Trade and the Global Recession

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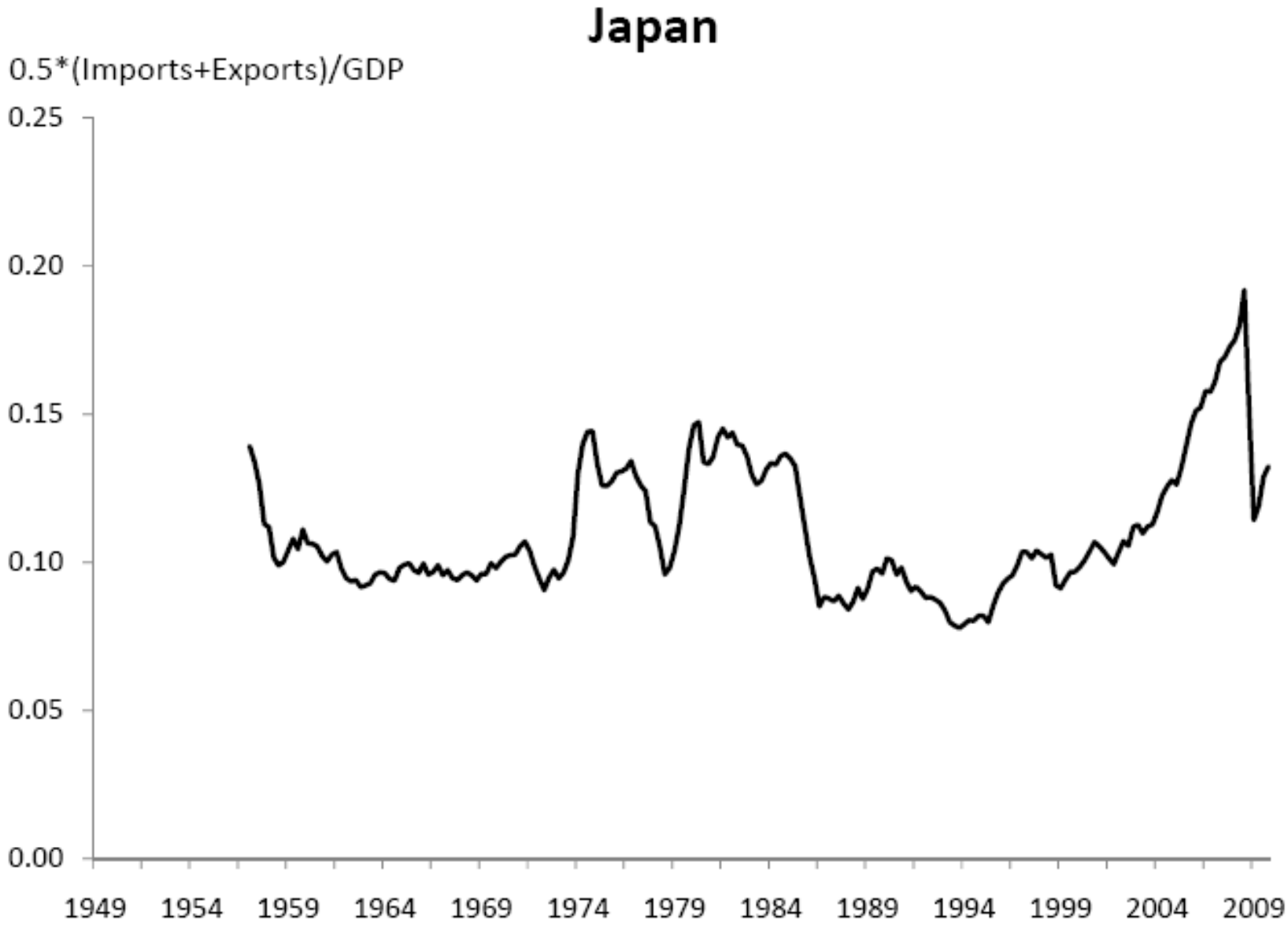
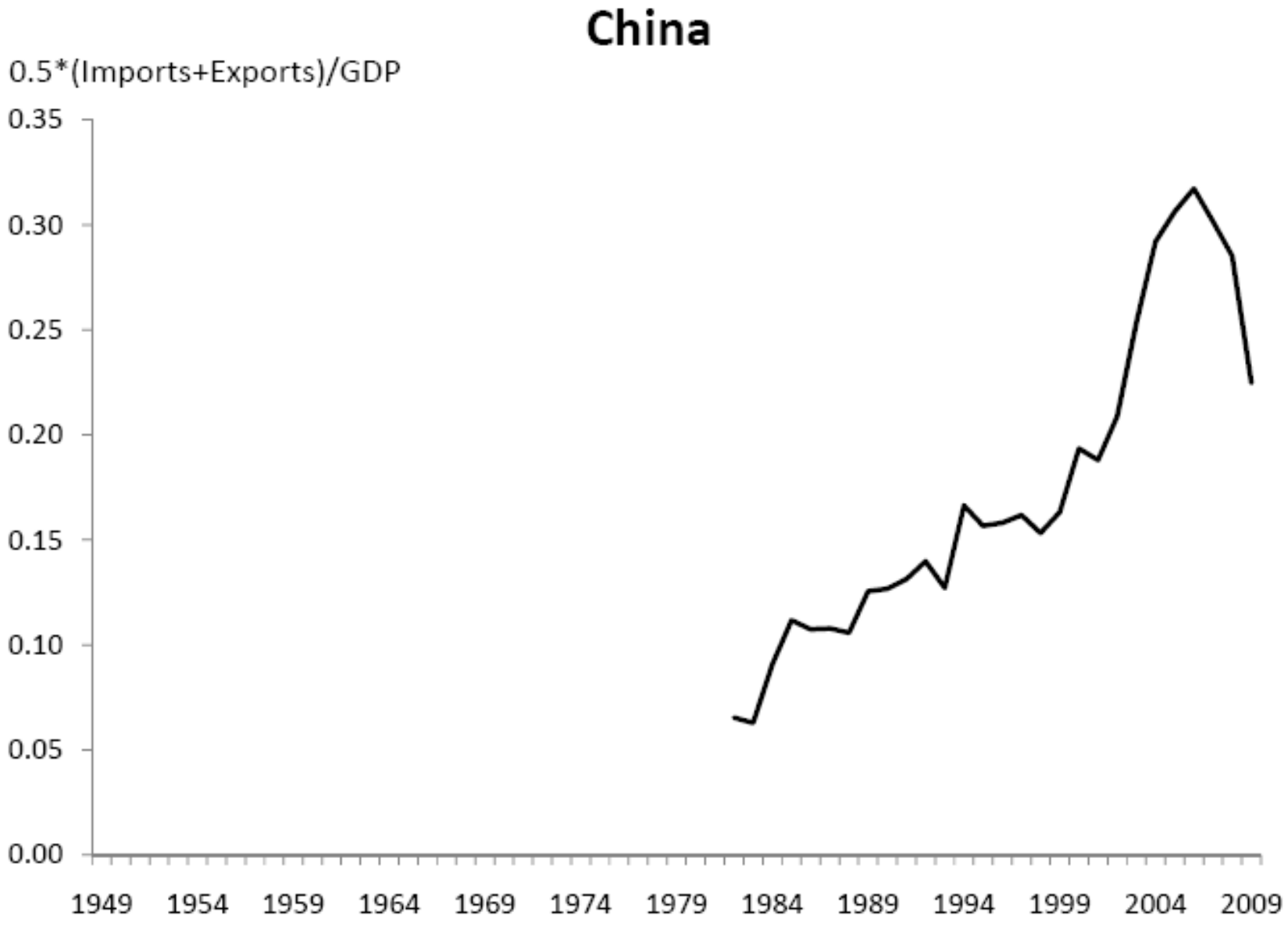
During the Great Recession the Ratio of Trade to GDP plunged

Trade/GDP Has Plunged [redacted]

Trade/GDP Has Plunged [redacted]



Trade/GDP Has Plunged [redacted]



Trade/GDP Has Plunged [redacted]

Trade/GDP Has Plunged [redacted]

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).

