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Are Uncertainties across the World Convergent?

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Abstract

We analyse the convergence of a news-based measure of uncertainty across 143 countries (spanning 99 percent of world GDP) over the quarterly period of 1996:01 to 2018:03. We apply a panel data-based unit root test, which controls for both nonlinearity and cross-sectional dependence, to the ratio of the uncertainty of individual countries relative to that of global uncertainty. We find overwhelming evidence of stationarity in 141 of the cross-sectional units, leading to a rejection of the null of a unit root for the entire panel. Our results provide strong evidence of convergence and hence, the spillover of uncertainty spillover across the economies of the world. Given this, policymakers need to be alert all the time to counteract the negative impact on the domestic economy in the wake of uncertainty increases around the world.

JEL Codes: O47; D80; C21

Keywords: uncertainty; economic policy; convergence; nonlinear panel data unit root test

1. Introduction

Theoretically, the negative impact of uncertainty upon economic activity has been well-recognized since the works of Bernanke (1983) and, Dixit and Pindyck (1994). However, uncertainty is a latent variable, and in order to quantify the impact of uncertainty on the macroeconomy, one would require appropriate metrics of it. In the wake of the “Great Recession of 2008-09” a large body of literature has developed which not only aims to measure uncertainty, but also analyse the size of its impact empirically on financial and macroeconomic variables (see e.g., Chuliá et al., 2017; Gupta et al., 2018a & 2019 for detailed reviews). In a parallel set of studies, researchers have also analysed the spillover of uncertainty across economies (see e.g., Colombo (2013), Ajmi et al. (2014), Klößner and Sekkel (2014), Yin and Han (2014), Gupta et al., (2016), Biljanovska et al. (2017), Caggiano et al. (2017), Antonakakis et al. (2018a & 2018b), Çekin et al., (2018), Gabauer and Gupta (2018), Liow et al., (2018), Thiem (2018)). This is an important line of research, since if uncertainties across economies are interrelated, as the above-mentioned studies indicate, then even if there is no change in uncertainty at the domestic level, a particular economy will end up witnessing the negative impact of uncertainty through linkages that exist in a modern globalized world. Moreover, if domestic uncertainty does increase, then international uncertainty feedbacks are likely to prolong the adverse effects on the domestic economy.

Against this backdrop, we revisit the question of the uncertainty spillovers in a panel of 143 countries, at different stages of economic development, covering the quarterly period of 1996:01 to 2018:03. Unlike the above-mentioned studies, which generally looks at a handful of either developed or developing economies, and hence primarily uses variation of the time-

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series-based spillover analysis of Diebold and Yilmaz (2012), we rely on a panel data approach given that in our case the cross-sectional component is larger than the time-series aspect of the data. Specifically speaking, we contextualise the issue of spillover as a convergence problem, whereby we analyse whether the time series of an individual country's uncertainty relative to the measure of global (overall) uncertainty is a stationary variable in a panel data set-up. Given the evidence of uncertainty spillovers occurring through the exchange rate, trade and financial linkages channels (Gupta et al., 2018b), and nonlinearity in the data generating process of uncertainty (Plakandaras et al., 2019), we use the panel data-based unit root tests of Cerrato et al. (2011 & 2013), which simultaneously controls for cross-sectional dependence and nonlinearity. In addition, these tests also provide evidence of the unit root properties of each of the cross-sectional members in the panel, and hence is more informative than standard panel data tests, whereby the result of the overall panel might be driven by a set of stationary or non-stationary cross-sectional units depending on the strength of their individual effects. Since we are able to detect the ratio for which countries are stationary or non-stationary, we are able to draw conclusions regarding the convergence and hence, spillovers of uncertainty in the context of each country.

To the best of our knowledge, this is the first attempt to analyse spillover or convergence of uncertainty for such a wide array of countries, which in turn covers 99 percent of the world's gross domestic product (GDP).

The remainder of the paper is organized as follows: Section 2 presents the econometric methodology and Section 3 presents the data and discusses the empirical results, with Section 4 concludes the paper.

