Effects of Aggregate Shocks in Inventory Models: Shedding light about the crisis

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Introduction

- Financial crisis 2007 - 2009
  - Large movements in firms' data. Several transmission channels. Relative importance not established.
- Goal: Identify main transmission channel (supply shock vs. demand shock)
  - Strategy: Different cross-section and time series dynamics
- Aggregate shocks in inventory models
  - Permanent shocks: variable cost-push stress, fixed cost-push stress, demand contraction

Literature

- Importance of inventory investment in business cycles
- Interaction between price, inventory and production decisions
- Inventories and international trade
- Inventories and corporate finance

Model

1. Inventory model, partial equilibrium, and market power.

2. 3 types of costs:

   i Fixed costs (F^q)
   ii Variable costs (c)
   iii Menu costs (F^p)

3. Positive inventory holdings as response to:

   i Fixed costs
   ii Demand uncertainty

Timing of the Model

1. State variables

   i Initial inventory holdings (I)
   ii Demand shock of last period (v)
   iii Price of last period (p)

2. Control variables

   i Orders / production (q)
   ii Price (p')

3. Sales (Positive stockout probability)

$$y = min\{I + q, D(p', v')\}$$

Recursive Formulation

$$V(I,v,p) = \max_{p',q\geq 0} p'E_{v'|v}(y') - \alpha I - F^p.D(p' \neq p) - F^q.D(q>0) - c(q)$$

