Price Setting and Volatility: Evidence from Oil Price Volatility Shocks

Matthew Klepacz

College of William and Mary

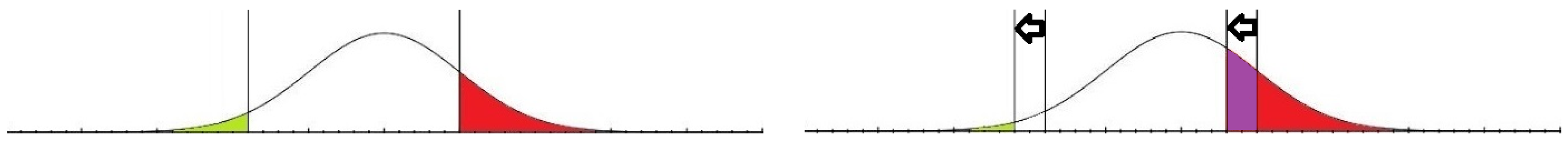
Motivation

- 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

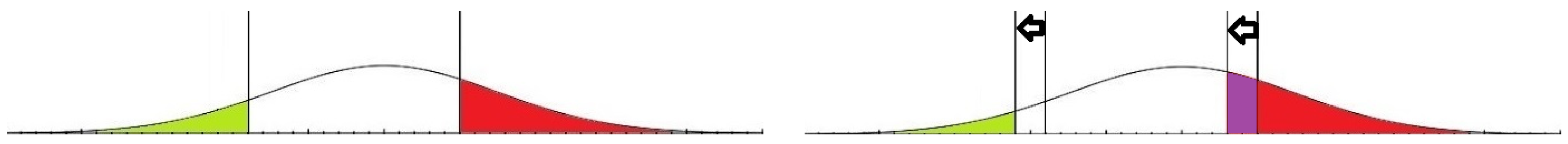
Pricing Data

- 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



Less Disperse Desired Price Change Distribution



Disperse Desired Price Change Distribution

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

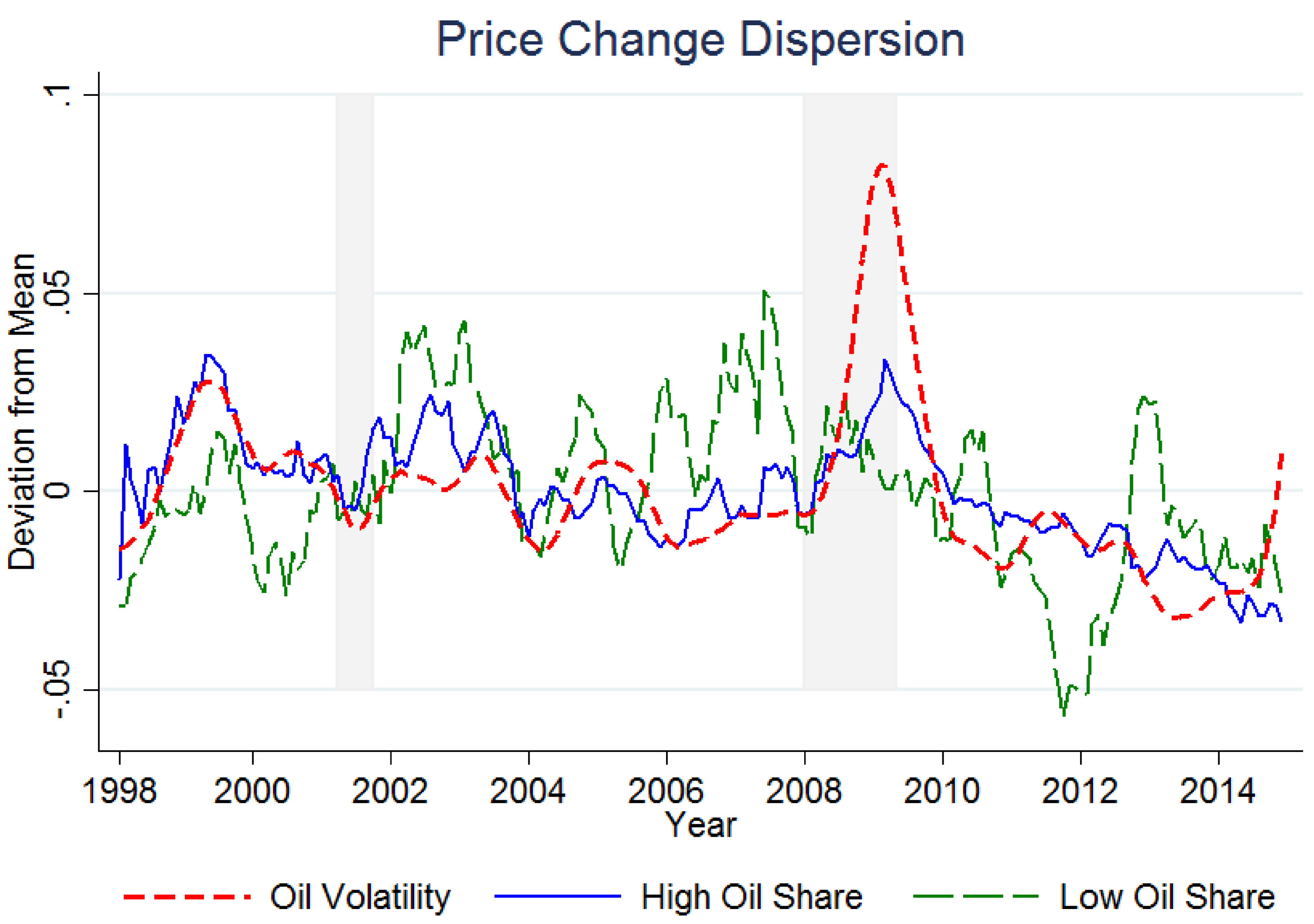
Empirical Strategy

- 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

$$s_{o,j,1997} = \frac{\text{Nominal Dollars Spent of Oil Input Industry j in 1997}}{\text{Nominal Dollars Value Added Industry j in 1997}}$$

- Identification assumption is that there is no omitted shock that comoves with oil price volatility and has stronger effects for industries that use more oil

Empirical Results



- Panel regression controlling for industry and time fixed effects

$$Y_{j,t} = \gamma * (s_{o,j,1997} * \Delta log(P^o_{t-1})) + \eta * (s_{o,j,1997} * \sigma_{t-1}) + \gamma' X_{j,t} + \alpha_j + \alpha_t + \epsilon_{jt}$$

- Identification of volatility shock comes from variation within an industry over time
- Positive relationship between oil price volatility and price chance dispersion
- Relationship robust to oil price, 2008 crisis period, zero lower bound, measurement of oil price volatility

Menu Cost Model

- Heterogeneous firms who use labor and oil for production
- Firms choose optimal price to maximize future expected profit

$$\pi_t(z) = p_t(z)y_t(z) - W_t L_t(z) - Q_t O_t(z) - \chi_t(z) W_t I_t(z)$$

where the menu cost follows

$$\chi_t(z) = \begin{cases} 0 & \text{with probability } \alpha \\ \tilde{\chi}_t & \text{with probability } 1-\alpha, \end{cases} \quad (1)$$

