J. of Multi. Fin. Manag. xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Journal of Multinational Financial Management

journal homepage: www.elsevier.com/locate/econbase

Economic policy uncertainty and stock market returns in pacific-rim countries: Evidence based on a Bayesian Panel VAR Model☆

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ARTICLE INFO

Article history:
Received 10 August 2016
Received in revised form 8 February 2017
Accepted 5 March 2017
Available online xxx

Keywords:
Economic policy uncertainty
Stock returns
Panel vector autoregressive model
Pacific-rim countries

JEL classifications:
C32
G10

ABSTRACT

This paper examines the role of Economic Policy Uncertainty (EPU) on the stock market returns for 6 countries (Australia, Canada, China, Japan, Korea and the US), based on a PVAR model estimated using the Stochastic Search Specification Selection (SSSS) prior. In order to account for international uncertainty spillovers, the impact of the own country's EPU shocks and the US EPU shocks are considered over the period of January 1998 to December 2014. The main results, suggest that stock market returns have been negatively affected by the increased policy uncertainty levels observed during the last decade. Furthermore, when uncertainty spillovers are considered, a significant negative relationship is found between stock market returns and US EPU shocks in all countries, except in Australia, which could be explained by the favorable opportunities that investors could gain by investing in this country, after an increase in policy uncertainty levels in the US economy.

1. Introduction

In the wake of the financial crisis, economic policy uncertainty has raised a lot of interest due to its potential negative effects on economic activity (Bloom et al, 2007; Bloom, 2009; Antonakakis et al., 2013; Pastor and Veronesi, 2012, 2013; Aasveit et al., 2013; Shoag and Veuger, 2013; Baker et al., 2015; Brogaard and Detzel, 2015; Gulen and Ion, 2015). For example, the Federal Open Market Committee (2009) and the International Monetary Fund (2012, 2013) have suggested that uncertainty about US and European fiscal, regulatory and monetary policies have contributed to a steep decline in 2008–2009. Furthermore, many authors, such as Baker et al. (2015) have also suggested that the high levels of policy uncertainty are behind the weak recoveries after the 2007 financial crisis.

The economic literature points to different channels through which uncertainty might negatively affect economic growth. Considering the demand side of the economy, in a highly uncertain environment, firms will reduce investment demand

☆ We would like to thank two anonymous referees for many helpful comments, and the Editor, Professor Peter Szilagyi, for allowing us an extension of the deadline for the revise-resubmit. However, any remaining errors are solely ours.
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http://dx.doi.org/10.1016/j.mulfin.2017.03.001
1042-444X/

and delay projects (Bernanke, 1983; McDonald and Siegel, 1986; Dixit and Pindyck, 1994), while households will reduce their consumption of durable goods (Carroll, 1996). On the other hand, on the supply side, firms' hiring plans will be also negatively affected by high uncertainty levels (Bloom, 2009). Policy uncertainty is also believed to have these potential effects on different macroeconomic variables (Friedman, 1968; Pastor and Veronesi, 2012, 2013; Fernández-Villaverde et al., 2015).

Among the different measures of policy uncertainty, the economic policy uncertainty index based on newspaper coverage frequency proposed by Baker et al. (2015) has become a benchmark[1] for measuring economic policy uncertainty (Sum, 2012a, 2012b; Antonakakis et al., 2013, 2016; Gulen and Ion, 2015).[2] Fig. A2 in the Appendix A plots the EPU indices of the countries considered in the paper. The historical evolution of the US EPU index, for example, shows that policy uncertainty sharply increased after several events, such as Black Monday's stock market fall in 1987, the 9/11 attack and the 2nd Gulf War. According to this index, the highest policy uncertainty levels correspond to the 2011 debt-ceiling dispute. It is impossible to deny the international influence of the U.S. economy as an exporter of international uncertainty spillover effects (Klößner and Sekkel, 2014; Yin and Han, 2014), which in turn, justifies the analysis of the impact of this variable on international stock market returns.

When the EPU indexes for Australia, Canada, China, Japan and Korea are considered, the data reveal that these indexes reached their peaks in 2011, coinciding with different national events, coupled with high international political uncertainty due to the Eurozone fears. An exception is the Japanese case where the index reached its highest level in 2010, with the Bank of Japan's monetary easing. In Canada, although the index spikes in 1995, with the Quebec Referendum and in 2008 with the collapse of Lehman Brothers, it also reaches its highest level in 2011, as it does in Australia (Baker et al., 2015). In Korea, the main spikes in the indexes correspond to the enforcement of the real-name financial transactions law' in August 1993, under Kim regime and the death of Il-Sung Kim in July 1994. Other episodes with high EPU indexes coincide with the bankruptcy of Daewoo Motors in 2000, the beginning of Roh regime and the disaster at a subway station in Daeggo in 2002, and the global financial crisis initiated by the collapse of Lehman Brothers. Again, the index reached its peak in 2011 with the serial bankruptcy of savings bank and the death of Jung-Il Kim (Choi and Shim, 2016). In China, the index spikes with the township and village enterprises bankruptcy in 1995–1996, privatization and restructuring in 1997–2000, accession to World Trade Organization in 2001, global financial crisis in 2008–2009, and euro crisis in 2010. The Chinese index also reaches its peak when Xi-Li Administration began with legislation aimed at corruption and poverty in 2011 (Kang and Ratti, 2015). These high levels of policy uncertainty are considered as one of the key differences of the on-going recovery from previous recoveries, by some authors such as Baker et al. (2015) and attests to the severity of the recent crisis (Yin and Han, 2014).