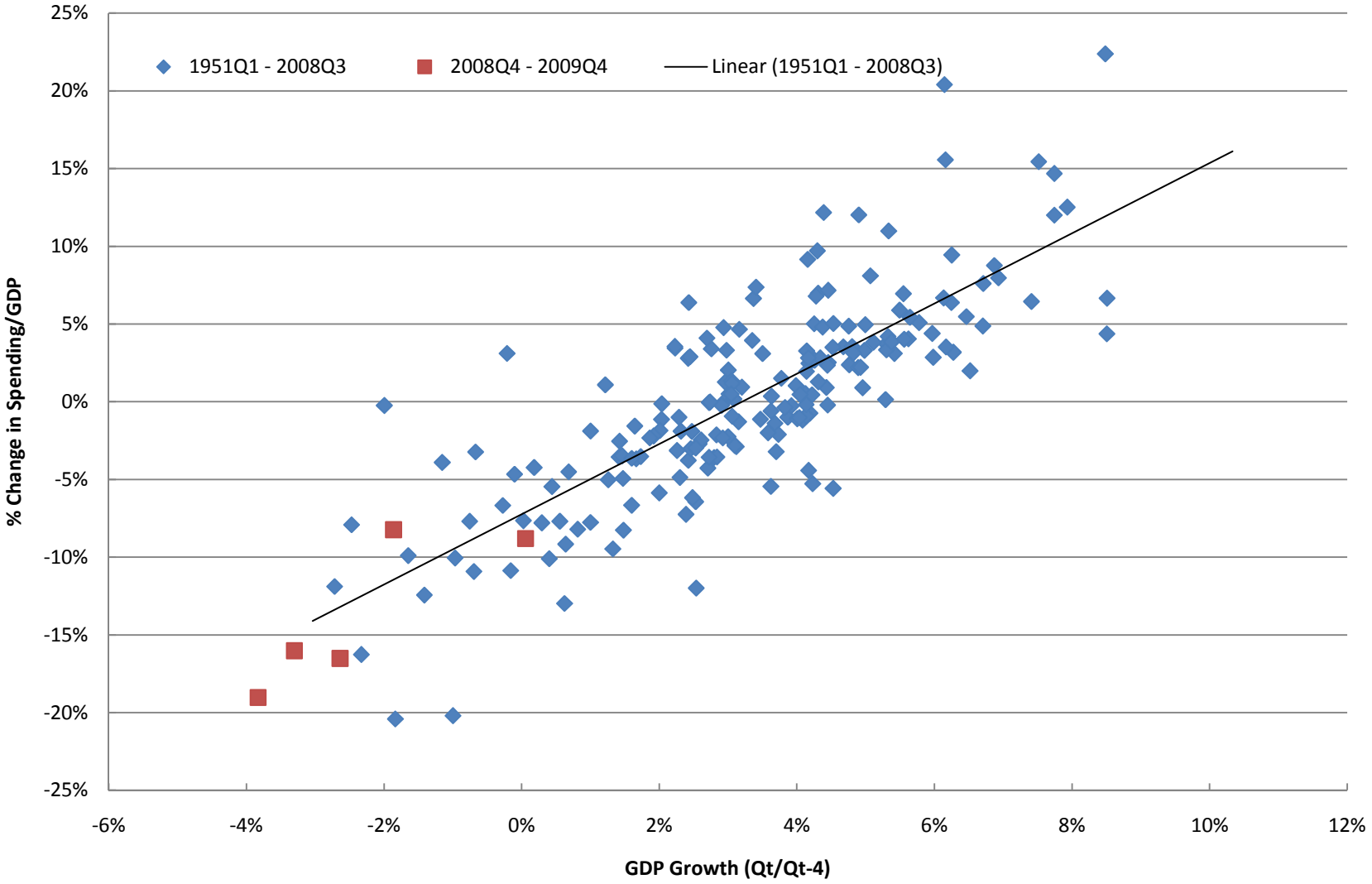
- Inventory dynamics and the inventory intensity of traded goods.
  - Alessandria, Kaboski, and Midrigan (2009, 2010).

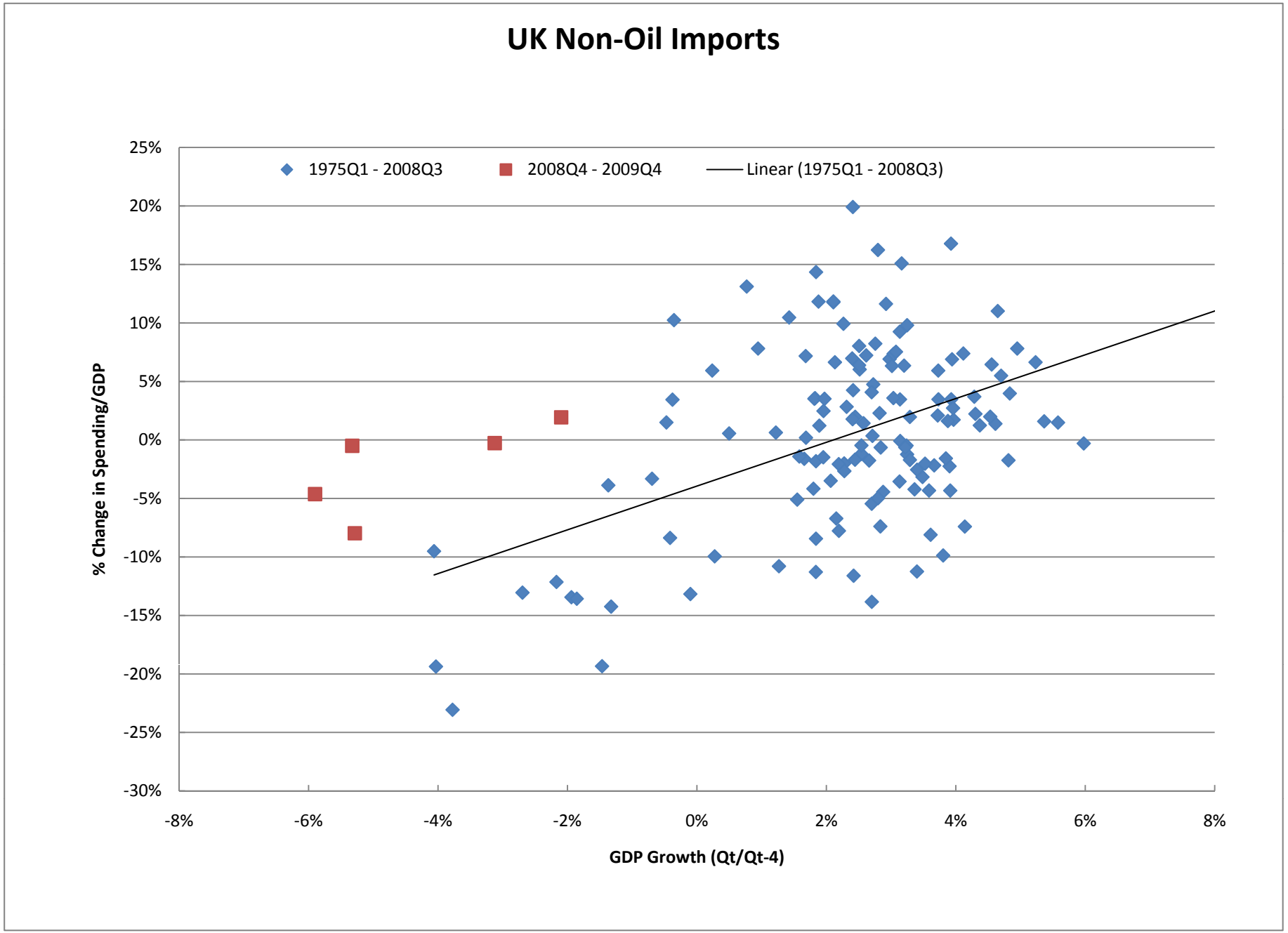
- Hypothesis II: The demand for goods that are most traded goods fell relative to goods that are less traded.
  - Levchenko, Lewis, and Tesar (2009)
  - Bems, Johnson, and Yi (2010)