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

- Compare standard Fixed MC model to a Random MC model

Oil Volatility Shock

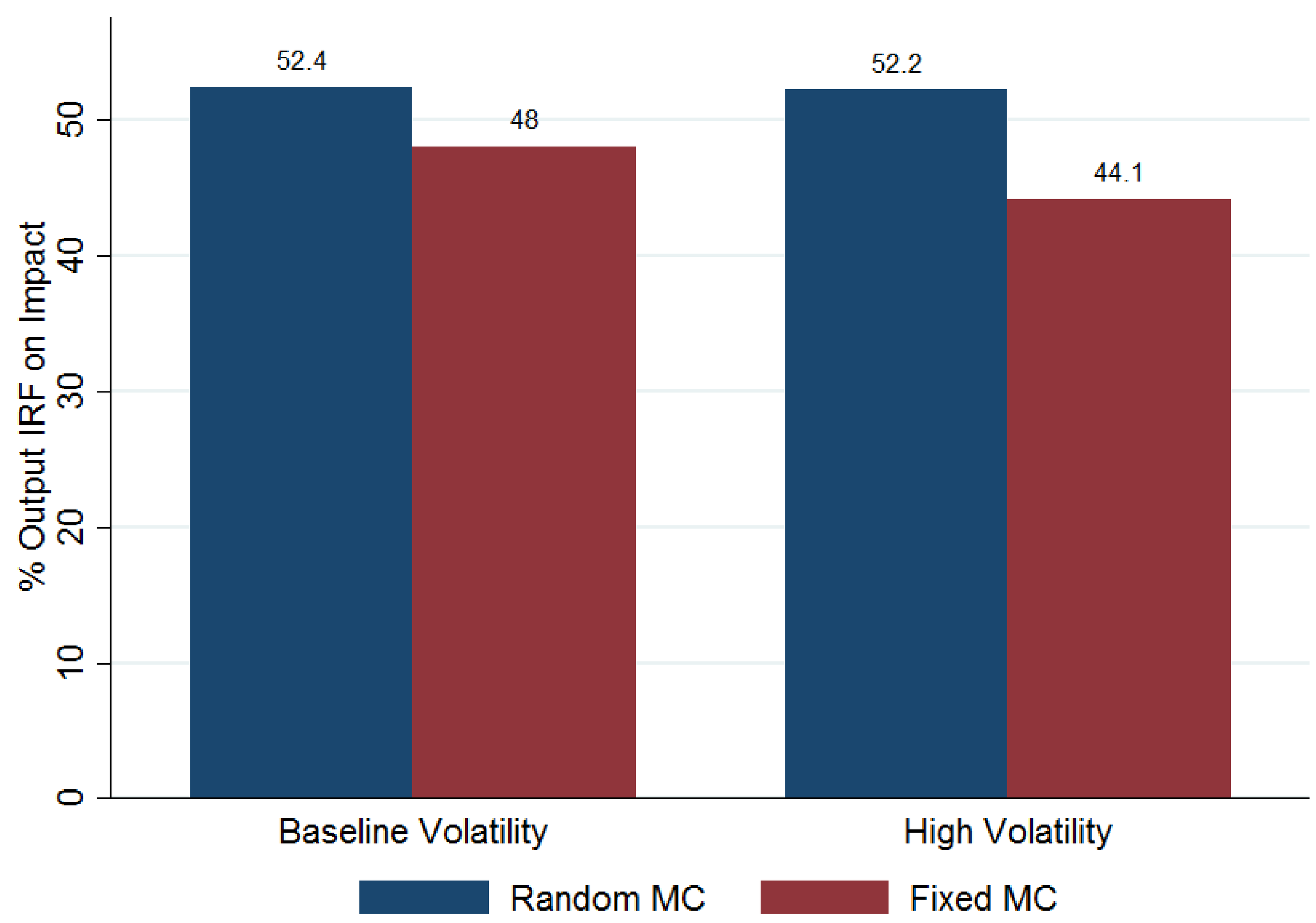
- Shock model with 1 standard deviation oil price volatility increase
- Fixed MC model predicts lower price change dispersion
  - Strong selection effect implies all prices move in the same direction
- Random MC model matches positive empirical relationship
  - Dampens response to common shock, increasing price change dispersion

Δ Standard Deviation

s_o	Fixed MC	Random MC
0.010	-3.84%	0.57%
0.016	-6.66%	0.83%
0.025	-9.54%	1.36%
0.050	-9.65%	7.18%

Policy Counterfactual

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



- Random MC model implies ability of central bank to stimulate consumption is nearly time invariant
- Fixed MC model implies 10% fall in monetary policy effectiveness

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