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A note on international spillovers of economic policy uncertainty across business cycles: evidence from OECD countries

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Abstract

We estimate a smooth-transition vector autoregression model (ST-VAR) using panel data from 14 OECD countries to study the cross-country spillover effects of economic policy uncertainty (EPU) shocks. An unexpected elevation of EPU originating abroad has an overall contractionary real effect, and the spillover effects depend on the state of the business cycle of the recipient country. EPU spillover shocks during recessions have stronger but less persistent effects on a number of economic indicators. We also find that the interconnectedness of EPU, financial markets, and business confidence are important channels for the EPU shocks to propagate across countries, while the trade channel has limited effects, especially during expansions.

Keywords: Economic policy uncertainty; spillover shocks; smooth transition vector autoregression; regime-dependent dynamics; business cycles

1. Introduction

A large literature that emerged after the Great Recession, including Baker et al. (2016), Pástor and Veronesi (2013), and Arbatli-Saxegaard et al. (2022), has found that economic policy uncertainty (EPU), the type of uncertainty relating to economic policy decisions, is an important driver of business cycles. EPU notably increased after major events that reduced the predictability of monetary policy, taxes, government spending, regulation, trade, and other economic policies. Elevated policy uncertainty imposes greater financial planning challenges for consumers and firms, thus reducing consumer spending, delaying investment and hiring, raising cost of financing, and undermining economic performance. A few studies, including Caggiano et al. (2014) and Popp and Zhang (2016), have found the effect of uncertainty shocks is dependent on the state of the economy, with stronger effects during recessions than expansions. There are also a few studies that examine the spillovers of EPU across countries, such as Colombo (2013), Caggiano et al. (2020), Biljanovska et al. (2021), Bhattarai et al. (2020), Fontaine et al. (2017), Gupta et al. (2019), and Huang et al. (2018).

We study the spillover effects of EPU shocks and their transmission mechanism in this paper. We ask three questions. How do domestic macroeconomic variables respond to an EPU shock originating abroad? Does the state of the economy, that is, recessions and expansions, matter for the response to an EPU spillover shock? What are the main channels for EPU shocks to spillover across countries?

To address these questions, we estimate a panel smooth-transition vector autoregression model (ST-VAR) for the following 14 OECD countries with available EPU data during 1998Q1–2017Q4: Australia, Canada, Chile, France, Germany, Greece, Ireland, Italy, Japan, South Korea, Mexico,

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Sweden, United Kingdom, and the USA. The panel ST-VAR assumes that the transitions across different states of the economy are smooth and allows for different dynamics in different states. To examine the transmission channels for the spillover effect, we perform a series of counterfactual analyses similar to Popp and Zhang (2016) that allow us to remove the influence caused by the endogenous response of a key variable. We examine the variables that represent four plausible transmission channels—countries' domestic EPU, interconnectedness of financial markets, business confidence, and trade.

We find that EPU shocks originating abroad have strong effects on major macroeconomic indicators during recessions of the recipient country, while the effects are much smaller during expansions. Our baseline estimation suggests that the maximum effect of an EPU spillover shock on real GDP and trade is more than twice the size in recessions than expansions. We also find that the reactions of financial markets and the interconnectedness of domestic EPU are important channels to allow EPU spillover effects during both regimes. The confidence channel is important during recessions but not in expansions. The trade channel has limited importance in both regimes.

Our contribution to the literature is threefold. First, we systematically study the impact of EPU spillover shocks among a large sample of major OECD countries on many economic indicators to draw more general conclusions about their effects. Most of the previous literature that studies the EPU spillover shocks focuses on those from or to the USA in a bilateral setting. For example, Colombo (2013) studied the EPU spillover shocks between the USA and EU. Caggiano et al. (2020) considers the effect of EPU shocks originating in the USA on Canada. Fontaine et al. (2017) studies the effects of Chinese EPU shocks on the USA. Bhattarai et al. (2020) studies the effect of US EPU shocks on a group of emerging economies. Second, we allow the spillover effects to vary across the state of business cycles. Our finding suggests that EPU spillover shocks lead to quantitatively and qualitatively different responses in a few major macroeconomic indicators between recessions and expansions. Third, we explore a number of possible transmission channels to understand how EPU shocks propagate across countries. Given the regime dependence of our model, we can not only study the importance of these channels overall but also explore the possible regime dependence of these channels.

The remainder of the paper is organized as follows. Section 2 presents our empirical methodology and describes the data. Section 3 reports our main empirical results. Section 4 studies the transmission channels of EPU spillover shocks. Section 5 concludes.

2. Empirical methodology

In this section, we explain the data and empirical methodology. Our empirical analysis is performed in two steps. We first construct the EPU spillover shocks by aggregating unanticipated innovations of EPU from the source countries. We then include the spillover shocks as exogenous regressors in a panel ST-VAR to assess their effects on the recipient countries. This method is similar to Auerbach and Gorodnichenko (2013) where they estimate fiscal spillover shocks and their effects. The ST-VAR framework assumes that the transitions across regimes (recession and expansions) are smooth. It allows differential responses to shocks that occur in different states of the economy and utilizes more information in the estimation than models that estimate each regime separately. All variables are transformed to ensure stationarity and demeaned (subtract the time average of own country) before they are used in the estimation.

