

A Service of

ZBW

Leibniz-Informationszentrum Wirtschaft Leibniz Information Centre for Economics

Raunig, Burkhard

## Working Paper Economic Policy Uncertainty and Stock Market Volatility: A Causality Check

Working Paper, No. 234

**Provided in Cooperation with:** Oesterreichische Nationalbank (OeNB), Vienna

*Suggested Citation:* Raunig, Burkhard (2021) : Economic Policy Uncertainty and Stock Market Volatility: A Causality Check, Working Paper, No. 234, Oesterreichische Nationalbank (OeNB), Vienna

This Version is available at: https://hdl.handle.net/10419/264826

#### Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

#### Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



# WWW.ECONSTOR.EU



# WORKING PAPER 234

Economic Policy Uncertainty and Stock Market Volatility: A Causality Check

Burkhard Raunig

The Working Paper series of the Oesterreichische Nationalbank is designed to disseminate and to provide a platform for discussion of either work of the staff of the OeNB economists or outside contributors on topics which are of special interest to the OeNB. To ensure the high quality of their content, the contributions are subjected to an international refereeing process. The opinions are strictly those of the authors and do in no way commit the OeNB.

The Working Papers are also available on our website (http://www.oenb.at) and they are indexed in RePEc (http://repec.org/).

Publisher and editor	Oesterreichische Nationalbank					
	Otto-Wagner-Platz 3, 1090 Vienna, Austria					
	PO Box 61, 1011 Vienna, Austria					
	www.oenb.at					
	oenb.info@oenb.at					
	Phone (+43-1) 40420-6666					
	Fax (+43-1) 40420-046698					
Editorial Board of the Working Papers	Doris Ritzberger-Grünwald, Ernest Gnan, Martin Summer					
Coordinating editor	Martin Summer					
Cover Design	Information Management and Services Division					
DVR 0031577						
ISSN 2310-5321 (Print) ISSN 2310-533X (Online)						

© Oesterreichische Nationalbank, 2021. All rights reserved.

# Economic Policy Uncertainty and Stock Market Volatility: A Causality Check

#### Burkhard Raunig\*

May 18, 2021

#### Abstract

Using causal graphs, this paper develops a simple check to uncover the direction of the causal link between economic policy uncertainty and stock market volatility. The check is applied to monthly data for 22 countries. The results imply that uncertainty is an instantaneous cause of stock market volatility. Estimates suggest that stock market volatility increases by 0.15% to 0.85% after a 1% increase in economic policy uncertainty.

Keywords: Causal inference; Causal graph; Economic policy uncertainty; Stock market volatility

<u>JEL codes</u>: C12, D80, E66, G10

<sup>\*</sup>Oesterreichische Nationalbank, Economic Studies Division, Otto-Wagner-Platz 3, A-1090 Vienna, Austria, Phone (+43-1) 404 20-7219, e-mail: burkhard.raunig@oenb.at. The views expressed in this paper do not necessarily reflect those of the Oesterreichische Nationalbank or the Eurosystem.

#### Non-Technical Summary

Empirical modeling that involves economic policy uncertainty (EPU) indices and measures of stock market volatility often requires an assumption about the causal relationship between these two variables. Using causal graphs, this paper develops a simple check to uncover the direction of the causal link between EPU and stock market volatility.

The check considers the causal links between domestic EPU, external EPU, and stock market volatility. The check is applied to monthly data for 22 countries. The empirical results suggest that domestic EPU and external EPU are both instantaneous causes of stock market volatility.

A further graphical analysis shows that the check is informative and robust against certain types of omitted variables. Estimates from a simple econometric model that is consistent with the results of the check suggest that a 1% increase in unexpected EPU leads to an increase in stock market volatility in a range of 0.15% to 0.85%.

