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Are Uncertainties across the World Convergent?

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Abstract

We analyze the convergence of a news-based measure of uncertainty across 143 countries (spanning 99 percent of world GDP) over the quarterly period of 1996Q1 to 2018Q3. We apply a panel data-based unit root test, which controls 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 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.

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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 to quantify the impact of uncertainty on the macro-economy, 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 analyze the size of its impact empirically on financial and macroeconomic variables (see, e.g., Bilgin et al., 2019; Chuliá et al., 2017; Gupta et al., 2018 and 2019b for detailed reviews).

In a parallel set of studies, researchers have also analyzed the spillover of uncertainty across economies (see, e.g., Ajmi et al., 2014; Antonakakis et al., 2018 and 2019; Biljanovska et al., 2017; Broll et al., 2018; Caggiano et al., 2017; Colombo, 2013; Çekin et al., 2020; Gabauer and Gupta, 2018; Gozgor and Demir, 2017; Gupta et al., 2016; Izadi and Hassan, 2018; Klößner and Sekkel, 2014; Liow et al., 2018; Thiem, 2018; Yin and Han, 2014). This issue is an essential line of research, since if uncertainties across economies are interrelated, as the studies mentioned above 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 and risks through linkages that exist in a modern globalized world due to trade linkages primarily (Gupta et al., 2019a). 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 1996Q1 to 2018Q3. Unlike the studies mentioned above, which generally looks at a handful of either developed or developing economies, and hence primarily uses a variation of the time-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 more significant than the time-series aspect of the data. Explicitly speaking, we contextualize the issue of spillover as a convergence problem, whereby we analyze 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. Note that spillover of uncertainty across countries should lead to long-run convergence of uncertainty around the world, which in turn implies that the deviations of the country-specific uncertainties from the global uncertainty (which is a weighted average of individual country-level uncertainties) should be stationary. In other words, the natural logarithm of the ratio of the country-level uncertainty to the world uncertainty should depict stationarity. This way of analyzing spillovers comes from the idea of "Ripple Effects" of housing prices, which aims to test spillover of housing prices across economies by framing the problem as an issue of convergence, and hence stationarity of relative prices (Meen, 1999).

Given the evidence of uncertainty spillovers occurring through the exchange rate, trade and financial linkages channels (Gupta et al., 2020), 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 and 2013), which simultaneously controls for cross-sectional dependence and nonlinearity. Besides, 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 can detect the ratio for which countries are stationary or non-stationary, we can conclude 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 analyze 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 and 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:

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

where,

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

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

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

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:

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

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:

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

We have the null hypothesis of non-stationarity $H_0: \theta_i = 0 \; \forall_i$, against its alternative $H_1: \theta_i > 0$ for $i = 1,2,\ldots, N_1$ and θ_i for $i = N_1 + 1,\ldots, N$. 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 reparametrized Equation (5) with the following auxiliary regression:

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

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

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

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

$$f_t \approx \frac{1}{\tilde{\tilde{\gamma}}} \Delta \tilde{\tilde{y}}_t - \frac{\bar{b}}{\bar{\gamma}} \tilde{\tilde{y}}_{t-1}^3 \tag{8}$$

Where $\tilde{\tilde{y}}_t$ 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:

$$\Delta \bar{y}_{i,t} = a_i + b_i \bar{y}_{i,t-1}^3 + c_i \Delta \tilde{\tilde{y}}_t + d_i \Delta \tilde{\tilde{y}}_{t-1}^3 + \varepsilon_{i,t} \tag{9}$$

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

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

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:

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

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., 2018): (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. (3) Uncertainty obtained from the dispersion of professional forecaster disagreements. As far as our metric of uncertainty is concerned, we use the first approach, i.e., the news-based measure of Ahir et al. (2018), primarily because 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. Besides, 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 significant 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 1996Q1 to 2018Q3.

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 natural logarithms of the ratio of the uncertainty index of each country to the global index, i.e., basically the log-deviation of the country-level and global uncertainties. 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.

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	***

[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.

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). ***, **, and * denote 1%, 5%, and 10% critical values respectively.

As can be seen, barring the case of Nigeria 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 the 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.

4. Conclusion

In this paper, we analyzed the convergence of a news-based measure of uncertainty across 143 countries over the quarterly period of 1996Q1 to 2018Q3. We applied a panel data-based unit root test, which controls both nonlinearity and cross-sectional dependence, to the ratio of the uncertainty of individual countries to that of the global measure of the same. Using the idea of "Ripple Effects" in the housing market, which tend to suggest that if spillovers of housing prices, in our case uncertainty, occurs, this would imply that there would be long-run convergence of house prices or uncertainties in our context, and requires that deviations of regional prices (country-level uncertainty) from the national price (global uncertainty) are stationary. Hence, posing the problem of convergence as that of a unit root, we found 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 external 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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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). ***, **, and * denote 1%, 5%, and 10% critical values respectively.