Microeceonomic Uncertainty, International Trade, and Aggregate Fluctuations

George Alessandria Horag Choi Joseph Kaboski
Virgiliu Midrigan

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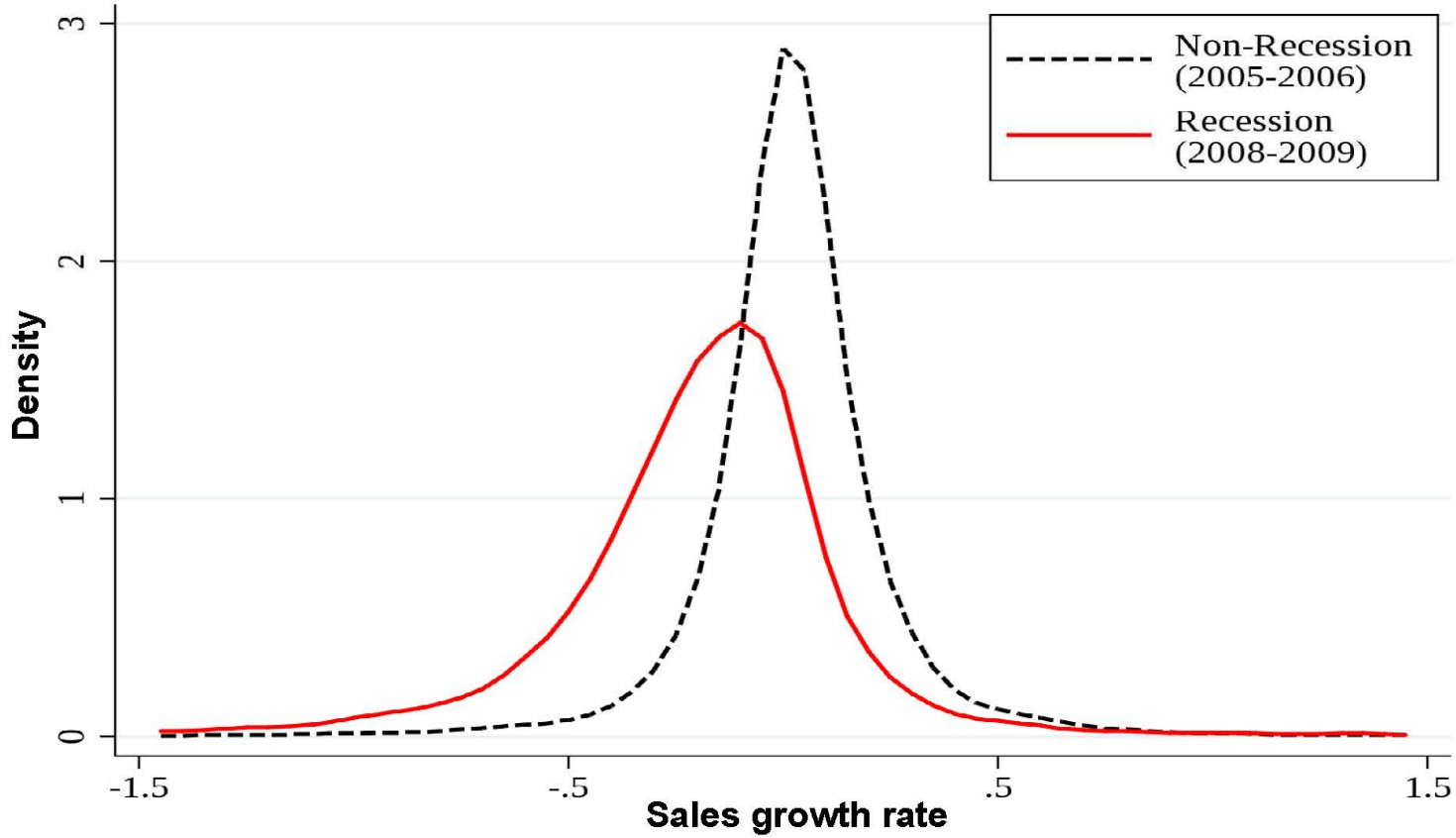
Introduction

- Evidence that producer-level volatility (*micro-volatility*) is strongly countercyclical (Bloom, 09)

Figure 5: Plant uncertainty – sales growth dispersion



Notes: Source Bloom, Floetotto, Jaimovich, Saporta and Terry (2013). Constructed from the Census of Manufactures and the Annual Survey of Manufactures using a balanced panel of 15,752 establishments active in 2005-06 and 2008-09. Moments of the distribution for non-recession (recession) years are: mean 0.026 (-0.191), variance 0.052 (0.131), coefficient of skewness 0.164 (-0.330) and kurtosis 13.07 (7.66). The year 2007 is omitted because according to the NBER the recession began in December 2007, so 2007 is not a clean "before" or "during" recession year.

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- Evidence that producer-level volatility (*micro-volatility*) is strongly countercyclical (Bloom, 09)

- Question: Is rise in micro-volatility a *symptom* or *cause* of downturns such as Great Recession?

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- Question: Is rise in micro-volatility a *symptom* or *cause* of downturns such as Great Recession?
- Study this theoretically & empirically in open economy
  - Potentially important given not all producers export & trade is cyclical.
  - Irreversibility & producer heterogeneity determine export participation.

Main Findings

- **Theory** - IRBC model w/het. producers & dynamic export decision
  - Recessions from 1st moment shocks raise micro-volatility (*Reallocation*)
  - Micro-volatility shocks expansionary, especially for trade (*Selection*)

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- **Theory** - IRBC model w/het. producers & dynamic export decision
  - Recessions from 1st moment shocks raise micro-volatility (*Reallocation*)
  - Micro-volatility shocks expansionary, especially for trade (*Selection*)
- **Empirics** - evidence of micro-volatility from international reallocation
  - Autos - rise in micro-volatility in GR attributed to shift between home & foreign brands
    - ★ Tsunami in Japan boosted micro-volatility almost as much as GR
  - Across industries, micro-volatility strongly related to trade reallocation.

Outline

1. Model
2. Empirical Evidence
    1. Autos
    2. Industry and trade data

Model

- Variation of Alessandria and Choi (2007) - standard IRBC model (BKK 1994) with producer-level uncertainty & fixed export costs (Dixit, 1989, Baldwin & Krugman, 1989).
  - Dynamic export decision because costs of starting to export $>$ costs of continuing to export.

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- Extend to include shocks to:
  - Variance of idiosyncratic productivity (Bloom, 09, Bloom et al. 13, Arellano et al. 11)
  - Trade cost/preference shocks (Stockman & Tesar, 95)

Model

- ∞-horizon, 2 symmetric countries $\{H, F\}$, nominal bond
- Unit mass of $\{H, F\}$ monopolistically competitive producers
  - Differ in productivity, z, fixed export cost, f_m, & capital: $\psi(z, m, k)$
  - Export costs: entry cost exceeds continuation cost, $f_0 > f_1$ (labor)
  - Idiosyncratic shocks $\phi(z'|z)$,

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- Final NT good made w/ local & imported intermediates used for investment and consumption
  - $C + X = D$

Consumer's Problem

$$V_{C,0} = \max_{\{C_t, L_t, B_t\}} E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, L_t),$$

$$C_t + q_t \frac{B_t}{P_t} \leq W_t L_t + B_{t-1} + \Pi_t,$$

- P_t, W_t denote price level & wage,
- Π_t sum of home country profits
- Foreign problem with *

$$q_t = \beta E_t \frac{U_{C,t+1}}{U_{C,t}} = \beta E_t \frac{U_{C^*,t+1}}{U_{C^*,t}} \frac{P_t^*}{P_{t+1}^*} \frac{P_{t+1}}{P_t}$$

Competitive Final Good Producers

- Combine intermediates to produce final good for C and I.
- Imports only purchased from foreign exporters.

Competitive Final Good Producers

$$\max \Pi_t = D_t - \sum_{m=\{0,1\}} \int_{z,k} y_H^d \left(z, m, k\right)^{\frac{\theta-1}{\theta}} \psi \left(z, m, k\right) dzdk$$

$$- \sum_{m=\{0,1\}} \int_{z,k} m' \left(z, m, k\right) y_F^d \left(z, m, k\right)^{\frac{\theta-1}{\theta}} \psi^* \left(z, m, k\right) dzdk$$

subject to

$$D_t = \left(Y_H^{\frac{\gamma-1}{\gamma}} + \bar{\omega}^{\frac{1}{\gamma}} e^{\omega_t} Y_F^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}} \qquad \omega_t \text{ taste shock,}$$

$$Y_H = \left(\sum_{m=\{0,1\}} \int_{z,k} y_H^d \left(z, m, k\right)^{\frac{\theta-1}{\theta}} \psi \left(z, m, k\right) \right)^{\frac{\theta}{\theta-1}}$$

$$Y_F = \left(\sum_{m=\{0,1\}} \int_{z,k} y_F^d \left(z, m, k\right)^{\frac{\theta-1}{\theta}} \psi^* \left(z, m, k\right) \right)^{\frac{\theta}{\theta-1}}$$

Pricing decisions

Isolelastic demand

$$y_H(z,m,k) = \left(\frac{p_H(z,m,k)}{P_H}\right)^{-\theta}\left(\frac{P_H}{P}\right)^{-\gamma} D$$

$$y_H^*(z,m,k) = m'(z,m,k)\,\bar{\omega}e^{\omega_t}\left(\frac{p_H^*(z,m,k)}{P_H^*}\right)^{-\theta}\left(\frac{P_H^*}{P^*}\right)^{-\gamma} D^*$$

$$P = \left(P_H^{1-\gamma} + \bar{\omega}e^{\omega_t}P_F^{1-\gamma}\right)^{\frac{1}{1-\gamma}}$$

$$P_H = \left(\sum_{m=\{0,1\}}\int p(z,m,k)^{1-\theta}\,\psi(z,k,m)\right)^{\frac{1}{1-\theta}}$$

$$P_H^* = \left(\sum_{m=\{0,1\}}\int m'(z,k)\,p(z,m,k)^{1-\theta}\,\psi(z,k,m)\right)^{\frac{1}{1-\theta}}$$

Constant markup pricing: $p_H(z,m,k) = p_H^*(z,m,k) = \frac{\theta}{\theta-1}\frac{Wl(z,m,k)}{(1-\alpha)y(z,m,k)}$

Note: mc(i) depends on markets served through predetermined k.