The impact of policy uncertainty, on stock market returns, has been already studied in the literature, primarily based on time-series approaches which involve single-country vector autoregressive (VAR) models. Even if multiple countries are analysed, individual VAR models and at times quantile regressions are used in the process, ignoring the role of dependence between markets in a globalized world. However, although the results seem to suggest that uncertainty negatively impact stock returns (Pastor and Veronesi, 2012; Antonakakis et al., 2013; Kang and Ratti, 2013, 2015; Chuliá et al., 2015; Chen et al., 2016), the results are far from conclusive. Given the dominance of the U.S. economy, Sum (2012a,b) examines the existence of international uncertainty spillovers and finds that US EPU shocks are non-significant in the stock returns in China, Brazil and India, while Momin and Masih (2015) find the same results when analysing their impact on the BRICS countries. Li et al. (2015) examine the causal link between US economic policy uncertainty and stock returns in India and China and they do not find evidence of causality between the two variables. Furthermore, Mensi et al. (2014, 2016) and Balcilar et al. (forthcoming) examine how an increase in US policy uncertainty could positively affect international stock markets, since it could lead to an improvement in foreign stock markets through the diversification channel of investor portfolios.

In this context, the objective of this paper is to analyze the effect of economic policy uncertainty on stock market returns in a sample of six Pacific-rim countries, which include Australia, Canada, China, Japan, South Korea and the US, using monthly data from January 1998 to December 2014, by means of estimating a restricted PVAR, estimated using the Stochastic Search Specification Selection (SSSS) prior (PVAR-SSSS) of Koop and Korobilis (2016). We use monthly data as the EPU indices, of the countries in our sample, are only available at monthly frequency. While the choice of the US economy is natural, given its global influence on other financial markets, the decision to look at the Pacific-rim countries is driven by the increased transmission of stock market return among these markets over recent periods (Balcilar et al., 2015). The main contributions of the paper are as follows: First, the PVAR methodology applied in this paper rather than the pure time-series based approaches, is an excellent way to examine international transmission of different shocks, allowing for cross-sectional dependence, given strong evidence of stock market return spillovers, interdependence and financial contagion, already found in the literature (Bekaert et al., 2009, 2014; Arouri et al., 2011; Diebold and Yilmaz, 2015), which as we show exists statistically as well. So, by using a panel approach, since we combine both time series and cross-sectional elements of the data set, we gain in efficiency over time series models (Rapach and Zhou, 2013), and by using non-homogenous coefficients, it allows us to obtain impulse responses for each of the six countries separately, rather than an average impulse response obtained under standard panel

[1] As an example of the great number of papers that have used this data, see the web page http://www.policyuncertainty.com/research.html

[2] Alternative measures of policy uncertainty can be found in Mumtaz and Zanetti (2013), Mumtaz and Surico (2013), Mumtaz and Theodoridis (2015), Carriero et al. (2015) Jurado et al. (2015), Ludvigson et al. (2015) and Rossi and Sekhposyan (2015), among others. See Strobel (2015) for a review of alternative approaches to measure uncertainty.

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data approaches. The cost of overparameterization due to the usage of heterogeneous coefficients in the PVAR, is in turn solved using the Bayesian methods proposed by Koop and Korobilis (2016). Second, and in order to account for international uncertainty spillovers, we not only analyze the impact of the own country's EPU shocks, but also the U.S. EPU shocks on the various stock markets. Furthermore, the sign and persistence of these spillovers based on impulse response functions will help us understand the mechanism through which international uncertainty spillovers affect stock market returns and for how long.

To the best of our knowledge, this is the first paper to use impulse responses in a heterogeneous coefficient Bayesian PVAR model to analyze the impact of own and US EPU shocks on stock returns of Pacific-rim countries.[3] Hence, we extend this literature on stock market and EPU, primarily based on time-series approaches, which fail to account for cross-sectional dependence in international stock markets and thus, could be leading to inaccurate inferences. In addition, our study also deviates from the existing time series work, which primarily looks at G7 or BRICS countries. The remainder of the paper is structured as follows. Section 2 discusses the methodology used in the paper. Section 3 describes the data and shows the empirical analysis. Section 4 summarizes the main findings.

2. Methodology: the Panel VAR framework with the stochastic search specification selection (SSSS) prior

In this paper, we are interested in modeling stock returns and uncertainty for each country using a Vector Autoregressive (VAR) model, but we also allow for linkages among countries. In such a setup, Panel VAR (PVAR) is the appropriate tool since it uncovers all sort of static and dynamic dependencies. Specifically, a PVAR model allows for (i) dynamic interdependencies (DI) which occur when one country's variables affect another country's lagged variables, (ii) static interdependencies (SI) which occur when the correlations between the VARs' errors of two countries are non-zero, and (iii) cross-section heterogeneities (CSH) which occur when two countries have VARs with different coefficients. Furthermore, given the autoregressive structure of a PVAR, endogeneity problems are solved. However, an unrestricted PVAR is heavily over-parameterized. For example, in a PVAR with P lags, N countries, each country with G variables, we have $P(NG)^2$ autoregressive coefficients, and $NG(NG+1)/2$ parameters in the error covariance matrix. Consequently, the total number of possible restrictions on DIs, SIs and CSHs is also huge. Thus, the researcher is faced with an over-parameterized unrestricted model and a large number of potentially interesting restricted models. Recently, Koop and Korobilis (2016) develop methods which allow the researcher to select among all possible combinations of restricted PVARs and find a parsimonious PVAR which deals with the over-parameterization problem. In the following subsection we briefly review the PVAR analysis framework, for a model with lag length of one (P = 1) which is a reasonable assumption for financial variables.