2. Econometric Methodology

For our purpose, we adopt a unit root test of Cerrato et al. (2011 & 2013) that accounts for nonlinearity and cross-sectional dependence among countries. The test is more powerful than various linear panel unit tests if non-linear elements are evident. Assuming the model has a functional form which follows an Exponential Smooth Transition Autoregressive (ESTAR) process, we have:

$$y_{it} = \xi_i y_{i,t-1} + \xi_i^* y_{i,t-1} Z(\theta_i; y_{i,t-d}) + \mu_{it} \quad t = 1, \dots, T \quad i = 1, \dots, N, \quad (1)$$

where,

$$Z(\theta_i; y_{i,t-d}) = 1 - \exp[-\theta_i (y_{i,t-d} - \chi^*)^2], \quad (2)$$

Given the initial value y_{it} , the error term is μ_{it} , it has a one-factor structure of the form:

$$\mu_{it} = \gamma_i f_t + \varepsilon_{it}, \quad (\varepsilon_{it})_t \sim i.i.d.(0, \sigma_i^2) \quad (3)$$

where f_t is the unobserved common factor, and ε_{it} is the idiosyncratic error. Equation (2) becomes the following specification when we set the delay parameter d to be unity, such that:

$$\Delta y_{i,t} = \alpha_i + \xi_i y_{i,t-1} + \sum_{h=1}^{h-1} \delta_{ijh} \Delta y_{ij,t-h} + (\alpha_i^* + \xi_i^* y_{i,t-1} + \sum_{h=1}^{h-1} \delta_{ih}^* \Delta y_{i,t-h}) * Z(\theta_i; y_{i,t-d}) + \gamma_i f_t + \varepsilon_{it} \quad (4)$$

Under the null hypothesis that $y_{i,t}$ follows a unit root process in the middle regime (i.e., $\xi_i = 0$) we have the following specification:

$$\Delta y_{i,t} = \xi_i^* y_{i,t-1} \left[1 - \exp(-\theta_i y_{i,t-1}^2) \right] + \gamma_i f_t + \varepsilon_{i,t} \quad (5)$$

We have the null hypothesis of non-stationarity $H_0: \theta_i = 0 \forall_i$, against its alternative $H_1: \theta_i > 0$ for $i = 1, 2, \dots, N_1$ and θ_i for $i = N_1 + 1, \dots, N$. Given ξ_i^* is not identified under the null hypothesis, the null hypothesis can only be developed by adopting a first-order Taylor series approximation method, which in turn reparametrizes Equation (5) with the following auxiliary regression:

$$\Delta y_{i,t} = a_i + \delta y_{i,t-1}^3 + \gamma_i f_t + \varepsilon_{i,t} \quad (6)$$

Taking account of serially correlated errors the empirical testing is based on:

$$\Delta y_{i,t} = a_i + \delta y_{i,t-1}^3 + \sum_{h=1}^{h-1} \rho_{ih} \Delta y_{i,t-h} + \gamma_i f_t + \varepsilon_{i,t} \quad (7)$$

Following Cerrato et al. (2011) we further assume the common factor f_t can be approximated by:

$$f_t \approx \frac{1}{\gamma} \Delta y_t - \frac{\bar{b}}{\gamma} y_{t-1}^3 \quad (8)$$

Where \bar{y}_t is the mean of y_{it} and $\bar{b} = \frac{1}{N} \sum_{i=1}^N b_i$.