### 1 Introduction

Economic policy uncertainty (EPU) and financial market volatility tend to move together. But does EPU cause volatility, or is EPU a result of volatile financial markets? Which assumption is more appropriate in empirical modeling that involves both variables?<sup>1</sup> EPU may create uncertainty about future cash flows and discount factors and thereby increase financial market volatility (Pástor and Veronesi, 2012). But volatile financial markets could also be a source of EPU (Ajmi et al., 2015; Antonakakis et al., 2013).<sup>2</sup>

Using causal graphs and d-separation (Pearl, 1995, 2009; Peters et al., 2017), this paper develops a simple check to uncover the causal relationship between EPU, as measured by monthly EPU indices (Baker et al., 2016), and stock market volatility. The check is applied to 22 countries. The results suggest that EPU is an instantaneous cause of stock market volatility. An additional graphical analysis shows that the check is informative and robust against certain types of omitted variables.

A simple econometric model suggests that an unexpected 1% increase in domestic EPU increases stock market volatility by 0.15% to 0.85%. An unexpected 1% increase in US EPU increases stock market volatility in other countries by 0.3% to 0.6%.

### 2 Preliminaries

Causal graphs express causal relationships between variables. In a causal graph the variables are the nodes, edges indicate links between the nodes, and arrowheads indicate the causal direction of the links. A path is a sequence of nodes connected by edges (ignoring arrowheads).



Figure 1: Basic causal configurations.

Figure 1 shows three causal graphs for random variables i, j, and m. The graphs are directed

<sup>&</sup>lt;sup>1</sup>The fast growing literature about uncertainty, business cycle fluctuations and financial markets includes Berger et al. (2020), Bloom (2009), Boutchkova et al. (2012), Jurado et al. (2015), Krol (2014), Liu and Zhang (2015), and Ludvigson et al. (forthcoming), among others. On causality in economics and econometrics, see Hoover (2001) and Hoover (2008).

 $<sup>^{2}</sup>$ Another, rather unlikely possibility is that volatility and EPU are entirely unrelated and determined by a third variable.

acyclic graphs (DAGs) because all links have directions and there are no cyclical paths. What happens if m is held constant in these basic causal configurations?

In the fork,  $i \leftarrow m \rightarrow j$ , the variable m causes i and j, and conditioning on m blocks the path between i and j. In the chain,  $i \rightarrow m \rightarrow j$ , the variable m mediates the effect of i on j. Again, conditioning on m blocks the path between i and j. Ignoring m keeps the path open. In the third configuration,  $i \rightarrow m \leftarrow j$ , the variable m is a collider - a joint outcome of i and j. Here, conditioning on m unblocks the path between i and j because holding m constant introduces a selection bias that creates correlation between i and j. The path remains blocked if m is ignored.

*D-separation* identifies independence relations in causal graphs and translates them into probabilistic independence relations.<sup>3</sup> A path between nodes A and B in a DAG G can be d-separated (blocked) by a set of nodes C in two ways. The path either contains a chain,  $i \longrightarrow m \longrightarrow j$ , or a fork,  $i \longleftarrow m \longrightarrow j$ , and m is in C. Or, the path contains a collider,  $i \longrightarrow m \longleftarrow j$ , and m (or any of its descendants) is not in C (Pearl (2009), Theorem 1.2.3).

If a set C blocks all paths between A and B in a DAG G, then A and B are d-separated by C, denoted as  $(A \perp B \mid C)_G$ . Then A is independent of B conditional on C, denoted as  $(A \perp B \mid C)_P$ , in every distribution P that is compatible with the DAG G.<sup>4</sup> If A and B are not d-separated by C, then they are dependent conditional on C in at least one distribution Pcompatible with the DAG G (Pearl (2009), Theorem 1.2.4).

As a result, d-separation can be applied to a causal graph to identify testable empirical implications of the implied causal model. Moreover, the configurations in Figure 1 help to uncover causal links between variables.

#### 3 Causality check

The check assumes that domestic EPU, external EPU, and past stock market volatility are structural causes of stock market volatility. Other causes of stock market volatility are assumed to be unsystematic (Gerlach et al., 2006).