Let y_{it} a vector of G dependent variables for country i at time t, $i = 1, 2, .., N$, $t = 1, 2, .., T$. In this paper Let$y_{it} = (EPU_{it}, MF_{it}, RETURNS_{it})'$, where EPU_{it}, MF_{it} and $RETURNS_{\text{it}}$ stand for the logarithm of economic policy uncertainty index, a macroeconomic factor and stock returns for country i at time t, respectively. The macroeconomic factor is used to prevent misspecification, due to omitted variable bias and comprises of the first principal component of output growth, inflation, short-term interest rate and the effective exchange rate, which are the standard variables used in open-economy VAR models. The ordering of the EPU, before the factor and the stock returns, is in line with the evidence of macroeconomic variables and stock market predictability emanating from uncertainty as provided by Balcilar et al. (2016a, 2016b, 2016c) and Bekiros et al., 2016; Bekiros et al. forthcoming respectively. Also, ordering of the macro variables before the stock market variable is quite standard, as it implies that a shock to the macro factor affects the stock market instantaneously, but the effect of the stock markets feeds into the macro factor with a delay (see for example, Bjørnland and Leitemo (2009); Bjørnland and Jacobsen (2010, 2013)). In other words, EPU acts as a leading indicator for stock returns and the macroeconomic factor. Note, as discussed, given the issue of overparameterization, we prefer to use the MF, rather than the four variables individually, since even with a Bayesian approach which prevents overparametrization, a six-variables PVAR would be computationally very tedious. The PVAR equation of country i is written as:

$$y_{it} = A_{i1}y_{1,t-1} + \ldots + A_{ii}y_{i,t-1} + \ldots + A_{iN}y_{N,t-1} + u_{it}, \tag{1}$$

where A_{ij} are $G \times G$ matrices for each $i, j = 1, 2, .., N$, and $u_{it} \sim N(0, \Sigma_{ii})$ with $G \times G$covariance matricesΣ_{ii}.

The unrestricted PVAR model is defined as:

$$Y_t = AY_{t-1} + U_t, \tag{2}$$

where $Y_t = \left(y'_{1t}, \ldots, y'_{Nt}\right)'$ is a $NG \times 1$ vector of endogenous variables, $U_t \sim (0, \Sigma)$with Σa full $NG \times NG$matrix. It is assumed that$cov\left(u_{it}, u_{jt}\right) = \Sigma_{ij} \neq 0$, where Σ_{ij} denotes the covariance matrix between the errors of country i and country j.

Within the unrestricted PVAR in equation (2), Koop and Korobilis (2016) define three categories of restrictions. First, $N(N-1)$ dynamic interdependency (DI) restrictions can be defined by imposing $A_{ij} = 0$ for $i, j = 1, 2, .., N$and $\neq j$, implying no DIs from country j to country i. Second, we can construct $N(N-1)/2$ static interdependency (SI) restrictions by setting $\Sigma_{ij} = 0$

[3] While Chang et al. (2015) and Wu et al. (2016) have used PVAR model to analyze the causality between EPU and stock returns of OECD countries, both these studies do not present impulse responses, and hence are silent about the persistence of EPU shocks on stock returns and its associated statistical significance. Additionally, these studies do not look at the impact of US uncertainty on stock returns of other markets.

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for $i, j = 1, 2, .., N$ and $\neq j$, implying no SIs between country i and country j. Third, $N(N-1)/2$ cross section heterogeneity (CSH) restrictions can be defined. By imposing $A_{ii} = A_{jj}$ for $i, j = 1, 2, .., N$ $i \neq j$ we impose homogeneity between two countries, i and j. The authors developed a stochastic search algorithm, the Stochastic Search Specification Selection (SSSS) algorithm, which explicitly checks all possible $2^{N(N-1)}$ DI restrictions and all possible $2^{N(N-1)/2}$ CSH restrictions. It is clear that the SSSS algorithm takes into account the panel structure of the model in equation (2).

The SSSS algorithm of Koop and Korobilis (2016) is based on the Stochastic Search Variable Selection (SSVS) hierarchical prior (see George and McCulloch (1993); George et al. (2008)). Within the SSSS prior the DI restrictions can be expressed as:

$$vec\left(A_{ij}\right) \sim \left(1-\gamma_{ij}^{DI}\right) N\left(0, \underline{\tau}_1^2 \times I\right) + \gamma_{ij}^{DI} N\left(0, \underline{\tau}_2^2 \times I\right), \tag{3}$$

$$\gamma_{ij}^{DI} \sim Bernoulli\left(\pi^{DI}\right), \forall i \neq j, \tag{4}$$

where $\underline{\tau}_1^2$ is "small" and $\underline{\tau}_2^2$ is "large" so that, if $\gamma_{ij}^{DI} = 0$, A_{ij} is shrunk to be near zero, and if $\gamma_{ij}^{DI} = 1$, a relatively noninformative prior is used. According to the SSSS prior the CSH restrictions are:

$$vec\left(A_{ii}\right) \sim \left(1-\gamma_{ij}^{CSH}\right) N\left(A_{jj}, \underline{\xi}_1^2 \times I\right) + \gamma_{ij}^{CSH} N\left(A_{jj}, \underline{\xi}_2^2 \times I\right), \tag{5}$$

$$\gamma_{ij}^{CSH} \sim Bernoulli\left(\pi^{CSH}\right), \forall i \neq j, \tag{6}$$

where $\underline{\xi}_1^2$ is "small" and $\underline{\xi}_2^2$ is "large" so that, if $\gamma_{ij}^{CSH} = 0$, A_{ii} is shrunk to be near, an A_{jj} and if $\gamma_{ij}^{CSH} = 1$, a relatively noninformative prior is used.