Intermediate Good Producer (z,m,k)

$$y_H + y_H^* = y = e^z e^A k^\alpha l^{1-\alpha}$$

Decisions: $l(z, m, k), k'(z, m, \kappa), m'(z, m, k)$

$$\begin{aligned}
\pi_{m'}(z, k) &= \max_l p(y_H) y_H + m' p^*(y_H^*) y_H^* - wl \\
V(z, m, k) &= \max_{m' \in \{0,1\}, x} \{\pi_{m'}(z, k) - m' f_m - Px \\
&\quad + EQV\left(z', m', (1-\delta) k + x\right)\}
\end{aligned}$$

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\end{aligned}$$

There is cutoff technology $z(m, k)$ to export

$$wf_m \leq (\pi_1 - \pi_0) + EQ\left[V\left(z', 1, k_1' | \cdot\right) - V\left(z', 0, k_0' | \cdot\right)\right] - P(x_1 - x_0)$$

And capital accumulation depends on export decision

$$P = EQV_k\left(z', m', k_m' | \cdot\right)$$

Calibration - Macro

$$U(C, L) = \log C + \eta \log(1 - L)$$

$\beta = 0.96$
$\alpha = 0.36$
$\delta = 0.10$
$\eta \longrightarrow 1/4$ time working

Calibration - Micro targets

- z is assumed to be iid
- Simplifies state - distribution of capital stock and exporters, (N, k_0, k_1)

Calibration - Micro targets

Focus on capturing moments of US manufacturing sector

1. Trade share: 20%
2. Exporters: 22% (Annual Survey of Manufactures - ASM)
3. Export Persistence: 5% (ASM)
4. Sales volatility & exporter premium (ASM and Davis & Haltiwanter)

Jointly determine $\{f_0, f_1, \bar{\omega}, \sigma_\varepsilon\}$

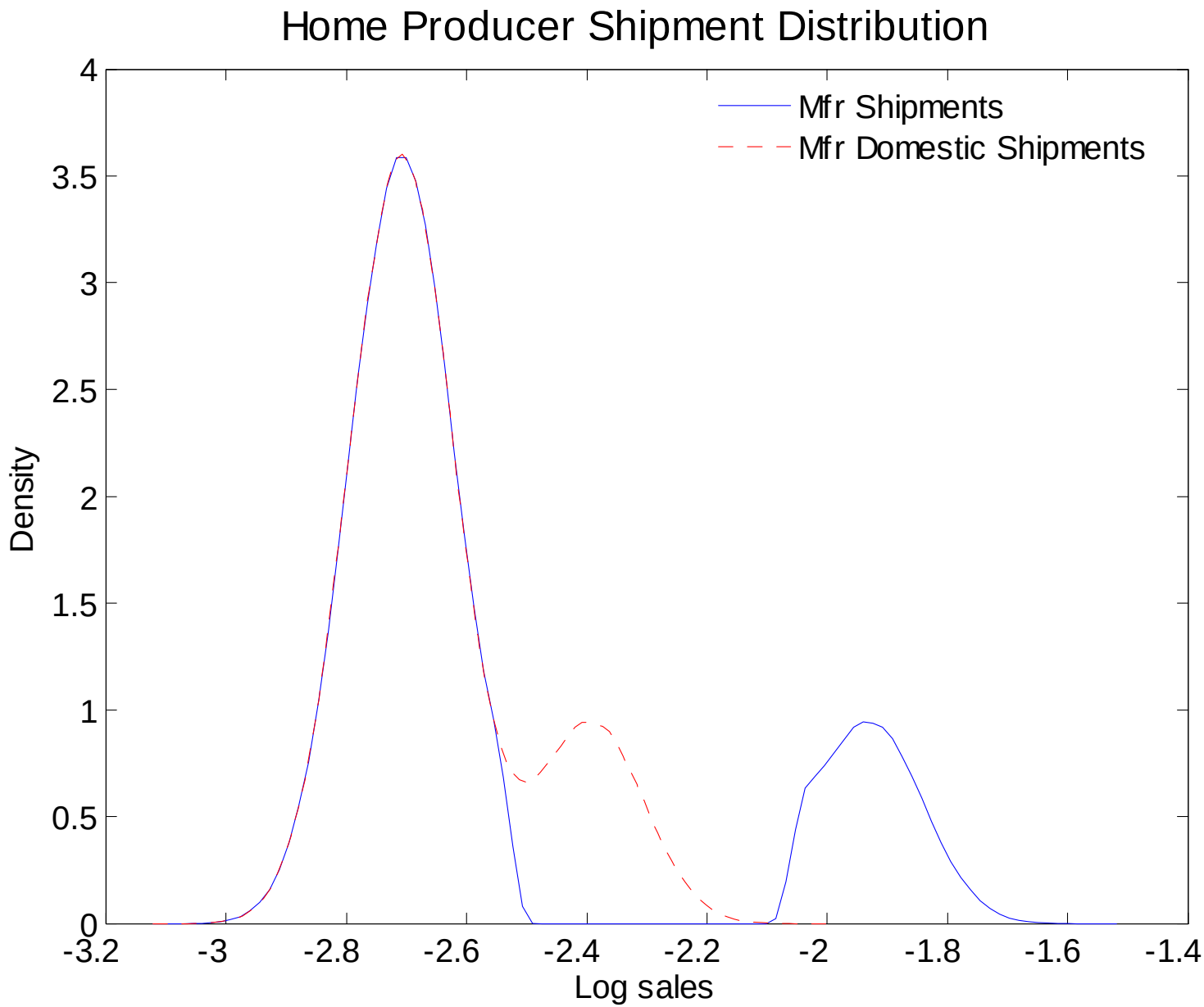
Calibration - Parameters

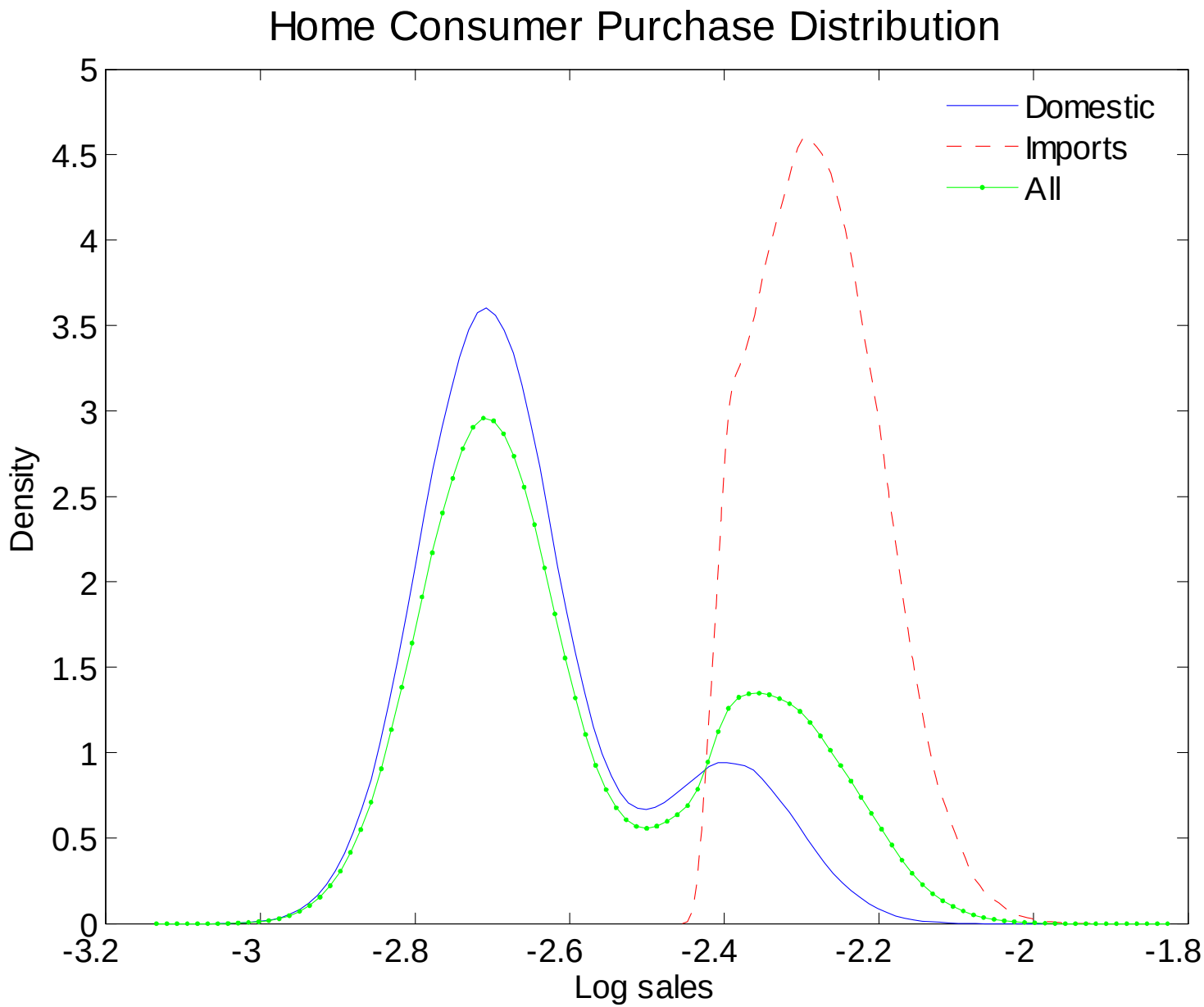
		Data	Sunk	Sunk - High
γ	Elasticity of Subst. H & F		1.5	
θ	Elasticity of Subst.		3	
σ_ε	Std Dev. of Idiosyncratic shock		0.075	0.30
f_0/f_1	Startup/Continuation cost		1.03*	1.66
	Sales Volatility	10	16.5	55
	Exporter Premium	4.5	2.5	2.65

*Low up-front cost vs existing literature - DRT (07) & AC (11).