The DAG in Figure 2 shows the assumed links between domestic EPU (x), external EPU (ex) and stock market volatility (y). EPU in month m - 1 can affect EPU and volatility in month m. Past volatility can also affect current volatility. External EPU can affect volatility directly and indirectly via spillovers to domestic EPU (Klößner and Sekkel, 2014). The US

<sup>&</sup>lt;sup>3</sup>D stands for "directional".

<sup>&</sup>lt;sup>4</sup>A distribution is (Markov) compatible with a DAG G if it admits a factorization that is implied by G.



Figure 2: Domestic EPU (x) and external EPU (ex) cause stock market volatility (y).

EPU is the external EPU for the other countries due to the global economic importance of the USA. European EPU is the external EPU for the USA. The variables  $u_m^x$ ,  $u_m^{ex}$ , and  $u_m$  indicate mutually independent unsystematic causes of domestic EPU, external EPU, and stock market volatility.<sup>5</sup>



Figure 3: Stock market volatility (y) causes domestic EPU (x).

The check empirically examines a *local* property of the DAG in Figure 2, namely whether  $y_m$  is a collider along the path  $(y_{m-1}, y_m, x_m)$ . If  $y_m$  is found to be a collider, then domestic EPU is a contemporaneous cause of stock market volatility. Otherwise, stock market volatility causes domestic EPU.

The first step of the check examines whether  $y_{m-1}$  and  $y_m$  are d-connected when  $x_{m-1}$  and  $ex_{m-1}$  are held constant. The second step examines whether  $y_{m-1}$  and  $x_m$  are d-connected if  $y_m$  can vary and  $x_{m-1}$  and  $ex_{m-1}$  are held constant.

If  $y_{m-1}$  is d-connected with  $y_m$  and  $x_m$  as in Figure 3, then  $y_m$  or (and)  $y_{m-1}$  are causes of  $x_m$ . Either  $y_m$  causes  $x_m$  as in link (1), or  $y_{m-1}$  causes  $x_m$  as in link (2), or both links exist.

<sup>&</sup>lt;sup>5</sup>To avoid clutter, unsystematic causes are suppressed from now on.

However, if  $y_{m-1}$  is only d-connected with  $y_m$ , but not with  $x_m$ , then  $y_m$  is a collider as in Figure 2 and  $x_m$  is a cause of  $y_m$ .

For simplicity, let us assume linear relationships and multivariate normally distributed variables. Then (conditional) uncorrelatedness implies (conditional) independence and the check can be based on two auxiliary regressions.<sup>6</sup>

The first regression,

$$y_m = b_0 + b_1 y_{m-1} + b_2 x_{m-1} + b_3 e x_{m-1} + r_m, \tag{1}$$

examines whether  $y_{m-1}$  and  $y_m$  are d-connected. Conditioning on  $x_{m-1}$  and  $ex_{m-1}$  isolates the link from  $y_{m-1}$  to  $y_m$ , and  $y_{m-1}$  is d-connected with  $y_m$  if  $b_1 \neq 0$ .

The second regression,

$$x_m = c_0 + c_1 y_{m-1} + c_2 x_{m-1} + c_3 e x_{m-1} + r_m,$$
(2)

examines whether  $y_{m-1}$  and  $x_m$  are d-connected conditional on  $x_{m-1}$  and  $ex_{m-1}$ . As  $y_m$  can vary it does not appear in Equation 2.

If  $b_1 \neq 0$  and  $c_1 \neq 0$ , then  $y_{m-1}$  is d-connected with  $y_m$  and  $x_m$ . Stock market volatility is then a cause of domestic EPU. Note that  $c_1 \neq 0$  does not rule out domestic EPU as a cause of stock market volatility. Arrow (1) in Figure 3 could point from  $x_m$  to  $y_m$  and  $c_1 \neq 0$  because of a direct link (2) from  $y_{m-1}$  to  $x_m$ .

In contrast, if  $b_1 \neq 0$  and  $c_1 = 0$ , then  $y_{m-1}$  and  $x_m$  are d-separated and  $y_m$  is a collider. This implies that domestic EPU is an instantaneous cause of stock market volatility. In addition,  $c_1 = 0$  also implies that there are no other unblocked links between  $y_{m-1}$  and  $x_m$ .