The final non-linear cross-sectionally augmented Dickey-Fuller (NCADF) regression can be obtained by combining equation (7) and equation (8), such that:

$$\Delta \bar{y}_{i,t} = a_i + b_i \bar{y}_{i,t-1}^3 + c_i \Delta y_t + d_i \Delta y_{t-1}^3 + \varepsilon_{i,t} \quad (9)$$

The t-statistics could be derived from \hat{b}_i , which are denoted by:

$$t_{iNL}(N, T) = \frac{\hat{b}_i}{s.e.(\hat{b}_i)} \quad (10)$$

where \hat{b}_i is the OLS estimate of b_i , and $s.e.(\hat{b}_i)$ is its associated standard error. The t -statistic in Equation (10) can be used to construct a panel unit root test by averaging the individual test statistics:

$$\bar{t}_{iNL}(N, T) = \frac{1}{N} \sum_{i=1}^N t_{iNL}(N, T) \quad (11)$$

3. Data and Empirical Results

Uncertainty is a latent variable, and hence one requires ways to measure it. In this regard, besides the various alternative metrics of uncertainty associated with financial markets (such as the implied-volatility indices (popularly called the VIX), realized volatility, idiosyncratic

volatility of equity returns, corporate spreads), there are primarily three broad approaches to quantify uncertainty (Gupta et al., 2018a): (1) A news-based approach, with the main idea behind this method being to perform searches of major newspapers for terms related to economic and policy uncertainty, and then to use the results to construct indices of uncertainty; (2) Derive measures of uncertainty from stochastic-volatility estimates of various types of small and large-scale structural models related to macroeconomics and finance, and; (3) Uncertainty obtained from dispersion of professional forecaster disagreements. As far as our metric of uncertainty is concerned, we use the first approach, i.e., news-based measure of Ahir et al., (2018), primarily due to the fact that the measure does not require any complicated estimation of a large-scale model to generate it in the first place, and hence, is not model-specific. In addition, the data is available publicly for download.¹ Ahir et al., (2018) construct quarterly indices of economic uncertainty for 143 countries (37 countries in Africa, 22 in Asia and the Pacific, 35 in Europe, 27 in the Middle East and Central Asia, and 22 in the Western Hemisphere.) from 1996 onwards using frequency counts of "uncertainty" (and its variants) in the quarterly Economist Intelligence Unit (EIU) country reports. The EIU reports discuss major political and economic developments in each country, along with analysis and forecasts of political, policy and economic conditions, created by country-specific teams of analysts and a central EIU editorial team. To make the WUI comparable across countries, the raw counts are scaled by the total number of words in each report. Based on the data availability, our sample period covers 1996:01 to 2018:03.

Besides reporting the uncertainty indices of the 143 countries, Ahir et al., (2018) also provide a global measure of uncertainty. For our econometric purpose, we use the ratio of the uncertainty index of each country to the global index. Understandably, if this ratio is stationary, then the country-specific uncertainty is converging to the global levels, which in turn can only happen through spillovers of uncertainty across economies.² We present the results of the nonlinear unit root test in Table 1.

[Insert Table 1 Around Here]

As can be seen, barring the case of Niger and Uruguay, all the other remaining 141 cross-sectional units indicate stationary ratios, suggesting convergence at least at the 10 percent level of significance. This strong result leads to an overwhelming rejection of unit root for the whole panel. In sum, we find evidence of convergence of uncertainty across the global world, highlighting spillover of uncertainties across economies.³

4. Conclusion

In this paper, we analysed the convergence of a news-based measure of uncertainty across 143 countries over the quarterly period of 1996:01 to 2018:03. We applied a panel data-based unit

¹ The data can be downloaded from http://policyuncertainty.com/wui_quarterly.html.

² Also available are uncertainty based on income level (advanced, emerging, and low-income economies), and at the regional level (Africa, Asia, and the Pacific, Europe, Middle East, Central Asia, and Western Hemisphere). We create ratios of these indices relative to the global index as well and analysed in a time-series set-up the unit root properties. The results have been reported in Table A1 in the Appendix of the paper. As can be seen, based on the Augmented Dickey and Fuller (ADF, 1981) test and, in particular the stronger, Phillips and Perron (PP, 1988) test, all the income- and regional-level ratios are found to be stationary, and hence, highlights convergence at these levels with the global uncertainty.