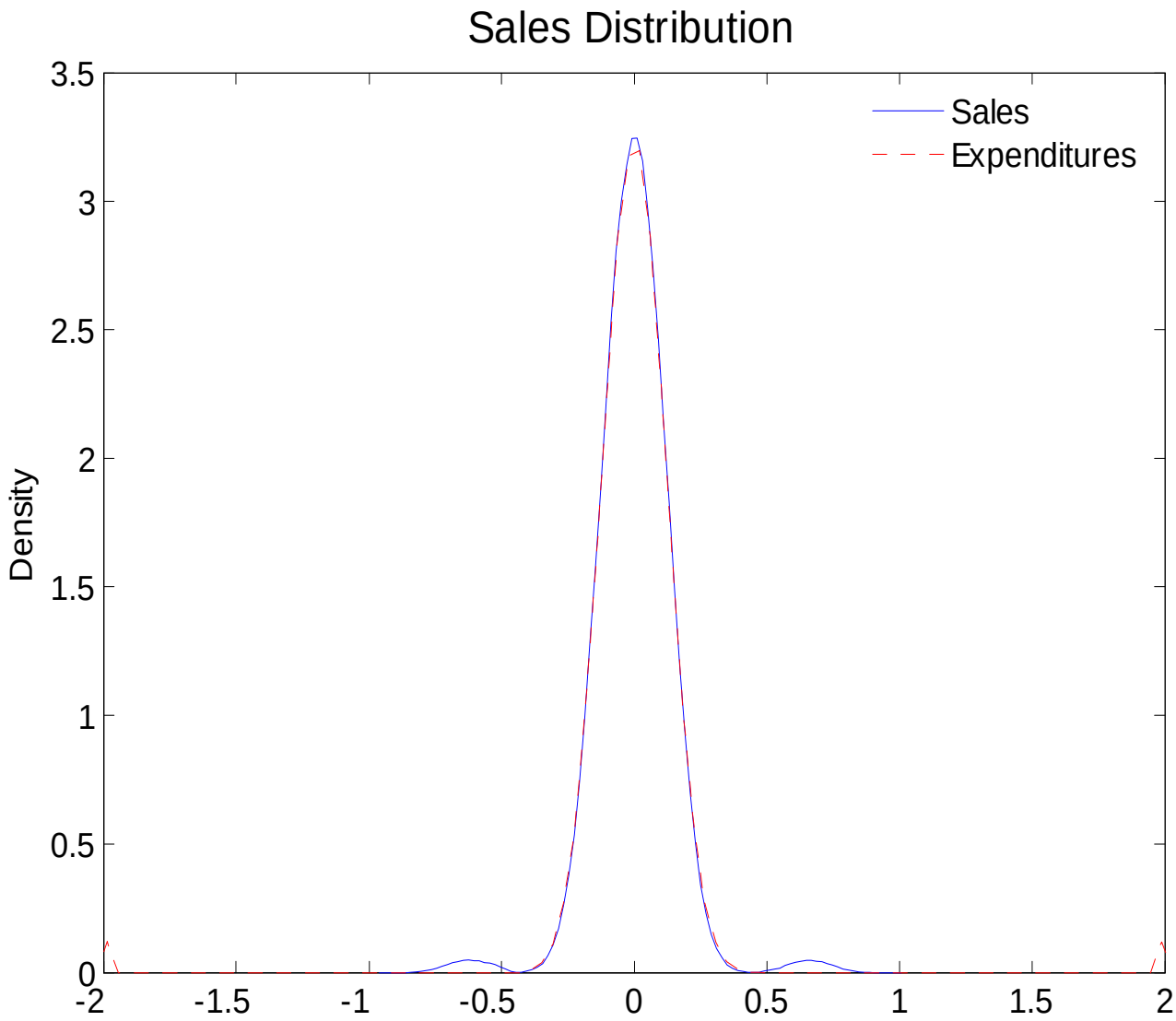
Dispersion in Open Economy

1. Home producer shipments
2. Home consumer purchases


Home Producer Shipment Distribution
Mfr Shipments
Mfr Domestic Shipments
Density
Log sales
4
3.5
3
2.5
2
1.5
1
0.5
0
-3.2
-3
-2.8
-2.6
-2.4
-2.2
-2
-1.8
-1.6
-1.4


Home Consumer Purchase Distribution
Domestic
Imports
All
Density
Log sales
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-3.2
-3
-2.8
-2.6
-2.4
-2.2
-2
-1.8

Sales Growth Distribution



Micro Dynamics

- Model matches growth premia related to changes in export status at different horizons among US manufacturers (Bernard & Jensen, 99)
  - $(g_{starters} > g_{cont}^{\text{exp}\,orters} > g_{cont}^{non\,\text{exp}} > g_{stoppers})$
  - Better quantitative fit at longer horizons.

Aggregate shocks

1. First moment shocks: US recession (Aggregate $\Rightarrow$ Volatility)
2. Second moment shocks: Micro-volatility (Volatility $\Rightarrow$ Aggregates)

US Recession

- Generate US recession that matches typical trade dynamics: imports fall 2x as much as tradable expenditures & exports increase slightly

$$\begin{aligned} A_t &= \rho A_{t-1} + \varepsilon_t \\ \omega_t &= \rho \omega_{t-1} + \varepsilon_t^{\omega} \\ \omega_t^* &= \rho \omega_{t-1}^* + \varepsilon_t^{\omega^*} \end{aligned}$$

- Results for model
  - Almost fixed export participation ($f_0 / f_1 \to \infty$)
  - Benchmark

Figure 2A: Home recession - *Fixed* Export Participation

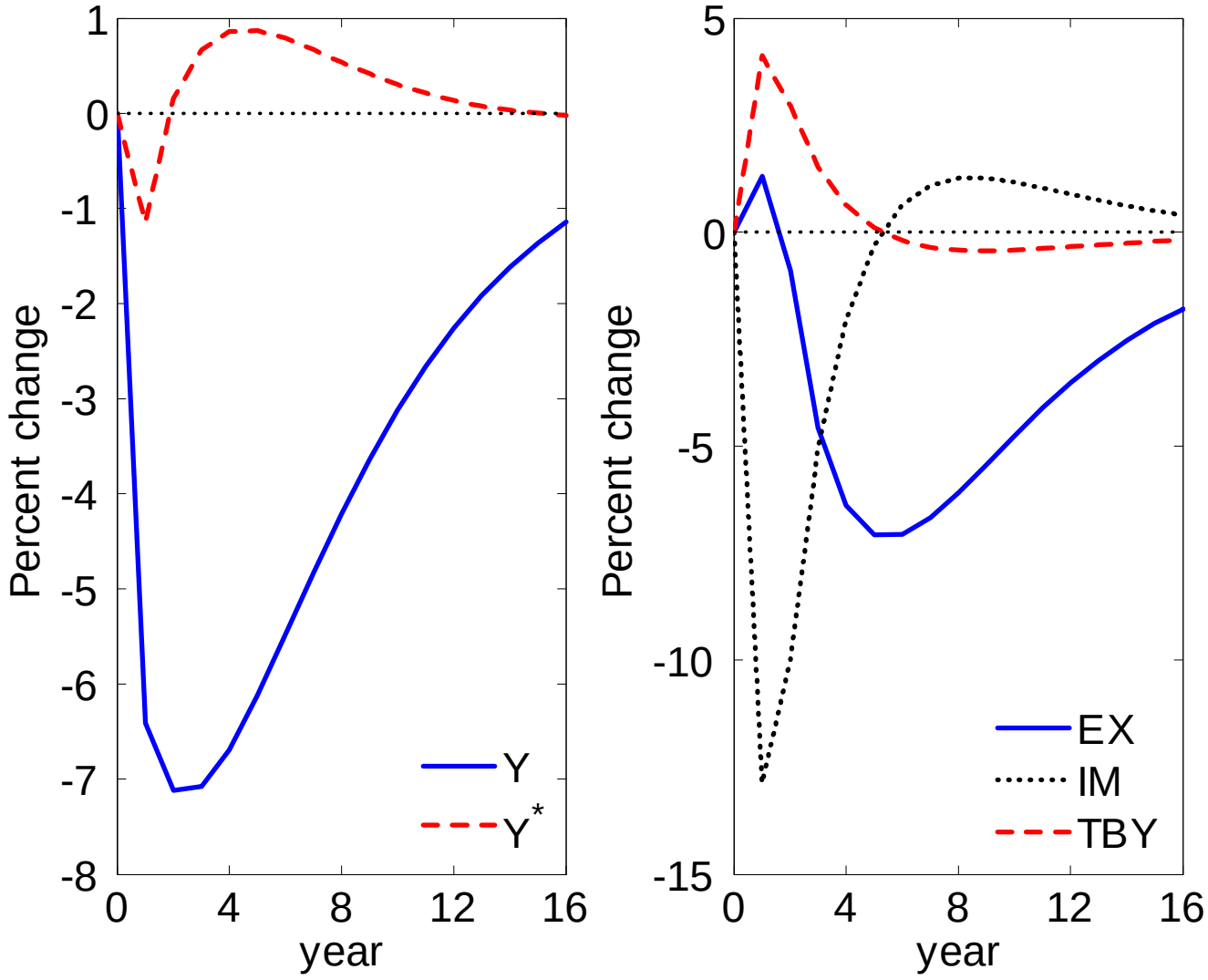
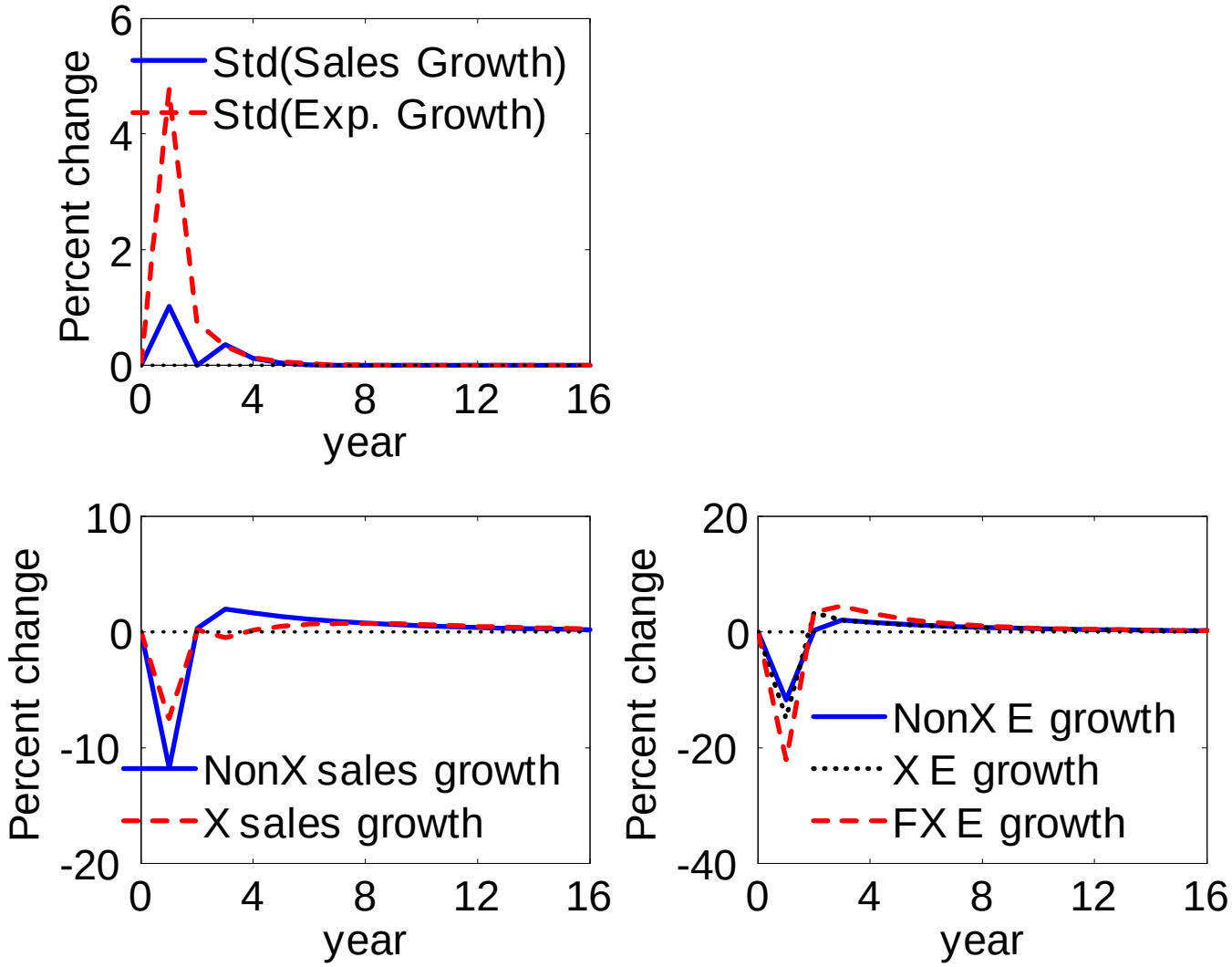