An analogous check can be carried out for external EPU. The second regression becomes

$$ex_m = d_0 + d_1 y_{m-1} + d_2 x_{m-1} + d_3 e x_{m-1} + r_m,$$
(3)

and  $b_1 \neq 0$  and  $d_1 = 0$  implies that external EPU is an instantaneous cause of volatility because  $y_m$  is a collider along the path  $(y_{m-1}, y_m, ex_m)$ .

In order to exclude pathological cases in which  $c_1 = 0$  or  $d_1 = 0$  occurs due to special (or "tuned") parameter constellations, we need a "stability" or "faithfulness" condition. Faithfulness implies that the independence relations embedded in the probability distribution generated by a causal model are stable and match with the independence relations implied by the DAG (Peters et al. (2017), chap. 6, Pearl (2009), chap. 2).

 $<sup>^{6}\</sup>mathrm{More}$  general assumptions require more sophisticated conditional independence tests, but the steps of the check remain the same.

#### 4 Data

The data cover Australia, Brazil, Canada, Chile, China, Croatia, France, Germany, Greece, India, Ireland, Italy, Japan, Mexico, Netherlands, Russia, Singapore, South Korea, Spain, Sweden, United Kingdom, and the USA. The sample period is March 2003 to February 2020.

EPU is measured by monthly EPU indices which are based on keyword searches in a county's most important newspapers.<sup>7</sup> The European EPU index covers France, Germany, Italy, Spain and the UK and is based on two newspapers per country.

Stock market volatility is calculated for a county's leading stock index. The daily index values  $I_t$  come from the Macrobond database. The daily index returns  $r_t = 100(ln(I_t) - ln(I_{t-1}))$  are first regressed on  $r_{t-1}$  to remove any predictability in the first moment of the returns. Then volatility is computed from the absolute values  $|e_i|$  of the regression residuals as

$$\sigma_m = a \sqrt{\frac{\pi}{2}} \sum_{i=1}^{D_m} \frac{|e_i|}{D_m},\tag{4}$$

where  $D_m$  denotes the number of trading days in month m,  $a = \sqrt{252}$  converts daily volatility into annualized volatility, and  $\sqrt{\pi/2}$  accounts for using absolute values to obtain a measure of volatility that is more robust to extreme observations (Schwert, 1989; Ederington and Guan, 2005).

#### 5 Empirical results

In the check EPU and volatility enter in logarithms to ensure that the variables are always positive. The transformation also removes most of the skewness in the distribution of the original data and yields data that are much closer to the normal distribution. There are 204 observations available for each country.

Table 1 reports the estimates for  $b_1$ ,  $c_1$ , and  $d_1$  in (1), (2) and (3) and p-values for t-tests for zero coefficients. The coefficient  $b_1$  is, Greece aside, always large and highly statistically significant. In contrast,  $c_1$  and  $d_1$  are typically close to zero and almost never statistically significant at usual levels. Hence, past stock market volatility is almost always found to be dseparated from domestic and external EPU. This suggests that domestic and external EPU are both instantaneous causes of stock market volatility. If we also allow the possibility that EPU

<sup>&</sup>lt;sup>7</sup>For the USA the keywords are: "economic" or "economy", "uncertain" or "uncertainty" and at least one of the terms "congress", "deficit", "Federal Reserve", "legislation" or "White House". Baker et al. (2016) provide details about the country-specific EPU indices, which are available at http://www.policyuncertainty.com/.