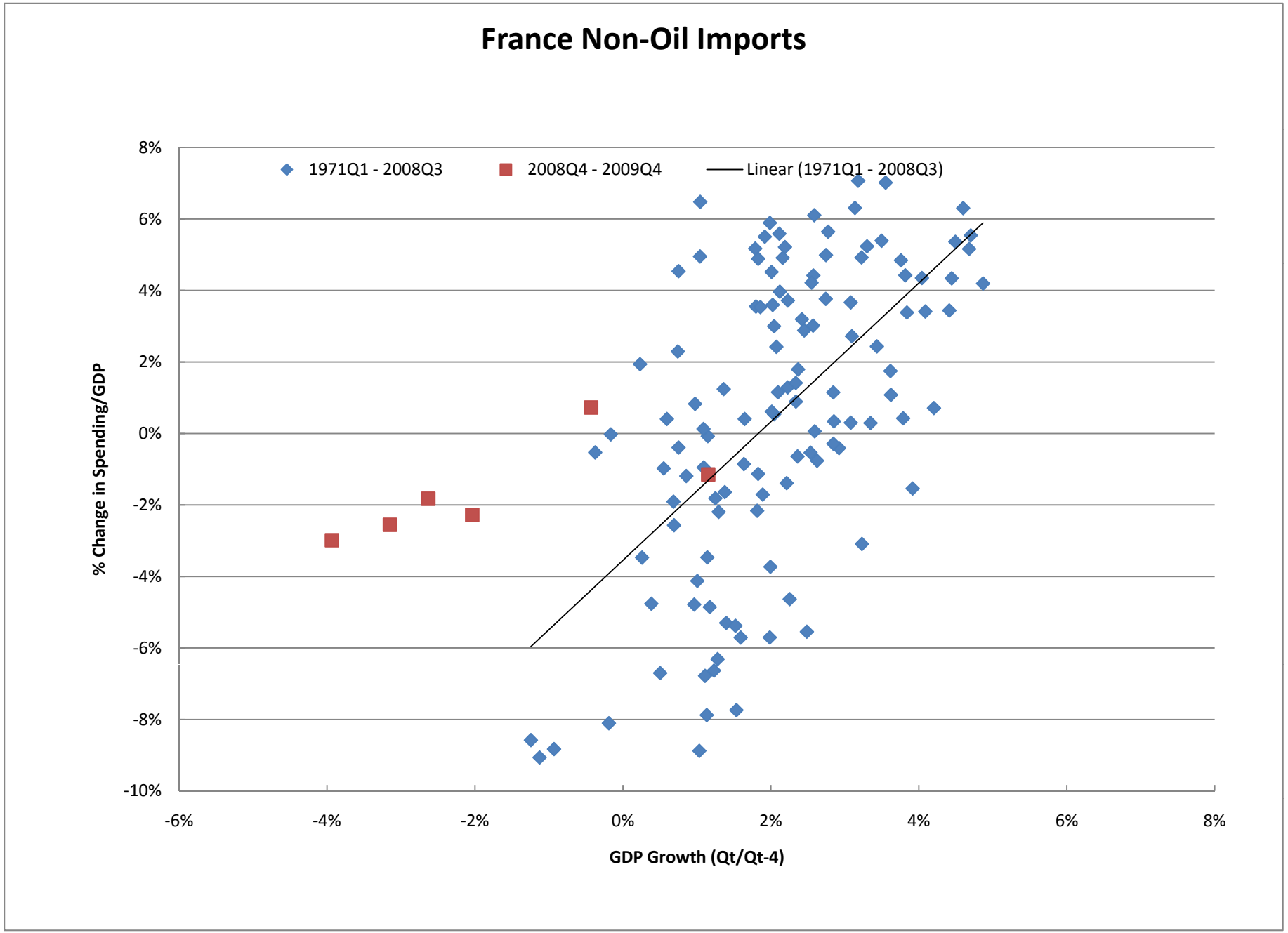
A First Look at Some Numbers

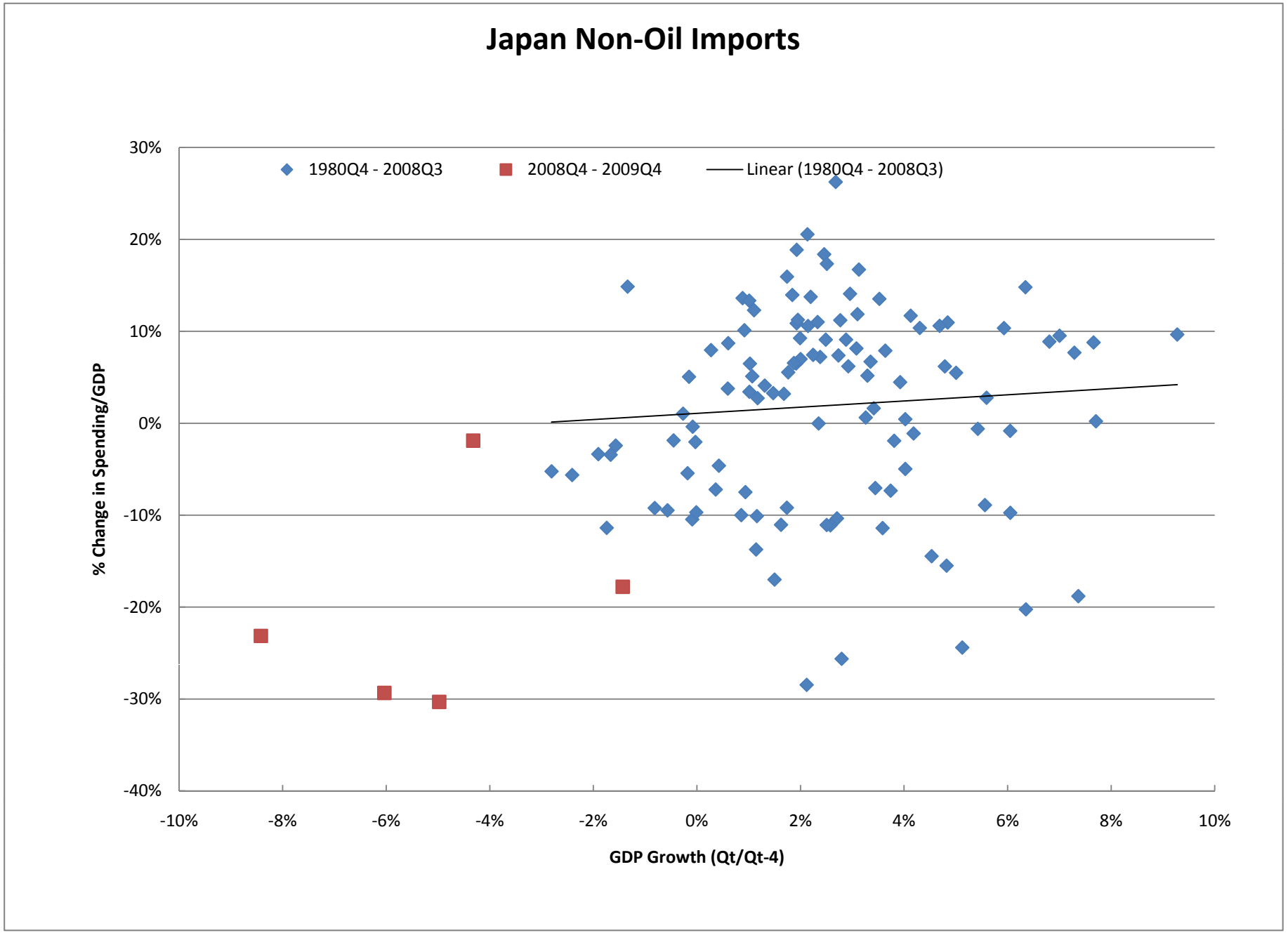
1. Is the Great Recession Special? Annual, quarter to quarter changes in trade/GDP against the growth of GDP

