Trade and the Global Recession

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During the Great Recession the Ratio of Trade to GDP plunged
Trade/GDP Has Plunged
Trade/GDP Has Plunged

Japan

0.5*(Imports+Exports)/GDP
Trade/GDP Has Plunged

[Graph showing a significant increase in \(0.5 \times (\text{Imports} + \text{Exports})/\text{GDP}\) from 1949 to 2009 in China, with a peak around 2004.]
Trade/GDP Has Plunged
Trade/GDP Has Plunged
Why?
Hypothesis I: An increase in home-bias

- trade credit

* Amiti and Weinstein (2009) for Japan in an earlier period the health of Japanese firms’ banks significantly affected the firms’ trading volumes, presumably through their role in issuing trade credit.

* Chor and Manova (2009) show that sectors requiring greater financing saw a greater decline in trade volume.

* McKinnon (2009) and Bhagwati (2009) also focus on the role of reduced trade credit availability in explaining the recent trade collapse.
– Protectionism. “...many political leaders find the old habits of protectionism irresistible ... This, then, is a large part of the answer to the question as to why world trade has been collapsing faster than world GDP.” Brock (2009). Stimulus measures possibly home biased.
– Disintegration of global supply chains.

* Eichengreen (2009)

* Yi (2009).
− Inventory dynamics and the inventory intensity of traded goods.

Hypothesis II: The demand for goods that are most traded goods fell relative to goods that are less traded.

- Levchenko, Lewis, and Tesar (2009)
- Bems, Johnson, and Yi (2010)
A First Look at Some Numbers
1. Is the Great Recession Special? Annual, quarter to quarter changes in trade/GDP against the growth of GDP
US Non-Oil Imports

- % Change in Spending/GDP
- GDP Growth (Qt/Qt-4)

Data points:
- 1951Q1 - 2008Q3
- 2008Q4 - 2009Q4
- Linear (1951Q1 - 2008Q3)

Graph shows the relationship between percent change in spending/GDP and GDP growth over time.
UK Non-Oil Imports

![Graph showing the relationship between GDP growth and percentage change in spending/GDP]
France Non-Oil Imports

![Chart showing the relationship between GDP growth and change in spending/GDP. The chart includes data points for 1971Q1 to 2008Q3 and 2008Q4 to 2009Q4, with a linear trend line indicating a decrease in spending/GDP with GDP growth.](image-url)
Japan Non-Oil Imports

GDP Growth (Qt/Qt-4)

% Change in Spending/GDP

-40% -30% -20% -10% 0% 10% 20% 30%

1980Q4 - 2008Q3
2008Q4 - 2009Q4
Linear (1980Q4 - 2008Q3)
2. What happens to manufacturing?
US Spending on Manufactures

GDP Growth (Qt/Qt-4) vs. % Change in Spending/GDP

- 1960Q1 - 2008Q3
- 2008Q4 - 2009Q4
- Linear (1960Q1 - 2008Q3)
UK Spending on Manufactures

GDP Growth (Qt/Qt-4) vs. % Change in Spending/GDP

- 1956Q1 - 2008Q3
- 2008Q4 - 2009Q4
- Linear (1956Q1 - 2008Q3)
France Spending on Manufactures

GDP Growth (Qt/Qt-4)

% Change in Spending/GDP

-8% -6% -4% -2% 0% 2% 4% 6% 8%

1971Q1 - 2008Q3
2008Q4 - 2009Q4
Linear (1971Q1 - 2008Q3)
Japan Spending on Manufactures

- Spending on Manufactures:
  - 1980Q4 - 2008Q3:
    - Linear:
      - 25% to 30%
  - Change in Spending:
    - 1980Q4 - 2009Q4:
      - 15% to 20%
      - GDP:
        - 10% to 15%
  - GDP Growth Qt/Qt-4:
    - -10% to 10%
3. What happens to the ratio of trade to industrial production? The Head-Ries index
• Start with a gravity equation:

\[ X_{ni} = \kappa \frac{Z_n^I Z_i^E}{\tau_{ni}} \]

\( Z_n^I \) a vector of destination characteristics \( Z_i^I \) a vector of source characteristics, \( \tau_{ni} \geq 1 \) an indicator of the barriers thwarting exports from \( i \) to \( n \).

