Uncertainty and Economic Activity: A Global Perspective

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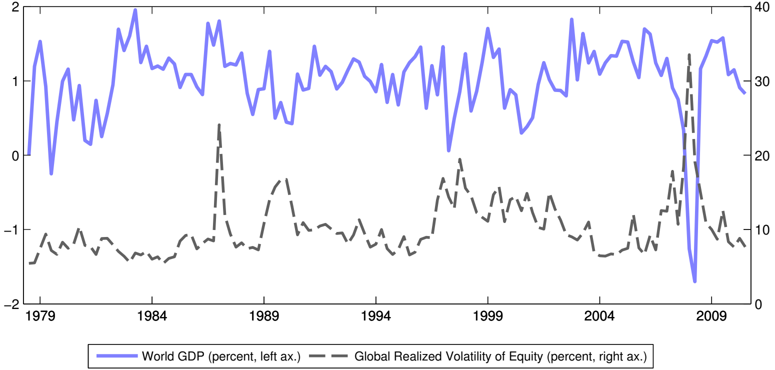
Strong correlation between "uncertainty" and economic activity



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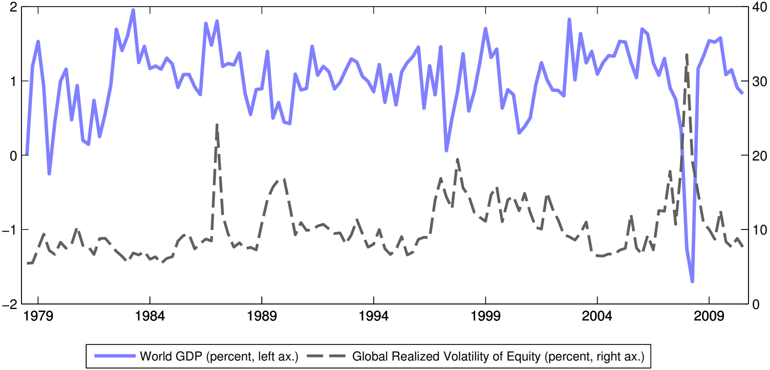

- During the crisis increase in uncertainty/volatility and contraction in activity
- After the crisis, low volatility and a recovery of economic activity

In this paper

- **What do we do?** Quantify the relation between uncertainty and economic activity using a novel multi-country approach

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- **How do we do it?**
  - Compute quarterly country-specific realized volatility measures (as a proxy for economic uncertainty) using daily returns of 109 asset prices worldwide
  - Set up a factor model for volatility and the business cycle in which both are driven by the same set of global common factors
  - Exploit the different cross-country correlation structure of volatility and GDP growth to identify the factors and the shocks

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- **What do we find?** Show that conditional on global factors there is little correlation left between volatility and economic activity

Outline

1. A simple factor model of volatility and macro dynamics
2. Results

A standard model of volatility and economic activity

- Model used in the literature (abstracting from dynamics) to interpret correlation between v_t and Δy_t

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\begin{aligned}
v_t &= \alpha \Delta y_t + \varepsilon_t \\
\Delta y_t &= \beta v_t + u_t
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$$v_t = \alpha \Delta y_t + \varepsilon_t$$
$$\Delta y_t = \beta v_t + u_t$$

- Since the covariance matrix $Cov(v_t, \Delta y_t)$ provides only three moments, the system is not identified

- Identification of structural parameters and shocks is typically achieved with an exclusion restriction (ie $\alpha = 0$ or $\beta = 0$)

An alternative model based on common factors

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- Again, identification of structural parameters and shocks cannot be achieved unless we impose an exclusion restriction, ie by assuming $\lambda = 0$ (or $\gamma = 0$)

An alternative model based on common factors: multi-country perspective

- Replace model above with the following disaggregated system of equations:

$$
\begin{aligned}
v_{it} &= \lambda_i n_t + \varepsilon_{it} \qquad \text{for } i = 1, 2, ..., N \\
\Delta y_{it} &= \gamma_i n_t + u_{it} \qquad \text{for } i = 1, 2, ..., N
\end{aligned}
$$