	10010	1. 1000	unes or			licen		
country	$b_1$	$\mathbf{p}\mathbf{v}$	$c_1$	$\mathbf{p}\mathbf{v}$	$d_1$	$\mathbf{p}\mathbf{v}$	pv-Fd	pv-Fex
Australia	0.74	0.00	0.12	0.05	0.00	0.95	0.87	0.69
Brazil	0.51	0.00	0.01	0.93	-0.03	0.45	0.68	0.35
Canada	0.69	0.00	-0.02	0.65	0.04	0.12	0.07	0.97
Chile	0.48	0.00	0.08	0.18	0.04	0.20	0.14	0.25
China	0.74	0.00	0.02	0.82	0.02	0.43	0.04	0.71
Croatia	0.63	0.00	-0.37	0.00	-0.04	0.20	0.12	0.19
France	0.57	0.00	-0.07	0.26	0.03	0.30	0.29	0.54
Germany	0.61	0.00	-0.04	0.52	0.01	0.87	0.46	0.83
Greece	0.17	0.03	0.03	0.37	0.00	0.92	0.60	0.22
Hong Kong	0.73	0.00	-0.02	0.79	0.05	0.10	0.88	0.47
India	0.65	0.00	0.05	0.38	-0.01	0.72	0.33	0.29
Ireland	0.73	0.00	0.05	0.53	0.05	0.11	0.38	0.66
Italy	0.55	0.00	0.06	0.34	0.02	0.72	0.52	0.88
Japan	0.57	0.00	0.01	0.80	-0.07	0.02	0.30	0.06
Mexico	0.62	0.00	0.04	0.64	0.02	0.58	0.75	0.96
Netherlands	0.59	0.00	0.07	0.32	0.02	0.50	0.53	0.89
Russia	0.65	0.00	-0.05	0.51	0.01	0.70	0.04	0.92
Singapore	0.72	0.00	-0.02	0.58	0.02	0.45	0.48	0.85
South Korea	0.70	0.00	-0.04	0.40	-0.00	0.94	0.85	0.96
Spain	0.63	0.00	0.03	0.70	0.05	0.12	0.72	0.63
Sweden	0.65	0.00	-0.03	0.36	0.03	0.36	0.25	0.85
United Kingdom	0.55	0.00	0.01	0.81	0.05	0.11	0.35	0.99
United States	0.57	0.00	0.04	0.12	-0.01	0.83	0.85	0.73

Table 1: Results of the causality check

Notes: Columns  $b_1$ ,  $c_1$ , and  $d_1$  report estimates for the corresponding coefficients in regressions (1), (2), and (3). Columns denoted as pv report p-values for t-tests for zero coefficients. The columns pv-Fx and pv-Fex show p-values for F tests of  $y_{m-1} = y_{m-2} = y_{m-3} = y_{m-4} = 0$  in regressions (2) and (3) that include  $x_{m-1}$  and  $ex_{m-1}$  and four lags of  $y_m$ .

and volatility are actually unrelated and determined by a third variable, then we can conclude that stock market volatility does not cause EPU.

### 6 Robustness

The causal assumptions behind the check may appear restrictive. However, omitted variables (e.g. another external EPU) and omitted lags of included variables do not necessarily invalid the check. On the contrary, these possible omissions increase the information content of the check, as omitted variables lead to  $c_1 \neq 0$  or (and)  $d_1 \neq 0$  in certain cases. The check can also easily be refined by including additional variables.

Figure 4 shows a DAG for  $b_1 \neq 0$ ,  $c_1 = 0$ , and  $d_1 = 0$  when a structural cause z of y is omitted. The variables  $x_{m-1}$  and  $ex_{m-1}$  are shown in bold to indicate that they are held constant. Blocked paths and paths that are already implied not to exist before omitted variables

are taken into account are suppressed for clarity.



Figure 4: Omitted structural variable.

If  $z_m$  causes  $y_m$  without links like (1), (2), (5), or (6), then the check is unaffected as there are no new open paths between  $y_{m-1}$  and  $y_m$ ,  $x_m$ , or  $ex_m$ , even if  $z_m$  causes  $x_m$  or  $ex_m$  as in links (3) and (4). Link (5) only affects  $b_1$  in regression (1) which is unproblematic, except when  $b_1$  is therefore close to zero.