• Apply it to home sales \( X_{ii} \) with \( \tau_{ii} = 1 \).

• Then the Head-Ries index for trade between \( i \) and \( n \), given by:

\[ \Theta_{ni} = \left( \frac{X_{ni} X_{in}}{X_{nn} X_{ii}} \right)^{1/2} = [\tau_{ni} \tau_{in}]^{-1/2}. \]
We show it for durable manufactures and nondurable manufactures.
Head-Ries Indices for Trade Between U.S. and Japan

4-Q Moving Average (Scaled, 2005:Q1=1)

Durables

Non-Durables
Head-Ries Indices for Trade Between U.S. and China

4-Q Moving Average (Scaled, 2005:Q1=1)
Head-Ries Indices for Trade Between U.S. and Germany

4-Q Moving Average (Scaled, 2005:Q1=1)
Head-Ries Indices for Trade Between Japan and China

4-Q Moving Average (Scaled, 2005:Q1=1)
Head-Ries Indices for Trade Between Japan and Germany

4-Q Moving Average (Scaled, 2005:Q1=1)
Head-Ries Indices for Trade Between China and Germany

4-Q Moving Average (Scaled, 2005:Q1=1)
A Model

- Precursors:
  - Eaton-Kortum (EK, 2002)
  - Alvarez-Lucas (AL, 2008)
  - Dekle et. al. (DEK, 2008)
  - Caliendo-Parro (2010).
• Countries $i = 1, \ldots, I$

• CRS, perfect competition

• Three Sectors $j = D, N, S$ (durable manufactures, nondurable manufactures, rest ("services")

• $\Omega = \{D, N, S\}$  $\Omega_M = \{D, N\}$

• Net trade in the $S$ sector exogenous in our framework.
Some Accounting

- $Y_{ij}^j$: country $i$’s gross production in sector $j \in \Omega$.

- $X_{ij}^j$: country $i$’s gross absorption of $j$

- $D_{ij}^j = X_{ij}^j - Y_{ij}^j$: country $i$’s deficit in sector $j$.

- $D_i$: country $i$’s overall deficit:

\[ D_i = \sum_{j \in \Omega} D_{ij}^j, \]
• For each $j \in \Omega,$

\[
\sum_{i=1}^{I} D^j_i = 0.
\]
• $Y_i$: country $i$’s GDP.

• $X_i = Y_i + D_i$: country $i$’s aggregate final spending.

• $\beta^j_i$: country $i$’s value-added share in industry $j$.

• GDP is the sum of sectoral value added:

$$Y_i = \sum_{j \in \Omega} \beta^j_i Y^j_i.$$ 

• All factors called labor, perfectly mobile across sectors:

$$Y_i = \sum_{j \in \Omega} w_i L^j_i = w_i L_i.$$
• $\alpha_i^j$: country $i$'s share of sector $j$ purchases in aggregate final demand.

• $\gamma_{lj}^i$: country $i$'s share of sector $j$ in intermediate demand by sector $l$.

• $\beta, \alpha, \gamma$ are Cobb-Douglas parameters treated as constant across time but allowed to differ across countries.

• Total demand for sector $j$ in country $i$:

$$X_i^j = \alpha_i^j X_i + \sum_{l \in \Omega} \gamma_{lj}^i (1 - \beta_{lj}^i) Y_i^l.$$
Fold Services into Manufactures

\[ c_i^j = \frac{1}{A_i^{jS}w_i^{\beta_i^j}} \prod_{l \in \Omega_M} \left( p_i^l \right)^{\gamma_i^{jl}(1-\tilde{\beta}_i^j)} = \frac{\gamma_i^{jS}(1-\beta_i^j)}{[1-\gamma_i^{S_2}(1-\beta_i^S)]} , \quad j \in \Omega_M \]

where:

\[ A_i^{jS} = \left( A_i^S \right)^{\gamma_i^{jS}(1-\beta_i^j)/[1-\gamma_i^{S_2}(1-\beta_i^S)]} , \]
Input-output parameters become

\[ \tilde{\beta}_i^j = \beta_i^j + \frac{\gamma_i^{jS}(1 - \beta_i^j)\beta_i^S}{1 - \gamma_i^{SS}(1 - \beta_i^S)}, \]

and

\[ \tilde{\gamma}_i^{jl} = \gamma_i^{jl} + \gamma_i^{jS} \frac{\gamma_i^{Sj}(1 - \beta_i^S) + \gamma_i^{jl}\beta_i^S}{1 - \gamma_i^{SS}(1 - \beta_i^S) - \gamma_i^{jS}\beta_i^S}. \]
The Resulting Two-Sector Model

\[ X^j_i = \tilde{\alpha}^j_i (w_i L_i + D_i) - \delta^j_i D^S_i + \sum_{l \in \Omega_M} \tilde{\gamma}^l_j (1 - \bar{\beta}^l_i) Y^l_i, \quad j \in \Omega_M \]

where

\[ \delta^j_i = \frac{\gamma^S_j (1 - \beta^S_i)}{1 - \gamma^{SS}_i (1 - \beta^S_i)}, \]

and

\[ \tilde{\alpha}^j_i = \alpha^j_i + \delta^j_i \alpha^S_i. \]
International Trade

\[ Y_{i}^{j} = \sum_{n=1}^{I} \pi_{ni}^{j} X_{n}^{j}. \]

where \( \pi_{ni}^{j} \) is the share of country \( n \)'s expenditures on goods in sector \( j \) purchased from country \( i \).

- \( D \) and \( N \) modeled as in the EK (2002) Ricardian model each with a continuum of goods indexed by \( z \).

- Following Alvarez and Lucas (2007) world GDP is the numeraire.
• We **cannot** account for the global decline in real GDP. Ours is a model of the movements of country-level variables and trade relative to the global totals.
• **Equilibrium:** a set of wages $w_i$ for each country $i = 1, \ldots, I$ and, for sectors $j \in \Omega_M$, spending levels $X^j_i$, price levels $p^j_i$, and trade shares $\pi^j_{ni}$ that solve equations the equations above given labor endowments $L_i$ and deficits $D_i$ and $D^S_i$. 
The Shocks

Given the parameters $\beta$, $\gamma$, and $\theta$ we can decompose the change in the trade shares to shocks in four sets of parameters:

1. Final demand $\alpha_i^j$.

2. Deficits $D_i, D_i^S$

3. Productivity $A_i^j$

4. Trade-frictions $d_{ni}^j$. 
Reformulating the Model in Changes

- For any time-varying variable $x$ denote baseline as $x$ and its end-of-period or counterfactual value as $x'$ and let $\hat{x} = x'/x$ denote the change.

- We treat $L_i$ as fixed so that $Y_i' = \hat{w}_i Y_i$. 
Equilibrium in terms of changes:

\[
(X_i^j)' = (\tilde{\alpha}_i^j)' (\hat{w}_i Y_i + D_i') - \delta_i^j (D_i^S)' + \sum_{l \in \Omega_M} \tilde{\gamma}_i^l (1 - \tilde{\beta}_i^l) \left[ \sum_{n=1}^{I} (\pi_n^l)' (X_n^l)' \right].
\]

\[
(X_i^D)' + (X_i^N)' - \left[ D_i' - (D_i^S)' \right] = \sum_{n=1}^{I} (\pi_n^D)' (X_n^D)' + \sum_{n=1}^{I} (\pi_n^N)' (X_n^N)'.
\]

\[
\hat{p}_n^j = \left( \sum_{i=1}^{I} \pi_{ni}^j \hat{w}_i - \theta_i^j \tilde{\beta}_i^j (\hat{p}_i^j) - \theta_i^j \tilde{\gamma}_i^j (1 - \tilde{\beta}_i^j) (\hat{p}_i^l) - \theta_i^j \tilde{\gamma}_i^l (1 - \tilde{\beta}_i^l) \left( \frac{d_{ni}^j}{\hat{A}_i^j} \right)^{-\theta_i^j} \right)^{-1/\theta_i^j},
\]