2.1. Modeling economic policy uncertainty spillovers

To construct the EPU spillover shock *EPUShock*, we implement the following procedure:

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First, we estimate a VAR model for each country $q = 1, 2, \ldots, N$, to obtain the innovations for EPU e_q:

$$\Psi(0)\begin{bmatrix} V_{qt} \\ Y_t \\ FU_{qt} \\ EPU_{qt} \end{bmatrix} = \Psi(L)\begin{bmatrix} V_{q,t-1} \\ Y_{t-1} \\ FU_{q,t-1} \\ EPU_{q,t-1} \end{bmatrix} + \begin{bmatrix} e^V_{q,t} \\ e^Y_t \\ e^F_t \\ e_{q,t} \end{bmatrix}. \tag{1}$$

The VAR includes a set of domestic macroeconomic indicators V_q, a global real economic activity indicator Y that are common across all countries, a set of foreign EPU index FU_q, and the domestic EPU index EPU_q. V_q includes the domestic *CPI* inflation, real *GDP*, the short-term (policy) interest rate, the real exchange rate, and a stock price index in country q. We use the global real economic activity index by Killian (2009) for Y. The structural shocks to the *EPU* equation, e_q, capture the innovations to EPU in source country q that are orthogonal to common macroeconomic indicators and foreign influences. We interpret shocks e_q as domestic *EPU* shocks in country q. The VAR model specified in (1) is estimated by imposing a Cholesky structure with *EPU* ordered last.[1]

To measure the size of policy uncertainty spillover shocks to a recipient country i, we aggregate $e_{q,t}$ across source countries $q \neq i$ as follows:

$$EPUShock_{i,t} = \frac{\sum_{q\neq i} w_{iq,t} e_{q,t}}{\sum_{q\neq i} w_{iq,t}}, \tag{2}$$

where $EPUShock_{i,t}$ is the EPU spillover shocks to country i, and w_{iq} are the weights that capture the strength of the economic links between countries i and q. In the baseline case, we construct $w_{iq,t}$ using the trade intensity between country i and country q in base year 2005. We consider alternative constructions of the weights for robustness. Specifically, we consider constructing $w_{iq,t}$ (1) using country q's imports from country i in base year 1998; (2) using time-varying weights given by country q's imports from country i from the previous year; (3) using equal weights. Our results are qualitatively robust to alternative weighing schemes.[2]

2.2. Panel ST-VAR

After we construct the EPU spillover shocks to each country i, we include these exogenous regressors in a panel ST-VAR to assess their effects on a set of core macroeconomic variables. Suppose our sample includes N countries indexed by $i = 1, 2, \ldots, N$. The specification is as follows:

$$\begin{aligned} X_{i,t} = {} & f(z_{i,t-1})\Pi_R(L)X_{i,t-1} + [1 - f(z_{i,t-1})]\Pi_E(L)X_{i,t-1} \\ & + f(z_{i,t-1})\Lambda_R(L)EPUShock_{i,t} + [1 - f(z_{i,t-1})]\Lambda_E(L)EPUShock_{i,t} + u_{i,t}, \end{aligned} \tag{3}$$

$$f(z_{i,t}) = \frac{\exp(-\gamma z_{i,t})}{1 + \exp(-\gamma z_{i,t})}, \quad \gamma > 0, \quad var(z_{i,t}) = 1, \quad E(z_{i,t}) = 0. \tag{4}$$

where $X_{i,t}$ is an $M \times 1$ vector of macroeconomic variables of country i and $z_{i,t}$ is a regime transition indicator.[3] $u_{i,t}$ is a $M \times 1$ vector of reduced form residuals. Π_R and Π_E are $M \times M$ matrices of autocorrelation coefficients capturing the dynamics of X during recessions and expansions. Λ_R and Λ_E are $M \times 1$ vector of coefficients capturing the effect of uncertainty spillover shocks during the two regimes. For $\mathbf{u}_t = \left[u'_{1,t}, \ldots, u'_{N,t}\right]'$ and $\mathbf{z}_t = \left[z'_{1,t}, \ldots, z'_{N,t}\right]'$,

$$\mathbf{u}_t \sim N(\mathbf{0}_{NM\times 1}, \mathbf{\Omega}_t), \tag{5}$$

$$\mathbf{\Omega}_t = f(\mathbf{z}_{t-1})\mathbf{\Omega}_R + [\boldsymbol{I}_{NM\times 1} - f(\mathbf{z}_{t-1})]\mathbf{\Omega}_E, \tag{6}$$

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where $\mathbf{\Omega}_R$ and $\mathbf{\Omega}_E$ are $NM \times NM$ positive-definite covariance matrices for recession and expansion regimes, respectively.

In our baseline specification, $X_{i,t}$ includes eight core macroeconomic variables, ordered as CPI inflation, real consumption, real GDP, real exports, short-term interest rate, real effective exchange rate, stock price index, and *EPU*.