Figure 2B: Home recession - *Fixed* Export Participation

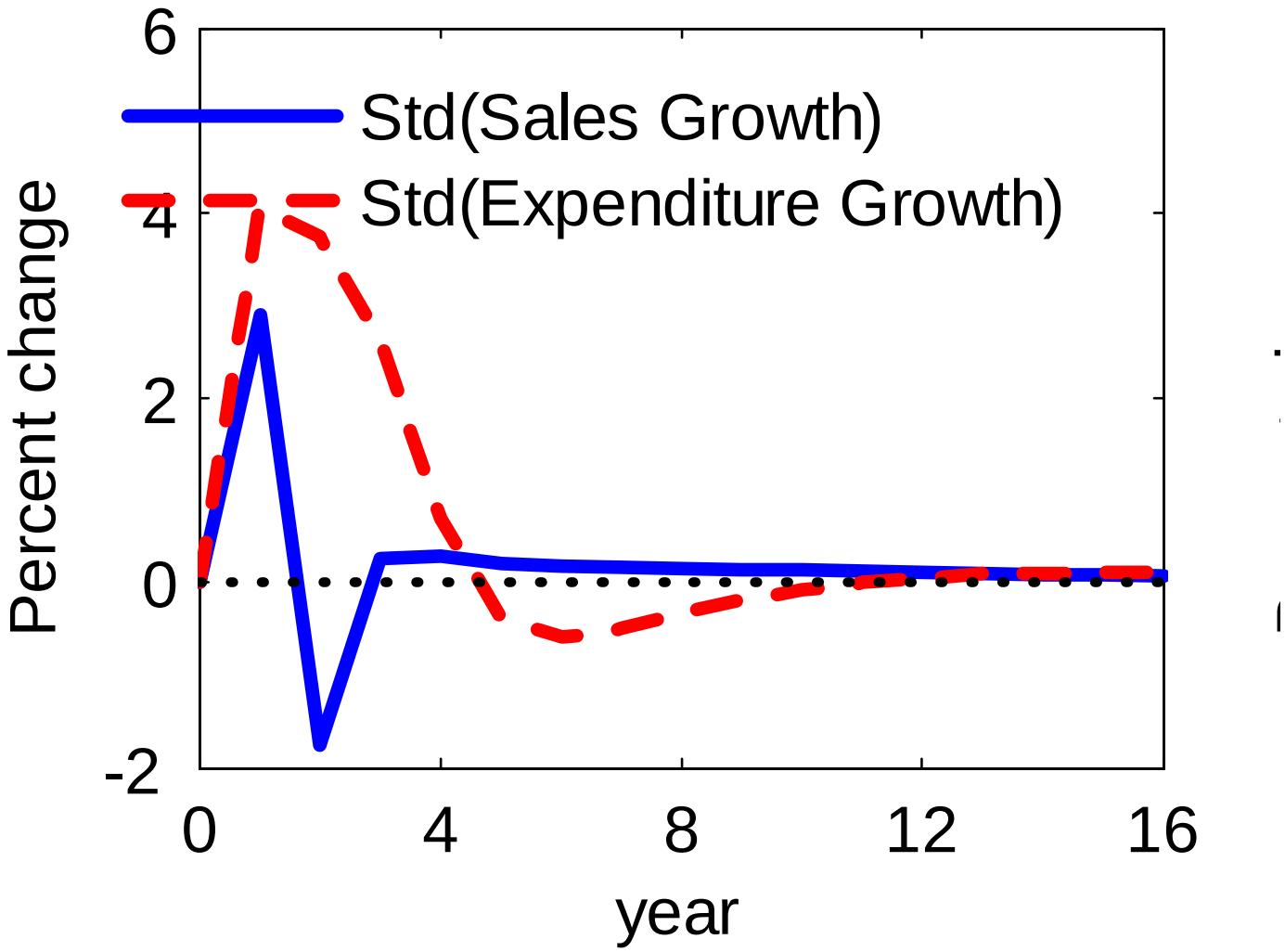


Channels increasing micro-volatility

- Home producer sales
  - Non-exporters are less "diversified" than exporters.
- Home expenditures
  - Imports fall more strongly than expenditures.
  - With diminishing returns (k predetermined), differences in export participation increases cost dispersion.

Robust to endogenous entry/exit

Figure 3: Home recession - *Benchmark* Model



Key Takeaways from country specific first moment shock

Micro-volatility

1. Increasing with international reallocation
2. Increasing with trade

Examine these relations in industry data

Aggregate shocks

- First moment shocks: US recession (Aggregate $\Rightarrow$ Volatility)
- **Second moment shocks: Micro-volatility (Volatility $\Rightarrow$ Aggregates)**

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Aggregate shocks

- First moment shocks: US recession (Aggregate $\Rightarrow$ Volatility)
- **Second moment shocks: Micro-volatility (Volatility $\Rightarrow$ Aggregates)**
  - 1-period unanticipated shock that doubles measured micro-uncertainty.
  - As in Bloom (09) - undo closed economy Oi-Hartman-Abel effect with negative TFP shock.
  - Still, expands trade & output from selection effect
  - Size of boom depends on micro-details, but can be quite large

Global micro volatility shock - small aggregate boom

Figure 6: Global Uncertainty Shock

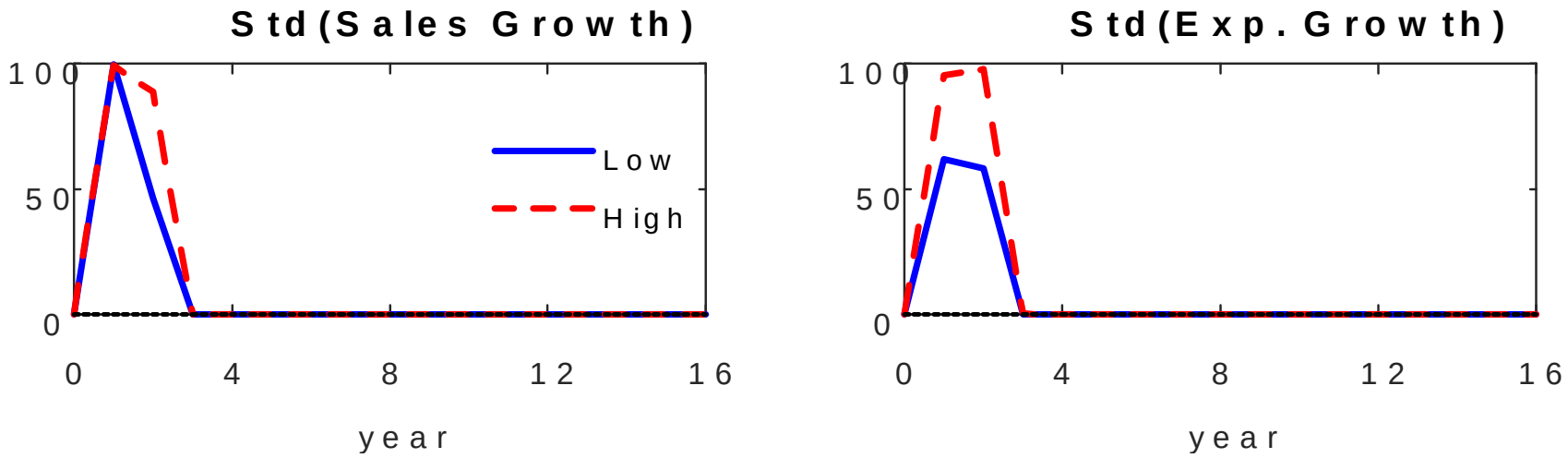

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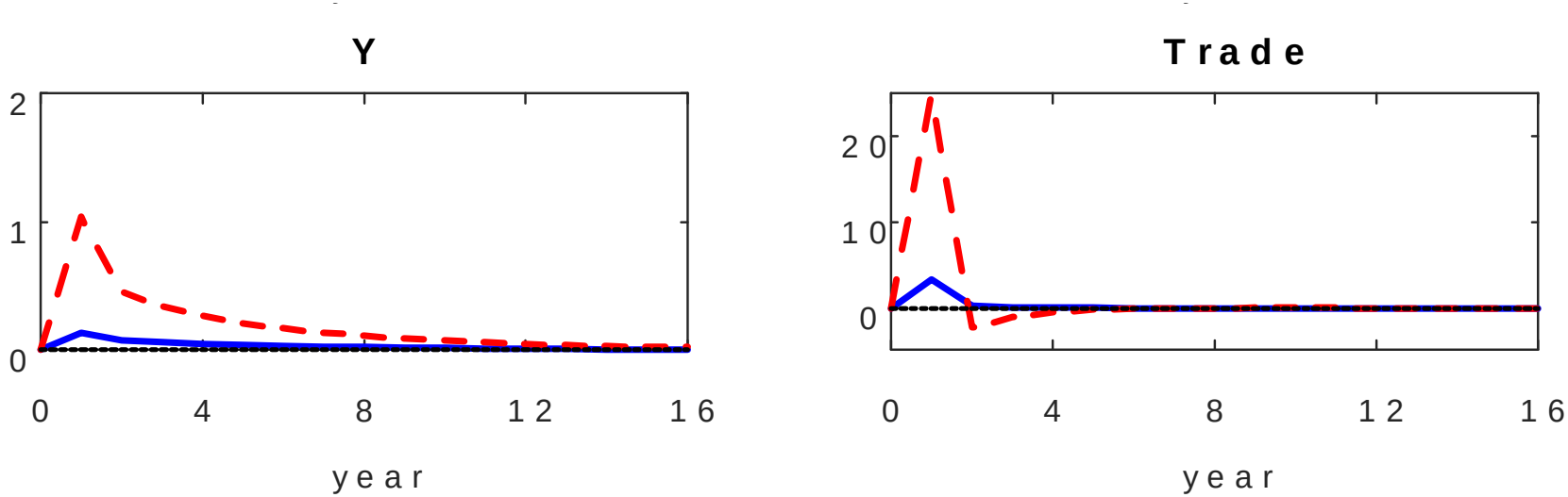
Figure 6: Global uncertainty Shock