US Non-Oil Imports



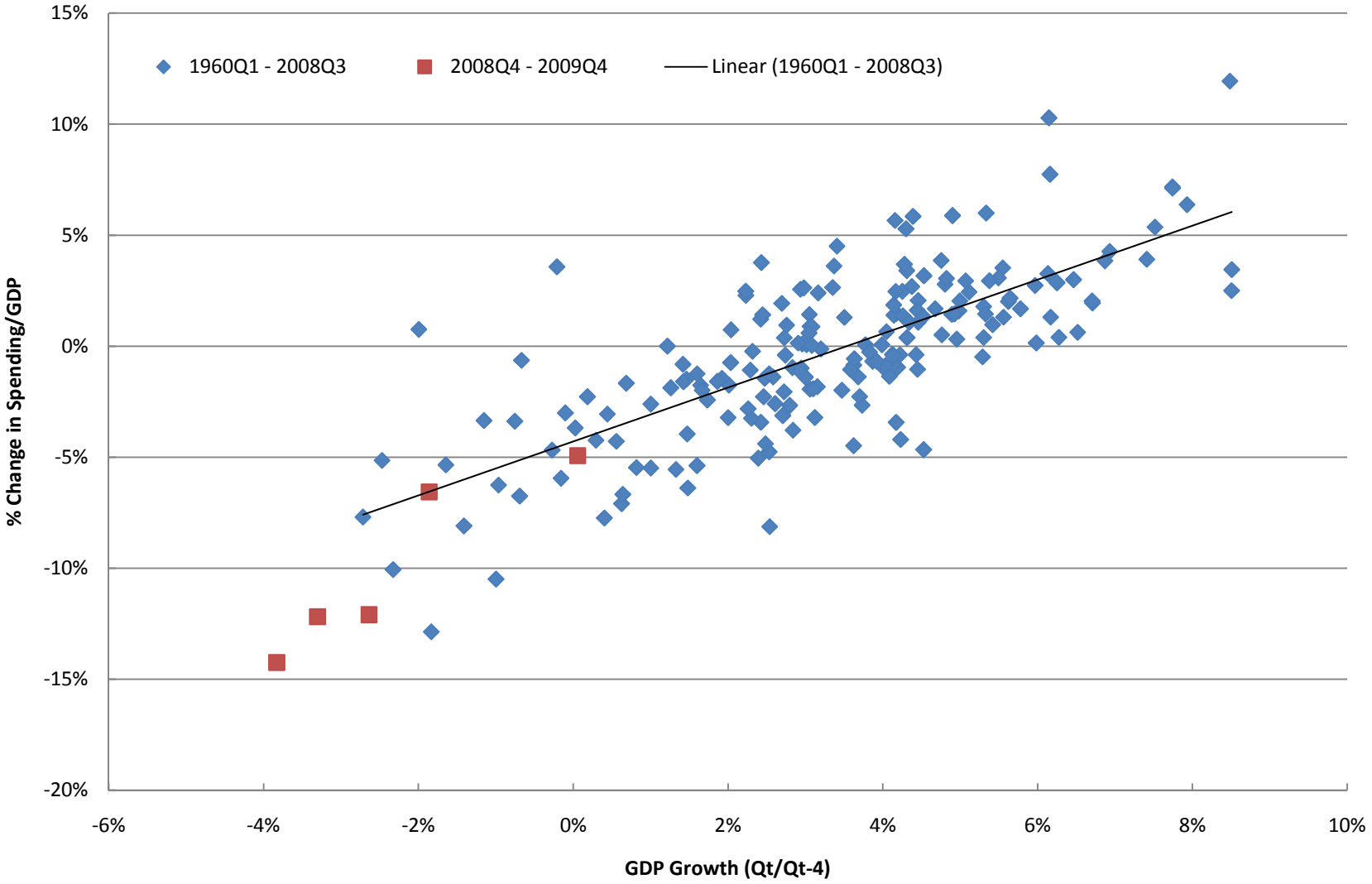

UK Non-Oil Imports
1975Q1 - 2008Q3
2008Q4 - 2009Q4
Linear (1975Q1 - 2008Q3)
% Change in Spending/GDP
25%
20%
15%
10%
5%
0%
-5%
-10%
-15%
-20%
-25%
-30%
-8%
-6%
-4%
-2%
0%
2%
4%
6%
8%
GDP Growth (Qt/Qt-4)

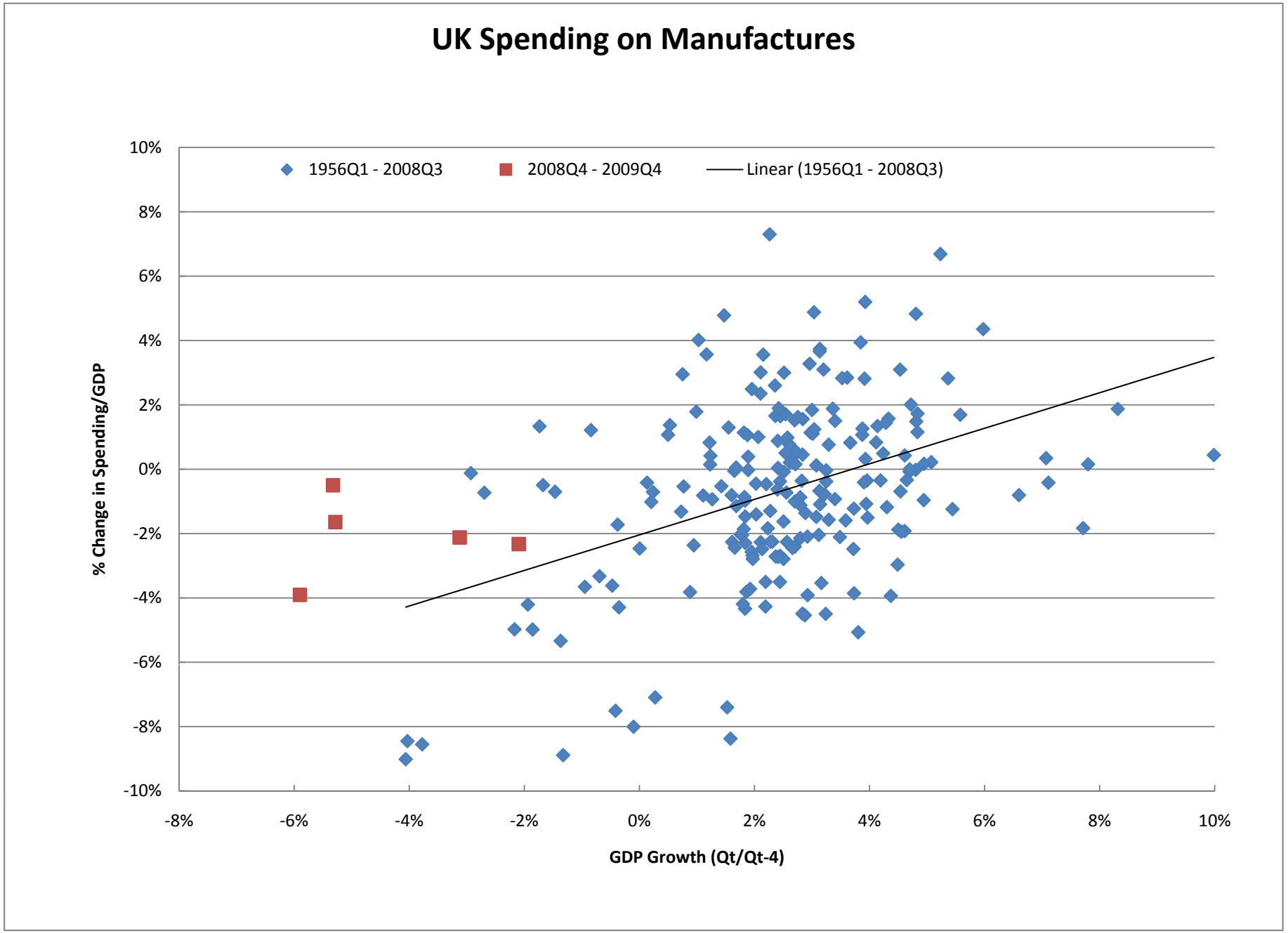

France Non-Oil Imports
1971Q1 - 2008Q3
2008Q4 - 2009Q4
Linear (1971Q1 - 2008Q3)
% Change in Spending/GDP
GDP Growth (Qt/Qt-4)
8%
6%
4%
2%
0%
-2%
-4%
-6%
-8%
-10%
-6%
-4%
-2%
0%
2%
4%
6%
8%