Link (6) could affect  $b_1$  via the path  $y_{m-1} \leftarrow z_{m-1} \rightarrow z_m \rightarrow y_m$ . But  $c_1 = 0$  and  $d_1 = 0$ implies that there are no unblocked paths between  $y_{m-1}$  and  $x_m$  or  $ex_m$ . Hence, links (1) and (2) can be ruled out immediately, and links (3) and (4) can also be ruled out if a link (6) exists. In contrast,  $c_1 \neq 0$  and (or)  $d_1 \neq 0$  would indicate that such links are present. The check could then be refined by including  $z_m$ .



Figure 5: Omitted lags.

Figure 5 shows a DAG for  $b_1 \neq 0$ ,  $c_1 = 0$  and  $d_1 = 0$  when  $x_{m-2}$ ,  $ex_{m-2}$ , and  $y_{m-2}$  are omitted. Now links (1), (2), (5), and (6) would imply  $c_1 \neq 0$  and  $d_1 \neq 0$ . A direct link from  $y_{m-2}$  to  $y_m$ , and links (3) and (4) would only affect  $b_1$ .

The finding  $c_1 = 0$  and  $d_1 = 0$  implies the absence of links (1), (2),(5) and (6). Hence,

including  $x_{m-2}$ ,  $ex_{m-2}$ , and  $y_{m-2}$  in the auxiliary regressions should not change our conclusion. Indeed, the pattern  $b_1 \neq 0$ ,  $c_1 = 0$ , and  $d_1 = 0$  also emerges when  $x_{m-2}$ ,  $ex_{m-2}$ , and  $y_{m-2}$  are included.<sup>8</sup>

We can also include more lags of  $y_m$  in the auxiliary regressions to account for more distant effects of volatility on EPU. The two rightmost columns in Table 1 report p-values for an F test of the restriction  $y_{m-1} = y_{m-2} = y_{m-3} = y_{m-4} = 0$  in regressions (2) and (3) that include  $x_{m-1}$ and  $ex_{m-1}$  and four lags of  $y_m$ . The rather large p-values suggest that past volatility has no effect on EPU.

## 7 Impact of EPU on stock market volatility

This section provides estimates of the impact of EPU on stock market volatility using a simple econometric model,

$$y_m = \alpha_0 + \beta_0 x_m + \gamma_0 e x_m + \beta_1 x_{m-1} + \gamma_1 e x_{m-1} + \rho_1 y_{m-1} + \dots + \rho_4 y_{m-4} + u_m, \tag{5}$$

that is consistent with the findings of the causality check. All variables enter again in logarithms. The model contains four lags of  $y_m$  to obtain a dynamically well specified model with uncorrelated residuals.



Figure 6: Impact of unexpected domestic and external EPU on stock market volatility.

Note that  $\beta_0$  and  $\gamma_0$  measure the impact of unexpected EPU. Keeping  $x_{m-1}$  and  $ex_m$  constant

<sup>&</sup>lt;sup>8</sup>Results available upon request.

eliminates their effects on  $x_m$ , and keeping  $ex_{m-1}$  constant eliminates its effect on  $ex_m$ . The variation left in  $x_m$  and  $ex_m$  thus reflects unexpected EPU.

Figure 6 shows the country-specific estimates for  $\beta_0$  and  $\gamma_0$  together with 90% confidence intervals based on robust standard errors.<sup>9</sup> As can be seen, unexpected EPU affects stock market volatility in many cases. The estimates for  $\beta_0$  imply that a 1% change in domestic EPU typically increases stock market volatility by 0.15% to 0.30%. US stock market volatility increases even by 0.85%. The estimates for  $\gamma_0$  imply that a 1% change in external EPU increases stock market volatility by 0.3% to 0.6% in most countries.

## 8 Conclusions

A graph-based causality check, developed in this paper, was applied to monthly data for 22 countries to uncover the direction of the causal link between EPU and stock market volatility. The results imply that EPU is an instantaneous cause of stock market volatility. Assuming that EPU is a cause of stock market volatility appears to be sensible in empirical modeling with monthly data.

<sup>&</sup>lt;sup>9</sup>Full results and specification tests available upon request.