\[
(\pi_{ni}^j)' = \pi_{ni}^j \hat{w}_i - \theta_i^j \tilde{\beta}_i^j (\hat{p}_i^j) - \theta_i^j \tilde{\gamma}_i^j (1 - \tilde{\beta}_i^j) (\hat{p}_i^l) - \theta_i^j \tilde{\gamma}_i^l (1 - \tilde{\beta}_i^l) \left( \frac{d_{ni}^j}{\hat{A}_i^j \hat{p}_n^j} \right)^{-\theta_i^j}.
\]
determining $\hat{w}_i, (X_i^j)', \hat{p}_i^j, (\pi_{ni}^j)'$ for $i = 1, \ldots, I$ and $j \in \Omega_M$.

Forcing variables $(\tilde{\alpha}_i^j)' (D_i^S)'$, $D_i'$, $\tilde{d}_{ni}^j$, $A_i^j$. 
Our Data

- Balanced panel of 22 countries with good data, representing 75 percent of global manufacturing trade and global GDP, plus ROW, for 23.

- Annual quarter to quarter changes (to avoid seasonality) from around 2000 through 2009.

- With all our shocks we match the data perfectly.
Parameter Values

- \( \theta^D = \theta^N = 2 \), elasticities between EK (2002) and macro literature.

\[
\left( \tilde{\alpha}_i^j \right)' = \left( \alpha_i^j \right)' + \frac{\gamma_i^{Sj}(1 - \beta_i^S)}{1 - \gamma_i^{SS}(1 - \beta_i^S)} \left( \alpha_i^S \right)' , \quad j \in \Omega_M
\]

- Demand Shocks:

\[
\alpha_i = \frac{1}{X_i} \left( X_i - \Gamma_i^T Y_i \right) ,
\]

using data on sectoral value added.

- Deficits from data.
• Head-Ries and $d_{ni}$:

\[
(\hat{\Theta}_{ni}^j)^2 = \frac{\hat{\pi}_{ni}^j \hat{\pi}_{in}^j}{\hat{\pi}_{nn}^j \hat{\pi}_{ii}^j} = (\hat{d}_{ni}^j)^{-\theta^j} (\hat{d}_{in}^j)^{-\theta^j}
\]

To get directional $d_{ni}$'s:

\[
(\hat{d}_{ni}^j)^{-\theta^j} = \frac{\hat{\pi}_{ni}^j}{\hat{\pi}_{ii}^j} \left( \frac{\hat{p}_i^j}{\hat{p}_n^j} \right)^{\theta^j}
\]

using trade and price data.

• Calculate:

\[
\hat{A}_i^j = (\hat{\pi}_{ii}^j)^{1/\theta^j} \hat{w}_i^j (\hat{p}_i^j)^{\hat{\gamma}_i^j} (1 - \tilde{\beta}_i^j)^{-1} (\hat{p}_i^j)^{\hat{\gamma}_i^j l} (1 - \tilde{\beta}_i^j).
\]
The Shocks in the Data
Figure 5: Shares of Manufacturing in Final Demand

Notes: Generated using interpolation procedure with elasticities set to equal one.
Figure 6: Overall and Non-Manufacturing Trade Deficits

Notes:
Figure 7: Countries without Large Negative Shock to Trade Frictions
Notes: Generated using interpolation procedure with endogenous elasticites.
Figure 8: Countries with Large Negative Shock to Trade Frictions
Notes: Generated using interpolation procedure with endogenous elasticites.
Japan

Productivities (2008:Q1=1)

