Discussion of "Dynamics of the price distribution in a general model of state-dependent pricing" by James Costain and Antón Nákov

Kevin Sheedy

LSE

26th February 2009

Overview

- Sets up a tractable model of state-dependent pricing suitable for DSGE analysis.
- Basic assumption: probability of price adjustment is increasing in the size of the gains from price adjustment.
- Calibrate to match features of the distribution of price changes observed in the micro data.
- Simulate the effects of a shock to monetary policy.

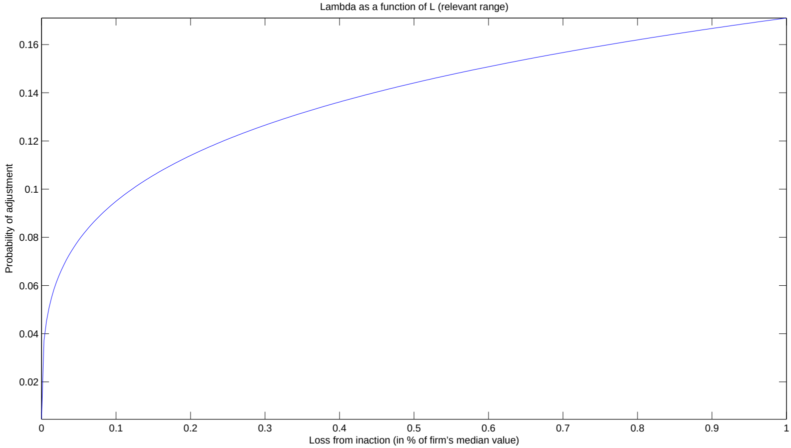
Model

- Standard CES preferences
- Linear production function
- Idiosyncratic productivity shocks
- Frictions implying that not all gains from price adjustment are realized with probability one

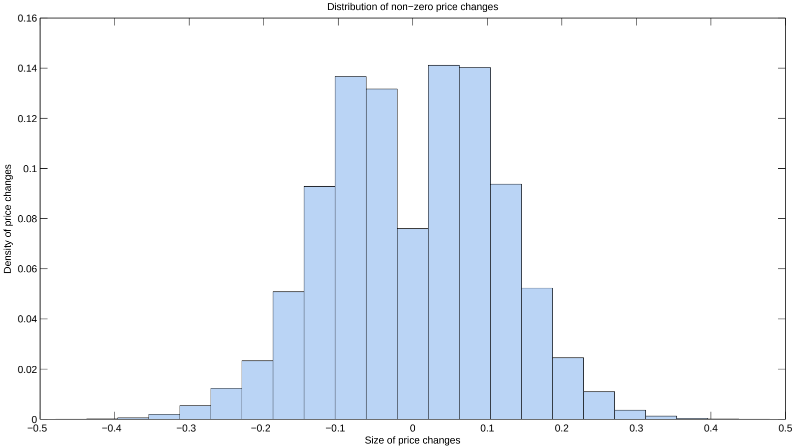
Solution method

- Smoothly varying probability of price adjustment means that log-linearization techniques can in principle be applied.
- But state-space in general is infinite dimensional: must track whole price distribution.
- Solution proposed: Use the method of Reiter (2008).
  1. project model on to a grid of points (price & idiosyncratic productivity)
  2. perturb equations of model around grid points (differentiability maintained by smooth interpolation)
- Log-linearize equations (Bellman equation, transitional equation for distribution) around each point on the price-productivity grid.
- Solve resulting large number of linear stochastic difference equations using the QZ decomposition method (standard solution method for rational expectations models).

Smooth state-dependent pricing

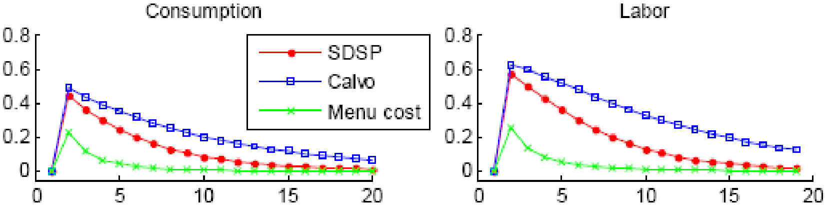


Result: A mixture of small and large price changes



Result: Monetary policy has large real effects

Unanticipated permanent money shock:



Comment: Interpretation of adjustment friction

How to interpret the "smoothness" in the adjustment probability:

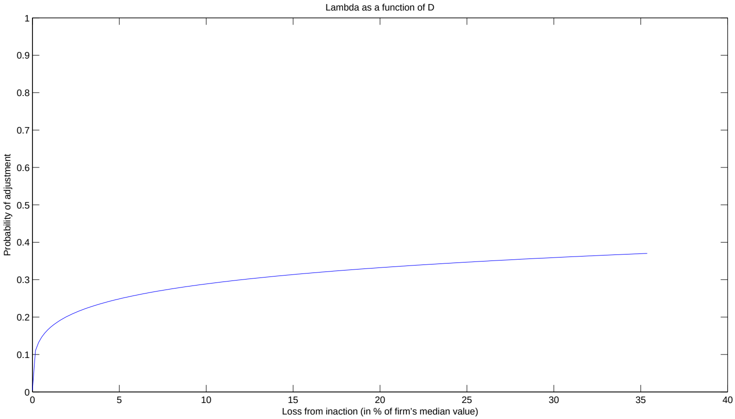
1. Stochastic menu cost — Dotsey, King & Wolman (1999)
2. Greater information flow is costly — Woodford (2008)

But the first interpretation is problematic given evidence on the size of menu costs: e.g. for U.S. supermarkets, 0.7% of revenues (Levy et al., 1997). The calibrated model features many firms with a menu cost draw significantly greater than this.

For the second interpretation: Can we assess how large the information collection/processing costs need to be and compare with the evidence in Zbaracki et al. (2004)?

Some very large menu costs

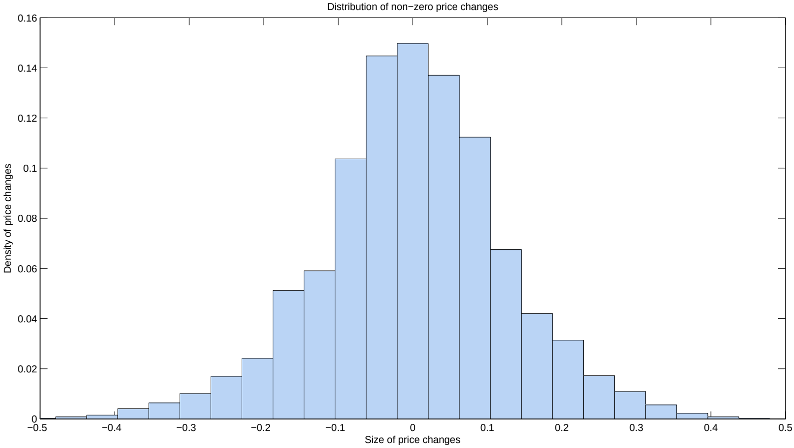
Cumulative distribution function of menu costs:



This does eventually reach 1 for extremely large menu costs.

Price distribution in Woodford (2008) case

Probability of price adjustment is still positive even with no gains. Perhaps too many small price changes:



Comment: Real rigidities

- Gertler & Leahy (2008) find that a real rigidity (local factor markets, leading to increasing marginal cost) is important in generating large real effects in a state-dependent pricing model.
- Earlier discussion in time-dependent literature emphasized importance of real rigidities in amplifying the effects of small nominal rigidities.
- Easy to implement in this setting.
- Should get similar implications for macro effects.
- But would this real rigidity make it harder to match the distribution of price changes?

Real rigidity

- diminishing MPL, or:
- local labour market

Changes the profit function:

$$\Pi_{it}/P_t = \left(\left(\frac{P_{it}}{P_t} \right)^{1-\epsilon} - \frac{W_t}{A_{it}^{1+\eta}} \left(\frac{P_{it}}{P_t} \right)^{-\epsilon(1+\eta)} \right) C_t$$

where η is the elasticity of the total cost of production w.r.t. firm output ($\eta > 1$ in these cases).