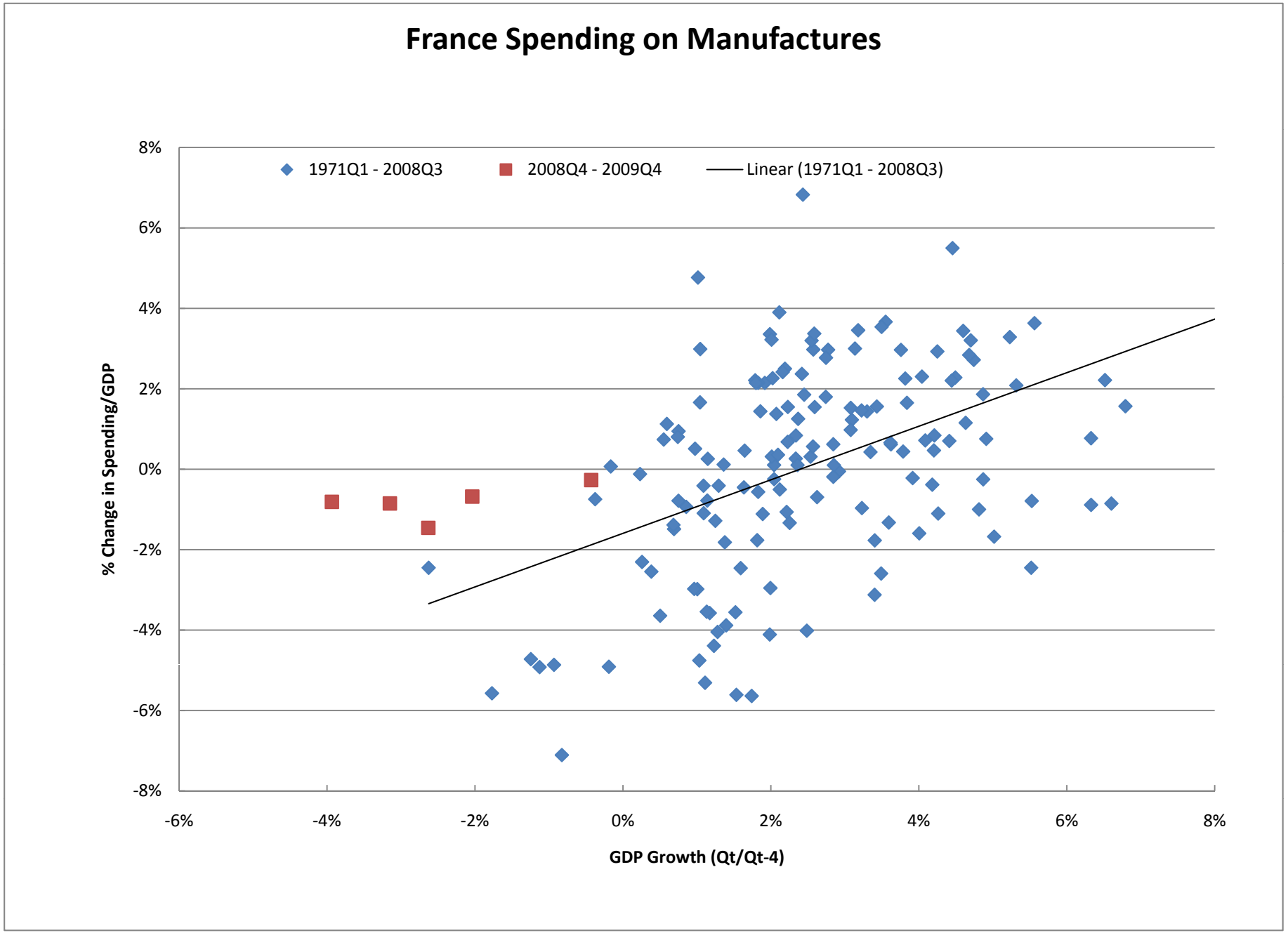

Japan Non-Oil Imports
1980Q4 - 2008Q3
2008Q4 - 2009Q4
Linear (1980Q4 - 2008Q3)
30%
20%
10%
0%
-10%
-20%
-30%
-40%
% Change in Spending/GDP
-10%
-8%
-6%
-4%
-2%
0%
2%
4%
6%
8%
10%
GDP Growth (Qt/Qt-4)

2. What happens to manufacturing?

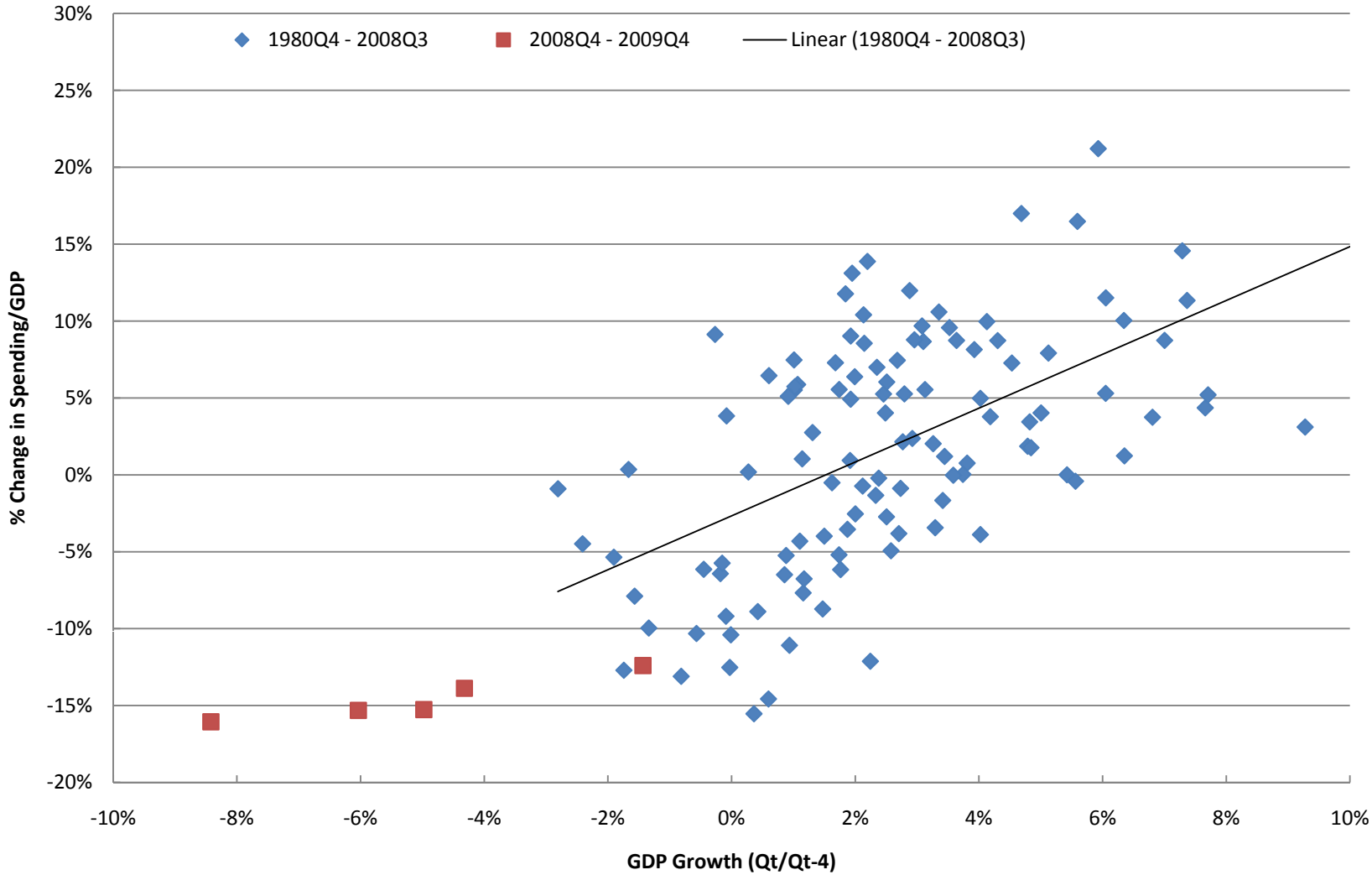
US Spending on Manufactures




UK Spending on Manufactures
1956Q1 - 2008Q3
2008Q4 - 2009Q4
Linear (1956Q1 - 2008Q3)
% Change in Spending/GDP
GDP Growth (Qt/Qt-4)
10%
8%
6%
4%
2%
0%
-2%
-4%
-6%
-8%
-10%
-8%
-6%
-4%
-2%
0%
2%
4%
6%
8%
10%


France Spending on Manufactures
1971Q1 - 2008Q3
2008Q4 - 2009Q4
Linear (1971Q1 - 2008Q3)
% Change in Spending/GDP
GDP Growth (Qt/Qt-4)
8%
6%
4%
2%
0%
-2%
-4%
-6%
-8%
-6%
-4%
-2%
0%
2%
4%
6%
8%

Japan Spending on Manufactures



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.

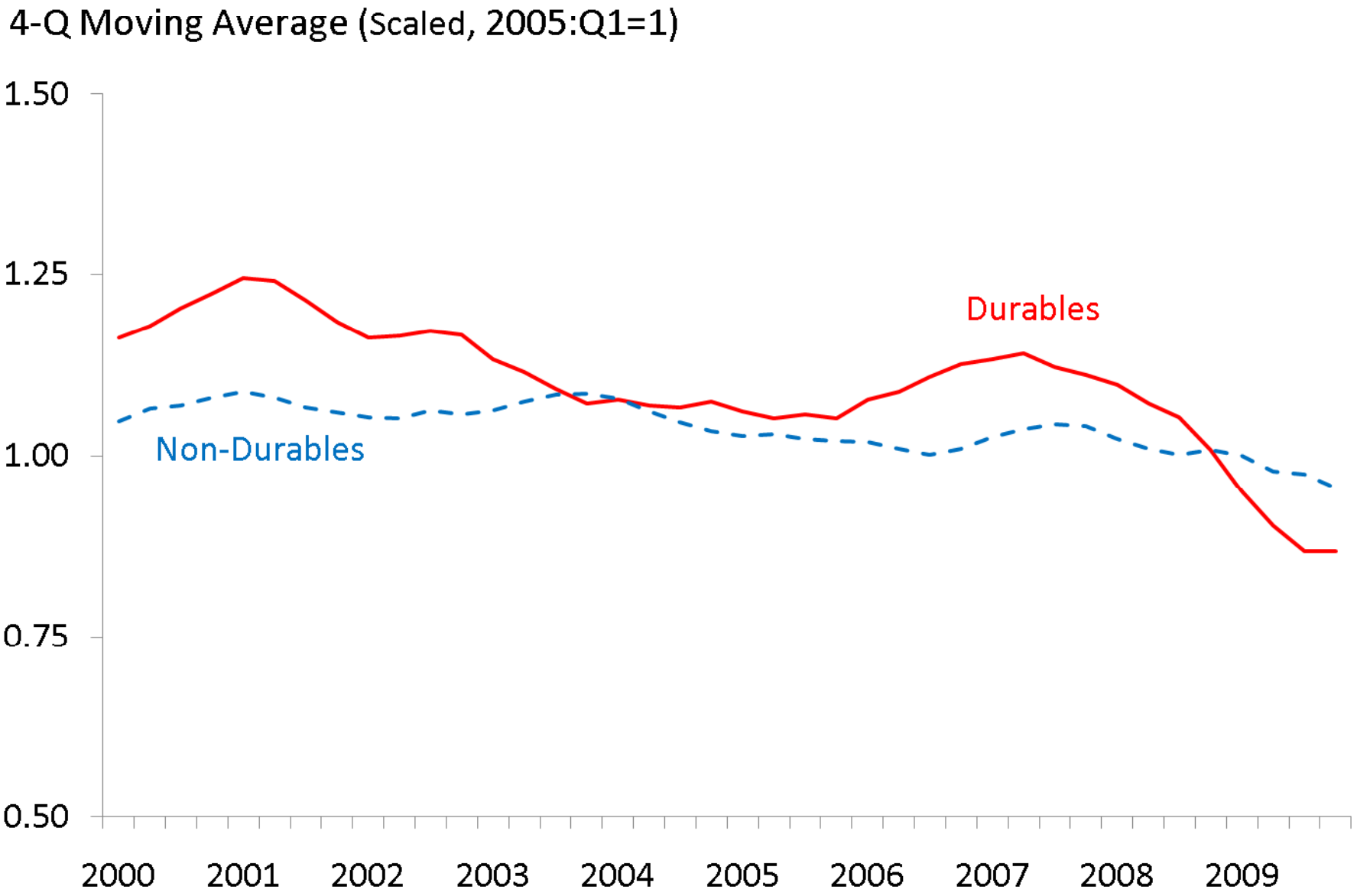
- Apply it to home sales X_{ii} with $\tau_{ii} = 1$.