Non-Durables

Durables

Q1 Q1

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Counterfactuals

- Set of all shocks:

\[ \Xi' = \left\{ \{ \tilde{\alpha}_i^D \}, \{ \tilde{\alpha}_i^N \}, \{ \tilde{D}_i \}, \{ \tilde{D}_S \}, \{ \tilde{d}_{ni}^D \}, \{ \tilde{d}_{ni}^N \}, \{ \tilde{A}_i^D \}, \{ \tilde{A}_i^S \} \right\}, \]

for all countries \( i, n \in I \). \( \Xi' = \{ 1 \} \) means no change, \( \Xi' = \text{"data"} \) means change as in the data.
Accounting for the changes in trade over 2006-2009


- Feed in different types of shocks individually.
Figure 14: Global Trade/GDP Across Many Four-Quarter Periods in Data and Counterfactuals

Notes:
Figure 15: Country Trade/GDP Across Many Four-Quarter Periods in Data and Counterfactuals

Notes: $\theta^D = \theta^N = 2$
• For most countries (e.g., USA and Germany) and the world, $\alpha$’s do most of the work.

• For some countries (e.g., Japan and China) $d_{ni}$’s do quite a bit of work.
Decomposing the Collapse: 2008:Q1 to 2009:Q1

- Write the gross change in any particular outcome variable $\xi$ for country $i$ as $\hat{\xi}_i(\Xi') = \xi'_i / \xi^{08Q1}_i$ to represent its value when the system is solved using the set of shocks $\Xi'$ relative to the value that was observed in the first quarter of 2008.

- Construct:

\[ v(\Xi') = \sum_{i}^{I} w_i \left( \hat{\xi}_i(\Xi') - \hat{\xi}_i(\Xi^{09Q1}) \right)^2. \]

- Define:

\[ \nabla(\Xi') = 1 - \frac{v(\Xi')}{v(\Xi^{08Q1})}. \]
Figure 16: Cross-Sectional Explanatory Power of Various Shocks

Notes: $\theta^D = \theta^N = 2$
Applying the Exercise to Industrial Production and GDP
Contribution of Demand Shocks

Share of Prod-Weighted Production Variance Explained: 67%
2008:Q1 to 2009:Q1

Changes in Production in Data vs. Changes in Counterfactual
Contribution of Deficit Shocks
Share of Prod-Weighted Production Variance Explained: -2%
2008:Q1 to 2009:Q1
Contribution of Trade Friction Shocks

Share of Prod-Weighted Production Variance Explained: 17%

2008:Q1 to 2009:Q1

Changes in Production in Data vs. Changes in Counterfactual Production

Countries: AUT, CAN, CHN, CZE, DEU, DNK, FIN, FRA, GBR, GRC, HUN, IND, ITA, JPN, KOR, MEX, ROU, SWE, USA, ROW

Graph showing the relationship between changes in production in data and changes in counterfactual production for various countries.
Contribution of Productivity Shocks

Share of Prod-Weighted Production Variance Explained: 32%
2008:Q1 to 2009:Q1

Changes in Production in Data vs. Changes in Counterfactual

Countries: AUT, CAN, CZE, DNK, FIN, FRA, DEU, GRC, IND, ITA, JPN, POL, ROU, SVK, KOR, ESP, SWE, GBR, USA, ROW
The Role of International Transmission through Trade: Shutting Down Domestic Shocks
<table>
<thead>
<tr>
<th>Country</th>
<th>Trade / GDP</th>
<th>GDP</th>
<th>Production</th>
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<tr>
<td></td>
<td>Actual</td>
<td>Counterfactual</td>
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<td>Small Countries</td>
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<td>0.78</td>
<td>0.95</td>
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</tbody>
</table>
How did these shocks play out at the firm level?

- Corroborating evidence from France and Belgium
  - Bricongne et al. (2010)
  - Behrens et al. (2010)

- A framework that links evidence at the two levels is desirable.
Finale: Head-Ries during the Great Depression vs. the Great Recession

- Limitations
  - Forced to pool durables and nondurables
  - Annual frequency
• The forces behind the trade collapses of the Great Depression and Great Depression appear very different:

• Protectionism then but not now?
While the world trading system seems to have responded well to the Great Recession, other aspects of policy coordination, governing fiscal and monetary policy in particular, did not.