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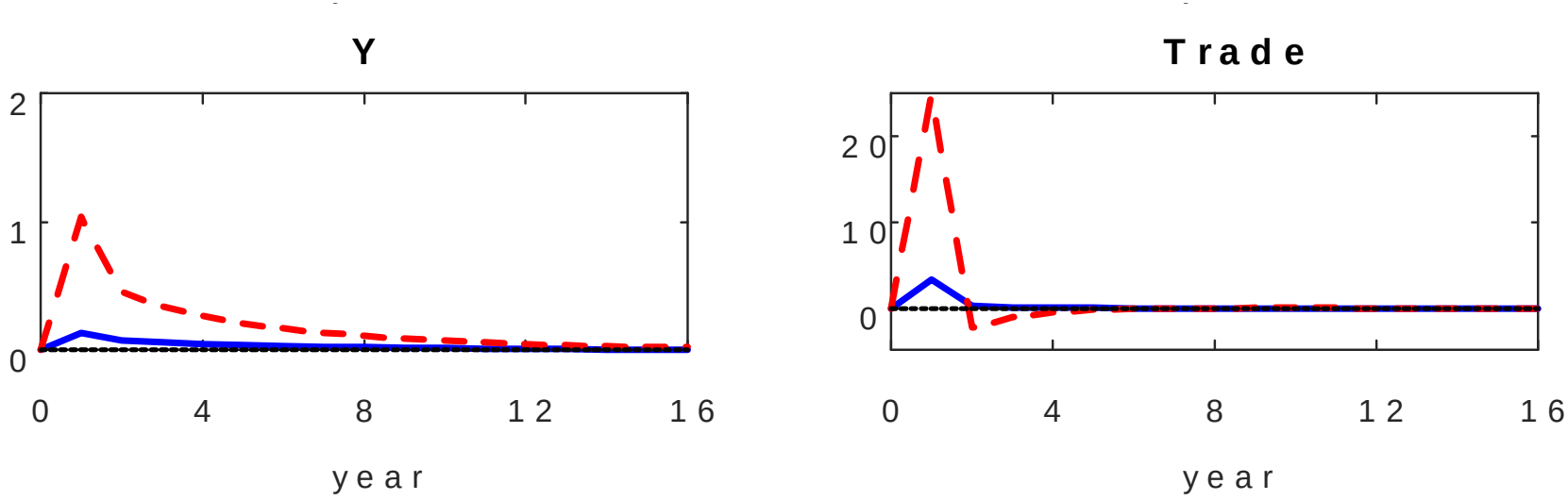

Positive impact from *selection* into exporting (Exporters are in right tail)

Global micro volatility shock - small aggregate boom

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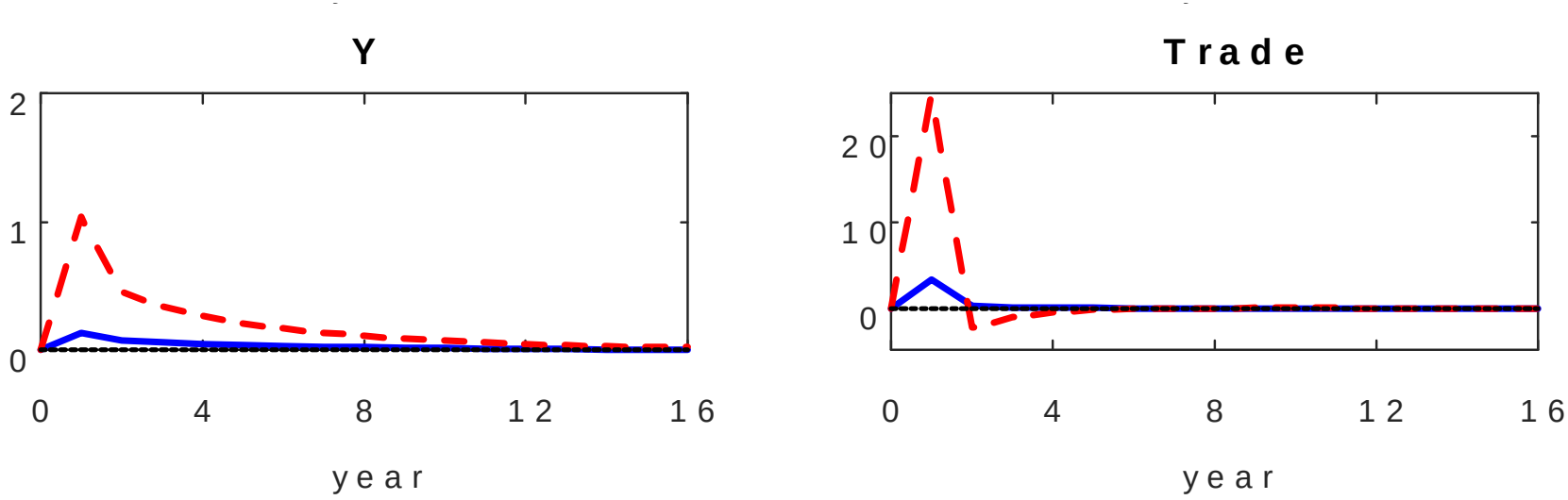


Positive impact from *selection* into exporting (Exporters are in right tail)
If uncertainty important, Great Trade Collapse a bigger puzzle!

