

Discussion of Kim and Ruge-Murcia "EXTREME EVENTS AND THE FED"

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Methods and Applications for DSGE Models

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The views expressed herein are those of the author and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

INTRODUCTION

- Interesting paper on very important topic.
- How do we model extreme events? What are their positive implications? What should policymakers do when facing risk of large and rare events?
- This paper: introduces GEV shocks in nonlinear small scale NK Model.
 - Good statistical representation of U.S. macroeconomic aggregates.
 - Positive analysis.
 - Normative analysis.
- Very nice exercise, continues the tradition of relaxing Gaussianity.

OUTLINE OF THE DISCUSSION

- Overview: Model, GEV shocks, Quantitative Analysis, Results.
- Three remarks:
 - A note on the moments.
 - Limited information with nonlinear non-Gaussian models.
 - Shocks or amplification?
- Conclusions.

REVIEW OF THE MODEL

- Small scale DSGE model with nominal price and wage rigidities.
- Model consists of
 - Households: consumption and labor.
 - Intermediate good producers: prices and wages.
 - Fed: Nominal interest rate result of a Taylor rule.
- Shocks: $\xi_t = [\log(z_t), \log(x_t), \log(e_t)]'$

$$\xi_t = \rho \xi_{t-1} + \varepsilon_t$$

- Elements of ε_t drawn from generalized extreme value (GEV) distribution.

PROPERTIES OF GEV DISTRIBUTION

$$\varepsilon_{i,t} \sim \mathcal{G}\mathcal{E}\mathcal{V}(\mu, \sigma, \xi)$$

- Parameter ξ governs shape
 - If $\xi < 0$, Weibull with support $x \in [\mu - \frac{\sigma}{\xi}, \infty)$.
 - If $\xi = 0$, Gumbel with support $\xi \in (-\infty, +\infty)$.
 - If $\xi > 0$, Frechet with support $x \in (-\infty, \mu - \frac{\sigma}{\xi}, \infty]$.
- Not all moments are defined (E.g. Mean not defined if $\xi \geq 1$, variance if $\xi \geq \frac{1}{2}$, kurtosis if $\xi \geq \frac{1}{4}$, ...).
- Does not nest Gaussian. Not big problem.
- Alternative? Skew normal shocks as in [Grabek et al. \(2011\)](#).
 - Authors tried, but skew normal too restrictive (skewness is bounded).

QUANTITATIVE ANALYSIS

- Policy functions approximated by third order perturbation around \bar{s}

$$[f(s_t, \sigma)]^k \approx \frac{1}{6} [f_{\sigma\sigma\sigma}(\bar{s}, \sigma)]^k [\sigma\sigma\sigma] + \dots$$

- Model parameters estimated with SMM.
 - Sample period: 1964:Q1-2012:Q4.
 - Hours, Wage and Price inflation, Real PCE per capita, FFR.
 - Moments: variances, covariances, autocovariances and skewness.
- Comparison with two alternative specifications.
 - Nonlinear Gaussian.
 - Linear GEV.

RESULTS

- Macroeconomic series display non-Gaussian behavior.
 - Consumption and hours negatively skewed.
 - Wage inflation, price inflation and FFR right skewed.
 - Excess kurtosis.
- Nonlinear and linear GEV capture these features, nonlinear Gaussian not.
- IRFs to equally likely positive and negative shocks differ (mainly result of asymmetry in the distribution).
- Ramsey planner responds more strongly to shocks relative to what prescribed by Taylor rule.

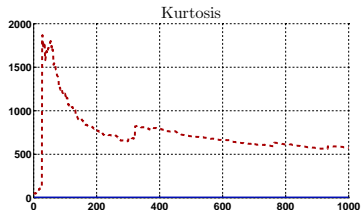
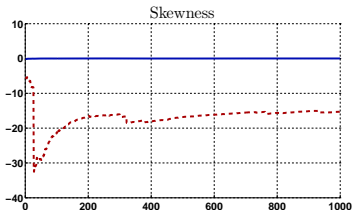
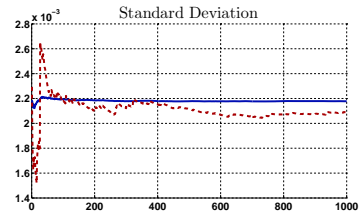
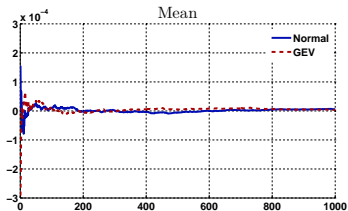
REMARK 1: A NOTE ON THE MOMENTS

- With $\mathcal{G}\mathcal{E}\mathcal{V}$ shocks, sample moments may have slow convergence.
- CLT may not apply even if moments exists.

