**Price Setting and Volatility:**

**Evidence from Oil Price Volatility Shocks**

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**Motivation**

- Do changes in aggregate volatility alter the effectiveness of monetary policy to stimulate output?
  - Time varying volatility affects firm decision making (Bloom (2009), Bloom et al. (2014))
  - Fiscal and monetary policy effectiveness falls during periods of high idiosyncratic volatility (Bloom et al. (2014), Vavra (2014), Bachmann et al. (2013))

- Study how individual prices react to common volatility shocks

- Use general equilibrium menu cost model to examine policy counterfactuals

**Pricing Data**

- U.S. Producer Price Index monthly item level data from 1998-2014
- Construct monthly 4-digit NAICS non-zero price change dispersion for 81 industries
- Finished goods in manufacturing sectors only

**Price Change Dispersion**

- Price change dispersion is a key measure of monetary non-neutrality

**Empirical Strategy**

- Oil price volatility is advantageous to use for three reasons:
  - Plausibly exogenous to disaggregated industries
  - Large, observable shifts in first and second moment
  - Oil prices pass through to producer prices

- Exploit pre-existing heterogeneity in oil usage across industries for identification
  - Oil price volatility and has stronger effects for industries that use more oil

- Identification assumption is that there is no omitted shock that comoves with oil price

- Evidence from Oil Price Volatility Shocks

- Policy Counterfactual

- Compare monetary policy effectiveness during period of normal and increased oil price volatility

- Fixed MC model implies ability of central bank to stimulate consumption is nearly time invariant

- Random MC model implies 10% fall in monetary policy effectiveness

- Fixed MC model matches positive empirical relationship

- Oil Volatility Shock

- Shock model with 1 standard deviation oil price volatility increase

- Menu Cost Model

- Heterogeneous firms who use labor and oil for production

- Firms choose optimal price to maximize future expected profit

\[ \pi_j(z) = p_j(z)y_j(z) - W_jL_j(z) - Q_jO_j(z) - \gamma(z)W_jI_j(z) \]

where the menu cost follows

\[ \chi(z) = \begin{cases} 0 & \text{with probability } \alpha \\ \lambda k & \text{with probability } 1 - \alpha \end{cases} \]

and \( F(k) = P(\xi \leq k) = 1 - e^{-\lambda k} \)

- Compare standard Fixed MC model to a Random MC model

**Empirical Results**

- Panel regression controlling for industry and time fixed effects

\[ Y_{jt} = \gamma \ast (s_{j,1997} \ast \Delta \log(P_{t-1})) + \eta \ast (s_{j,1997} \ast \sigma_{t-1}) + \gamma X_{jt} + \alpha_j + \alpha_t + \epsilon_{jt} \]

- Identification of volatility shock comes from variation within an industry over time

- Positive relationship between oil price volatility and price change dispersion

- Relationship robust to oil price, 2008 crisis period, zero lower bound, measurement of oil price volatility

- Conclusion

- Aggregate volatility shocks increase price change dispersion

- Tradeoff between output stabilization and inflation is nearly time invariant in response to aggregate volatility shocks

- Source of volatility matters for policy makers