We follow the literature to select the transition indicator $z_{i,t}$ to be the seven-quarter moving average of GDP growth rate in country i, normalized to have zero mean and unit variance. $f(z)$, bounded between 0 and 1, is a logistic transition function that measures the probability or degree of being in a recession given z. Note that z enters the equation (3) with one period lag to avoid contemporaneous feedback from shocks to the state of the economy. The smoothness of the transition function is measured by parameter γ. Larger values of γ imply more abrupt switches from one regime to another. Intuitively, the above ST-VAR model assumes that the dynamics of X can be described by a linear combination of two linear VARs: one suited to describe the dynamics during recessions and the other suited to describe the dynamics during expansions. Small values of z during economic stress translate into large values of $f(z)$ near 1, resulting in a heavier weight of the recession-regime VAR in the characterization of the data in these periods. The model nests a standard linear VAR in the limiting cases when $f(z) = 0$ or $f(z) = 1$.

By adding the international spillover shocks *EPUShock* as exogenous regressors in the system, we assume that X_t and their lags cannot influence $EPUShock_t$. We think the assumption is reasonable given the way that $EPUShock_t$ is constructed. We also performed exogeneity tests based on whether X_t can Granger-cause $EPUShock_t$ using Bayesian information criteria (BIC) selected lags. At the 5% significance level, we cannot reject the hypothesis that X_t does not Granger-cause $EPUShock_t$.

The model is estimated using two lags as suggested by BIC criteria. Given the nonlinearity of the model,[4] we estimate the model using a Markov Chain Monte Carlo method as in Chernozhukov and Hong (2003) to find a global optimum and create confidence intervals. Detailed estimation strategy is discussed in the Section 1 of the online appendix.

2.3. Data

We use quarterly data from 1998Q1 to 2017Q4 to maximize the number of countries in our sample. Our sample includes $N = 14$ Organisation for Economic Co-operation and Development (OECD) countries, including Australia, Canada, Chile, France, Germany, Greece, Ireland, Italy, Japan, South Korea, Mexico, Sweden, United Kingdom, and the USA. This selection is based on the availability of EPU index data. The EPU index, proposed by Baker et al. (2016), is available for 23 economies with different lengths of observations going back as early as 1985. The index measures economic policy-related uncertainty based on newspaper frequency counts of relevant key words. Among the 23 economies with EPU data, we dropped non-OECD economies, including Brazil, China, Colombia, India, Hong Kong, Russia, and Singapore. We then exclude the Netherlands and Spain, which only have EPU data going back to 2003 and 2001, respectively. We convert the monthly index into a quarterly index by taking the monthly average within each quarter.

We obtain real GDP, consumption, investment, consumer price index (CPI), imports and exports, short-term interest rate, exchange rate, and share price indices data for the OECD countries from the Federal Reserve Economic Data (FRED) dataset by the Federal Reserve Bank of St. Louis. The bilateral import flow data is from the United Nations. The world economic activity index is from Killian's website. The EPU data is from www.policyuncertainty.com.

3. Results

This section presents our main empirical findings on the effects of EPU spillover shocks on the main macroeconomic indicators.

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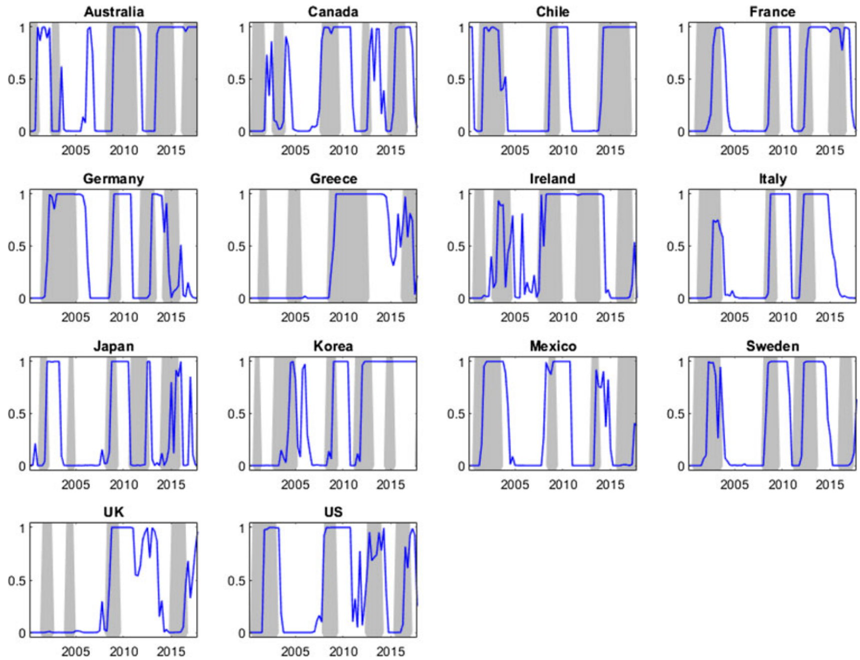

Figure 1. Probabilities of recessions.

3.1. Estimated probability of recession

Parameter γ measures the smoothness in the transition function $f(z)$. Figure 1 presents the probability of being in the recession regime based on the estimated transition indicators and the mean value $\bar{\gamma} = 13.8$ from the draws. The shaded areas are the recession periods according to OECD-Based Recession Indicators from FRED, which are constructed using the Turning Points and Component Series of OECD Composite Leading Indicators. As Figure 1 shows, though only GDP growth rate is used in the estimation of our transition indicators, the estimated function $f(z)$ successfully replicates most of the recession episodes from the OECD Recession Indicators in these countries and the global economic downturn of 2007−2010.