$$+\beta E_{v'|v}(V(I',v',p'))$$

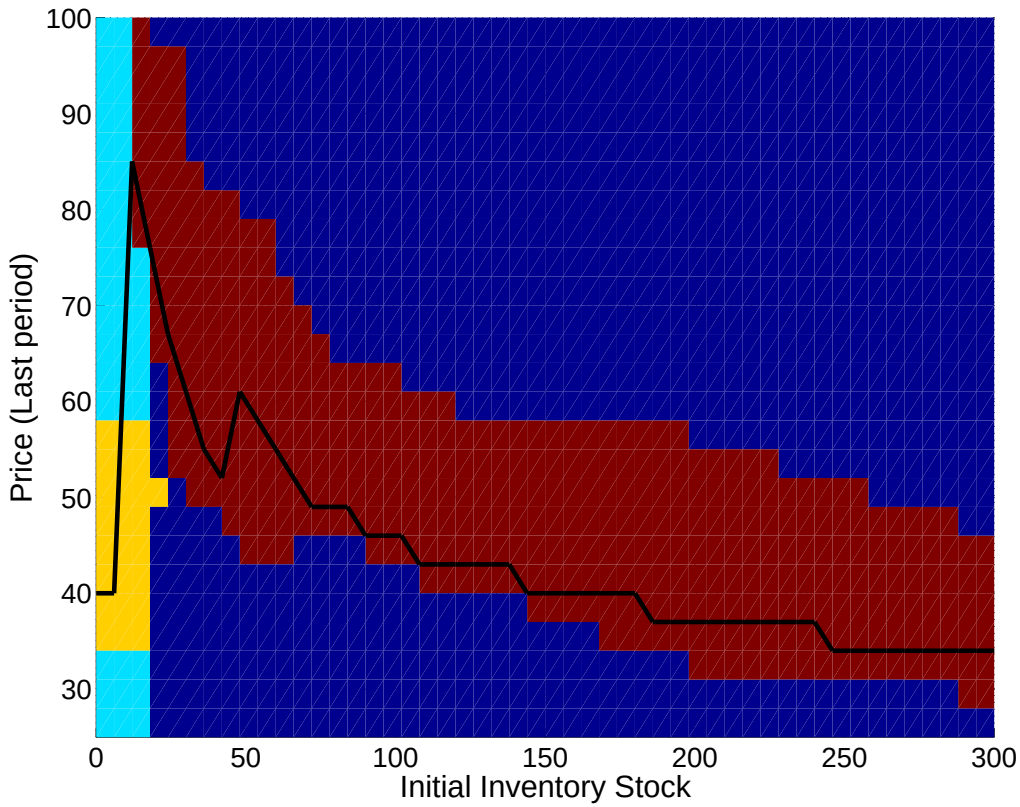
$$s.t.\ I'=R(I+q-y)$$

Optimal decision rule

- Price stickiness and (S,s) rule

$\rightarrow$ Change P $q > 0$

$\rightarrow$ Same P $q > 0$

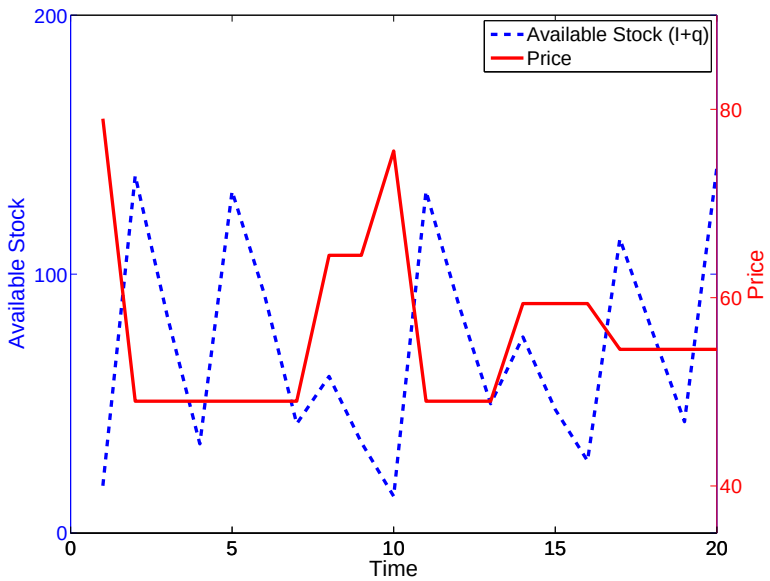


$\leftarrow$ Change P $q = 0$

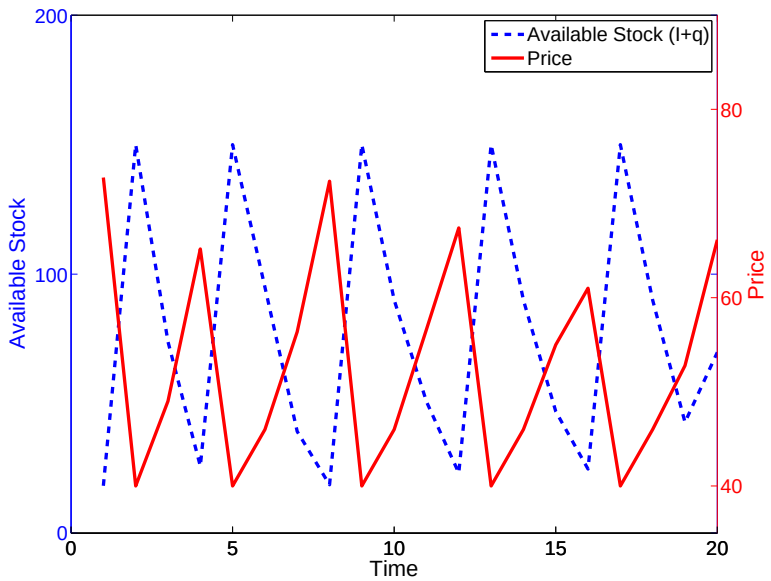
$\leftarrow$ Same P $q = 0$

Substitution relationship between available stock and price

a) With menu costs



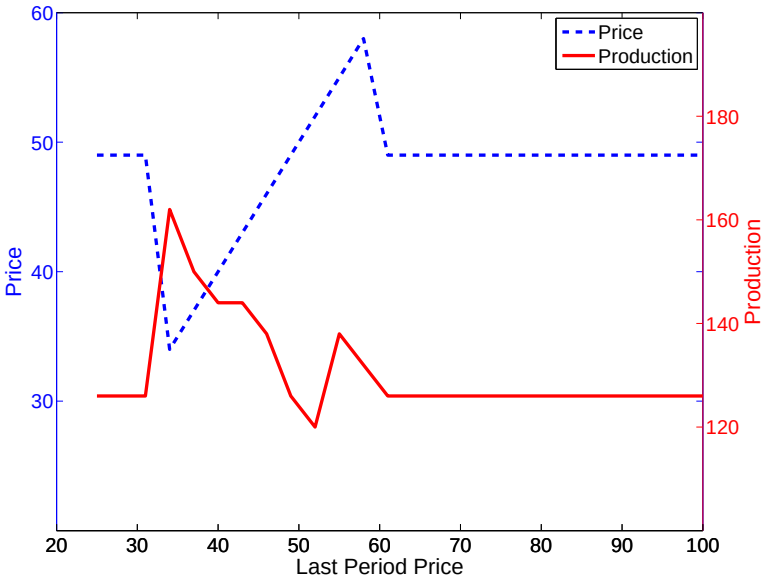
b) Without menu costs



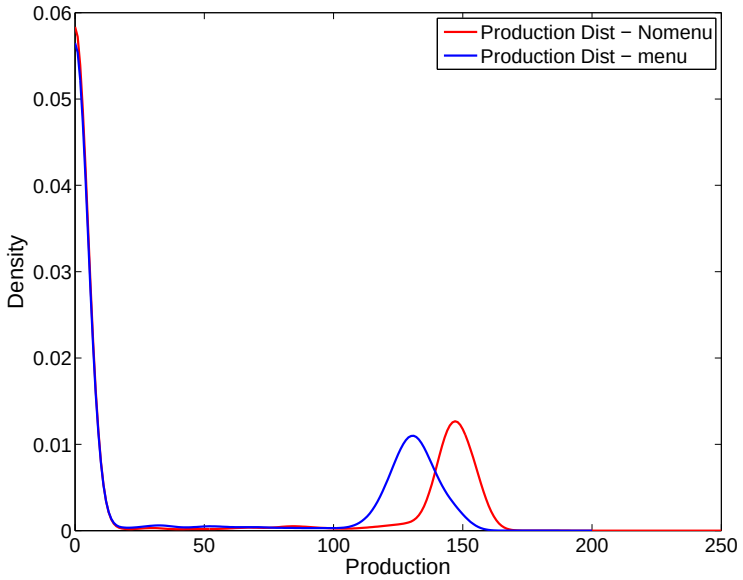
Menu costs and production

- Menu costs increase cross-section variability of production

a) Optimal decision



b) Distribution of production



(Conditioned) First order conditions

- FOC Production

$$\underbrace{p'\,(1-F(D))}_{\text{Stockout probability}} + \underbrace{\beta.R.E\left[\frac{\partial E(V(I',v'))}{\partial I'}\right]}_{\text{Expected value of an additional unit of inventories}} \underbrace{F(D)}_{\text{Non-stockout probability}} = c$$