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

$$\Theta_{ni} = \left(\frac{X_{ni}}{X_{nn}} \frac{X_{in}}{X_{ii}} \right)^{1/2} = [\tau_{ni}\tau_{in}]^{-1^j/2} .$$

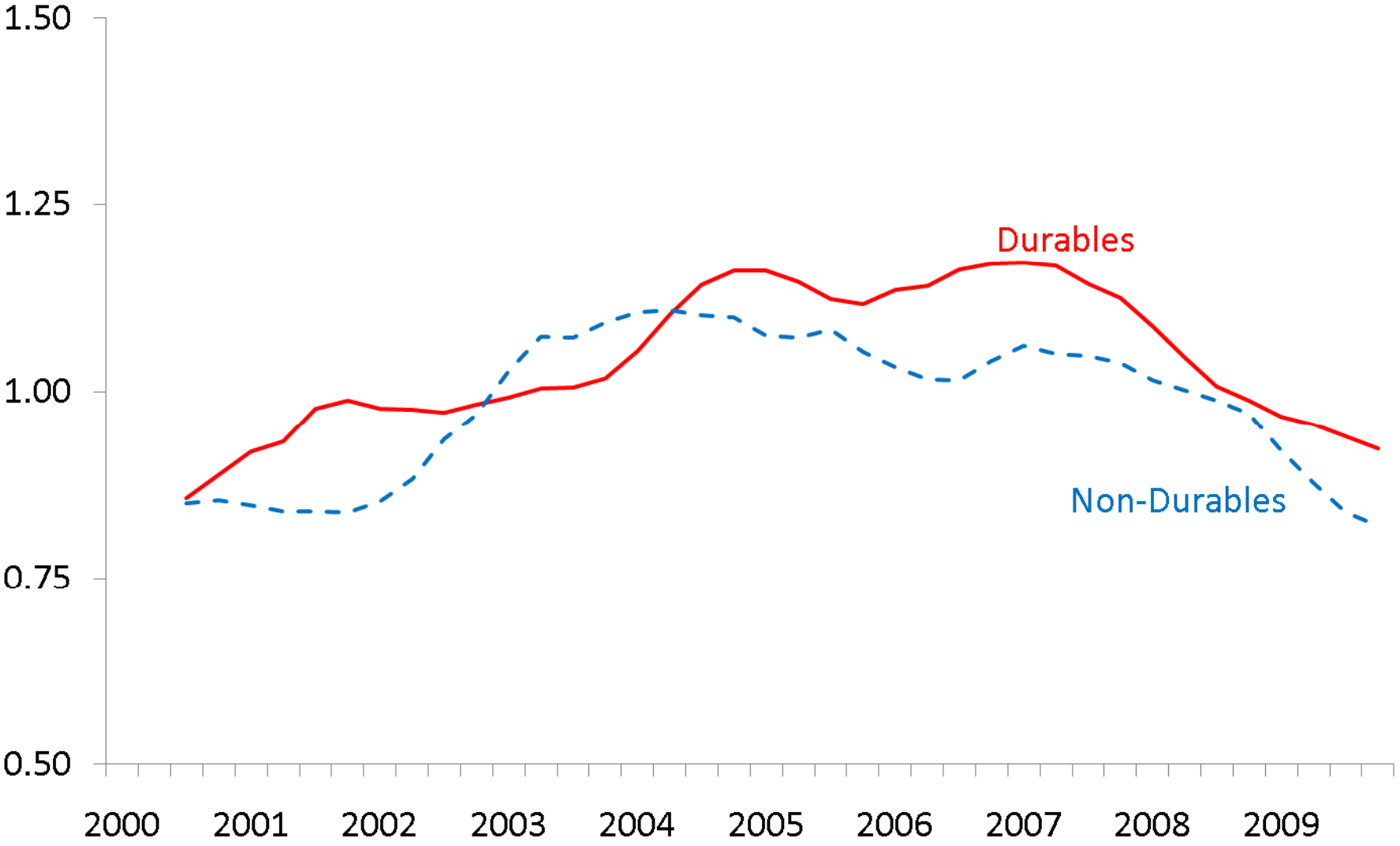
- We show it for durable manufactures and nondurable manufactures.

Head-Ries Indices for Trade Between U.S. and Japan



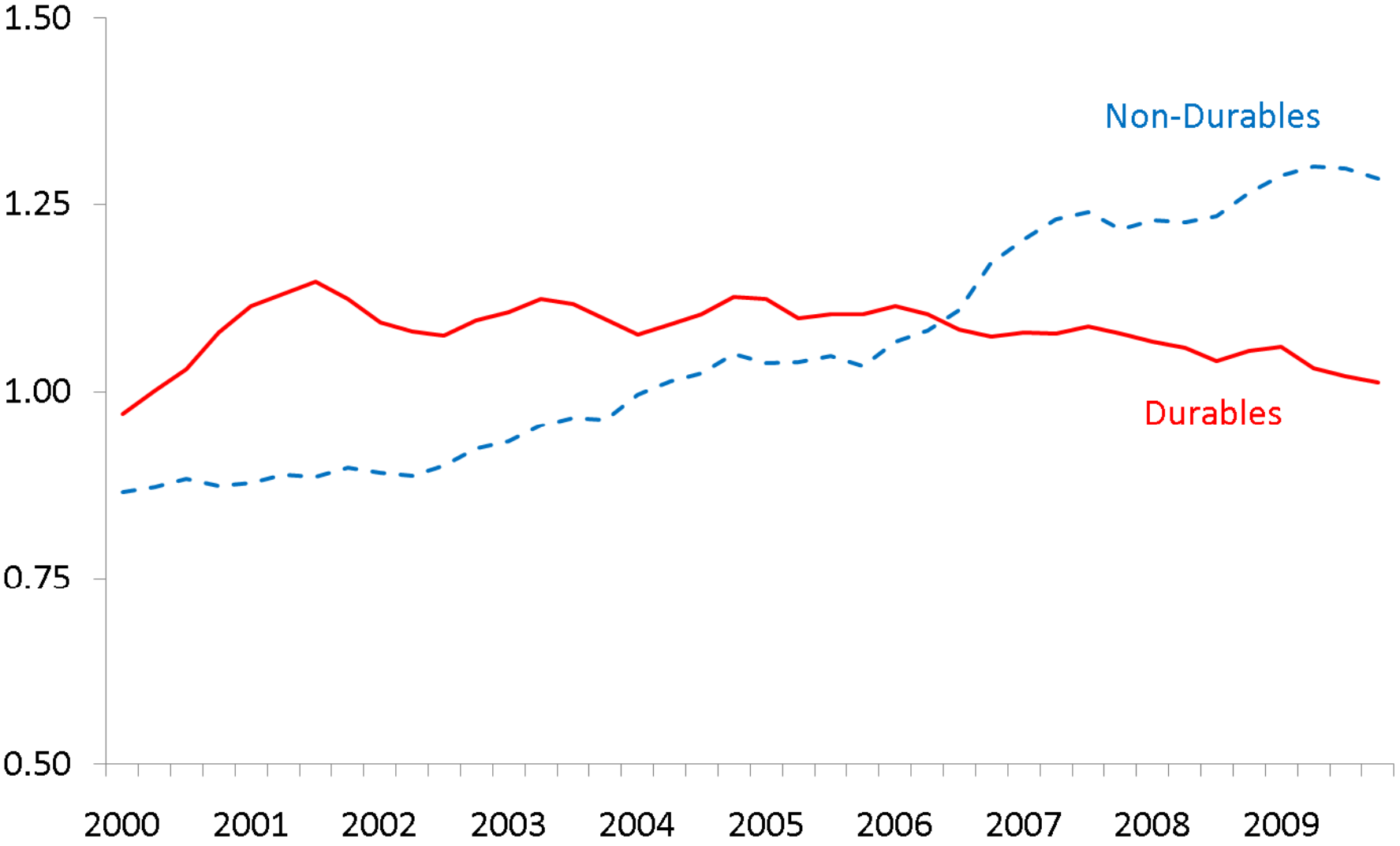
Head-Ries Indices for Trade Between U.S. and China