SI restrictions have the following form:

$$vec\left(\Psi_{ij}\right) \sim \left(1-\gamma_{ij}^{SI}\right) N\left(0, \underline{\kappa}_1^2 \times I\right) + \gamma_{ij}^{\Sigma I} N\left(0, \underline{\kappa}_2^2 \times I\right), \tag{7}$$

$$\gamma_{ij}^{SI} \sim Bernoulli\left(\pi^{SI}\right), \forall i \neq j, \tag{8}$$

where $\underline{\kappa}_1^2$ is "small" and $\underline{\kappa}_2^2$ is "large" so that, if $\gamma_{ij}^{SI} = 0$, Ψ_{ij} (and thus $\Sigma_{ij} = \Psi_{ij}^{-1\prime} \Psi_{ij}^{-1}$) is shrunk to be near zero, and if $\gamma_{ij}^{SI} = 1$, a relatively noninformative prior is used. Following Koop and Korobilis (2016) we use the following prior for the error variances:

$$\psi_{ij}^{ii} \sim \begin{cases} N\left(0, \underline{\kappa}_2^2\right), \text{if} k \neq l \\ Gamma\left(\underline{\rho}_1, \underline{\rho}_2\right), \text{if} k \neq l \end{cases}$$

Furthermore, as in Koop and Korobilis (2016), we set $\underline{\tau}_1^2 = \underline{\xi}_1^2 = \underline{\kappa}_1^2 = 0.01$ to ensure tight shrinkage towards the restrictions. For the other hyperparameters we set $\underline{\tau}_2^2 = \underline{\xi}_2^2 = \underline{\kappa}_2^2 = 10$, $\underline{\rho}_1 = \underline{\rho}_2 = 0.01$, and $\pi^{DI} = \pi^{CSH} = \pi^{SI} = 0.5$, which are relatively noninformative choices.

As explained in detail in Korobilis (2016), the SSSS type of restriction is different in nature from typical variable shrinkage/selection procedures, such as the Minnesota prior, which rely on finding zero restrictions on the coefficients of a VAR model. Indeed, one could use the Minnesota prior readily in the PVAR setting in order to impose restrictions. However, the Minnesota prior completely ignore the panel dimension of a PVAR and the existence of homogeneities. This is because the Minnesota prior treats each of the $N \times G$ with equal weight apriori, ignoring that there are N copies of the same G variables in such a VAR and also that many times macroeconomic and financial variables for several countries tend to comove. Additionally, priors should be specified in such a way that reflect our desire to be agnostic about which (groups of) countries are homogeneous and which countries lack dynamic interdependencies – the SSSS prior allows us to do this as well. Finally, Korobilis (2016) using both simulations and data, shows that the SSSS prior can significantly improve mean and density forecasts compared to the Minnesota prior and an automatic Bayesian model selection prior for VARs, as well as existing competing priors for PVARs.

3. Data and empirical results

3.1. Data

Our analysis comprises of two variables, namely, the stock returns and the EPU. We look at six Pacific-rim countries (Australia, Canada, China, Japan, South Korea and the US) over the monthly periods of January 1998 to December 2014, with the start and end date being purely driven by data availability of the EPU variable. Note that we are constrained in using monthly data, even when stock prices are available at higher frequencies, because the EPU indices of the countries are available only at the monthly frequency. In fact, barring the US (and UK), EPU indices are not available at the daily frequency. Stock returns are defined as the first-difference of the natural log of the stock index. The data on stock indices are obtained from the macroeconomic indicators database of the OECD. The data on the EPU indices for the six countries are obtained from www.policyuncertainty.com and are based on the work of Baker et al. (2015). The authors construct indices for major economies of the world by quantifying month-by-month searches for newspaper coverage on terms related to policy-related

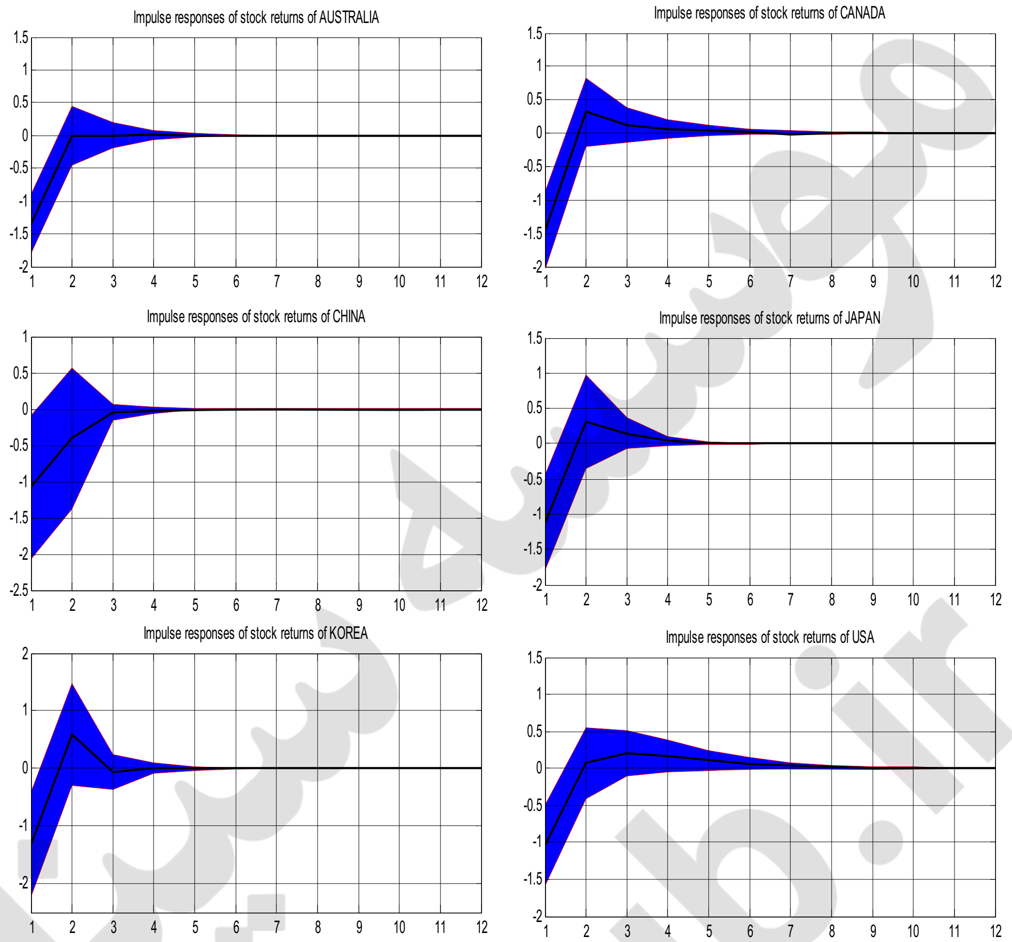

Fig. 1. Responses of stock returns to a shock to own country EPU index from single country VARs (macroeconomic factor is included).