where $D = Ln(I+q) - Ln(A(p'/\tilde{p})^{-\gamma}$

(Conditioned) First order conditions

- FOC Price

$$p' = \underbrace{(\frac{\gamma}{\gamma-1})\beta.R.E\left[\frac{\partial E(V(I',v'))}{\partial I'}\right]}_{\text{Constant mark-up over marginal valuation}} + \underbrace{\frac{(p')^{\gamma+1}(I+q)}{(\gamma-1)}\frac{(1-F(D))}{A\int_{-\infty}^{D} exp(v')dF(v')}}_{\text{Price increase due to positive stockout probability}}$$

where $D = Ln(I+q) - Ln(A(p'/\tilde{p})^{-\gamma}$

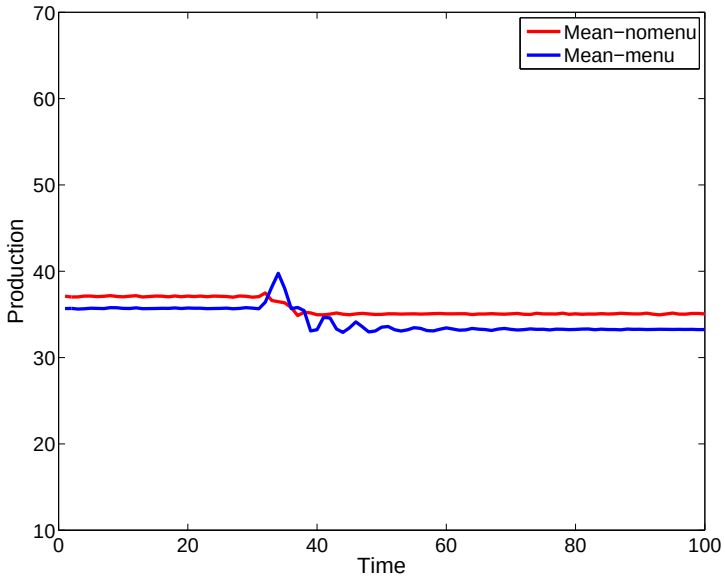
Simulations

- Panel of 100 thousand firms, 100 periods.
- Aggregate shocks: $\uparrow$ fixed costs, $\uparrow$ variable costs, $\downarrow$ demand.