3.2. Regime-dependent impulse responses

We present the impulse responses from our baseline specification in Figure 2. The shock is a one-standard-deviation (STD) positive shock to *EPUShock*, which measures the spillover effect of an unexpected elevation of international EPU. The black and red lines are median responses in the expansion and recession regimes. The gray and pink shaded areas are 68% confidence bands (CI). The responses for consumption, output, exports, price, and real exchange rate are reported in the STD of their first log difference (i.e. quarterly growth rate), and the responses to interest rate and *EPU* are in the STD of their level and logarithmic level, respectively.

There are two main observations from Figure 2. First, there are significant spillover effects caused by *EPU* shocks that originated abroad. During most reported horizons in both regimes, a positive *EPU* spillover shock leads to elevated domestic EPU, and lower inflation, consumption, output, exports, stock market returns, domestic interest rate, and real exchange rate. The shock's effects are similar to a contractionary aggregate demand shock.

Second, the shock has quantitatively and qualitatively different effects on many reported macroeconomic variables across regimes. In particular, the *EPU* spillover shocks that occur during

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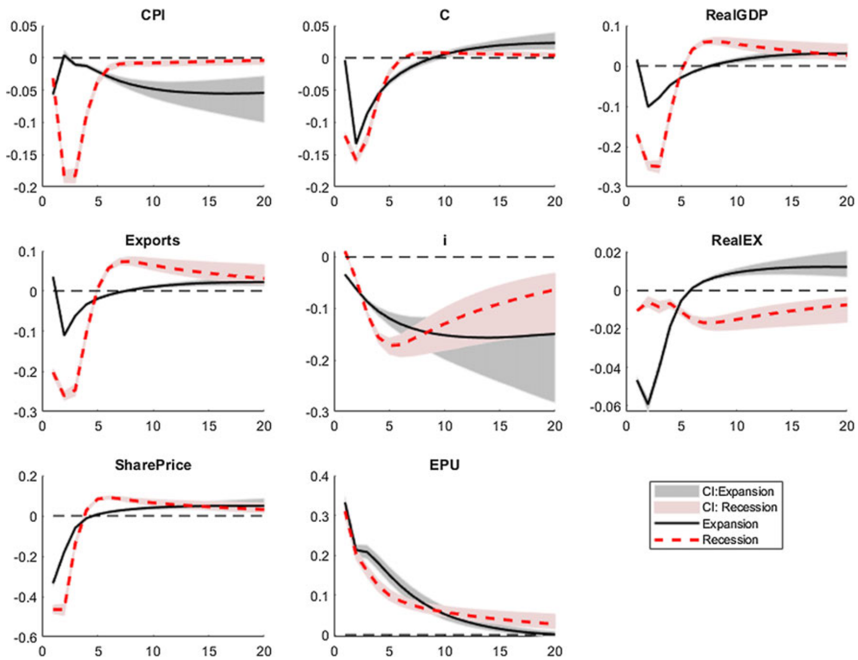

Figure 2. Effects of EPU spillover shocks during recessions and expansions.

the recession periods have much stronger and less persistent negative effects on most real economic indicators than those that occur during expansions. For example, a unit STD shock leads to a maximum contraction of 0.249 STD in real GDP growth during recessions compared to 0.102 STD during expansions. When the shock occurs during recessions, real GDP responds with an immediate and sharp decline, quick recovery, and small overshoot after five quarters. The shock that occurs during expansions causes a decline in GDP starting from the second quarter to the eighth quarter before overshooting, and the decline is nearly half than the decline during recessions. Consumption and exports respond abruptly and strongly followed by faster recovery during recessions, with the contractionary effect lasting only 5–6 quarters. During expansions, the effects of spillover shocks on consumption and exports are more modest and persistent. Compared to output and exports, the cross-regime difference in the maximum impact on consumption is smaller, possibly because the lower prices during recessions mitigates the effects of the spillover shocks on consumption during recessions. In recessions, the share price index decreases with a larger magnitude on impact and recovers faster with overshooting after four quarters. Inflation declines sharply initially with a slow recovery during recessions. The shock that occurs during expansions causes a smaller decline in the short run but persistently lowers inflation afterwards. For the domestic EPU, the shock has a similar immediate positive impact between the regimes, but the effect is less persistent during recessions than expansions. In contrast to other real measures, the real exchange rate exhibits a larger initial decline, recovers more quickly, and overshoots after six quarters during expansions. *EPU* spillover shocks have smaller and more persistent negative effects on the real exchange rate during recessions.

4. The transmission channels of uncertainty spillovers

The previous section documented that unexpected elevations in EPU from abroad have contractionary real effects domestically. But how do the spillover effects occur? In this section, we would like to examine the possible transmission channels and their relative importance. We proceed by

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presenting the methodology that allows us to examine the role of a channel and then by applying the method to breakdown the possible transmission channels.