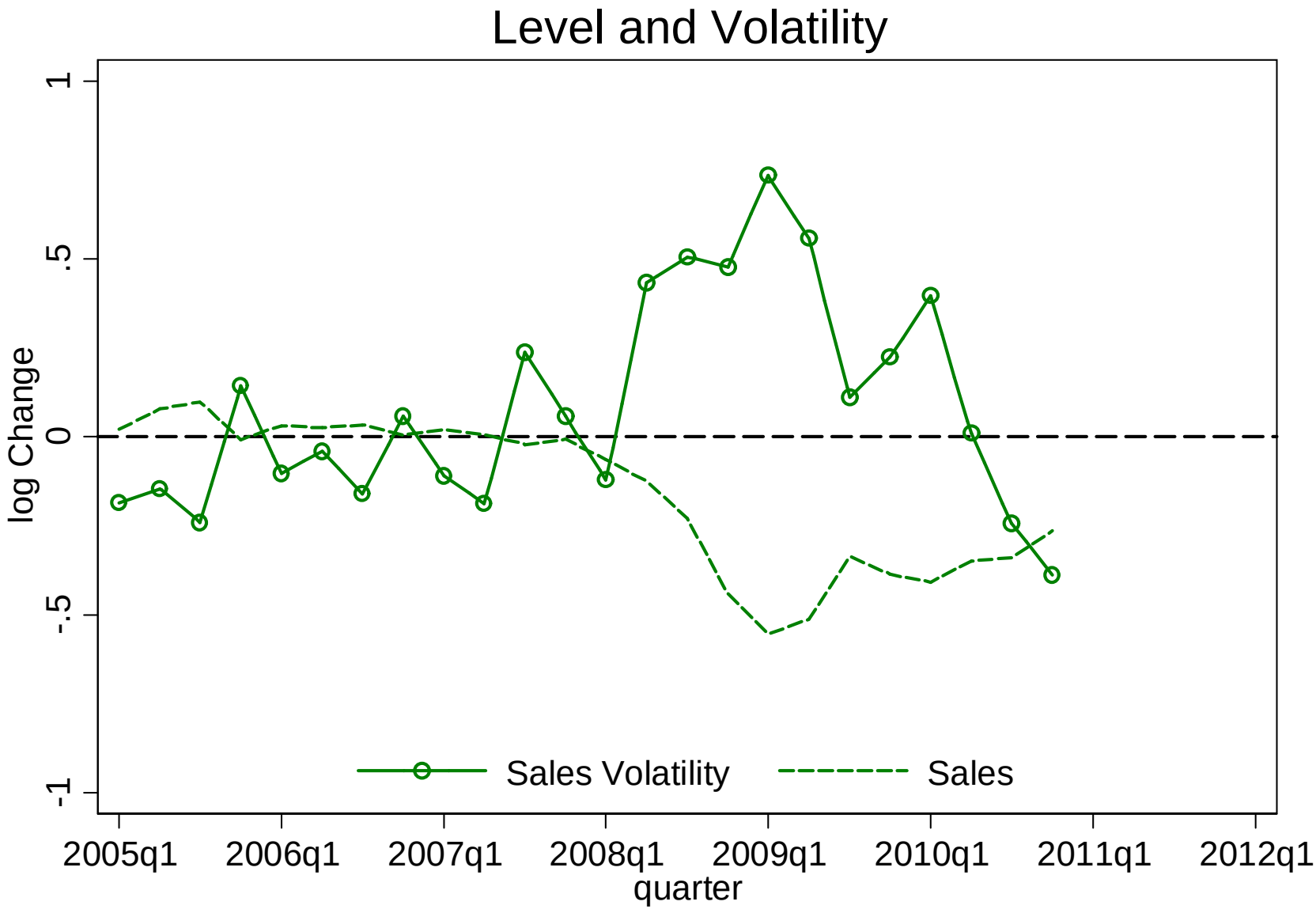
Empirical Work

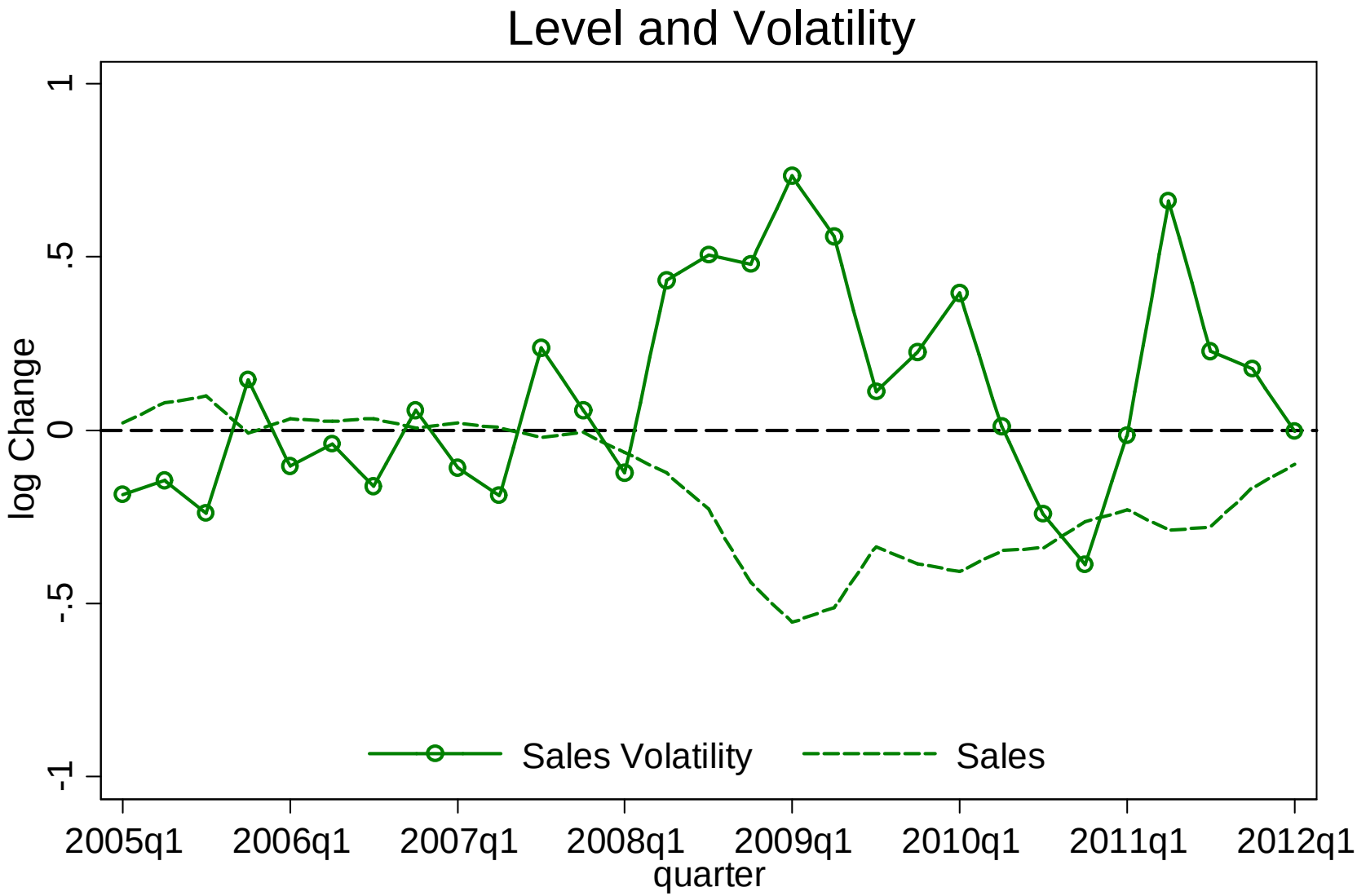
Study international reallocation in

1. Auto Industry
2. US manufacturing

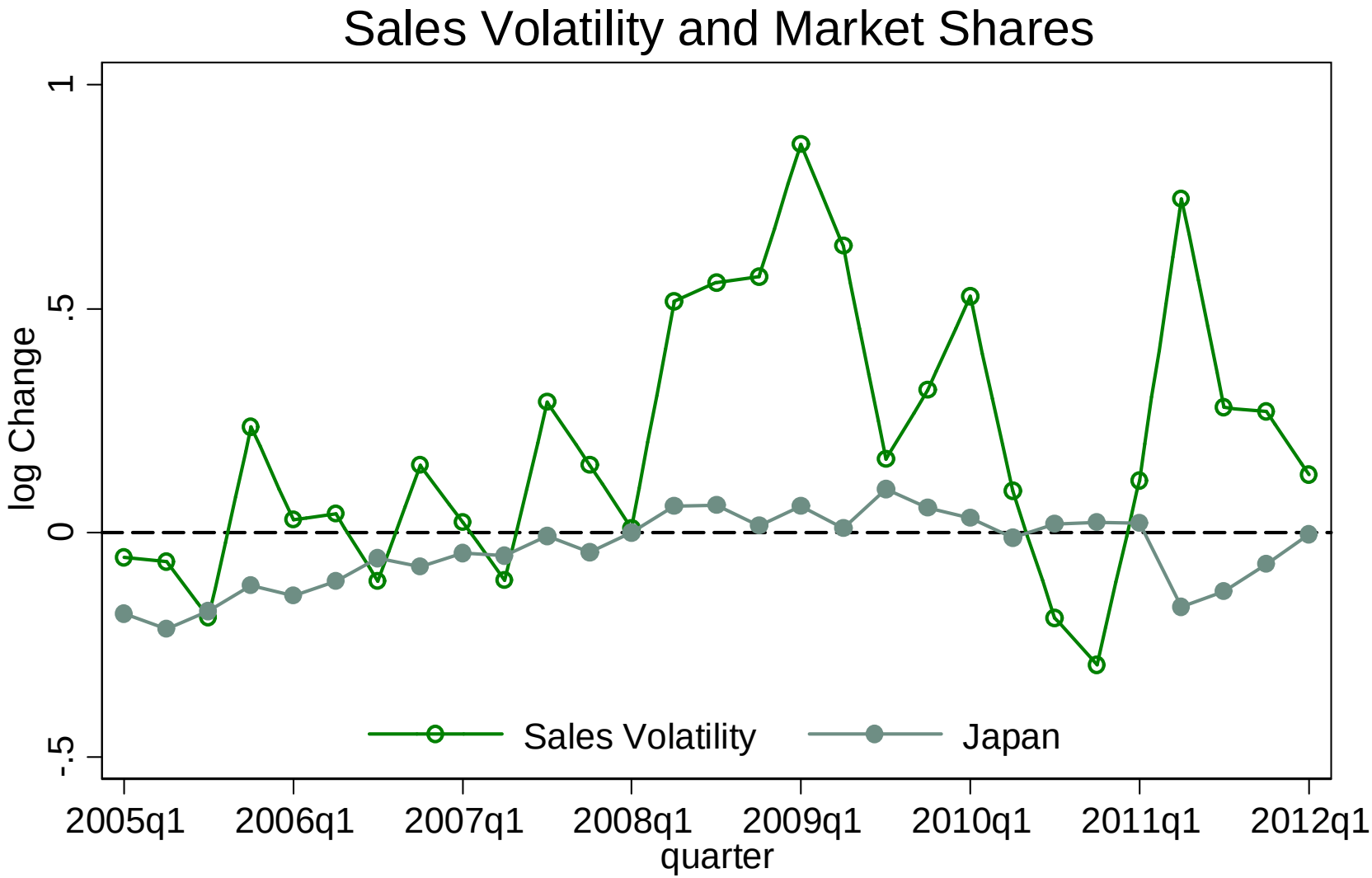
Auto Industry

- Important industry where we can see reallocation across countries.
- Advantages:
  - detailed monthly data (company, brand, product, trim)
  - well-identified country-specific shocks
- Measure log micro-volatility of U.S. sales growth, weighted by market share.
  - Includes imports and domestic production.
  - Similar for production measures.


Level and Volatility
log Change
1
.5
0
-.5
-1
2005q1
2006q1
2007q1
2008q1
2009q1
2010q1
2011q1
2012q1
quarter
Sales Volatility
Sales



Note: Tsunami March 2011.

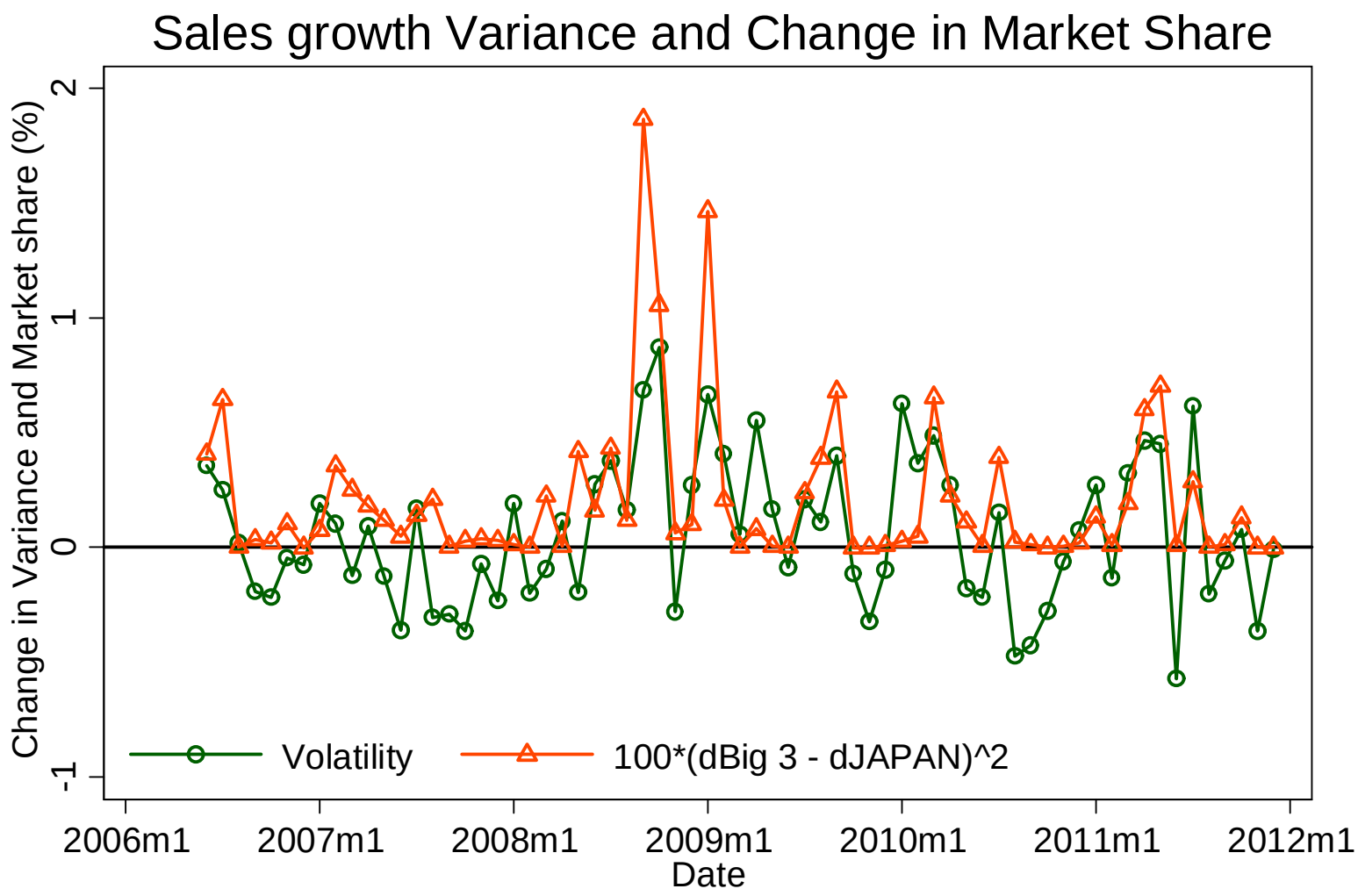


Note: Not Seasonally adjusted.
Market shares are log deviations from pre recession mean.