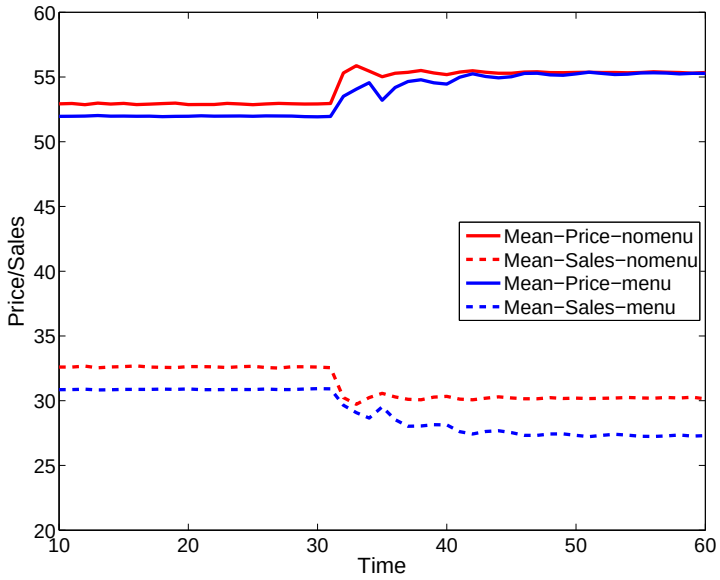
Simulations

- Fixed cost-push stress

a) Production



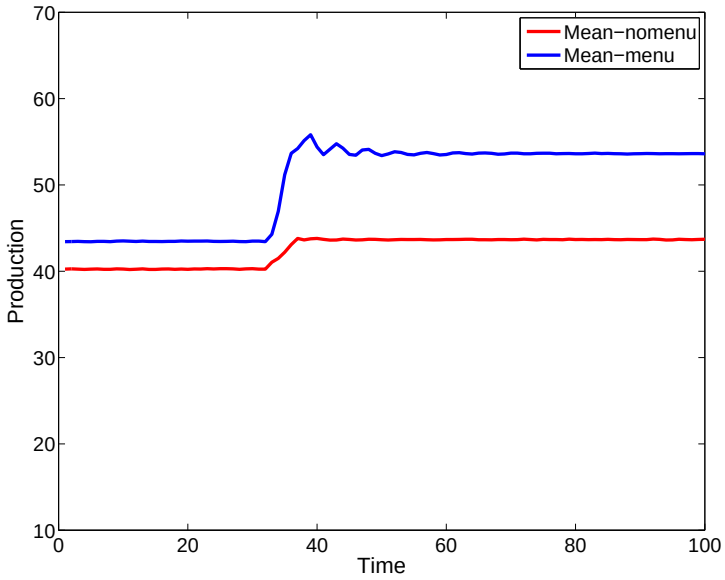
b) Price and sales



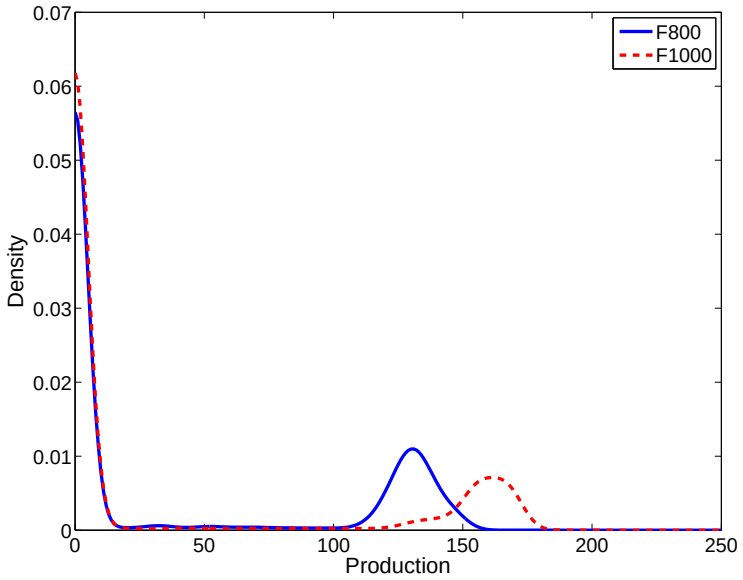
Simulations

- Fixed cost-push stress

c) Inventories



d) Production



Identification strategy

		Fixed costs		Marginal costs		Demand	
		ST	LT	ST	LT	ST	LT
Inventories	Mean	↑	↑	↓	↓	↑	↓
	Variability	↑	↑	↓	↓	↓	↓
	Right tail (p90)	↑	↑	↓	↓	↑	↓
Production	Mean	↑	↓	↓	↓	↓	↓
	Variability	↑	↑	↑	↑	↑	↑
	Right tail (p90)	↑	↑	↓	↓	↓	↓
Price	Mean	↑	↑	↑	↑	↑	↑
	Variability	↑	↑	↑	↓	↑	↓
	Right tail (p90)	↑	↑	↑	↑	↑	↓
Sales	Mean	↓	↓	↓	↓	↓	↓
	Variability	↑	↓	↑	↓	↓	↓
	Right tail (p90)	↓	↓	↓	↓	↓	↓
Mark-up	Mean	↑	↑	↓	↑	↑	↑

Empirical Analysis: U.S.

- Trade sector: Variable cost-push stress

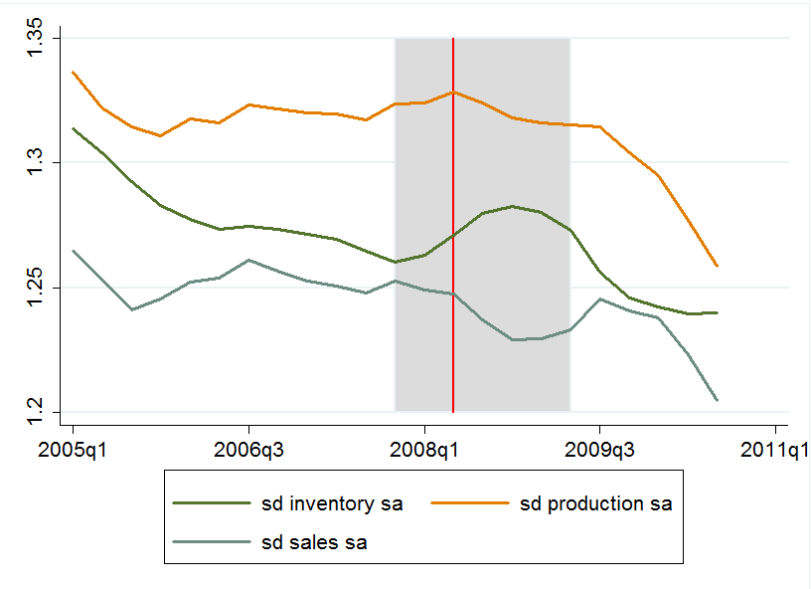
a) Mean dynamics
(deviations from trend)

