

Discussion of “Resolving the Missing Deflation Puzzle” by Lindé and Trabandt

S. Borağan Aruoba

University of Maryland

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Chicago Fed / NBER DSGE Conference

Summary of the Paper

Missing deflation after the Great Recession is **not** a puzzle if you accept:

- **Kimball aggregator**

- Demand for intermediate goods does not have constant elasticity. (elasticity increases in price)

When an adverse shock hits firms, they cut prices as much

- **Nonlinear solution**

To preserve the nonlinear behavior of demand

- **Calvo pricing** (this is implicit but important)

To have a distribution of prices

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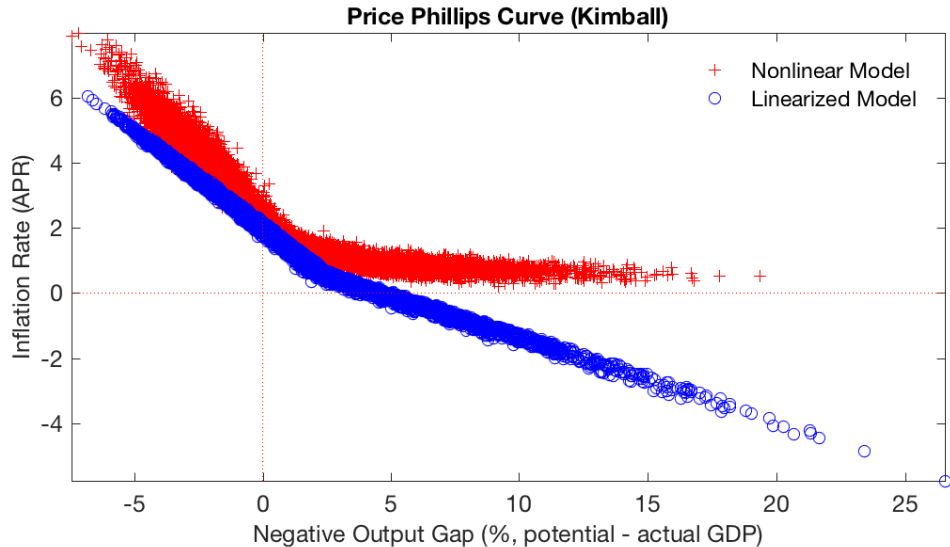
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Key Features

- Each of the three features [**nonlinear**, **Calvo**, **Kimball**] is essential for the results:
 - **Nonlinear** + **Calvo** + DS [this paper]
 - **Nonlinear** + **Rotemberg** + **Kimball** [Rau's work; need price dispersion]
 - **Nonlinear** + **Rotemberg** + DS [Gust et al (2017), AER]
 - **Linear** + **Calvo** + **Kimball** [Smith and Wacziarg (2007)]
- **Aside:** **Nonlinear** + Rotemberg + DS [Aruoba, Cuba-Borda, Higa-Flores, Schorfheide, Villalvazo-Martin (2019), see next]
- **Question:** Is wage stickiness + Kimball important?
- **Aside:** Flexibility of Kimball aggregator allows models to match micro pricing facts while delivering a small enough slope of the NKPC.

• $\xi = 0.007$, reported duration 3 quarters, NKPC slope 0.012

• Same model with DS, $\xi = 0.9$, reported duration 10 quarters

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Calvo = 0.007, reported duration 3 months, NKPC slope = -0.012

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Smets and Wouters (2007) report that during 3 quarters, NKPC slope is 0.012

Smets and Wouters (2007) with DS, $\beta = 0.9$, reported that $\beta = 0.001$

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Smets and Wouters (2007) and Gust et al (2017) show that Kimball is essential for the NKPC.

Smets and Wouters (2007) show that Calvo is essential for the NKPC.

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Smets and Wouters (2007) and Gali (2007) use a Kimball aggregator to match the NKPC.

Smets and Wouters (2007) use $\alpha = 0.9$, and Galí (2007) uses $\alpha = 0.99$.

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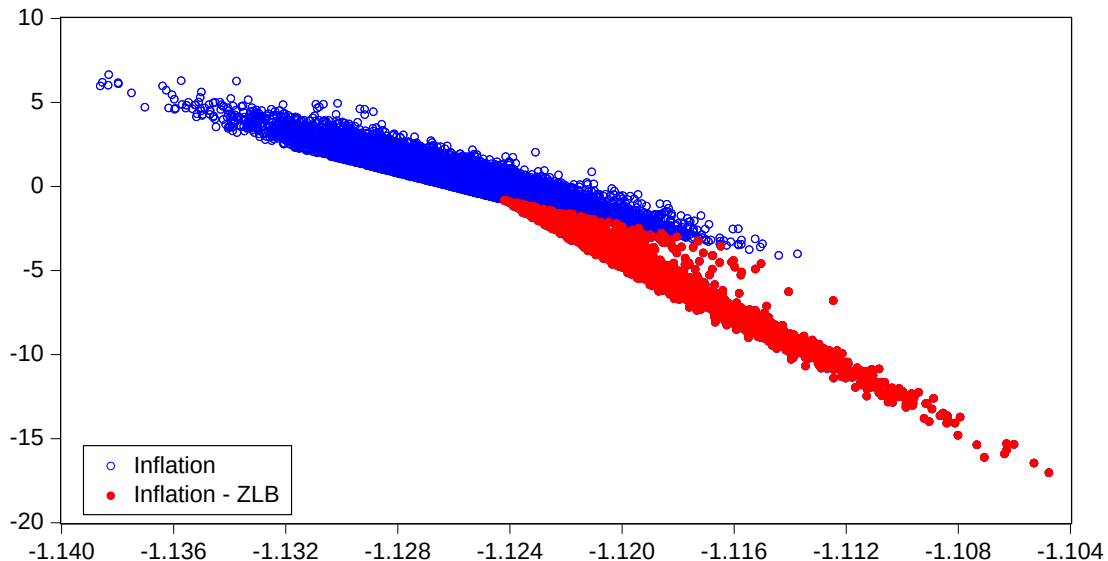
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NKPC with Rotemberg and Dixit-Stiglitz