- Global volatility (v_t) and world GDP growth (Δy_t) are aggregates over a large number of countries

$$
v_t = \sum_{i=1}^{N} \mathring{w}_i v_{it}, \qquad \Delta y_t = \sum_{i=1}^{N} w_i \Delta y_{it},
$$

Identifying assumptions

- **Assumption 1** Weights $\mathbf{w} = (w_1, w_2, ..., w_N)'$ are of order $1/N$

$$||\mathbf{w}|| = O_p(N^{-\frac{1}{2}}), \qquad \frac{w_i}{||\mathbf{w}||} = O_p(N^{-\frac{1}{2}}) \qquad \forall i,$$

  - Ensures that the weights are not dominated by a few of the cross-section units

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- **Assumption 2** The volatility innovations (ε_{it}) are strongly correlated across countries, whilst the output innovations (u_{it}) are weakly cross-correlated across countries.

$$\lambda_{\max}(\mathbf{\Sigma}_\varepsilon) = O_p(N) \quad \text{and} \quad \lambda_{\max}(\mathbf{\Sigma}_u) = O_p(1)$$

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- These assumptions are not contradicted by the time series evidence

Identification of the factor by aggregation

- Consider the cross-country weighted averages of the disaggregated system

$$
\begin{aligned}
v_t &= \lambda n_t + \bar{\varepsilon}_t \\
\Delta y_t &= \gamma n_t + \bar{u}_t
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where $\bar{\varepsilon}_t = \mathring{\mathbf{w}}' \varepsilon_t$ and $\bar{u}_t = \mathbf{w}' \mathbf{u}_t$

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- For N sufficiently large n_t can be identified from macro equation

$$n_t = \gamma^{-1}\Delta y_t + \underbrace{\bar{u}_t}_{O_p\left(N^{-1/2}\right)}$$

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- For N sufficiently large n_t can be identified from macro equation

$$n_t = \gamma^{-1} \Delta y_t + \underbrace{\bar{u}_t}_{O_p\left(N^{-1/2}\right)}$$

- However, since the volatility shocks (ε_{it}) are strongly correlated across countries, n_t cannot be approximated by v_t

Implications: volatility equation

- Substitute n_t into the volatility equation to get

$$
\begin{aligned}
v_{it} = &\quad \lambda_i \underbrace{\gamma^{-1}\Delta y_t + \bar{u}_t}_{n_t} + \varepsilon_{it} = \\
= &\quad \left(\lambda_i \gamma^{-1}\right) \Delta y_t + \varepsilon_{it} + O_p\left(N^{-1/2}\right)
\end{aligned}
$$

- **Result** OLS consistently estimate the impact of contemporaneous changes in global activity on country-specific volatility

- **Result** We can identify the volatility innovation ε_{it}

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- Get volatility innovations $\hat{\varepsilon}_{it}^{eq}$
- Check validity of identifying assumption: strong cross-sectional dependence of volatility innovations $\hat{\varepsilon}_{it}^{eq}$

Pairwise correlation of volatility innovations: strong cross-sectional dependence

Table : Pairwise Correlation Of The Volatility Innovations

	PC		PC		PC
ARG	0.25	INDIA	0.30	PHLP	0.35
AUSTLIA	0.53	INDNS	0.30	SAFRC	0.51
AUSTRIA	0.44	ITALY	0.44	SARBIA	0.33
BEL	0.49	JAPAN	0.47	SING	0.52
BRA	0.13	KOR	0.40	SPAIN	0.53
CAN	0.56	MAL	0.38	SWE	0.54
CHINA	0.47	MEX	0.50	SWITZ	0.55
CHL	0.40	NETH	0.54	THAI	0.41
FIN	0.21	NOR	0.56	TURK	0.35
FRANCE	0.54	NZLD	0.42	UK	0.55
GERM	0.56	PER	0.49	US	0.56