b) Mark-up dynamics

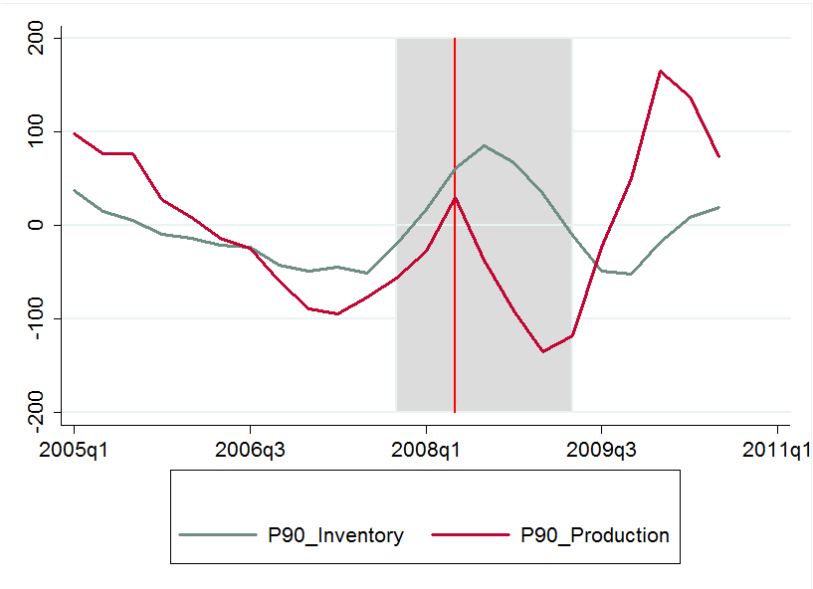
Empirical Analysis: U.S.

- Trade sector: Variable cost-push stress

c) Variability dynamics



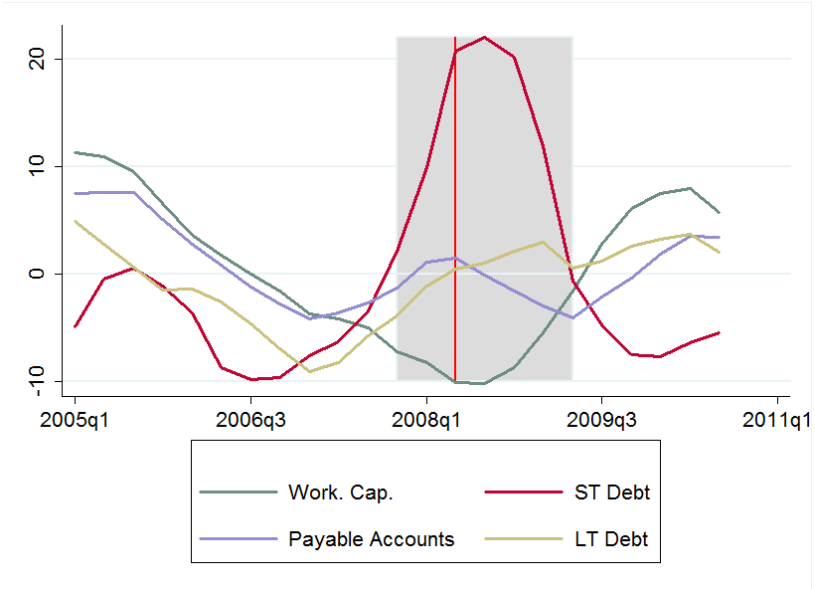
d) Right tail dynamics



Empirical Analysis: U.S.

- Trade sector: Variable cost-push stress

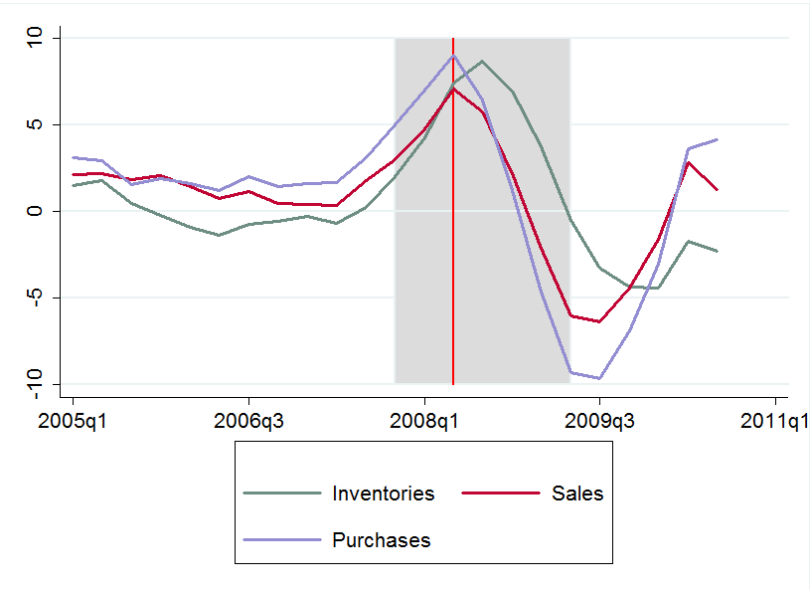
e) Mean dynamics
(deviations from trend)