³ In Table A2, we report four widely-used linear panel unit root tests (Hadri (2000), Levin et al., (2002), Im et al., (2003), and Pesaran (2007)) for the entire cross-section of countries. As can be seen, these tests also provide strong evidence of convergence of uncertainties across the globe.

root test, which controls for both nonlinearity and cross-sectional dependence, to the ratio of the uncertainty of individual countries to that of the global measure of the same. Posing the problem of convergence as that of a unit root, we found the overwhelming evidence of stationarity in 141 (barring Nigeria and Uruguay) of the cross-sectional units, leading to a rejection of the null of a unit root for the entire panel. Our results provide strong evidence of uncertainty spillover across the economies of the world. In other words, an increase in uncertainty in a particular economy is likely to end up affecting virtually all the other economies in the world to varying degrees, and in turn, negatively influencing the macroeconomic indicators and financial markets. Our results imply that, even when domestic uncertainty is unchanged initially, policymakers in a specific country cannot ignore the importance of foreign uncertainty increases, as this would ultimately spillover to the domestic economy. Hence, monetary and fiscal authorities need to be alert all the time to counteract uncertainty increases around the world. Future papers on this subject can use other econometric techniques to test the validity of the uncertainty spillover hypothesis across the globe.

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Table 1
Results of the Nonlinear Panel Unit Root Test

Countries	Statistic		Countries	Statistic		Countries	Statistic
Afghanistan	-5.1583	***	Guinea	-3.3032	**	Panama	-3.9879 ***
Albania	-7.5741	***	Guinea-Bissau	-4.5353	***	Papua New Guinea	-3.6286 **
Algeria	-6.1111	***	Haiti	-7.6339	***	Paraguay	-6.5306 ***
Angola	-5.4110	***	Honduras	-6.4877	***	Peru	-4.2287 ***
Argentina	-3.4869	***	Hong Kong SAR	-5.4342	***	Philippines	-4.0439 ***
Armenia	-4.4002	***	Hungary	-5.4200	***	Poland	-3.4812 **
Australia	-4.0815	***	India	-5.9157	***	Portugal	-6.3813 ***
Austria	-6.3966	***	Indonesia	-5.9412	***	Qatar	-5.3514 ***
Azerbaijan	-5.1501	***	Islamic Republic of Iran	-5.3596	***	Romania	-8.0768 ***
Bangladesh	-4.7233	***	Iraq	-9.5868	***	Russia	-4.6377 ***
Belarus	-4.6628	***	Ireland	-4.1567	***	Rwanda	-4.4396 ***
Belgium	-4.2568	***	Israel	-3.3652	**	Saudi Arabia	-6.1639 ***
Benin	-5.9267	***	Italy	-6.8292	***	Senegal	-4.4203 ***
Bolivia	-6.4341	***	Jamaica	-5.7837	***	Sierra Leone	-4.7318 ***
Bosnia and Herzegovina	-4.6377	***	Japan	-3.8927	***	Singapore	-5.3686 ***
Botswana	-4.5915	***	Jordan	-4.7838	***	Slovak Republic	-2.4599 ***

