Microeconomic Uncertainty, International Trade, and Aggregate Fluctuations

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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.
Introduction

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- Question: Is rise in micro-volatility a \textit{symptom} or \textit{cause} of downturns such as Great Recession?
Introduction

- 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?

- Study this theoretically & empirically in open economy
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?

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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  - 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

  - Dynamic export decision because costs of starting to export > costs of continuing to export.

- Captures 1) Not all producers export 2) Exporters are relatively large & 3) Exporting is persistent (Das, Roberts, Tybout 2007).

- 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)
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Model

- $\infty$-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 $\phi(z'|z)$,
Model

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  ▶ Idiosyncratic shocks $\phi(z'|z)$,

• 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,
- \( \Pi_t \) 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

\[
\max \Pi_t = D_t - \sum_{m=\{0,1\}} \int_{z,k} y_H^d (z, m, k)^{\frac{\theta-1}{\theta}} \psi (z, m, k) \, dzdk \\
- \sum_{m=\{0,1\}} \int_{z,k} m' (z, m, k) y_F^d (z, m, k)^{\frac{\theta-1}{\theta}} \psi^* (z, m, k) \, dzdk
\]

subject to

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

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

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

Isolelastic demand

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

\[ y^*_H (z, m, k) = m' (z, m, k) \tilde{\omega} e^{\omega t} \left( \frac{p^*_H(z,m,k)}{P^*_H} \right)^{-\theta} \left( \frac{P^*_H}{\bar{P}} \right)^{-\gamma} D^* \]

\[ P = \left( P_H^{1-\gamma} + \tilde{\omega} e^{\omega t} P_F^{1-\gamma} \right)^{\frac{1}{1-\gamma}} \]

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

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

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

\[
\pi_{m'}(z,k) = \max_l p(y_H)y_H + m' p^*(y_H^*) y_H^* - wl
\]

\[
V(z,m,k) = \max_{m' \in \{0,1\}, x} \left\{ \pi_{m'}(z,k) - m' f_m - Px 
+ EQV(z',m',(1-\delta)k + x) \right\}
\]
Intermediate Good Producer \((z,m,k)\)

\[
y_H + y^*_H = y = e^z e^{A_k^\alpha} l^{1-\alpha}
\]

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

\[
\pi_{m'}(z,k) = \max_l p(y_H)y_H + m' p^*(y^*_H) y^*_H - wl
\]

\[
V(z,m,k) = \max_{m' \in \{0,1\}, x} \left\{ \pi_{m'}(z,k) - m' f_m - Px + EQV(z', m', (1-\delta) k + x) \right\}
\]

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

\[
wf_m \leq (\pi_1 - \pi_0) + EQ \left[ V(z', 1, k'_1|\cdot) - V(z', 0, k'_0|\cdot) \right] - P(x_1 - x_0)
\]

And capital accumulation depends on export decision

\[
P = EQV_k(z', m', k'_m|\cdot)
\]
Calibration - Macro

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

\[ \beta = 0.96 \]
\[ \alpha = 0.36 \]
\[ \delta = 0.10 \]
\[ \eta \rightarrow 1/4 \text{ time working} \]
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

<table>
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<tr>
<th>Parameter</th>
<th>Data</th>
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<td>$\sigma_\epsilon$</td>
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</tr>
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</table>

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

1. Home producer shipments

2. Home consumer purchases
Micro Dynamics

- Model matches growth premia related to changes in export status at different horizons among US manufacturers (Bernard & Jensen, 99)

  \[(g_{starters} > g_{exporters}^{cont} > g_{non\ exp}^{cont} > g_{stoppers})\]

- 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

\[ A_t = \rho A_{t-1} + \varepsilon_t \]
\[ \omega_t = \rho \omega_{t-1} + \varepsilon^\omega_t \]
\[ \omega^*_t = \rho \omega^*_t + \varepsilon^\omega^*_t \]