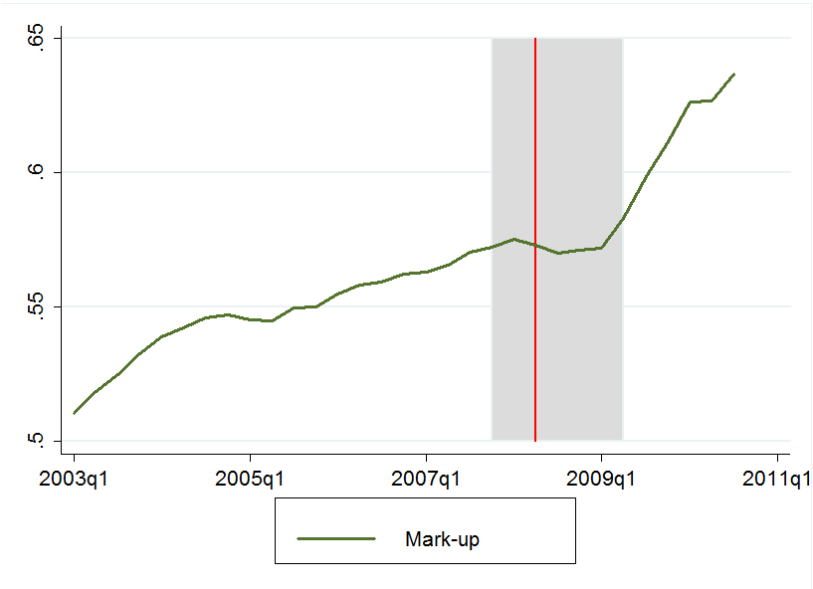
Empirical Analysis: U.S.

- Manufacturing sector: Variable cost-push stress

a) Mean dynamics
(deviations from trend)



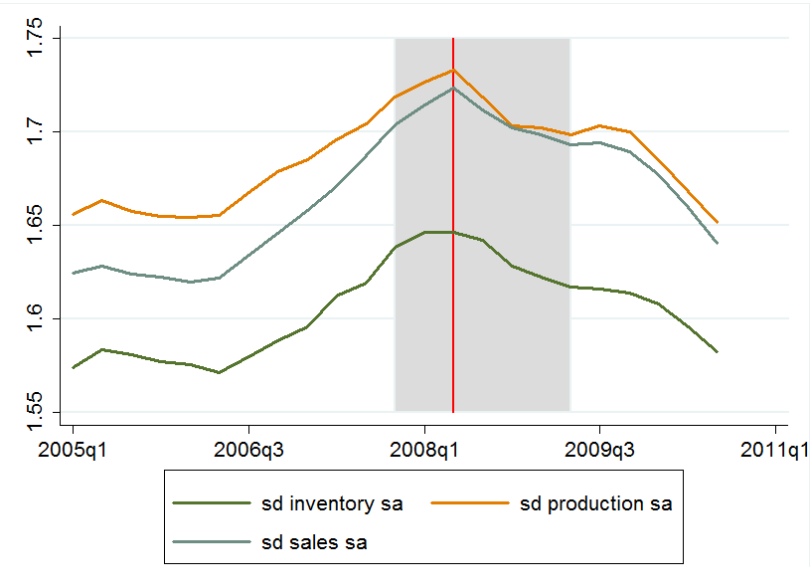
b) Mark-up dynamics



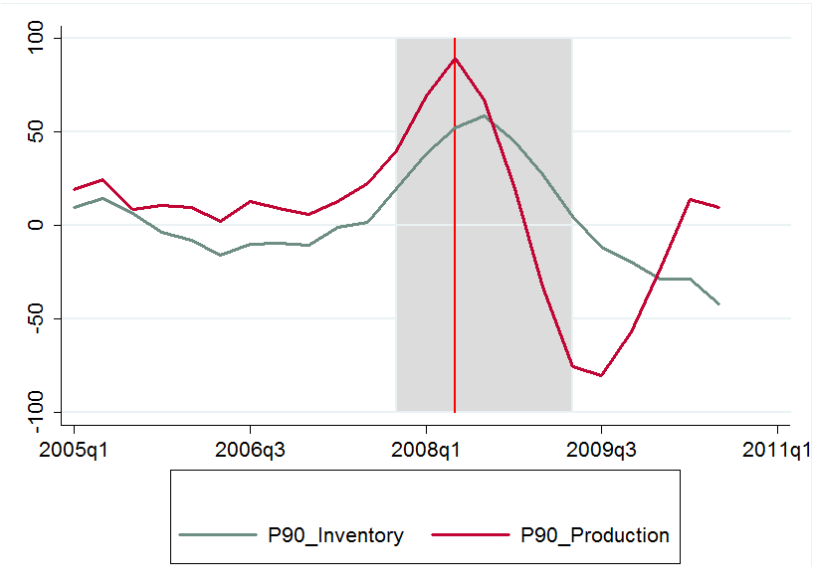
Empirical Analysis: U.S.

