
Mikhail Stolbov  
PhD in Economics, Chair of the Department of Applied Economics,  
Moscow State Institute of International Relations (MGIMO–University)

Maria Shchepeleva  
PhD in Economics, Assistant Professor, Department of Theoretical Economics,  
National Research University Higher School of Economics

10 April 2019
Outline

- Motivation
- Literature Review
- Data
- Methodology
- Results
Motivation

- The extant literature studies isolated effects of systemic risk and economic policy uncertainty (EPU) on industrial production, real GDP growth, unemployment.

- Engle et al. (2015)
- De Nicoló and Luccheta (2011)
- Giglio et al. (2016)
- Istiak and Serletis (2018)
- Belke and Osowski (2018)

- We shift attention towards firm bankruptcies to study real effects of systemic risk and EPU from business-demographic aspect.
Literature Review

- Firm dynamics is closely related to variation in macroeconomic fundamentals.
  - Clementi and Palazzo (2016)
  - Tian (2018)
  - Carree et al. (2008) and Santarelli et al. (2009)

- There are very few studies linking financial frictions or stress and business demography.
  - Macnamara (2014)
  - Carreira and Teixeira (2016)
  - Byrne et al. (2016)
Data

- Variables
  - SRISK index (Brownlees and Engle, 2017, data from https://vlab.stern.nyu.edu/welcome/risk/)
  - EPU index (Baker et al., 2016, data from http://www.policyuncertainty.com/)
  - Total number of bankruptcies (data from national business registers)
  - VIX index (CBOE)

- Sample
  15 countries: Australia, Canada, France, Germany, Hong Kong, Italy, Japan, Netherlands, Russia, Singapore, South Korea, Spain, Sweden, the UK, the USA

- Period
  Monthly, January 2008-June 2018
Methodology (1)

- Causality test in time domain
  Granger & Diks-Wolski nonlinear test

- Causality test in frequency domain
  Breitung-Candelon test

- Causality in dynamic complex system framework
  Convergent cross-mapping
Methodology (2). Diks-Wolski test

- This procedure adjusts the bivariate nonparametric test by Diks and Panchenko (2006) to the multivariate setting.

- We apply the multivariate nonlinear causality test by Diks and Wolski (2016) to the residuals from the lag-augmented VAR model.

- To test the null of no Granger causality running from $X$ to $Y$, which can be formulated in terms of ratios of joint distributions:

$$H_0: \frac{f_{X,Y,Z}(X,Y,Z)}{f_Y(Y)} - \frac{f_{X,Y}(X,Y)}{f_Y(Y)} + \frac{f_{Y,Z}(Y,Z)}{f_Y(Y)} = 0$$

- Diks and Wolski propose a “sharpened” test statistic

$$T^S_n(\varepsilon) = \frac{n-1}{n(n-2)} \sum_i \left( \hat{f}^S_{X,Y,Z}(X_i, Y_i, Z_i) f_Y(Y_i) - \hat{f}^S_{X,Y}(X_i, Y_i) f_{Y,Z}(Y_i, Z_i) \right)$$

which satisfies:

$$\sqrt{n} \left( T^S_n(\varepsilon_n) - q \right) \overset{d}{\rightarrow} N(0, 1) \quad (8)$$

- $\varepsilon$ - bandwith dependent on the sample size $n$;

- $\frac{n-1}{n(n-2)}$ - the normalization factor inherited from the $U$-statistic representation of $T^S_n(\varepsilon)$; $\hat{f}^S_{X,Y,Z}(X,Y,Z)$, $\hat{f}^S_{X,Y}(X,Y)$, $\hat{f}^S_{Y,Z}(Y,Z)$, $\hat{f}^S_Y(Y)$ – sharpened local kernel density estimators.
Methodology (3). Breitung-Candelon test

- This test is based on the Fourier transformation of initial time series.

- It determines whether a particular component of the “cause” variable at frequency $\omega$ is useful in predicting the component of the “effect” variable at the same frequency.

- Suppose we have a VAR model of order $p$:

  $$X_t = \sum_{j=1}^{p} \theta_{11,j} X_{t-j} + \sum_{j=1}^{p} \theta_{12,j} Y_{t-j} + \epsilon_{1t},$$

  where $\theta_{11,j}$ and $\theta_{12,j}$ are the coefficients of the lag polynomials $\theta_{11}(L)$ and $\theta_{12}(L)$.

- A necessary and sufficient set of conditions for no Granger causality at frequency $\omega$ is given by:

  $$\begin{align*}
  \sum_{j=1}^{p} \theta_{12,j} \cos(j\omega) &= 0 \\
  \theta_{12,j} \sin(j\omega) &= 0
  \end{align*}$$

  These linear restrictions on VAR coefficients can be tested by a simple F-statistics which is approximately distributed as $F(2, T - 2p)$, where 2 is the number of restrictions and $T$ is the number of observations used to estimate the VAR model of order $p$.

- The power of the Breitung-Candelon test tends to decrease in the vicinity of extreme frequencies, i.e. 0 and $\pi$. 