economic uncertainty. For inclusion in the index, the articles must contain all of the three terms of economy, policy and uncertainty simultaneously. The EPU index is converted into its natural logarithmic form. As can be seen from the summary statistics in Table A1a in the Appendix A, South Korea (US) has the highest average stock returns (EPU), and Japan (Australia) has the lowest average stock returns (EPU). China has the highest standard deviation for both the stock returns and EPU, while Australia (US) has the lowest corresponding values of the standard deviation for the stock returns (EPU). Further, all stock returns are non-normal at the one percent level, while for the EPU, non-normality holds at the 1 percent level, for China and the US and at 10 percent level for Canada. The data on stock returns and EPU have been plotted in Figs. A1 and A2 respectively, in the Appendix A.

As suggested by an anonymous referee, to control for the possible influence of other macroeconomic variables in the system, (i.e., on both stock returns and EPU), we computed the first principal component of the growth rate of industrial production, CPI inflation rate, short-term interest (policy) rate and the nominal effective exchange rates. We call this the macroeconomic factor (*MF*) used to control for possible omitted variable bias.[4] Data, to create this factor individually for each one of the countries, were derived from the macroeconomic indicators database of the OECD, IHS Global Insight and the Bank of International Settlements (BIS). The summary statistics of the *MF* for each country is reported in Table A1b, while Fig. A3, plots the factor.

[4] In an earlier version of the paper, we had a bivariate model, i.e., without the macroeconomic factor. Our results, when compared to those discussed in the next segment with the factor included, were quite comparable in the qualitative sense. Complete details of the results without the factor are available upon request from the authors.

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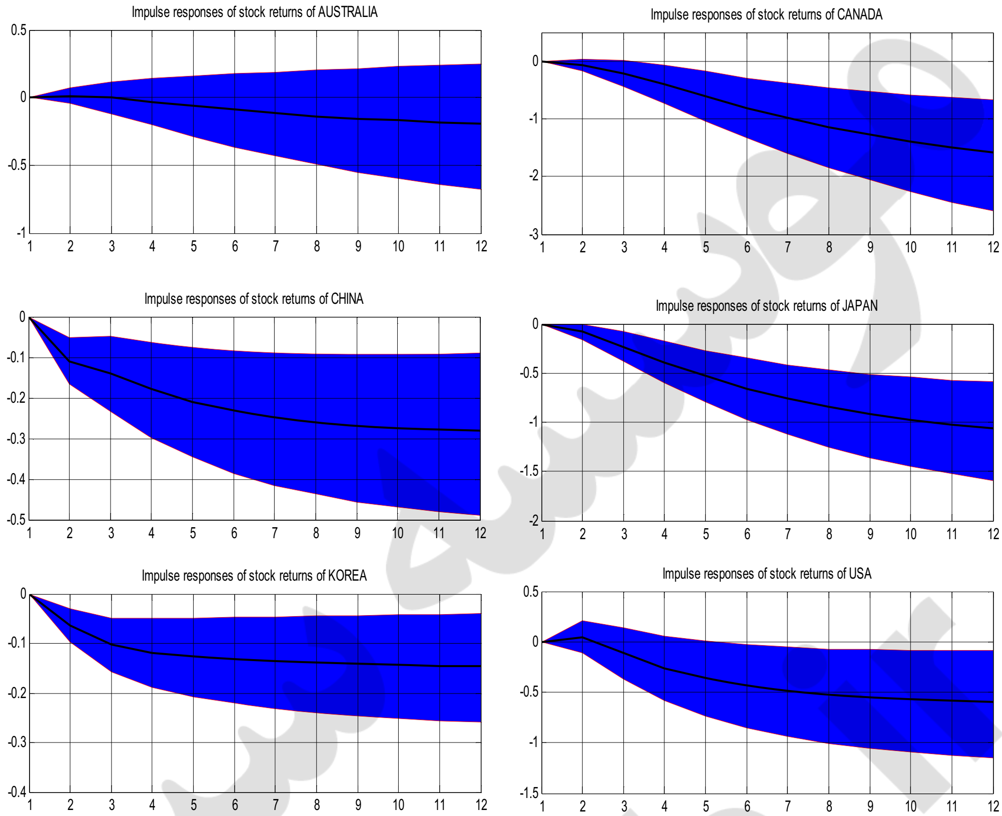

Fig. 2. Responses of stock returns to a shock to own country EPU index from the PVAR with SSSS prior (macroeconomic factor is included).

3.2. Empirical results

Based on the suggestions of an anonymous referee and the fact that the literature analysing the impact of EPU shocks on stock returns primarily uses a time series approach, we present, in Fig. 1, the impulse response function from a time series VAR model. Consistent with the literature, the impact of own country EPU shocks on stock returns are negative and significant, initially for a month, but becomes positive and insignificant, within the next month, to only die-off within at most six-periods. In other words, the effect, based on the VAR is quite short-lived.

We now turn our attention to the main focus of the paper; we carry out impulse response analysis to investigate the effects of EPU shocks on stock returns, based on a restricted PVAR model estimated using the SSSS prior (PVAR-SSSS) of Koop and Korobilis (2016). The time series evidence serves as a benchmark of comparison with our PVAR results shown in Fig. 2.