4.1. Strategy

To examine the importance of the possible transmission channels, we perform the following counterfactual experiments that allow us to isolate the role of one particular channel at a time. The basic idea is to assume an economy with the same underlying economic environment as described by Equations (3) and (4), except that the international EPU spillover shocks are restricted not to affect one particular macroeconomic variable that directly links to the transmission channel of interest, so any propagation effect caused by the response of the variable is removed. For example, to study the importance of the trade channel, we restrict that the EPU spillover shocks do not affect exports (imports) at *all* horizons, so the shock's influence on other macroeconomic variables *through trade* is shut down. We then compare the baseline responses (unrestricted) and restricted responses to examine the importance of the channel.

Specifically, conditional on a particular regime $s = E, R$, the VAR system (3) and (4) is linear with regime-specific parameters. We rewrite the VAR system in the structural form:

$$A_0^{(s)}\mathbf{X}_t = \sum_{k=1}^{K} A_k^{(s)}\mathbf{X}_{t-k} + \sum_{k=1}^{K} B_k^{(s)}\mathbf{EPUShock}_{t-k+1} + \boldsymbol{\varepsilon}_t, \tag{7}$$

where $s = E, R$. Parameters with superscript (s) indicate the parameter estimates conditional on the regime. $\boldsymbol{\varepsilon}_t$ is a vector of orthogonal structural shocks given by $\boldsymbol{\varepsilon}_t = A_0^{(s)}\mathbf{u}_t$ where $A_0^{(s)}$ is a lower-triangular regime-dependent impact matrix.

Let e_i be a $1 \times M$ selection row vector with a one in the i^{th} place and zeros elsewhere, $A_0^{(s)\,\text{-}1}(i)$ be the ith column of the matrix $A_0^{(s)\,\text{-}1}$, and $A_0^{(s)\,\text{-}1}B_k^{(s)}(i)$ be the i^{th} element of the vector $A_0^{(s)\,\text{-}1}B_k^{(s)}$. The impulse response of variable i to a unit *EPU* spillover shock at horizon h in regime s is

$$\delta_{i,h}^{(s)} = \sum_{q=1}^{\min(h,K)} e_i \Phi^{(s)\,h-q}\, A_0^{(s)\,\text{-}1} B_q^{(s)}(i).$$

where Φ is the companion matrix defined as:

$$\Phi^{(s)} = \begin{bmatrix} A_0^{(s)\,\text{-}1}A_1^{(s)} & A_0^{(s)\,\text{-}1}A_2^{(s)} & \dots & \dots & A_0^{(s)\,\text{-}1}A_K^{(s)} \\ I & 0 & 0 & \dots & 0 \\ 0 & I & 0 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & \dots & \dots & I & 0 \end{bmatrix}.$$

Meanwhile, the impulse response of variable i to a unit size structural shock to endogenous variable j at horizon h is $e_i\Phi^{(s)\,h-1}\,A_0^{(s)\,\text{-}1}(j)$.

Suppose, we would like to shut down the effect of EPU spillover shocks channeled by variable j. We need to restrict the response of variable j at all horizons $h = 1, 2, \dots, H$ to be zero. This is achieved by creating a sequence of hypothetical structural shocks to variable j, $\{\tilde{\varepsilon}_{j,h}^{(s)}\}_{h=1,\dots,H}$, so that the created shocks offset the effect of the spillover shock on variable j at *all* horizons.

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In the first period, to shut down the effect of a one unit shock in *EPUShock* on variable j on impact, $\tilde{\varepsilon}^{(s)}_{j,1}$ must satisfy

$$\delta^{(s)}_{j,1} + A^{(s)\,\text{-}1}_0(j,j)\tilde{\varepsilon}^{(s)}_{j,1} = 0, \;\; \text{or } \tilde{\varepsilon}^{(s)}_{j,1} = -\frac{A^{(s)\,\text{-}1}_0 B^{(s)}_1(j)}{A^{(s)\,\text{-}1}_0(j,j)}.$$

The subsequent shocks $\{\tilde{\varepsilon}^{(s)}_{j,h}\}_{h=2,\ldots,H}$ starting from the second period can be computed recursively by solving

$$\delta^{(s)}_{j,h} + \sum_{q=1}^{h-1} e_j \Phi^{(s)\,h-q} A^{(s)\,\text{-}1}_0(j)\tilde{\varepsilon}^{(s)}_{j,q} + A^{(s)\,\text{-}1}_0(j,j)\tilde{\varepsilon}^{(s)}_{j,h} = 0.$$

The solution yields the shock sequence:

$$\tilde{\varepsilon}^{(s)}_{j,h} = -\frac{\delta^{(s)}_{j,h} + \sum_{q=1}^{h-1} e_j \Phi^{(s)\,h-q} A^{(s)\,\text{-}1}_0(j)\tilde{\varepsilon}^{(s)}_{j,q}}{A^{(s)\,\text{-}1}_0(j,j)}, \quad h = 2, \ldots, H.$$

Given $\{\tilde{\varepsilon}^{s}_{j,h}\}_{h=1,\ldots,H}$ and unrestricted impulse responses, we can construct the hypothetical impulse responses (restricted) of any variable i in the VAR system to a unit shock to *EPUShock* as:

$$\tilde{\delta}^{(s)}_{i,h} = \delta^{(s)}_{i,h} + \sum_{q=1}^{h} e_i \Phi^{(s)\,h-q} A^{(s)\,\text{-}1}_0(j)\tilde{\varepsilon}^{(s)}_{j,q}, \;\; i = 1, 2, \ldots, M.$$

Comparing the restricted responses $\tilde{\delta}^{(s)}_{i,h}$ to the baseline unrestricted responses $\delta^{(s)}_{i,h}$ allows us to examine the importance of variable j in transmitting the effects of the *EPUShock* to variable i.

