FEDERAL RESERVE BANK OF SAN FRANCISCO

Should Central Banks Worry About Nonlinearities of their Large-Scale Macroeconomic Models?

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Is linearizing DSGE models a sin?

- DSGE models often solved/estimated by linearization
- But nonlinearity can be important:
  - ZLB
  - Credit constraints
  - Uncertainty
- How bad are linear approximations? Do they mislead policy inferences?

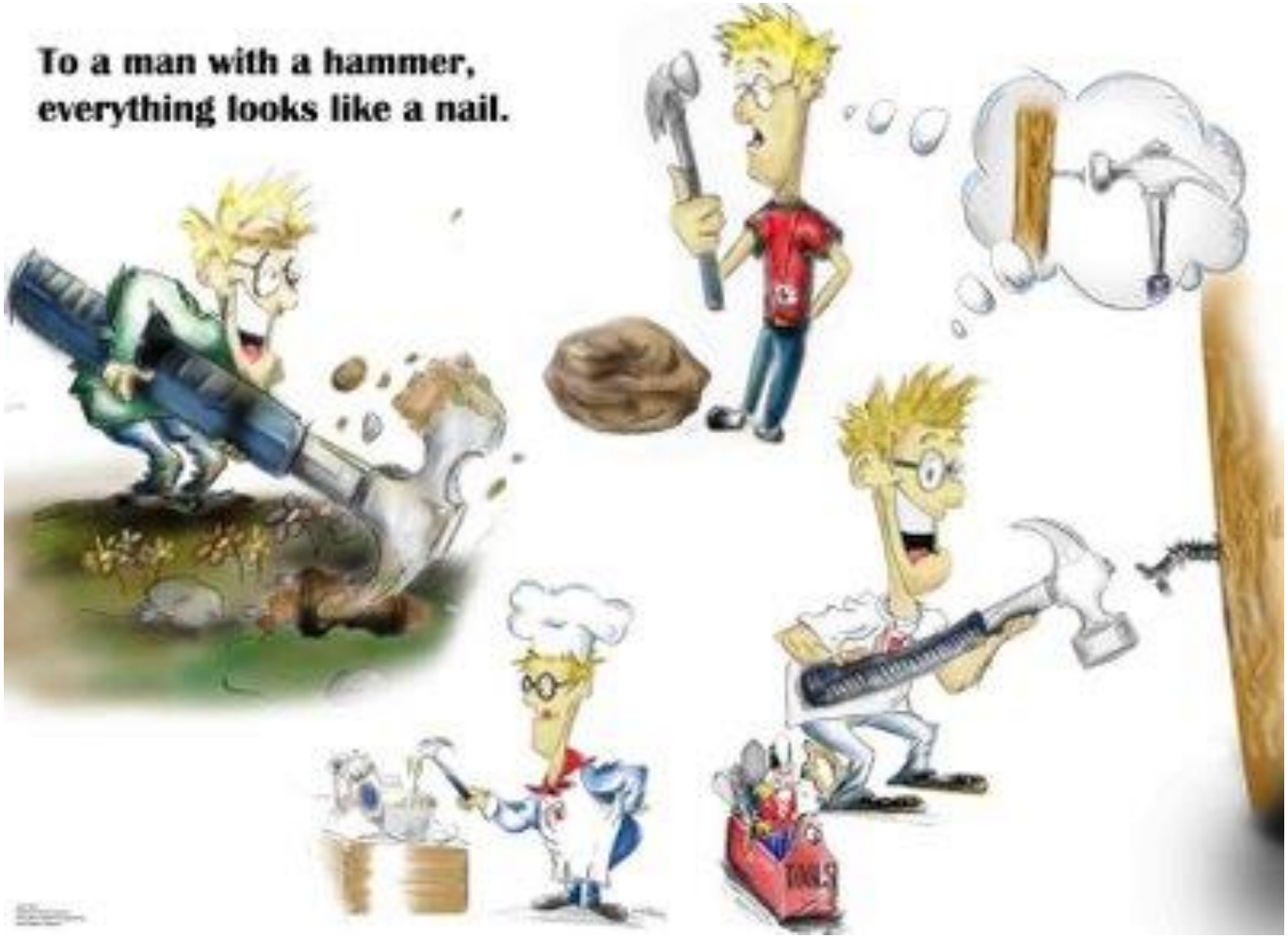
This paper: linearization not too bad!

- Considers a “baby version” of ToTEM with ZLB, a DSGE model by Bank of Canada.
  - Model still large (49 eq, 21 state variables)
- Compare 3 different solution methods
  1. Linearization (with ELB, use OccBin/IRIS)
  2. Second-order approx. around SS (ELB ignored)
  3. Global solution with CGA (with ELB)
- Surprising finding: very little difference b/n linearization and global solution
  - ZLB dynamics are similar
  - Transition dynamics to a higher inflation target also similar (if started from appropriate SS)

Similarity between linearization and global solutions perhaps not surprising

- Model may be complicated but still “close to linear”: price/wage dispersions not very important quantitatively
- Shocks are small: near-SS dynamics (appropriate for Canada, but not for EMEs)
- Rep household: risk sharing mitigates/eliminates uncertainty
- ZLB: infrequently observed, small “spillover” to aggregate dynamics

Hammer looking for a nail?



Some suggestions (nails)

- The baby ToTEM still too complicated
  - Can similar point be made in a medium-scale DSGE model (Smets-Wouters, 2007)?
- DSGE models with uncertainty shocks (e.g., Basu-Bundick, 2017; Leduc-Liu, 2016)
  - Linear perturbation inappropriate
  - Neither is 2nd-order approx.
  - Can use global solution to evaluate accuracy of the standard 3rd-order local approx.
- Apply global solution to policy evaluations:
  - Uncertainty and high-order effects important for welfare

Broader applications of global solution

- A few more nails:

1. Sovereign default models (Mendoza-Yue, 2012; Aguiar, et al. 2016)

2. Financial/banking crisis models (Brunnermeire-Sannikov, 2014; Gertler-Kiyotaki, 2015)
   - Can CGA deal with bank runs and multiple equilibria?

3. Heterogeneous agent models (Kaplan, et al. 2017)
   - Distributional consequences of macro policy?

Conclusion

- Well written paper on a specific subject: accuracy of linear approx. in a large-scale DSGE model

- Global solution approach can have much broader applications, where nonlinearity is inherent
  - Optimal policy
  - Discrete choices (sovereign default)
  - Financial crisis and multiple equilibria
  - Distributional issues