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



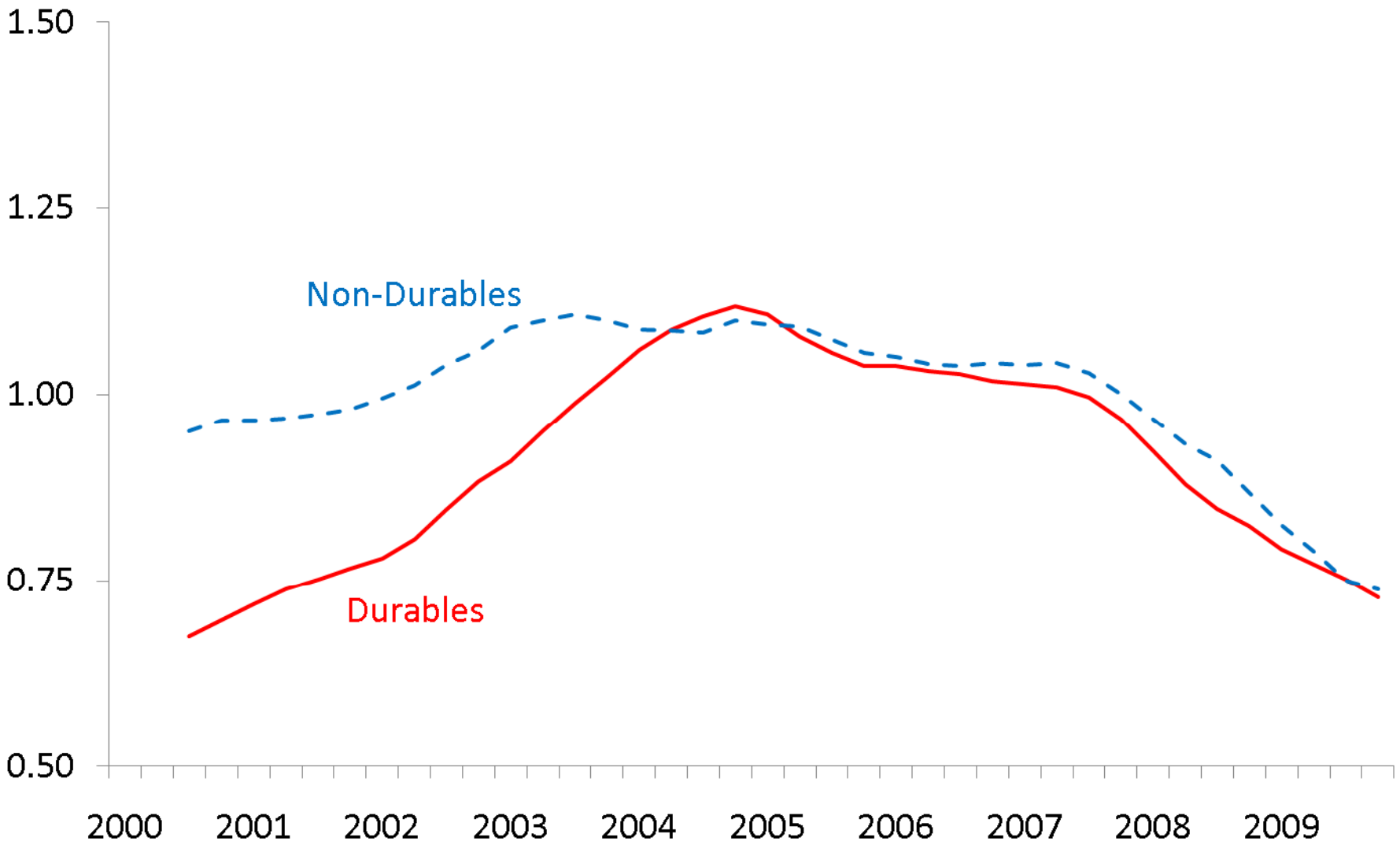
Head-Ries Indices for Trade Between U.S. and Germany

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



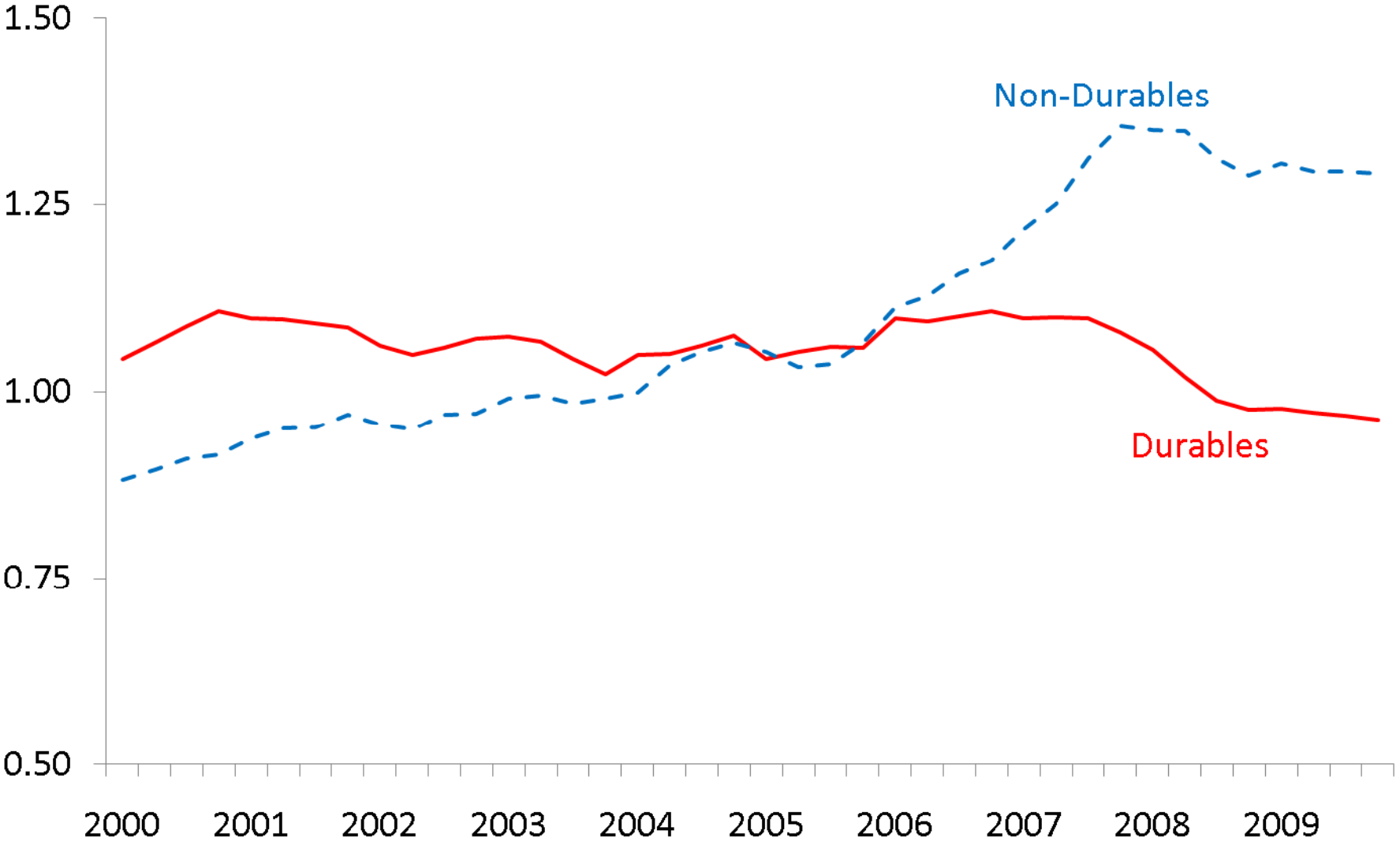
Head-Ries Indices for Trade Between Japan and China