4.2. Possible channels

We apply the above method to our model and examine a few possible transmission channels.

4.2.1. Interconnected economic policy uncertainty

Given the increasing interconnectedness of the global economy, policymakers may need to respond not only to changes in domestic economic conditions but also to shocks emanating from abroad, including policy changes. When uncertainty rises about the economic policies that foreign policymakers may adopt, it makes deciding the country's own economic policy more challenging and increases domestic policy uncertainty. As shown in Figure 2, the EPU spillover shocks significantly increase the domestic EPU level. An increase in domestic policy uncertainty, in turn, has contractionary effects on its economy. A large literature that focuses on the local effects of policy uncertainty, including Bloom (2014), Caldara et al. (2016), Baker et al. (2016), and Bloom et al. (2018), finds that higher uncertainty can reduce both investment and hiring, make households too cautious in spending, increase risk premium in financial markets, and undercut productivity growth by resource misallocation.

Using the method described in Section 4.1 and comparing the impulse responses with and without the endogenous responses in domestic EPU, we find that the domestic EPU channel is an important transmission channel for international EPU spillover shocks, especially during expansions. As shown in Figure 3, the spillover shocks during expansions have significantly smaller and less persistent contractionary effects on important real economic indicators once the channel is shut down. Removing the EPU channel reduces the maximum responses in real GDP, consumption, and exports by 54.2%, 46.8%, and 31.2% during expansions, and the declines in real GDP,

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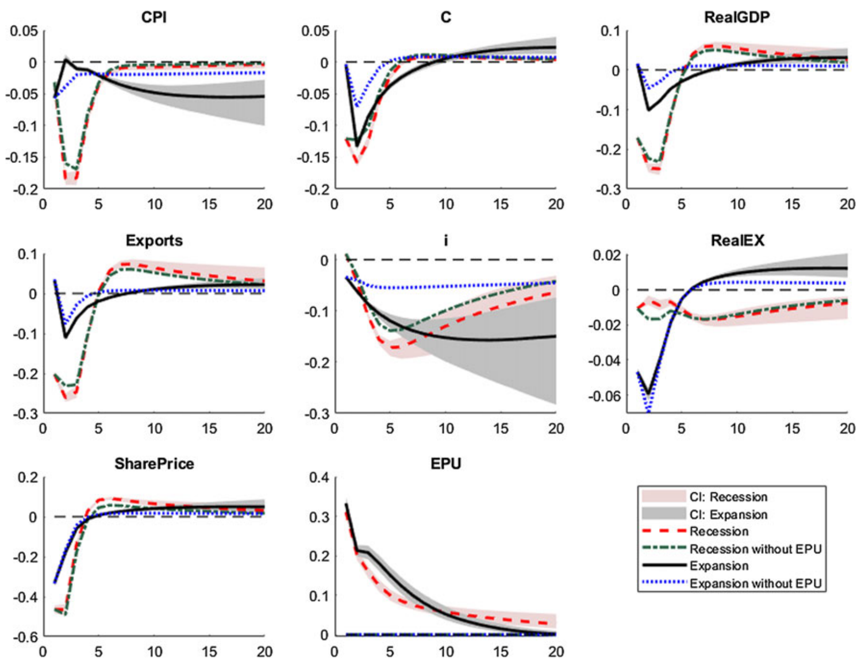

Figure 3. Impulse responses after removing the endogenous responses in EPU.

consumption, and exports only last four quarters in expansions, compared to 7–8 quarters in the unrestricted baseline. During recessions, removing the EPU channel reduces the maximum responses in real GDP, consumption, and exports by 7.0%, 22.4%, and 11.3%, but it does not shorten the duration of real contractions caused by the EPU spillover shocks.

4.2.2. Financial channel

A literature, including Gilchrist et al. (2014) and Popp and Zhang (2016), finds that the financial channel is important for transmitting domestic uncertainty shocks. We also explore the role of the financial channel in transmitting international spillovers of EPU shocks. Our ST-VAR includes stock market returns, measured by the first log differences in share price indices, to proxy the financial market conditions in our sample countries. An unexpected elevation of uncertainty in another country can increase the degree of financial stress domestically, and through the international connectedness of the financial markets and financial institutions, such shocks can have spillover effects on financial conditions. The changes in financial conditions then affect the availability of credit, and the liquidity and risk premium required by investors in the affected country, propagating the effects of the spillover EPU shocks on its macroeconomic variables.