Fig. 2 illustrates impulse response functions of stock returns to own country's EPU. As can be seen for all the countries considered, the effect is negative as in the time series evidence provided in Fig. 1, and barring Australia, is significant. Note that, the effect on the US economy is a delayed one, with the stock returns initially increasing in a statistically insignificant manner,[5] before being affected negatively in a statistically significant and prolonged fashion.[6] However, when compared to Fig. 1, the stark difference is in the persistence of the effect, with the impulse response functions showing very little evidence of dying-off even after a year. This we believe is due to the interconnectedness of the stock markets between these economies. While, the own shocks affects the stock markets, the fact that the stock markets in the other economies are also negatively affected and that the stock markets are connected with each other, prolongs the negative impact for a one-time

[5] This result though insignificant could be due to two reasons: First, if investors expect uncertainty to increase further in the future, then stock market activity might increase following a shock to EPU. This seems to make sense here, since, as the investors realize that the EPU shock is an one-time shock and is decaying, they respond negatively to it. Second, as discussed in Chang et al. (2015), higher uncertainty leads to lower interest rates (which we saw during the zero-lower bound scenario following the great recession), which in turn, boosts the stock market, but only temporarily and that too in an insignificant fashion.

[6] Note that, effects are considered to be statistically significant and different from zero for a certain horizon, if the response and the corresponding confidence bands all falls in the same (positive or negative axis) for that particular horizon, i.e, when the confidence bands do not include the zero-line.

Table 1a
Test results for cross-sectional dependence.

Variable	EPU	Macroeconomic Factor	Stock Returns	Pooled
CD test	33.260[0.000]	2.730 [0.006]	28.270[0.000]	9.240[0.000]

Notes: Figures in square brackets are *p*-values.

Table 1b
Cases where restrictions do not hold.

Countries where dynamic interdependency restrictions do not hold			Countries where static interdependency restrictions do not hold		
No	To	From	No	C1	C2
1	Australia	China	1	China	Japan
2	Australia	Japan	2	China	Korea
3	Australia	Korea	3	China	USA
4	Australia	USA	4	Japan	Korea
5	Canada	Australia	5	Korea	USA
6	Canada	China			
7	Canada	Japan			
8	Canada	Korea			
9	Canada	USA			
10	China	Korea			
11	China	USA			
12	Japan	Korea			
13	Japan	USA			

shock in the own-country EPU. In other words, the PVAR model is capturing the existence of cross-sectional dependence, as well as the various static and dynamic interdependencies that exist.

We believe that the results obtained from the PVAR model are more reliable, given the interconnectedness of the global stock markets (for a detailed discussion, see for example, Diebold and Yilmaz (2015)). We provide statistical evidence of this in Tables 1a and 1b. In Table 1a, we report the results of the bias-adjusted *LM* test of cross-sectional dependence as proposed by Pesaran et al. (2008) for the three equations (EPU, MF and Stock Returns) individually and the pooled model. As can be seen, in all cases, the null of cross-sectional independence is overwhelmingly rejected at the highest level of significance, thus providing evidence of interconnectedness amongst the stock markets and hence, the need to use a PVAR approach rather than a time-series based methodology. In Table 1b, we report the specific dynamic and static restrictions that do not hold. As can be seen, out of the possible 30 and 15 dynamic and static restrictions, 13 and 5 restrictions respectively fail to hold. This implies that there are 13 cases of dynamic and 5 instances of static interdependenecies amongst the countries, i.e, in 17 and 10 cases respectively, we have no dynamic and static interdependencies. Again, this provides strong evidence in favour of a PVAR approach over a time-series based VAR model. However, we find that all CSH restrictions hold, i.e., there is homogeneity of coefficients across the countries. But notice that, with the SSSS prior, unlike the Minnesota prior, we do not need to make any apriori assumptions about the DI, SI and CSH structure of the model, but we can determine this explicitly from the data and the model at hand. Clearly, this is where the advantage of the SSSS-prior is over other standard shrinkage-based approaches for PVAR models.

In order to account for the possible international spillovers from the US economic policy uncertainty, or to analyze how international stock markets react to global market uncertainty, Fig. 3 shows the response of stock returns to the US EPU shocks. Barring the case of Australia, in all the other cases the effect is negative and significant. In addition, the effect is very persistent.[7] In the case of Australia impulse responses are not statistically different from zero, that is, they show that stock market returns in this country are not significantly affected by global policy uncertainty levels, and consistent with the papers by Sum (2012a, b), Momin and Masih (2015), among others. The positive relationship between stock market returns in Australia and the US EPU shocks could be explained due to the favorable opportunities that investors could gain by the temporary diversification of their portfolios (Mensi et al., 2014, 2016; Balcilar et al., 2015; forthcoming) after a global increase in policy uncertainty levels. The results suggest that, after an increase in the US EPU levels, investors are more likely to invest in the stock markets in Australia, but the gains are not likely to be statistically significant.

[7] Qualitatively similar results, albeit without the persistence, was obtained from the time-series VAR model following a shock to the US EPU. Complete details of these results are available upon request from the authors.