- Manufacturing sector: Variable cost-push stress

c) Variability dynamics



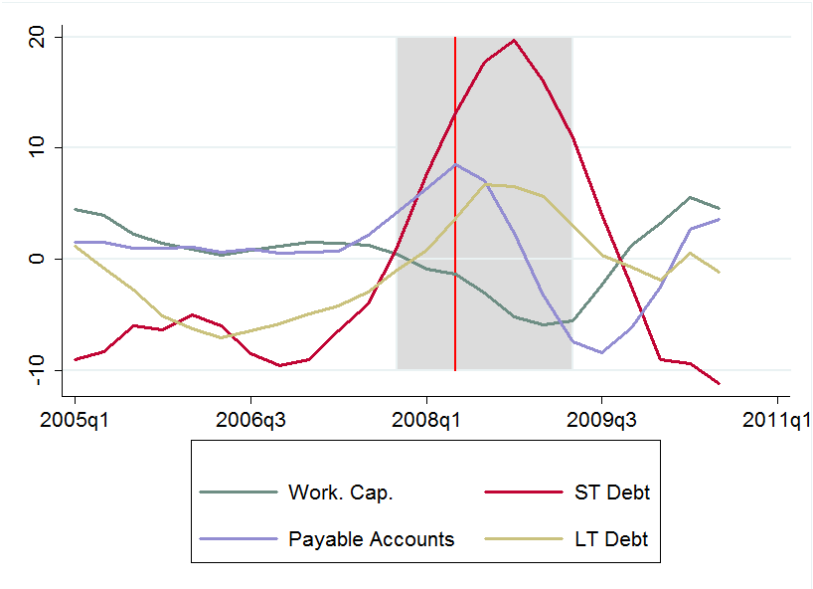
d) Right tail dynamics



Empirical Analysis: U.S.

- Manufacturing sector: Variable cost-push stress

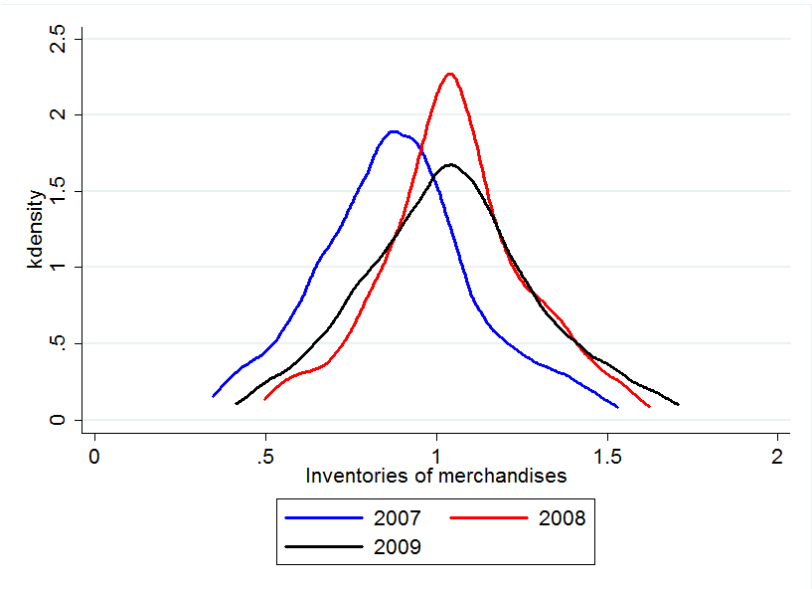
e) Mean dynamics
(deviations from trend)



