficient | Estimate | Standard deviation |
|-------------|----------|--------------------|
| $\beta$     | -0.006*  | 0.003              |
| $\rho$      | 0.663*** | 0.051              |
| $\delta$    | 0.442*** | 0.098              |
| $\varphi$   | 0.227*** | 0.041              |
| $\lambda$   | -0.133** | 0.053              |
| $\omega_0$  | 0.365*** | 0.067              |
| $\omega_1$  | 0.063**  | 0.025              |
| $\eta$      | 0.068*** | 0.023              |
| $\omega_2$  | 0.714*** | 0.030              |
| $R^2$       | 0.865    |                    |
| $ML$        | 5232.6   |                    |
| $RMSE$      | 2.012    |                    |

Note: The $R^2$ is goodness of fit, $ML$ is the value of maximum likelihood function, $RMSE$ is the mean square error. ***, **, and * denote 1%, 5% and 10% statistically significant levels, respectively.

Figure 1. The property indices and conditional variances of US and HK.

5. Conclusions

This paper examines the response of the property market return to the economic policy uncertainty (EPU) and its spillover. Using a generalized VAR model based on the variance decompositions, the directional spillover index of EPU between different economies is obtained. To simultaneously consider the effect from the EPU and its spillover, a DSP-GARCH model is used to incorporate the
obtained spillover matrix of EPU. The regression uses the date of eight economies, namely United
State, Canada, Australia, United Kingdom, France, Germany, Hong Kong and Japan. Empirical results
show that the increased change of EPU in each economy has negative effect on its property market
return. As for the spillover of EPU, its significant implication on the comovement and interdependence
of property market is demonstrated; moreover, it has positive impact for the volatility spillover of
property market. All in all, the findings confirm the importance of EPU and its spillover in the
property market.

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