Methodology (4). Convergent cross-mapping (1)

- Let us consider two time series from the same dynamic system, x and y.
- The reconstructions of these time-series, M(x) and M(y) correspondingly, will uniquely define the system states.
- In case x unidirectionally causes y, we will observe cross mapping in one direction, from M(y) to M(x), but not vice versa. The rationale is that My contains complete information about y and all its causes, including x, while Mx may be missing information about y.
Methodology(4). Convergent cross-mapping (2)
Causal graph for the SRISK, EPU index, firm bankruptcies and the VIX index for the UK
Results (1)
Venn diagram of the total number of significant causal linkages based on all causality tests

<table>
<thead>
<tr>
<th>Country</th>
<th>Robust causal linkages</th>
<th>Variance decomposition</th>
<th>Breitung-Candelon test results</th>
<th>Historical decomposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>SRISK causes Firm bankruptcies</td>
<td>SRISK accounts for 22.6% of bankruptcies’ variance</td>
<td>over longer horizons</td>
<td>Causalities manifest themselves in the aftermath of shocks</td>
</tr>
<tr>
<td>Netherlands</td>
<td>EPU index causes Firm bankruptcies</td>
<td>SRISK accounts for 22.6% of bankruptcies’ variance</td>
<td>over longer horizons</td>
<td>Causalities manifest themselves in the aftermath of shocks</td>
</tr>
<tr>
<td>UK</td>
<td>EPU index causes Firm bankruptcies</td>
<td>SRISK accounts for 22.6% of bankruptcies’ variance</td>
<td>over all time horizons</td>
<td>Causalities manifest themselves during the Brexit referendum</td>
</tr>
<tr>
<td>South Korea</td>
<td>VIX causes Firm bankruptcies</td>
<td>SRISK accounts for 22.6% of bankruptcies’ variance</td>
<td>over all time horizons</td>
<td>Causalities manifest themselves in the aftermath of shocks</td>
</tr>
</tbody>
</table>
## Results (2). ANOVA test

<table>
<thead>
<tr>
<th>Variable</th>
<th>F-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of micro-, small and medium enterprises (% of total enterprises)</td>
<td>0.27</td>
<td>0.85</td>
</tr>
<tr>
<td>Density of micro-, small and medium enterprises (per 1000 persons)</td>
<td>0.68</td>
<td>0.58</td>
</tr>
<tr>
<td>Average credit to private sector/GDP (%)</td>
<td>0.85</td>
<td>0.49</td>
</tr>
<tr>
<td>Average credit-to-GDP gap (%)</td>
<td>1.55</td>
<td>0.25</td>
</tr>
<tr>
<td>Credit-to-GDP gap volatility (S.D.)</td>
<td><strong>7.71</strong></td>
<td><strong>0.00</strong></td>
</tr>
<tr>
<td>Debt service ratio (%)</td>
<td>0.70</td>
<td>0.57</td>
</tr>
<tr>
<td>Average ease of doing business (score)</td>
<td>1.16</td>
<td>0.37</td>
</tr>
<tr>
<td>Getting Credit Score</td>
<td>0.16</td>
<td>0.92</td>
</tr>
<tr>
<td>Enforcing Contracts Score</td>
<td>1.05</td>
<td>0.41</td>
</tr>
<tr>
<td>Resolving Insolvency Score</td>
<td>0.36</td>
<td>0.79</td>
</tr>
<tr>
<td>Resolving Insolvency Outcome (0 as piecemeal sale and 1 as going concern)</td>
<td>0.20</td>
<td>0.89</td>
</tr>
<tr>
<td>Resolving Insolvency Time (years)</td>
<td>0.45</td>
<td>0.73</td>
</tr>
<tr>
<td>Resolving Insolvency Cost (% of estate)</td>
<td>0.91</td>
<td>0.47</td>
</tr>
<tr>
<td>Recovery Rate (cents on the dollar)</td>
<td>0.54</td>
<td>0.66</td>
</tr>
<tr>
<td>Strength of Insolvency Framework Index (0-16)</td>
<td>0.47</td>
<td>0.71</td>
</tr>
<tr>
<td>Commencement of proceedings index (0-3)</td>
<td>0.26</td>
<td>0.85</td>
</tr>
<tr>
<td>Management of debtor’s assets index (0-6)</td>
<td>0.78</td>
<td>0.53</td>
</tr>
<tr>
<td>Reorganization proceedings index (0-3)</td>
<td>0.44</td>
<td>0.73</td>
</tr>
<tr>
<td>Creditor participation index (0-4)</td>
<td>1.13</td>
<td>0.38</td>
</tr>
<tr>
<td>Nonfinancial corporate debt, loans and debt securities (% of GDP)</td>
<td>1.36</td>
<td>0.31</td>
</tr>
<tr>
<td>Private debt, loans and debt securities (% of GDP)</td>
<td>1.48</td>
<td>0.28</td>
</tr>
<tr>
<td>General Government Debt (% of GDP)</td>
<td>0.65</td>
<td>0.60</td>
</tr>
<tr>
<td>Average Corporate Sector Probability of Default</td>
<td>0.03</td>
<td>0.99</td>
</tr>
<tr>
<td>Bank nonperforming loans to total gross loans (%)</td>
<td>0.37</td>
<td>0.77</td>
</tr>
<tr>
<td>Bank capital to assets ratio (%)</td>
<td>0.34</td>
<td>0.79</td>
</tr>
<tr>
<td>Average GDP growth (annual %)</td>
<td>0.99</td>
<td>0.44</td>
</tr>
</tbody>
</table>
Results (4). Dynamics of credit-to-GDP gap for the countries with robust and non-robust causal impact
Results (4). Scatterplot of credit-to-GDP gap volatility and response time to FSB/G20 recommendations for the sample countries.
Conclusions

- The paper investigates the causal relationships between systemic risk, economic policy uncertainty and firm bankruptcies for a sample of 15 advanced and major emerging market economies over January 2008-June 2018.

- Our analysis involves a comprehensive multivariate causal inference.

- The number of causal linkages robust across all the methods is limited.

- Based on the ANOVA tests, we argue that the magnitude of decline in corporate lending by banks during the observation period largely shapes the causal impact by the SRISK, EPU or VIX indices on firm bankruptcies.

- Our evidence suggests that systemic risk and economic policy uncertainty can significantly affect business demography.
Thank you for your attention!