Comments: Functional form

Mapping from price adjustment gain to probability of adjustment:

$$\lambda(L) = \frac{\bar{\lambda}}{\bar{\lambda} + (1 - \bar{\lambda}) \left(\frac{\alpha}{L}\right)^{\xi}}$$

- What feature of the function is most important for explaining the results?
  - $\lambda'(L)$ small, or:
  - $\lambda(L)$ far from 1 for high L

Comment: Unobservable idiosyncratic productivity shocks

- Calibration exercise is based on unobserved idiosyncratic shocks.
- Some micro datasets have both price and cost data, e.g. Eichenbaum, Jaimovich & Rebelo (2008).
- Can estimate probability of price adjustment as a function of gap between price and cost.
- Would this exercise also lead to a low value of $\lambda'(L)$?

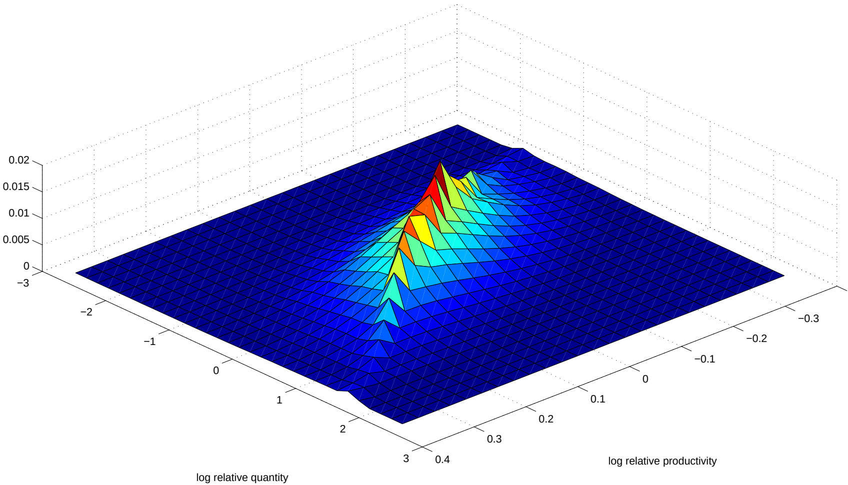
Question: Accuracy of log linearization approximation

- All functions appearing in the model are smooth (if $\xi < \infty$), but they can still be highly non-linear.
- So while we can formally define a first-order Taylor expansion in logs, we don't know how accurate it will be.
- e.g. consider a linear approximation to $\lambda(L)$ as ξ increases:
  - First-order Taylor expansion exists for all $\xi < \infty$
  - Accuracy of linear approximation falls as ξ increases
- Also a problem for joint distribution of prices-productivities? — Many entries close to zero.

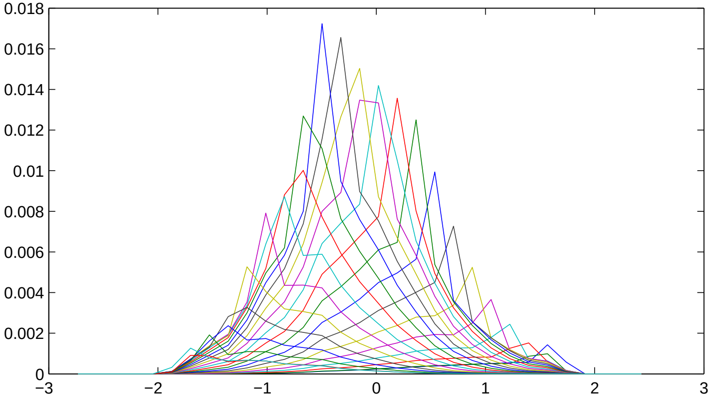
Comment: Implications for quantities

- Calibration implies large changes in quantities sold relative to volatility of prices.
- Explained by high price elasticity of demand ($\epsilon = 7$).
- Choice of price elasticity affects distribution of price changes: sensitivity analysis?
- Price adjustment costs versus quantity adjustment costs?

Joint quantity-productivity distribution



Quantity distributions for same productivity level



Question: Multiplicity of equilibria?

- Many simple static state-dependent pricing models feature multiple equilibria: i.e. gains from adjusting price are greater when others are also adjusting price.
- Especially when real rigidities are present (create strategic complementarity in pricing decisions).
- Would these effects also be present here?
- Or can it be shown that the equilibrium is unique?

Future extensions of paper?

This framework for analysing state-dependent pricing could be profitably applied to:

- Richer DSGE models
- Optimal policy analysis