Micro-volatility and International Reallocation

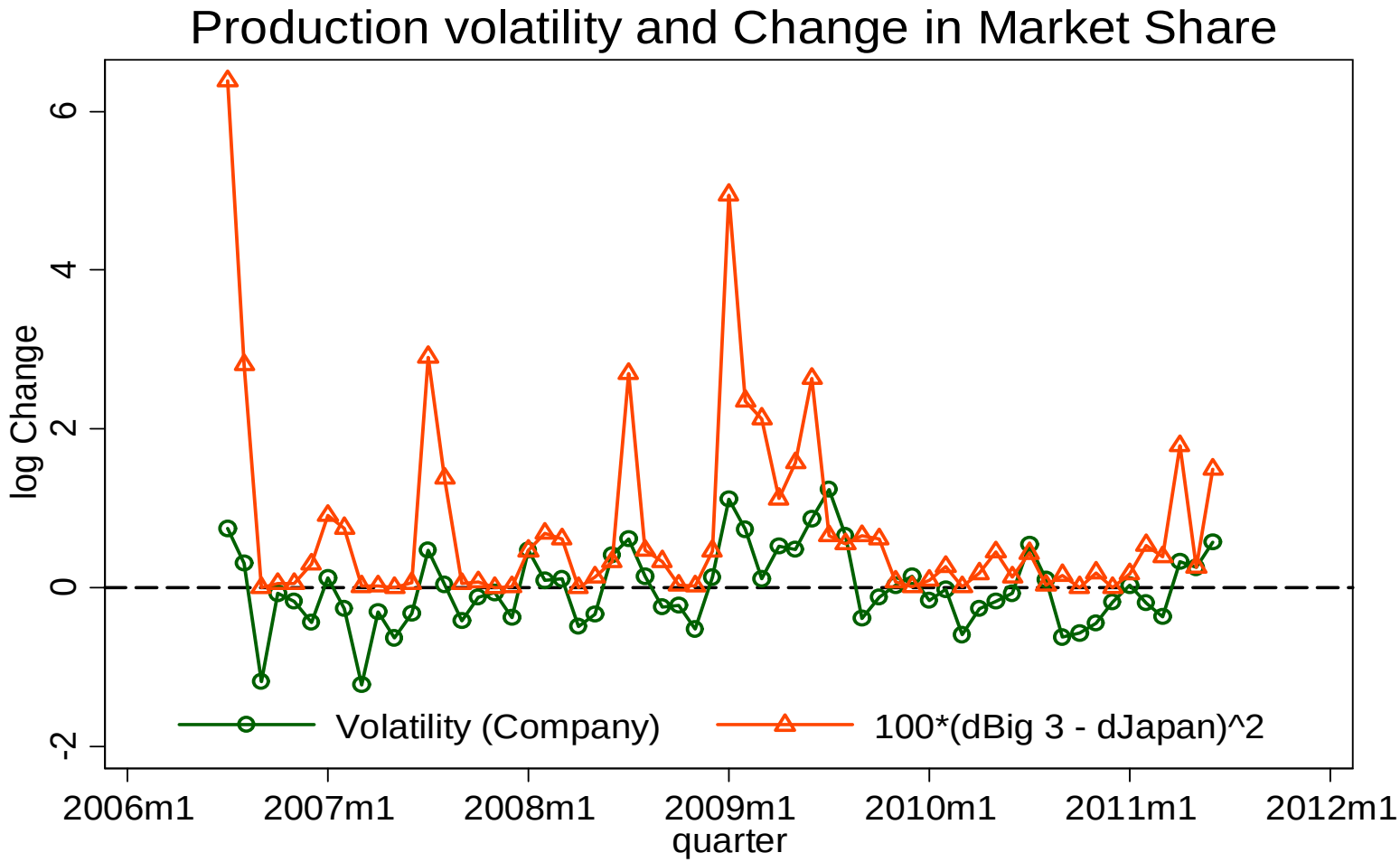
Want to control for micro-volatility due to reallocation of market share between US- and Japan-owned

$$\mu_t = 100 \left(\frac{Sales_t^{US} - Sales_t^{Japan}}{Sales_t} - \frac{Sales_{t-1}^{US} - Sales_{t-1}^{Japan}}{Sales_{t-1}} \right)^2$$



Correlation = 0.58

Figure 8: Volatility and Reallocation by Country Ownership



Note: 100*Squared Market Share change of Big3 - Transplant Production .

Industry Evidence I

Question: In Great Recession, did open industries experience larger increases in volatility?
Data: Using trade and NBER data, construct openness measures for industry i in year t:

$$
\begin{aligned}
Open_{i,t}^{Overall} &= \ln \frac{EX_{i,t} + M_{i,t}}{S_{i,t}} \\
Open_{i,t}^{\mathrm{Im}\,port} &= \ln \frac{M_{i,t}}{S_{i,t} - EX_{i,t} + M_{i,t}} \\
Open_{i,t}^{Export} &= \ln \frac{EX_{i,t}}{S_{i,t}}
\end{aligned}
$$

Regression Equation:

$$V_{i,2009} - V_{i,2007} = \beta Open_{i,2007} + \epsilon_{i,t}$$

Industry Evidence I - Results

Answer: Yes

	Overall	Export	Import
Industry Openness	0.048^{***}	0.040^{***}	0.040^{***}
R^2	0.08	0.06	0.09
Observations	191	191	191

Note: Bloom et al. (2013) does not find significant correlates with cross-industry variation

Industry Evidence II

Question: Are open industries associated with increases in volatility in broader time series?

Regression Equation:

$$V_{i,t} = \beta Open_{i,t} + \gamma Open_{i,t} * \text{Reallocation} + \delta t + \phi_i + \epsilon_{i,t}$$

Two measures of international reallocation

- 1. $|\Delta \text{RER}|$
  2. $|\Delta \text{NX}|$

Industry Evidence I - Results

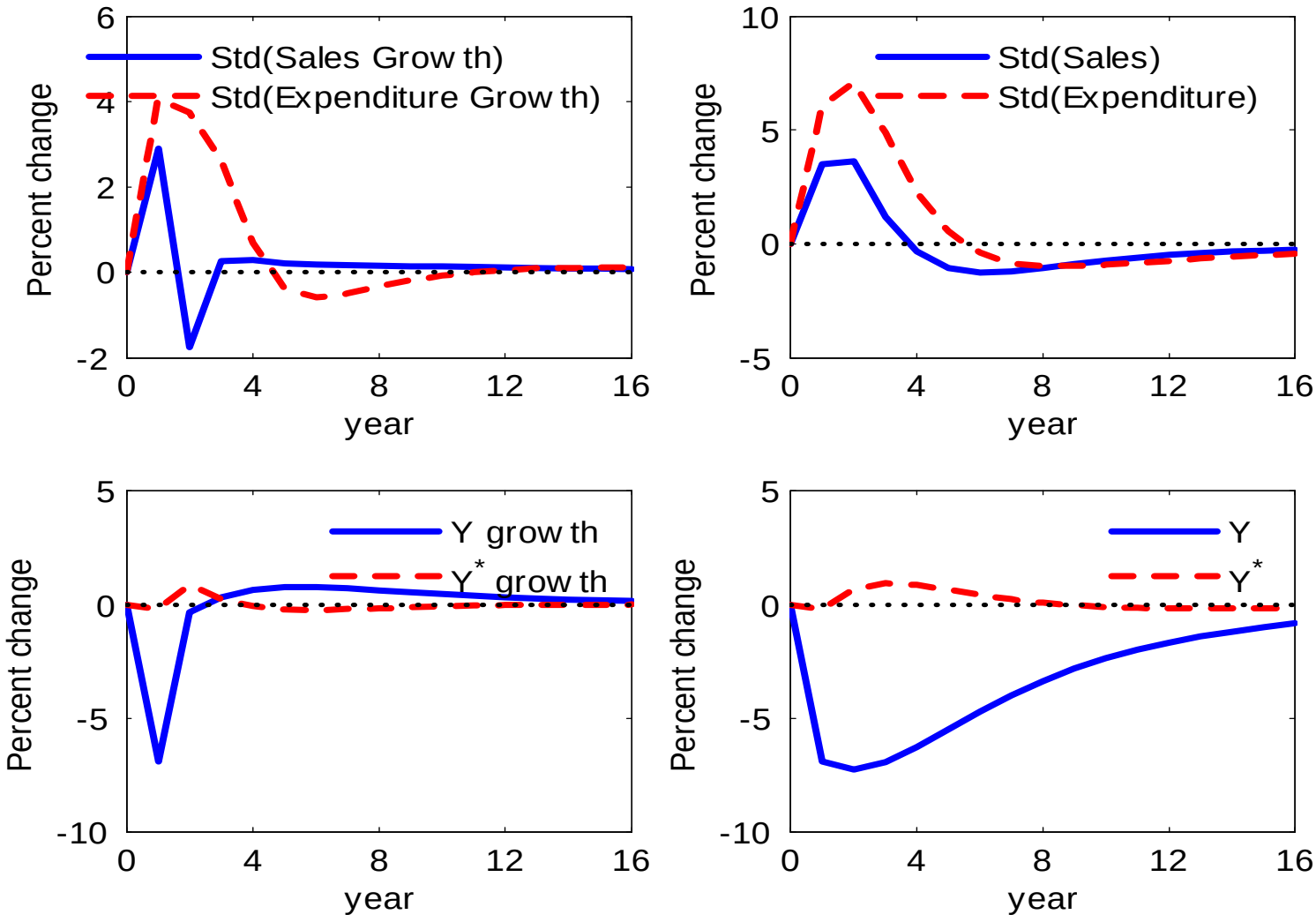
Answer: Yes, but only in times of international reallocation

	Overall	$\lvert\Delta$RER$\rvert$	$\lvert\Delta$NX$\rvert$
Industry Openness	0.01	0.040	0.014
ΔRER		2.39***	
ΔRER x Open		0.773**	
ΔNX			0.549***
ΔNX x Open			0.135*
R^2	0.63	0.63	0.63
Observations	4840	4840	4840

Summary

- Micro-volatility shocks boost trade, makes Great Trade Collapse more puzzling.
- Micro-volatility increases with country-specific first moment shocks.
- Industry evidence shows that $\Delta' s$ in micro-volatility related to international reallocation.
  - Attributable in part to country-specific first moment shocks