Figure 2 shows that a positive EPU spillover shock lowers stock market returns, consistent with this intuition. Figure 4 reports the IRFs when the share price indices are restricted not to move after the shock occurs. We have two main comments. First, the financial channel is an important transmission channel in both regimes. Though the initial responses to the shock remain similar, removing the financial channel significantly reduces the subsequent responses to the shock and lowers the persistence of the shock's effect on many real macroeconomic indicators. There is a 68.1%, 68.2%, and 80.3% reduction in the maximum responses of consumption, output, and export during expansions, and a 23.6%, 31.6%, and 22.6% reduction during recessions. Second, the restricted impact of the shocks is more front-loaded during recessions. Over 50% of the maximum impact on real GDP is recovered by the second quarter during recessions and by the third

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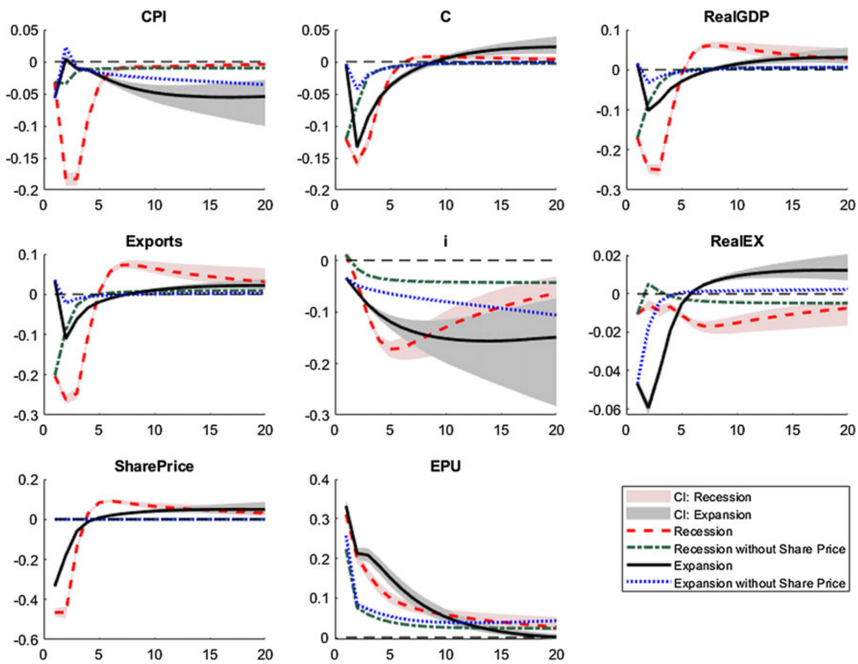

Figure 4. Impulse responses after removing the financial channel.

quarter during expansions, while it takes 4–5 quarters in the unrestricted baseline. This result suggests that the endogenous responses of the financial conditions make the shock effects more persistent and longer-lasting.

4.2.3. Confidence

Confidence is likely another channel for EPU spillover shocks, since elevated global uncertainty creates anxiety for households and firms. Their caution in spending, investment, and hiring decreases domestic aggregate demand. To examine this channel, we estimated our model with the business confidence index (BCI) from OECD following the same method described in Section 4.1. To see the importance of the confidence channel, we restrict the BCI index to remain fixed when there is a spillover shock *EPUShock*. The BCI index is not available for Ireland prior to 2008Q4 and for Canada prior to 1998Q3, so we remove Ireland from our sample and adjust the sample period to 1998Q4−2017Q4. We re-estimate equations (1)−(4) to include the BCI index using the reduced sample, and the result is reported in Figure 5. First, we observe that business confidence falls significantly following a positive EPU spillover shock during recessions, while the effect is much smaller during expansions. Second, the confidence channel appears to be important during recessions but not in expansions. During recessions, removing the BCI responses lowers the maximum response of real GDP and exports by 23.2% and 24.1%. We do not observe that the channel is as important during expansions, since the impulse responses are similar with and without the endogenous response in the BCI index during this state.

4.2.4. International trade

Another possible transmission channel is through trade. Higher policy uncertainty in source countries contracts their own economies, leading to lower demand for goods produced domestically and abroad. Therefore, exports from the recipient country may be lower.

As illustrated in Figure 2, exports from the recipient country fall following uncertainty spillover. To examine the importance of the trade channel, we restricted exports to be fixed when

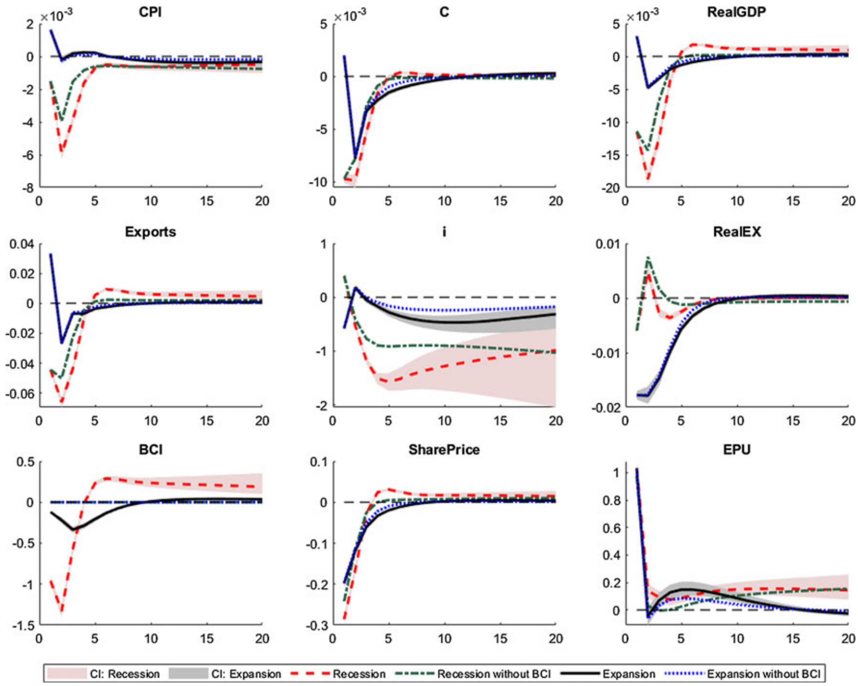

Figure 5. Impulse responses after removing the BCI index.