Brazil	-4.8234	***	Kazakhstan	-5.2019	***	Slovenia	-3.7715	***
Bulgaria	-4.7571	***	Kenya	-5.1854	***	South Africa	-4.7559	***
Burkina Faso	-3.3869	**	Korea	-4.8257	***	Spain	-6.0087	***
Burundi	-6.3997	***	Kuwait	-3.7904	***	Sri Lanka	-3.2629	**
Cambodia	-3.1254	**	Kyrgyz Republic	-4.1513	***	Sudan	-5.2564	***
Cameroon	-7.2839	***	Lao P.D.R.	-4.1067	***	Sweden	-3.8748	***
Canada	-3.2805	**	Latvia	-5.2189	***	Switzerland	-6.1324	***
Central African Republic	-6.2282	***	Lebanon	-5.6588	***	Taiwan	-4.6107	***
Chad	-5.2085	***	Lesotho	-5.2368	***	Tajikistan	-4.5064	***
Chile	-3.9379	***	Liberia	-4.4240	***	Tanzania	-5.4294	***
China	-6.7833	***	Libya	-4.0884	***	Thailand	-6.7668	***
Colombia	-5.5733	***	Lithuania	-3.5044	**	Togo	-3.0075	*
Democratic Republic of the Congo	-5.2438	***	FYR Macedonia	-4.6697	***	Tunisia	-4.4335	***
Republic of Congo	-5.3776	***	Madagascar	-4.8314	***	Turkey	-5.6245	***
Costa Rica	-4.7940	***	Malawi	-6.3227	***	Turkmenistan	-4.9174	***
Côte d'Ivoire	-6.4172	***	Malaysia	-5.3895	***	Uganda	-5.2555	***
Croatia	-6.4329	***	Mali	-2.7250		Ukraine	-6.2643	***
Czech Republic	-2.9412	*	Mauritania	-5.9631	***	United Arab Emirates	-3.6207	**
Denmark	-5.9743	***	Mexico	-5.2282	***	United Kingdom	-4.2467	***
Dominican Republic	-7.5926	***	Moldova	-5.6132	***	United States	-4.3179	***

Ecuador	-3.6500	***	Mongolia	-6.1469	***	Uruguay	-2.3313
Egypt	-2.8549	*	Morocco	-3.7323	***	Uzbekistan	-4.6949 ***
El Salvador	-7.4289	***	Mozambique	-6.4691	***	Venezuela	-4.5625 ***
Eritrea	-4.6197	***	Myanmar	-5.0873	***	Vietnam	-5.8050 ***
Ethiopia	-5.1879	***	Namibia	-5.3856	***	Yemen	-3.7698 ***
Finland	-5.8458	***	Nepal	-3.7776	***	Zambia	-5.0992 ***
France	-4.7896	***	Netherlands	-4.2528	***	Zimbabwe	-4.5670 ***
Gabon	-3.1020	**	New Zealand	-4.4675	***		
The Gambia	-3.7620	***	Nicaragua	-5.1642	***		
Georgia	-4.8565	***	Niger	-3.6111	**		
Germany	-5.8496	***	Nigeria	-2.1685			
Ghana	-3.0317	**	Norway	-6.1483	***		
Greece	-6.7607	***	Oman	-2.8495	*		
Guatemala	-5.6722	***	Pakistan	-4.0777	***		

AVERAGE -4.95598***

Critical values of Panel NCADF Distribution (N = 200, T = 100):

1%	-2.01
5%	-1.96
10%	-1.92

Critical Values of Individual NCADF Distribution (N = 200, T = 100):

1%	-3.7
5%	-3.11
10%	-2.79

Notes: Critical values are from Table 13 and Table 14 of Cerrato et al. (2011). ***, **, & * denote 1%, 5%, & 10% critical values respectively.

APPENDIX

Table A1: Results of Time-series Unit Root Tests

Regions	ADF	PP
Advanced Economies	-5.5554***	-5.5554***
Africa	-2.9677**	-4.1120***
Asia and the Pacific	-2.5510	-5.1705***
Emerging Economies	-3.8779***	-6.0010***
Europe	-5.9009***	-5.8758***
Low Income Economies	-3.0485**	-4.6347***
Middle East and Central Asia	-2.4001	-5.4901***
Western Hemisphere	-3.5742***	-3.5742***

Notes: ADF: Augmented Dickey and Fuller (1981); PP: Phillips and Perron (1988). ***, **, & * denote 1%, 5%, & 10% critical values respectively.

Table A2. Results of Linear Panel Unit Root Tests

Panel Unit Root Test	Assumption	Test Statistic
Im, Pesaran and Shin (2003)		-63.3835***
Levin, Lin, and Chu (2002)		-71.6707***
Hadri (2000)	Homogenous variance	15.183***
	Heterogeneous variance	13.149***
Pesaran (2007)		-5.613***

Notes: ***, **, & * denote 1%, 5%, & 10% critical values respectively. Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.