CONVERGENCE OF MOMENTS

$$y_t = 0.8y_{t-1} + \varepsilon_t$$

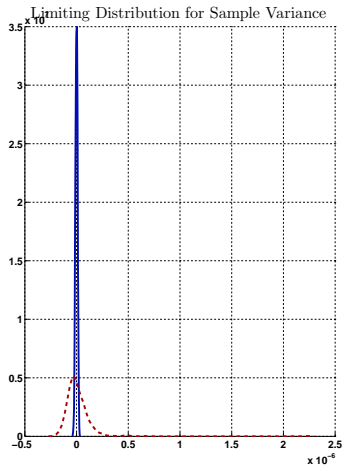
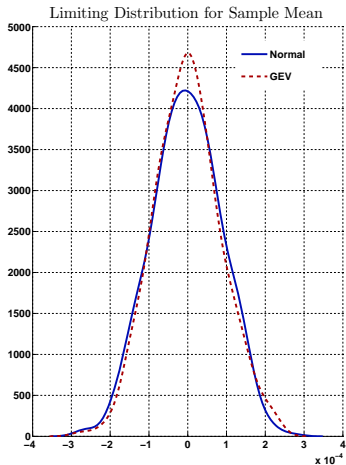
Shocks $\mathcal{GEV}(10^{-3}0.17385, 10^{-4}0.4183, -3.75)$ and $\mathcal{N}(0, 0.0013)$.



CLT AND THE SHAPE OF THE GEV DISTRIBUTION

$$y_t = \varepsilon_t$$

Shocks $\mathcal{GEV}(10^{-3}0.17385, 10^{-4}0.4183, 0.25)$ and $\mathcal{N}(0, 0.0013)$.



A NOTE ON THE MOMENTS: SUGGESTIONS

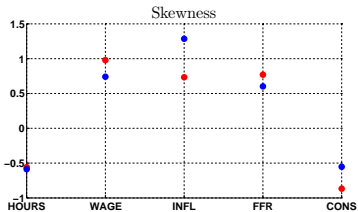
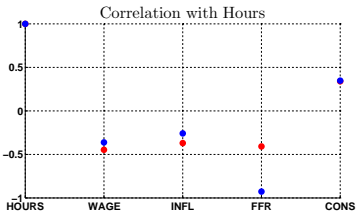
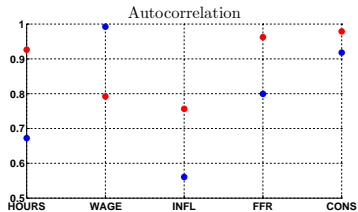
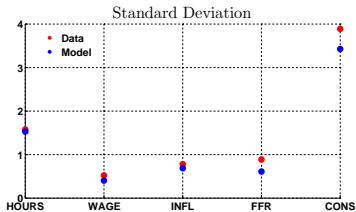
- With $\mathcal{G}\mathcal{E}\mathcal{V}$ shocks, convergence of sample moments slow \rightarrow big T and variance reduction techniques. Or GMM, using results in Andreasen, Fernandez-Villaverde and Rubio-Ramirez (2014) .
- CLT may not apply even if moments exists. \rightarrow Need to guarantee the existence of high order moments for SMM.

REMARK 2: LIMITED INFORMATION WITH NONLINEAR NON-GAUSSIAN MODELS

- Authors select autocovariance and skewness.
- This may not be enough to describe these extreme events.