Paper's Contributions

The paper kills 4-5 birds with one stone:

- 1 Show that the missing deflation puzzle is not a puzzle.
- 2 Demonstrate importance of nonlinear solutions (again)
- 3 A (rare) instance where Calvo and Rotemberg pricing produce significantly different results.

Models that are identical up to a first approximation may still look very different (see [2])

- 4 Show that missing inflation puzzle (if people are calling it that) is not a puzzle.
- 5 Have a model that matches some of the key nonlinear characteristics of U.S. data.
[Maybe. Next]

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- A nonlinear model that mimicks the type of nonlinearity in a second-order approximation of a DSGE model.

$$\begin{aligned}y_t &= \phi_0 + \phi_1(y_{t-1} - \phi_0) + \phi_2 s_{t-1}^2 + (1 + \gamma s_{t-1})\sigma u_t \\s_t &= \phi_1 s_{t-1} + \sigma u_t \quad u_t \stackrel{\text{i.i.d.}}{\sim} \mathcal{N}(0, 1)\end{aligned}$$

- We estimate QAR(1,1) using U.S. data and identify cases where ϕ_2 and/or γ are nonzero.
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Estimation of QAR(1,1) Model on U.S. Data

$$y_t = \phi_0 + \phi_1(y_{t-1} - \phi_0) + \phi_2 s_{t-1}^2 + (1 + \gamma s_{t-1})\sigma u_t, \quad s_t = \phi_1 s_{t-1} + \sigma u_t$$

- $\phi_2 < 0$ for GDP growth and for FFR in samples that start in 1984.
 - Captures asymmetric behavior of GDP and FFR: dip quickly increase slowly.
- $\gamma < 0$ for GDP growth for 1984-2012 sample.
 - Captures conditional heteroskedasticity: volatility higher when the variable is low (effect of Great Recession)
- $\gamma > 0$ for inflation, wage growth and FFR in samples that start in 1960.
 - Captures conditional heteroskedasticity: volatility higher when the variable is high
- Our model generates $\gamma > 0$ for inflation and wage growth but cannot generate $\phi_2 < 0$ for GDP growth or $\gamma > 0$ for FFR. So asymmetry in pricing (via cost function) does not spill over to quantities or policy.

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- $\gamma > 0$ for inflation, wage growth and FFR in samples that start in 1960.
 - Captures asymmetric behavior of inflation, wage growth and FFR: dip slowly increase quickly
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Estimation of QAR(1,1) Model on U.S. Data

$$y_t = \phi_0 + \phi_1(y_{t-1} - \phi_0) + \phi_2 s_{t-1}^2 + (1 + \gamma s_{t-1})\sigma u_t, \quad s_t = \phi_1 s_{t-1} + \sigma u_t$$

- $\phi_2 < 0$ for GDP growth and for FFR in samples that start in 1984.
 - Captures asymmetric behavior of GDP and FFR: dip quickly increase slowly.
- $\gamma < 0$ for GDP growth for 1984-2012 sample.
 - Captures conditional heteroskedasticity: shocks become larger when the variable is low. (effect of Great Recession)
- $\gamma > 0$ for inflation, wage growth and FFR in samples that start in 1960.
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QAR with Lindé-Trabandt

- Estimated QAR using U.S. data for 1965-2007 (their exact sample)
- Key nonlinearities in the data for this sample : $\gamma > 0$ for inflation, wage growth and FFR.
- They provided me with a long simulation from their full model.
- Estimated QAR for 100 samples that mimic the 1965-2007 sample from their simulation.
- γ estimates:

	Data			Model (Across Simulations)		
	5%	Mean	95%	5%	median	95%
Inflation	0.16	0.26	0.35	0.05	0.23	0.40
Wage Growth	0.01	0.09	0.18	-0.07	0.08	0.30
FFR	0.26	0.34	0.43	-0.04	0.02	0.11

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- **Question:** What is the relationship between asymmetric adjustment cost + DS and Calvo + Kimball?

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Final Thoughts

- Very nice paper, lots to think about.
- A very (most?) natural resolution of the missing deflation puzzle.
 - Had we estimated Full-Scale-Model with ZLB, we would have seen it.
- Next step: Estimate a medium-large scale model with ZLB and Kimball aggregator.
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