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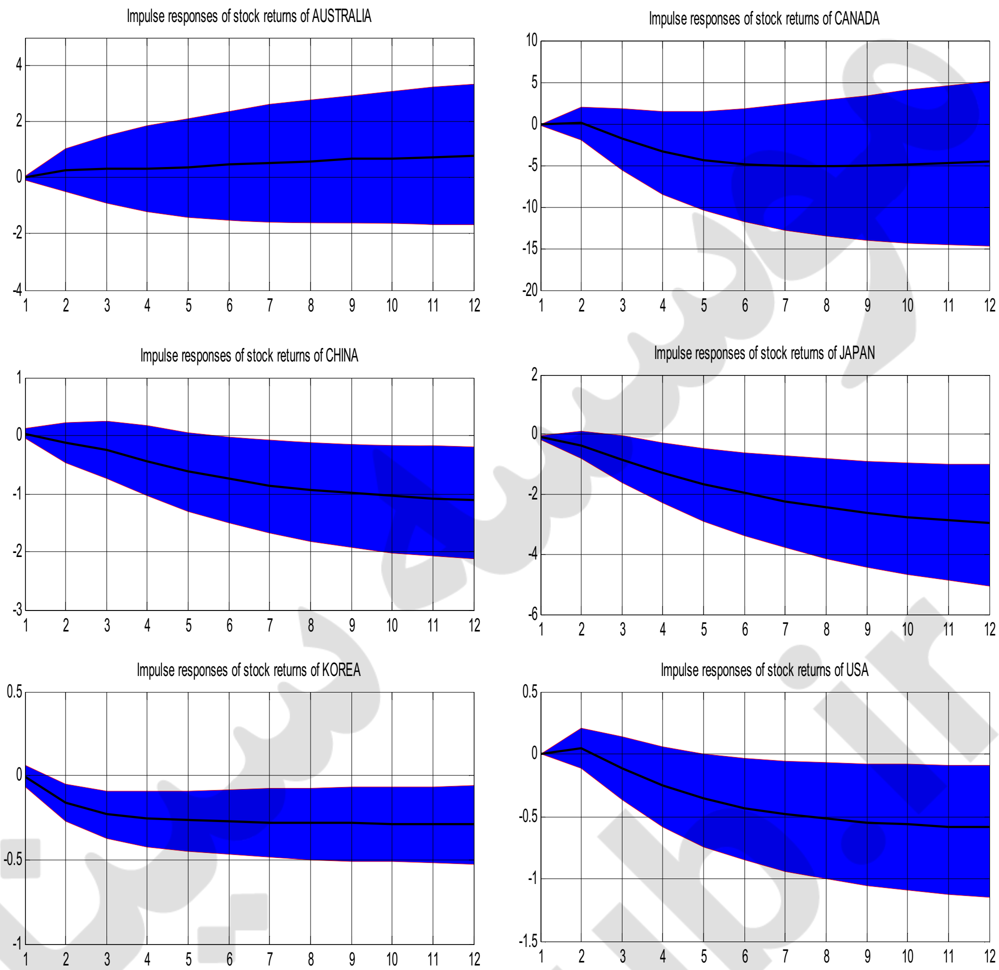

Fig. 3. Responses of stock returns to a shock to the U.S. EPU index from the PVAR with SSSS prior (macroeconomic factor is included).

4. Conclusions

The high economic policy uncertainty (EPU) levels observed during the last decade, together with the data availability to measure it, explain the great amount of papers that have already analysed the macroeconomic impact of EPU shocks on different variables. In this context, this paper examines the role of EPU shocks on the stock returns in a sample of countries which include Australia, Canada, China, Japan, Korea and the US, using monthly data from January 1998 to December 2014, by means of estimating a restricted PVAR estimated using the SSSS prior (PVAR-SSSS) of Koop and Korobilis (2016). In order to account for international uncertainty spillovers, the impact of the own country's EPU shocks and the U.S. EPU shocks are considered.

The main results suggest that, in all cases, stock market returns have been negatively affected by the increased policy uncertainty levels observed during the last decade. In fact, when own country's policy uncertainty is considered, this variable has a significant negative impact on stock returns for all the six Pacific-Rim countries considered. Furthermore, when the existence of international spillovers are considered, the results suggest that the US EPU shocks also have a negative and significant effect on the stock market returns in Canada, China, Japan and Korea, suggesting the existence of international uncertainty spillovers, as in Sum (2012a, 2012b) or Yin and Han (2014). On the contrary, we do not find evidence of negative US uncertainty spillovers on the stock market in Australia. As already suggested in Mensi et al. (2014, 2016) and Balcilar et al. (forthcoming), this result could be explained by the favorable opportunities that investors could gain by investing in this country after an increase in policy uncertainty levels in the US economy.

As part of future research, it would be interesting to conduct such an analysis, using a time-varying parameter and stochastic volatility based model as in Koop and Korobilis (2015), to analyze the impact of EPU shocks on stock markets over time.

Appendix A.

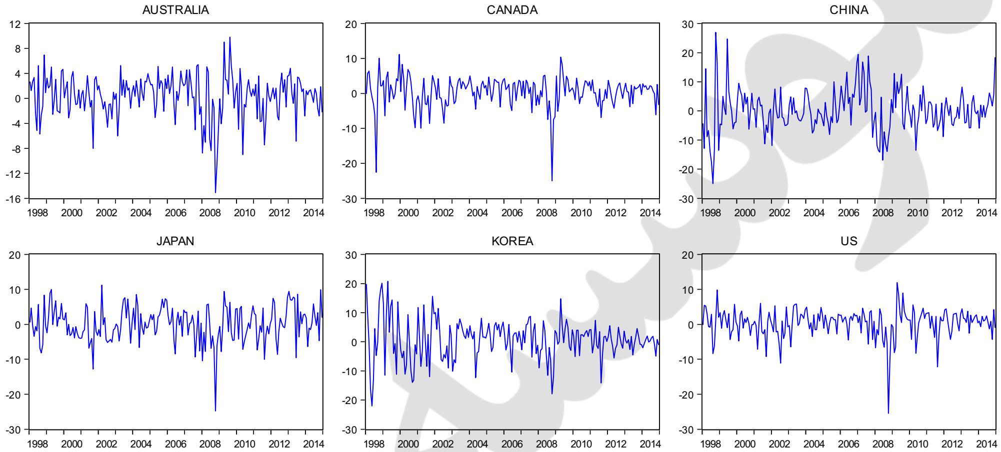

Fig. A1. Stock returns: 1998:M1-2014:M12.