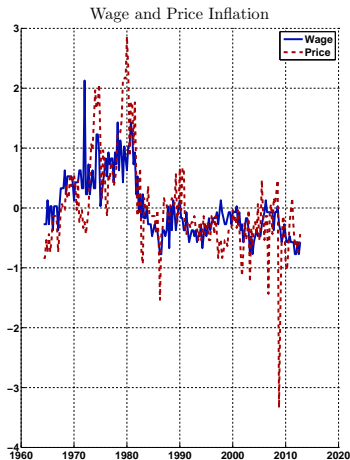
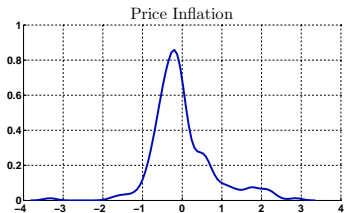
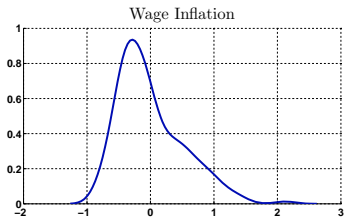
IN SAMPLE FIT

In sample fit reasonable



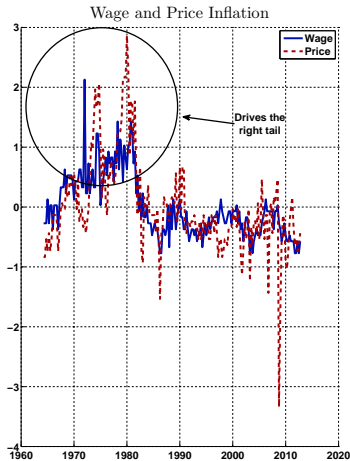
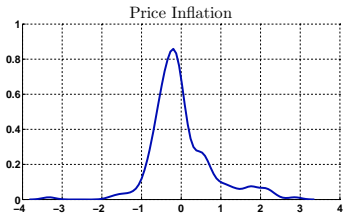
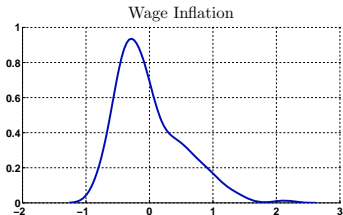
DOES THE MODEL CAPTURES NONLINEARITIES IN THE DATA?

Wage and price inflation in the U.S.



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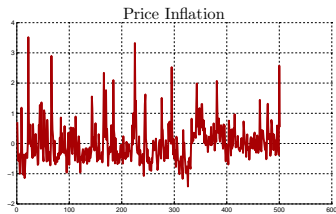
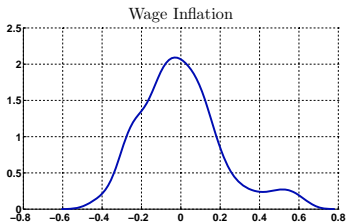
Wage and price inflation in the U.S.



Extreme observations in wage and price inflation coincide.

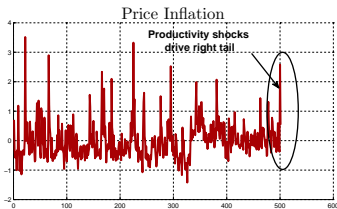
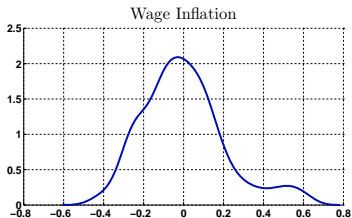
DOES THE MODEL CAPTURES NONLINEARITIES IN THE DATA?

Wage and price inflation in the model



DOES THE MODEL CAPTURES NONLINEARITIES IN THE DATA?

Wage and price inflation in the model



Extreme observations driven by different shocks.

LIMITED INFORMATION WITH NONLINEAR NON-GAUSSIAN MODELS: SUGGESTIONS

- Authors select autocovariance and skewness
 - Think on how to summarize high order information.
 - First moments provide information too.
- **Wanted:** nonlinear auxiliary time series model for DSGE model
 - Indirect inference in limited information.
 - Model evaluation with full information.

REMARK 3: SHOCKS OR AMPLIFICATION?

- Stark view: extreme events due to “shocks”.
- Another (stark) view: extreme events due to amplification.
 - E.g. Occasionally binding financial constraints ([Mendoza, 2013](#); [Guerrieri and Iacoviello, 2014](#); [Bocola, 2014](#))
- Important for normative analysis
 - If shocks, policymakers can only insure
 - If amplification, policymakers can also affect the likelihood of these events (e.g. macroprudential policies)
- Nice to have a discussion of these issues.

CONCLUSION

- Very interesting paper on very important research question.
- Suggestions:
 - Discuss issues related to GEV shocks moments.
 - Think about moments' selection (or indirect inference).
 - More economics (Is third order perturbation enough?).