## References

- Ajmi, A. N., Aye, G. C., Balcilar, M., El Montasser, G., Gupta, R., 2015. Causality between US economic policy and equity market uncertainties: Evidence from linear and nonlinear tests. Journal of Applied Economics 18 (2), 225–246.
- Antonakakis, N., Chatziantoniou, I., Filis, G., 2013. Dynamic co-movements of stock market returns, implied volatility and policy uncertainty. Economics Letters 120 (1), 87 – 92. URL http://www.sciencedirect.com/science/article/pii/S0165176513001754
- Baker, S. R., Bloom, N., Davis, S. J., 2016. Measuring economic policy uncertainty. The Quarterly Journal of Economics 131 (4), 1593–1636.
- Berger, D., Dew-Becker, I., Giglio, S., 2020. Uncertainty shocks as second-moment news shocks. The Review of Economic Studies 87 (1), 40–76.
- Bloom, N., 2009. The impact of uncertainty shocks. Econometrica 77 (3), 623–685.
- Boutchkova, M., Doshi, H., Durnev, A., Molchanov, A., 2012. Precarious politics and return volatility. The Review of Financial Studies 25 (4), 1111–1154. URL http://www.jstor.org/stable/41407857
- Ederington, L. H., Guan, W., 2005. Forecasting volatility. Journal of Futures Markets 25 (5), 465–490.

URL http://dx.doi.org/10.1002/fut.20146

- Gerlach, S., Ramaswamy, S., Scatigna, M., 2006. 150 years of financial market volatility. BIS Quarterly Review September 2006, 77–91. URL https://ssrn.com/abstract=1632414
- Hoover, K. D., 2001. Causality in Macroeconomics. Cambridge University Press.
- Hoover, K. D., 2008. Causality in economics and econometrics. The new Palgrave dictionary of economics 2.
- Jurado, K., Ludvigson, S. C., Ng, S., 2015. Measuring uncertainty. American Economic Review 105 (3), 1177–1216.

URL http://www.aeaweb.org/articles/?doi=10.1257/aer.20131193

Klößner, S., Sekkel, R., 2014. International spillovers of policy uncertainty. Economics Letters 124 (3), 508 – 512.

 ${\rm URL\ http://www.sciencedirect.com/science/article/pii/S0165176514002705}$ 

- Krol, R., 2014. Economic policy uncertainty and exchange rate volatility. International Finance 17 (2), 241-256. URL https://onlinelibrary.wiley.com/doi/abs/10.1111/infi.12049
- Liu, L., Zhang, T., 2015. Economic policy uncertainty and stock market volatility. Finance Research Letters 15, 99 - 105. URL //www.sciencedirect.com/science/article/pii/S1544612315000835
- Ludvigson, S. C., Ma, S., Ng, S., forthcoming. Uncertainty and business cycles: exogenous impulse or endogenous response? American Economic Journal.
- Pástor, Ľ., Veronesi, P., 2012. Uncertainty about government policy and stock prices. The journal of Finance 67 (4), 1219–1264.
- Pearl, J., 1995. Causal diagrams for empirical research. Biometrika 82 (4), 669–688.
- Pearl, J., 2009. Causality: models, reasoning and inference, 2nd Edition. Cambridge University Press.
- Peters, J., Janzing, D., Schölkopf, B., 2017. Elements of causal inference. The MIT Press.
- Schwert, G. W., 1989. Why does stock market volatility change over time? Journal of Finance 44 (5), 1115–53.