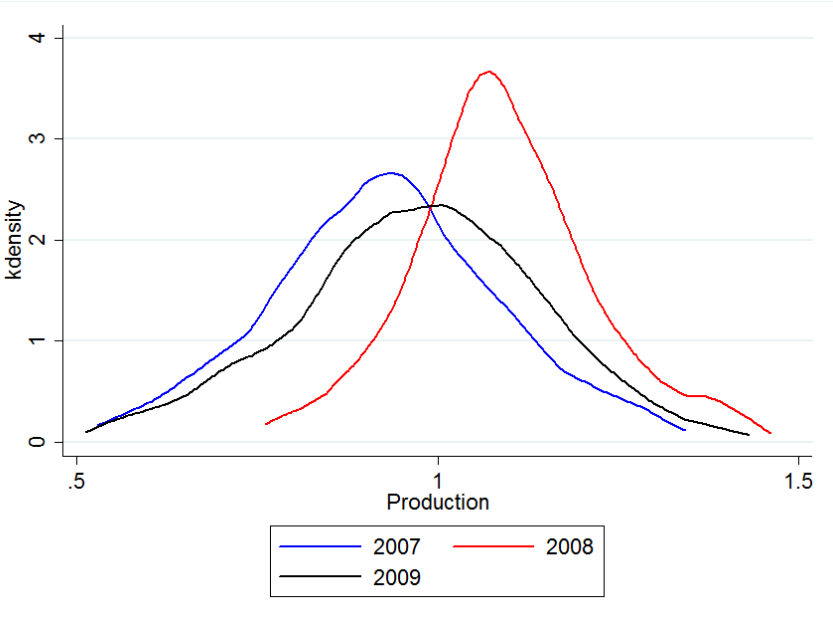
Empirical Analysis: Peru

- Trade sector: fixed cost-push stress

a) Inventories



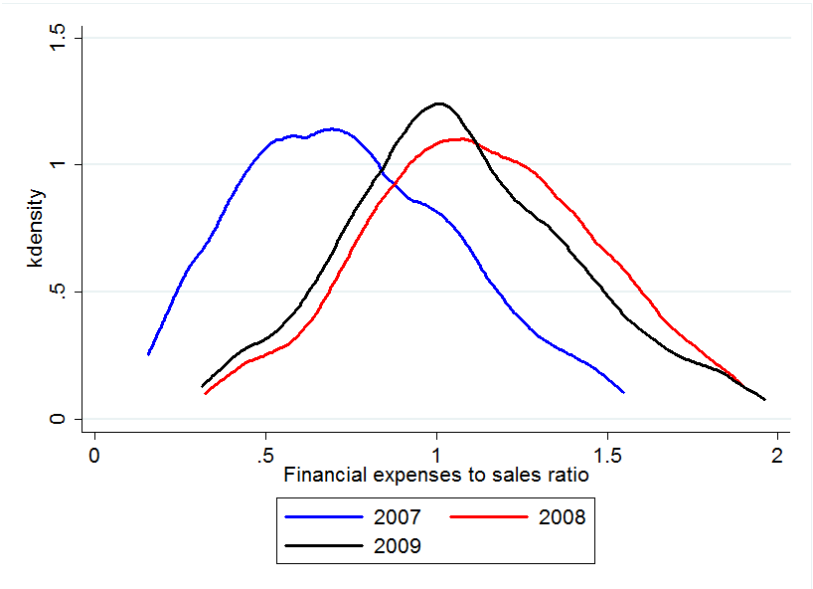
b) Production



Empirical Analysis: Peru

- Trade sector: fixed cost-push stress

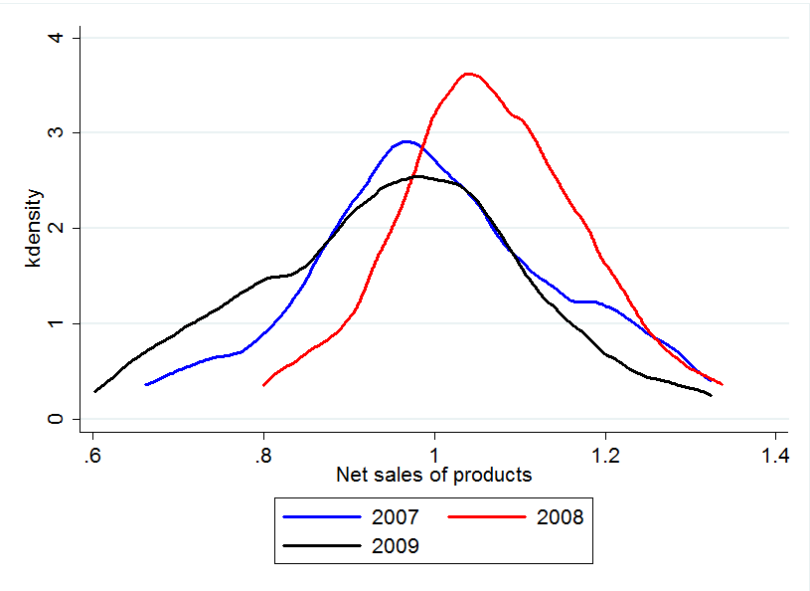
c) Financial expenses to sales ratio



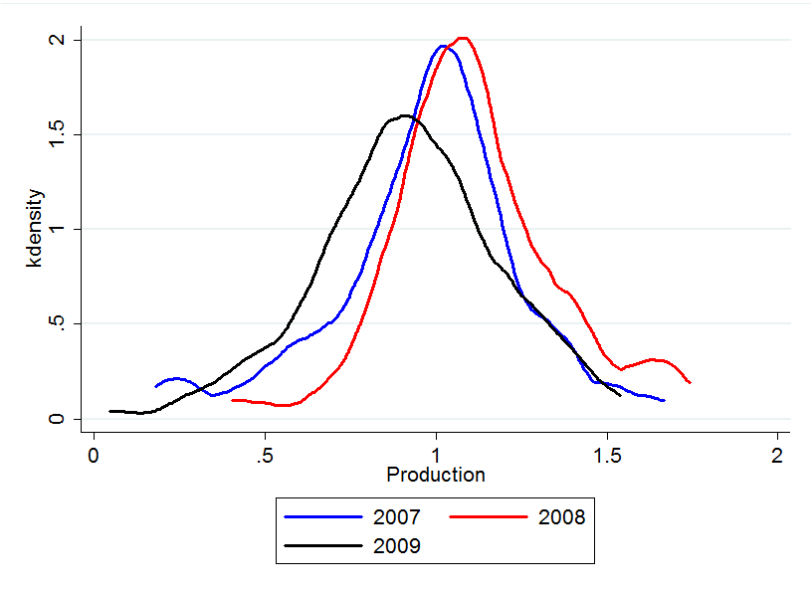
Empirical Analysis: Peru

- Manufacturing sector: demand contraction

a) Sales



b) Production



Conclusions and next steps

- Key role of inventories in firms' decisions
- Different transmission channels $\Rightarrow$ different cross-section dynamics (short and long-term)
- Firm-level data $\Rightarrow$ Identification of main propagation channel

Conclusions and next steps

- Next steps
  - General equilibrium approach
  - Financial intermediaries
  - Calibration / estimation (more complete database)