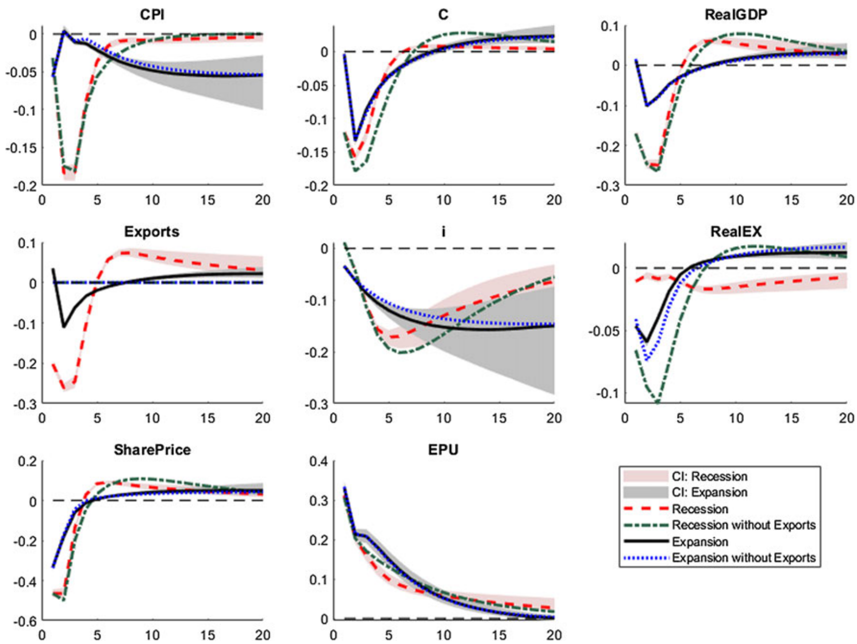

Figure 6. Impulse responses after removing exports.

the EPU spillover shock occurs. Figure 6 plots the baseline IRFs when exports are free to change and the restricted IRFs with the trade channel shut down. We do not find that the trade channel is important in EPU spillovers to many of the economic indicators, most importantly real GDP growth. In either regime, the baseline unrestricted responses and restricted responses of real GDP

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to the spillover shocks are similar, suggesting weak propagation effects via trade. This result suggests that the the lower exports caused by lower foreign demand could be offset by higher domestic demand, possibly due to lower domestic prices and decreasing real exchange rate, leaving the real output responses similar between the two cases.

During recessions, the trade channel does appear to affect the way that the real exchange rate and consumption respond to the spillover shocks. Shutting down the movements of exports and its propagation, the EPU spillover shocks would have further lowered consumption in the short−medium run and makes their response more sluggish, though the effect is small. The real exchanges rate would also have had a significantly larger decline in the short−medium run, especially during recessions.

To check for robustness of this result, we estimated (1)−(4) with imports replacing exports as a measurement of trade flow. We also explored the effect of shutting down real exchange rate movements instead of exports. We find our results robust to these alternative specifications.[5]

5. Conclusion

We study the spillover effects of EPU shocks using ST-VAR among major OECD countries. We find that an unanticipated increase in the EPU originating in other countries has significant effects on many macroeconomic indicators, and the overall effect is similar to a negative aggregate demand shock. In addition, we find that the responses to EPU spillover shocks depend on the state of the economy of the recipient countries. Shocks that occur during recessions have stronger and less persistent real effects than those that occur during expansions. To examine the transmission channel of the EPU spillover shocks, we perform a number of counterfactual exercises that allow us to shut down the endogenous responses of a variable at a time. We find that the interconnectedness of economic policies and financial markets across countries are important channels for the EPU shocks to propagate across countries in both regimes. The confidence channel is also important in recessions. The trade channel has limited effect, especially during expansions.

Supplementary materials. To view supplementary material for this article, please visit https://doi.org/10.1017/S1365100522000748.

Notes

1 Though using a recursive assumption is common in the literature, there is little consensus on the ordering of uncertainty given the endogenous nature of the variables. We perform a robustness check to place uncertainties first in equation (1). We do not find the results sensitive to the alternative ordering. The result is available in Section 3.2 of the online appendix.
2 The results are available in Section 3.1 of the online appendix.
3 There is no country-fixed effect as we demeaned the variables by subtracting their country-specific average. Section 2 in the online appendix provides a detailed description of the data and the transformation methods.
4 BIC suggests that a nonlinear model is preferred over a linear model.
5 Please see Section 3.4 in the online appendix for these results.

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