# Index of Working Papers:

June 15, 2015	Anil Ari	202	Sovereign Risk and Bank Risk-Taking
June 15, 2015	Matteo Crosignani	203	Why Are Banks Not Recapitalized During Crises?
February 19, 2016	Burkhard Raunig	204	Background Indicators
February 22, 2016	Jesús Crespo Cuaresma, Gernot Doppelhofer, Martin Feldkircher, Florian Huber	205	US Monetary Policy in a Globalized World
March 4, 2016	Helmut Elsinger, Philipp Schmidt- Dengler, Christine Zulehner	206	Competition in Treasury Auctions
May 14, 2016	Apostolos Thomadakis	207	Determinants of Credit Constrained Firms: Evidence from Central and Eastern Europe Region
July 1, 2016	Martin Feldkircher, Florian Huber	208	Unconventional US Monetary Policy: New Tools Same Channels?
November 24, 2016	François de Soyres	209	Value Added and Productivity Linkages Across Countries
November 25, 2016	Maria Coelho	210	Fiscal Stimulus in a Monetary Union: Evidence from Eurozone Regions
January 9, 2017	Markus Knell, Helmut Stix	211	Inequality, Perception Biases and Trust
January 31, 2017	Steve Ambler, Fabio Rumler	212	The Effectiveness of Unconventional Monetary Policy Announcements in the Euro Area: An Event and Econometric Study
May 29, 2017	Filippo De Marco	213	Bank Lending and the European Sovereign Debt Crisis
June 1, 2017	Jean-Marie Meier	214	Regulatory Integration of International Capital Markets

October 13, 2017	Markus Knell	215	Actuarial Deductions for Early Retirement
October 16, 2017	Markus Knell, Helmut Stix	216	Perceptions of Inequality
November 17, 2017	Engelbert J. Dockner, Manuel Mayer, Josef Zechner	217	Sovereign Bond Risk Premiums
December 1, 2017	Stefan Niemann, Paul Pichler	218	Optimal fiscal policy and sovereign debt crises
January 17, 2018	Burkhard Raunig	219	Economic Policy Uncertainty and the Volatility of Sovereign CDS Spreads
February 21, 2018	Andrej Cupak, Pirmin Fessler, Maria Silgoner, Elisabeth Ulbrich	220	Exploring differences in financial literacy across countries: the role of individual characteristics and institutions
May 15, 2018	Peter Lindner, Axel Loeffler, Esther Segalla, Guzel Valitova, Ursula Vogel	221	International monetary policy spillovers through the bank funding channel
May 23, 2018	Christian A. Belabed, Mariya Hake	222	Income inequality and trust in national governments in Central, Eastern and Southeastern Europe
October 16, 2018	Pirmin Fessler, Martin Schürz	223	The functions of wealth: renters, owners and capitalists across Europe and the United States
October 24, 2018	Philipp Poyntner, Thomas Reininger	224	Bail-in and Legacy Assets: Harmonized rules for targeted partial compensation to strengthen the bail-in regime
Dezember 14, 2018	Thomas Breuer, Martin Summer	225	Systematic Systemic Stress Tests
May 20, 2019	Helmut Stix	226	Ownership and purchase intention of crypto- assets – survey results
October 17, 2019	Markus Knell, Helmut Stix	227	How Peer Groups Influence Economic Perceptions

February 26, 2020	Helmut Elsinger	228	Serial Correlation in Contingency Tables
March 2, 2020	Mariarosaria Comunale, Markus Eller, Mathias Lahnsteiner	229	Assessing Credit Gaps in CESEE Based on Levels Justified by Fundamentals –A Comparison Across Different Estimation Approaches
April 30, 2020	Martin Brown, Nicole Hentschel, Hannes Mettler, Helmut Stix	230	Financial Innovation, Payment Choice and Cash Demand – Causal Evidence from the Staggered Introduction of Contactless Debit Cards
July 30, 2020	Katharina Drescher, Pirmin Fessler, Peter Lindner	231	Helicopter Money in Europe: New Evidence on the Marginal Propensity to Consume across European Households
November 20, 2020	Michael Sigmund	232	The Capital Buffer Calibration for Other Systemically Important Institutions – Is the Country Heterogeneity in the EU caused by Regulatory Capture?
January 13, 2021	Maximilian Böck, Martin Feldkircher, Burkhard Raunig	233	A View from Outside: Sovereign CDS Volatility as an Indicator of Economic Uncertainty
May 20, 2021	Burkhard Raunig	234	Economic Policy Uncertainty and Stock Market Volatility: A Causality Check