- Results for model
  - Almost fixed export participation \((f_0 / f_1 \to \infty)\)
  - Benchmark
Figure 2A: Home recession - *Fixed* Export Participation

![Graph showing the relationship between home recession and export participation over time. The graph includes lines for various economic indicators, such as *Y* (Y) and *Y* (Y*) representing different economic scenarios. The x-axis represents years, and the y-axis shows percent change.]
Figure 2B: Home recession - *Fixed* Export Participation

- **Std(Sales Growth)**
- **Std(Exp. Growth)**

- **NonX sales growth**
- **X sales growth**
- **FX E growth**
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

- \text{Std(Sales Growth)}
- \text{Std(Expenditure Growth)}
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)
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.
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

Std (Sales Growth)

Std (Exp. Growth)

Year

Low

High

Year
Global micro volatility shock - small aggregate boom

Figure 6: Global uncertainty Shock

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

If uncertainty important, Great Trade Collapse a bigger puzzle!
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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

Sales Volatility

Sales

log Change

2005q1 2006q1 2007q1 2008q1 2009q1 2010q1 2011q1 2012q1
quarter
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

$$\mu_t = 100 \left( \frac{Sales^US_t - Sales^Japan_t}{Sales_t} - \frac{Sales^US_{t-1} - Sales^Japan_{t-1}}{Sales_{t-1}} \right)^2$$
Sales growth Variance and Change in Market Share

Change in Variance and Market share (%)
2006m1 2007m1 2008m1 2009m1 2010m1 2011m1 2012m1
Date
Volatility 100*(dBig 3 - dJAPAN)^2

Correlation = 0.58

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Figure 8: Volatility and Reallocation by Country Ownership

Production volatility and Change in Market Share

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

Volatility (Company) 100*(dBig 3 - dJapan)^2
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 $t$:

$$
Open_{i,t}^{Overall} = \ln \frac{EX_{i,t} + M_{i,t}}{S_{i,t}}
$$

$$
Open_{i,t}^{Import} = \ln \frac{M_{i,t}}{S_{i,t} - EX_{i,t} + M_{i,t}}
$$

$$
Open_{i,t}^{Export} = \ln \frac{EX_{i,t}}{S_{i,t}}
$$

Regression Equation:

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

**Answer:** Yes

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Export</th>
<th>Import</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry Openness</td>
<td>0.048***</td>
<td>0.040***</td>
<td>0.040***</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.08</td>
<td>0.06</td>
<td>0.09</td>
</tr>
<tr>
<td>Observations</td>
<td>191</td>
<td>191</td>
<td>191</td>
</tr>
</tbody>
</table>

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:

\[ V_{i,t} = \beta Open_{i,t} + \gamma Open_{i,t} \times \text{Reallocation} + \delta t + \phi_i + \epsilon_{i,t} \]

Two measures of international reallocation

1. \( |\Delta \text{RER}| \)
2. \( |\Delta \text{NX}| \)
**Answer:** Yes, but only in times of international reallocation

|                        | Overall | |ΔRER| | |ΔNX| |
|------------------------|---------|-----------------|-----------------|
| Industry Openness      | 0.01    | 0.040           | 0.014           |
| ΔRER                   |         | 2.39***         |                 |
| ΔRER x Open            |         | 0.773**         |                 |
| ΔNX                    |         |                 | 0.549***        |
| ΔNX x Open             |         |                 | 0.135*          |
| R²                     | 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

- Std(Sales Growth) vs. Std(Expenditure Growth)
- Std(Sales) vs. Std(Expenditure)
- Y growth th vs. Y* growth th
- Y vs. Y*
Figure 3: Home recession
Figure 7: Volatility and Level of Activity (Sales and Production of Autos)

Level and Volatility

Sales Volatility in green, Production Volatility in blue, Sales in dashed green, Production in dashed blue.
Global micro volatility shock - small aggregate boom

Figure 6: Global uncertainty Shock

- **N**
- **Stoppers**

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