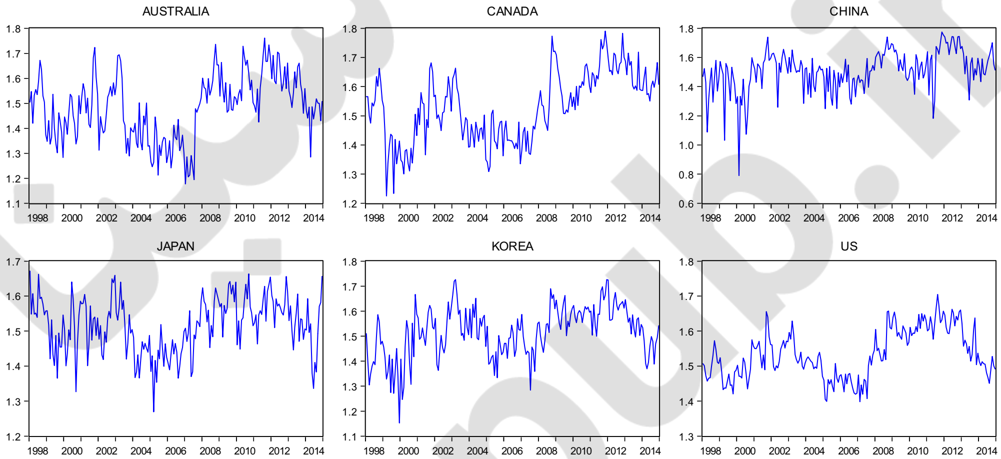

Fig. A2. Economic Uncertainty Policy (EPU) indices (in logs): 1998:M1-2014:M12.

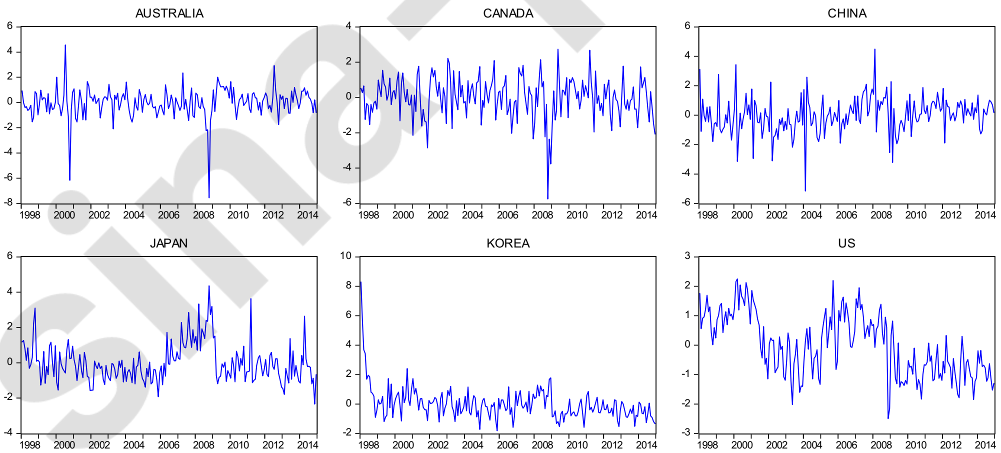

Fig. A3. Macroeconomic Factor: 1998:M1-2014:M12.

Table A1a
Summary Statistics of Stock Returns and EPU.

Statistic	Variable											
	Stock Returns						EPU					
	Australia	Canada	China	Japan	South Korea	US	Australia	Canada	China	Japan	South Korea	US
Mean	0.3690	0.3736	0.1637	0.0779	0.7863	0.3467	4.4433	4.6475	4.5620	4.5713	4.5796	4.6521
Median	0.9017	1.1911	0.0351	−0.0791	1.2833	0.9320	4.4790	4.6250	4.5846	4.6055	4.6050	4.5956
Maximum	9.8245	11.1872	26.9644	11.2563	20.7196	11.9270	5.8202	5.9911	5.8958	5.3217	5.6160	5.5018
Minimum	−15.1131	−24.9987	−24.9749	−24.7912	−22.0491	−25.4720	3.2450	3.4044	2.2046	3.5583	3.1640	4.0466
Std. Dev.	3.4354	4.3501	7.4013	5.0074	6.8316	4.0762	0.5681	0.5472	0.6048	0.3569	0.4580	0.3261
Skewness	−0.9139	−1.7852	0.3259	−0.5685	−0.0861	−1.6270	0.1242	0.1633	−0.5023	−0.1356	−0.1979	0.3191
Kurtosis	5.1617	11.2445	4.5185	4.9967	4.0264	10.7074	2.3875	2.3173	3.8104	2.4748	2.8189	2.1756
Jarque-Bera	68.1194	686.1195	23.2088	44.8761	9.2065	594.9289	3.7140	4.8688	14.1612	2.9693	1.6098	9.2390
Probability	0.0000	0.0000	0.0000	0.0000	0.0100	0.0000	0.1561	0.0877	0.0008	0.2266	0.4471	0.0099

Note: Std. Dev. stands for standard deviation; Probability corresponds to the Jarque-Bera test which tests the null hypothesis of normality.

Table A1b
Summary Statistics of the Macroeconomic Factor.

Statistic	Australia	Canada	China	Japan	South Korea	US
Mean	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Median	0.0864	0.0555	−0.0169	−0.1864	−0.1598	−0.0490
Maximum	4.5761	2.7284	4.4934	4.3549	8.2936	2.2539
Minimum	−7.5439	−5.7450	−5.1545	−2.3419	−1.8121	−2.5006
Std. Dev.	1.1364	1.1392	1.2145	1.0940	1.1076	1.0470
Skewness	−1.8234	−0.8145	−0.1516	1.1656	3.0684	0.0951
Kurtosis	16.2401	5.7437	5.1450	4.7758	20.6532	2.0948
Jarque-Bera	1603.0950	86.5423	39.8921	72.9967	2969.0030	7.2727
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0263

Note: See Notes to Table A1(a).

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