Macro equation estimation

- Model country-specific GDP growth (Δy_{it}) as:

$$\Delta y_{it} = \sum_{k=1}^{p} \Phi_{ik} \Delta y_{i,t-k} + \sum_{k=0}^{q} \Lambda_{ik} \Delta y_{t-k} + u_{it}$$

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- Get macro innovations $\hat{u}_{it}$
- Check validity of identifying assumption: weak cross-sectional dependence of macro innovations $\hat{u}_{it}$

Pairwise correlation of GDP innovations: weak cross-sectional dependence

Table : Pairwise Correlation Of The GDP Innovations

	PC		PC		PC
ARG	0.00	INDIA	0.00	PHLP	0.01
AUSTLIA	0.02	INDNS	-0.02	SAFRC	0.03
AUSTRIA	-0.01	ITALY	0.03	SARBIA	-0.02
BEL	-0.01	JAPAN	-0.01	SING	-0.03
BRA	0.02	KOR	0.01	SPAIN	0.01
CAN	0.01	MAL	0.01	SWE	0.02
CHINA	-0.08	MEX	0.02	SWITZ	0.00
CHL	0.01	NETH	0.00	THAI	0.03
FIN	0.00	NOR	-0.01	TURK	-0.01
FRANCE	0.01	NZLD	0.04	UK	0.01
GERM	-0.06	PER	0.00	US	-0.04

Note. Lag length determined with Akaike criterion with a max of 4 lags.

The impact of volatility innovations on economic activity

- Is there any relation left (after controlling for the global factor) between volatility and economic activity?

The impact of volatility innovations on economic activity

- Is there any relation left (after controlling for the global factor) between volatility and economic activity?
- If yes, we should observe a (negative) correlation between $\hat{u}_{it}$ and $\hat{\varepsilon}_{it}^{eq}$
- Estimate the following country-specific equations

$$\hat{u}_{it} = b_i \hat{\varepsilon}_{it}^{eq} + \eta_{it} \quad \text{for } i = 0, 1, ..., N$$

The impact of volatility innovations on economic activity

Table : The Relation Between GDP Innovations And Volatility Innovations

	ARG	AUSTLIA	AUSTRIA	BEL	BRA	CAN	CHINA	CHL	FIN	FRANCE	GERM
beta	-0.04	0.00	-0.01	-0.02	-0.02	0.00	-0.01	0.01	0.00	0.01	0.01
t-stat	-2.79	-0.22	-0.46	-1.09	-2.01	-0.12	-0.35	0.24	0.22	0.88	0.58
R2	0.08	0.00	0.00	0.01	0.04	0.00	-0.03	0.00	0.00	0.01	0.00

	INDIA	INDNS	ITALY	JAPAN	KOR	MAL	MEX	NETH	NOR	NZLD	PER
beta	-0.01	-0.02	0.00	-0.04	-0.01	-0.05	0.02	0.00	-0.02	-0.04	0.03
t-stat	-0.61	-1.27	0.20	-2.05	-0.61	-2.83	0.82	0.19	-1.06	-1.75	0.74
R2	0.00	0.02	0.00	0.03	0.00	0.06	0.00	0.00	0.01	0.03	-0.04

	PHLP	SAFRC	SARBIA	SING	SPAIN	SWE	SWITZ	THAI	TURK	UK	US
beta	-0.02	-0.01	-0.02	0.02	0.00	-0.02	-0.01	-0.01	0.02	-0.01	-0.02
t-stat	-0.93	-0.77	-0.66	0.68	0.41	-1.06	-0.81	-0.44	0.59	-0.57	-1.67
R2	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02

Conclusions

- Quantify the relation between uncertainty and economic activity using a novel multi-country approach
- Exploit the different cross-country correlation structure of volatility and GDP growth to establish the direction of causation
- Much of the reduced form correlation between volatility and economic is driven by common (first moment) factors