Figure 3: Home recession



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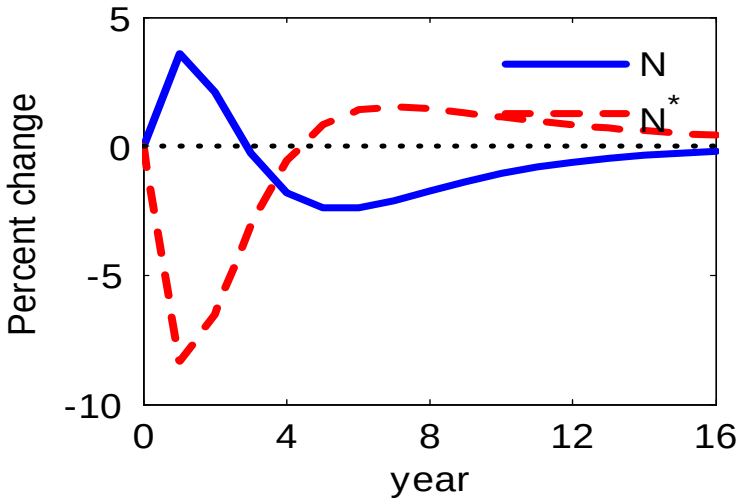
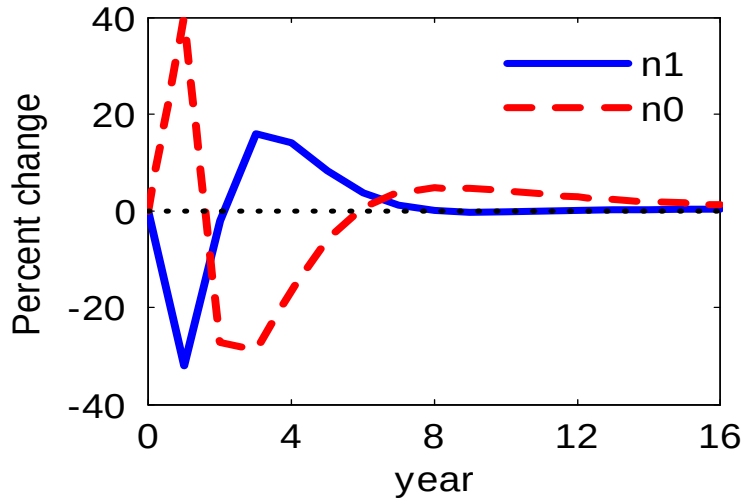




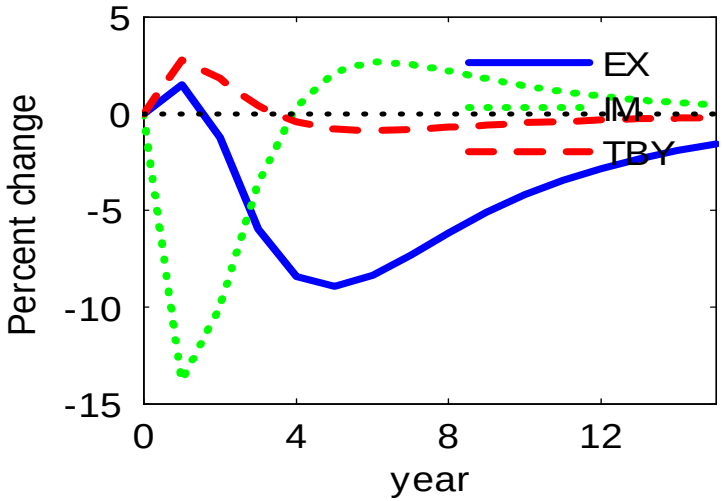
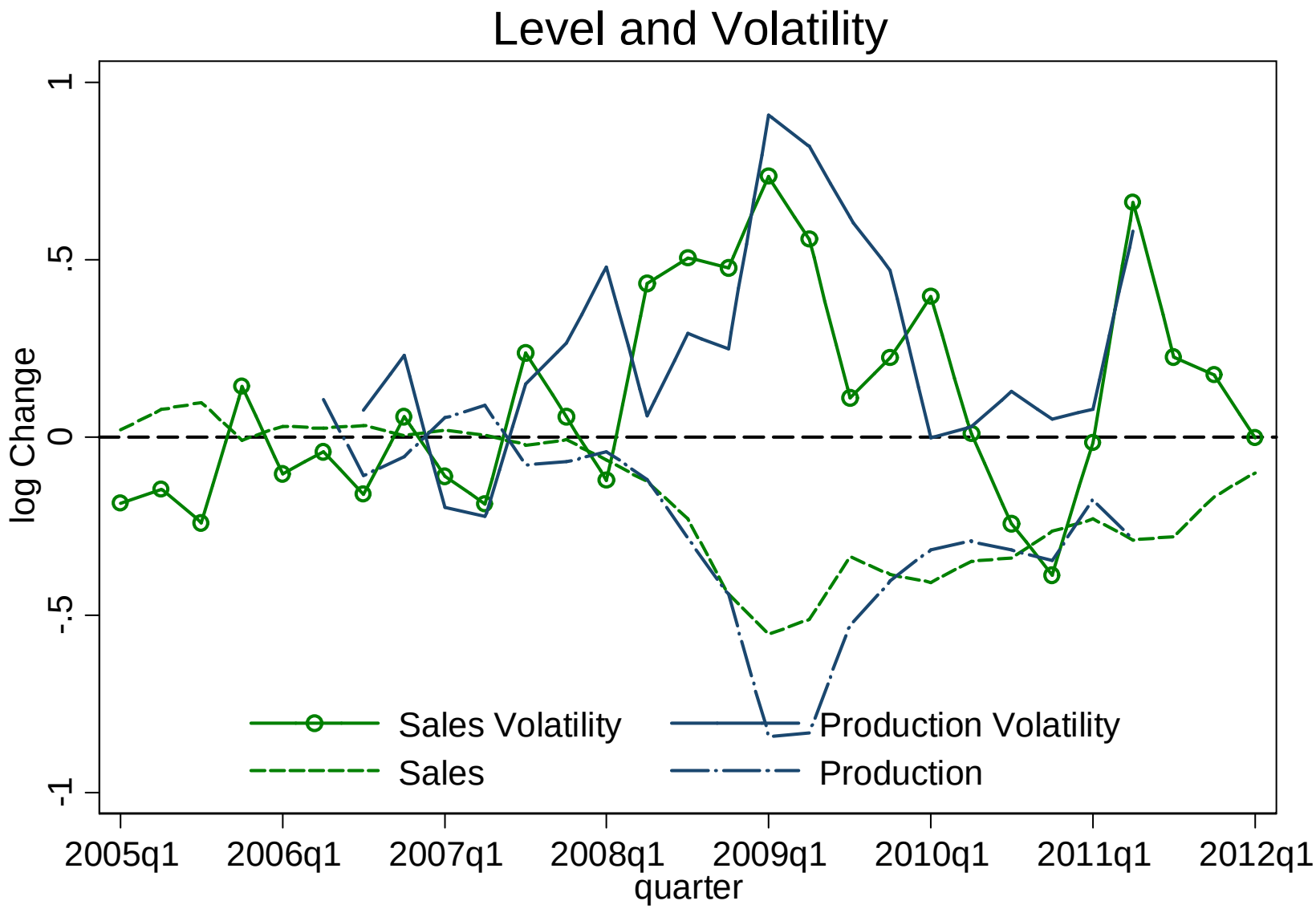
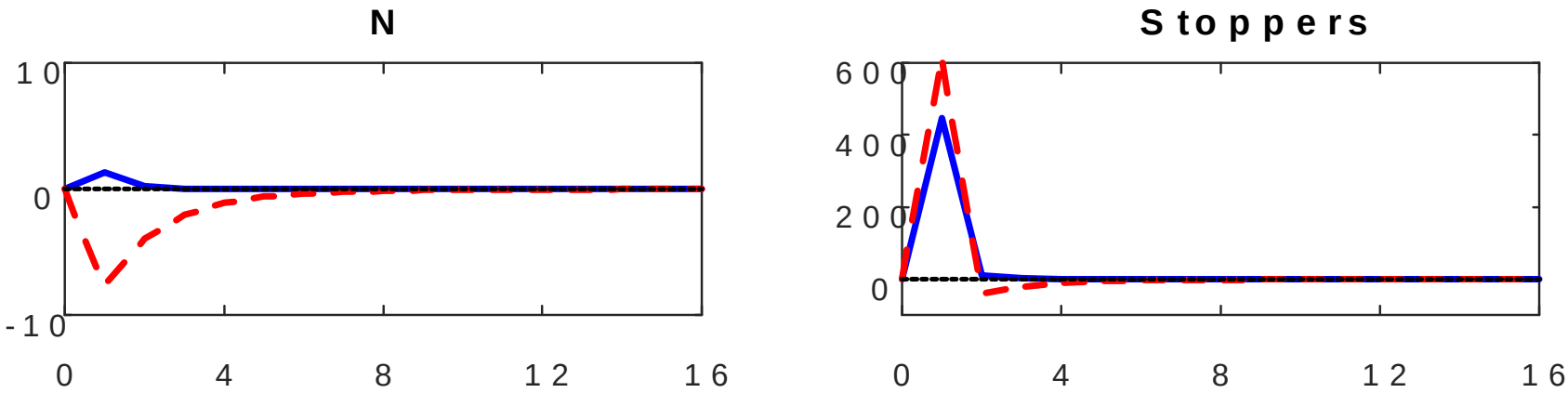


Figure 7: Volatility and Level of Activity (Sales and Production of Autos)



Global micro volatility shock - small aggregate boom

Figure 6: Global uncertainty Shock



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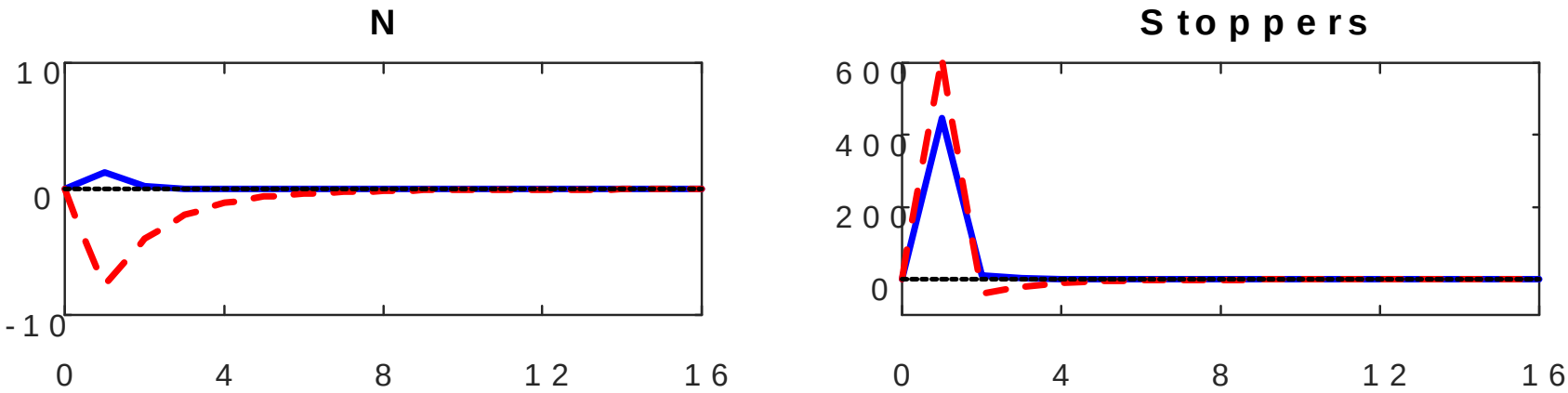

Positive impact from *selection* into exporting (Exporters are in right tail)