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



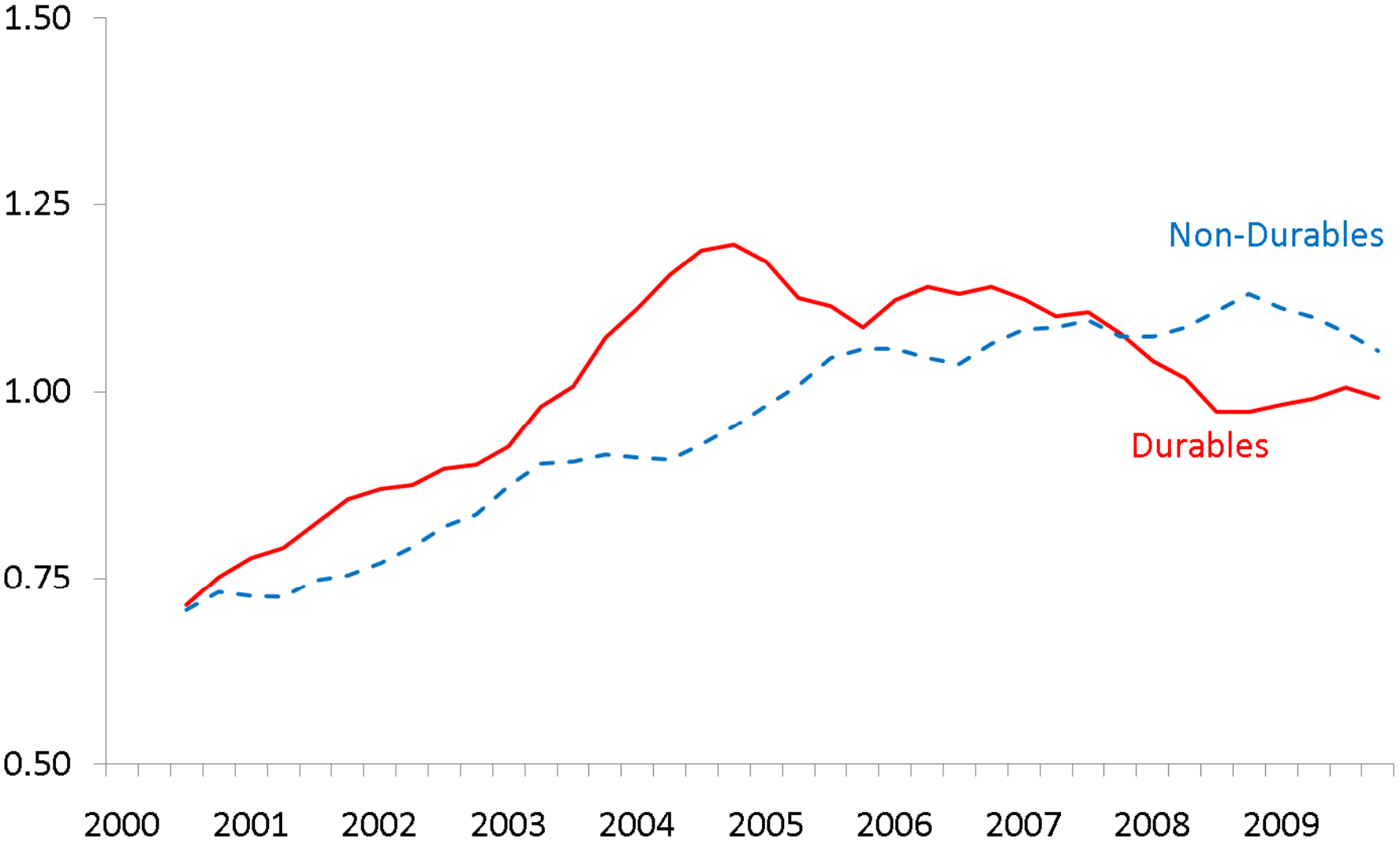
Head-Ries Indices for Trade Between Japan and Germany

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_i^j: country i's gross production in sector $j \in \Omega$.
- X_i^j: country i's gross absorption of j
- $D_i^j = X_i^j - Y_i^j$: country i's deficit in sector j.
- D_i: country i's overall deficit:

$$D_i = \sum_{j \in \Omega} D_i^j,$$

- For each $j \in \Omega$,

$$\sum_{i=1}^{I} D_i^j = 0.$$

- Y_i: country i 's GDP.
- $X_i = Y_i + D_i$: country i 's aggregate final spending .
- β_i^j: country i's value-added share in industry j.
- GDP is the sum of sectoral value added:

$$Y_i = \sum_{j \in \Omega} \beta_i^j Y_i^j.$$

- All factors called labor, perfectly mobile across sectors:

$$Y_i = \sum_{j \in \Omega} w_i L_i^j = w_i L_i.$$

- α_i^j: country i 's share of sector j purchases in aggregate final demand.

- γ_i^{lj}: country i's share of sector j in intermediate demand by sector l.

- β, α, γ are Cobb-Douglas parameters treated as constant across time but allowed to differ across countries.

- Total demand for sector j in country i:

$$X_i^j = \alpha_i^j X_i + \sum_{l \in \Omega} \gamma_i^{lj} (1 - \beta_i^l) Y_i^l.$$

Fold Services into Manufactures

$$c_i^j = \frac{1}{A_i^{jS}} w_i^{\widetilde{\beta}_i^j} \prod_{l \in \Omega_M} \left(p_i^l\right)^{\widetilde{\gamma}_i^{jl}(1-\widetilde{\beta}_i^j)}, \quad j \in \Omega_M$$

where:

$$A_i^{jS} = \left(A_i^S\right)^{\gamma_i^{jS}(1-\beta_i^j)/[1-\gamma_i^{SS}(1-\beta_i^S)]},$$

Input-output parameters become

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

and

$$\widetilde{\gamma}_i^{jl} = \gamma_i^{jl} + \gamma_i^{jS}\frac{\gamma_i^{Sl}(1-\beta_i^S)+\gamma_i^{jl}\beta_i^S}{1-\gamma_i^{SS}(1-\beta_i^S)-\gamma_i^{jS}\beta_i^S}.$$

The Resulting Two-Sector Model

$$X_i^j = \widetilde{\alpha}_i^j(w_i L_i + D_i) - \delta_i^j D_i^S + \sum_{l \in \Omega_M} \widetilde{\gamma}_i^{lj}(1 - \widetilde{\beta}_i^l) Y_i^l, \quad j \in \Omega_M$$

where

$$\delta_i^j = \frac{\gamma_i^{Sj}(1 - \beta_i^S)}{1 - \gamma_i^{SS}(1 - \beta_i^S)},$$

and

$$\widetilde{\alpha}_i^j = \alpha_i^j + \delta_i^j \alpha_i^S.$$

International Trade

$$Y_i^j = \sum_{n=1}^{I} \pi_{ni}^j X_n^j.$$

where π_{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 $i = 1, ..., I$ and, for sectors $j \in \Omega_M$, spending levels X_i^j, price levels p_i^j, and trade shares π_{ni}^j that solve equations the equations above given labor endowments L_i and deficits D_i and D_i^S.

The Shocks

Given the parameters β, γ, and θ we can decompose the change in the trade shares to shocks in four sets of parameters:

1. Final demand α_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:

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

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

$$\hat{p}_n^j = \left(\sum_{i=1}^{I} \pi_{ni}^j \hat{w}_i^{-\theta^j \widetilde{\beta}_i^j} \left(\hat{p}_i^j\right)^{-\theta^j \widetilde{\gamma}_i^{jj}(1-\widetilde{\beta}_i^j)} \left(\hat{p}_i^l\right)^{-\theta^j \widetilde{\gamma}_i^{jl}(1-\widetilde{\beta}_i^j)} \left(\frac{\hat{d}_{ni}^j}{\hat{A}_i^j}\right)^{-\theta^j}\right)^{-1/\theta^j},$$

$$\left(\pi_{ni}^j\right)' = \pi_{ni}^j \hat{w}_i^{-\theta^j \widetilde{\beta}_i^j} \left(\hat{p}_i^j\right)^{-\theta^j \widetilde{\gamma}_i^{jj}(1-\widetilde{\beta}_i^j)} \left(\hat{p}_i^l\right)^{-\theta^j \widetilde{\gamma}_i^{jl}(1-\widetilde{\beta}_i^j)} \left(\frac{\hat{d}_{ni}^j}{\hat{A}_i^j \hat{p}_n^j}\right)^{-\theta^j}.$$

determining $\hat{w}_i$, $(X_i^j)'$, $\hat{p}_i^j$, $\left(\pi_{ni}^j\right)'$ for $i = 1, ..., I$ and $j \in \Omega_M$.

Forcing variables $\left(\widetilde{\alpha}_i^j\right)'$ $\left(D_i^S\right)'$, D_i', $\hat{d}_{ni}^j$, $\hat{A}_i^j$.

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.

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

- Demand Shocks:

$$\boldsymbol{\alpha}_i = \frac{1}{X_i}\left(\mathbf{X}_i - \boldsymbol{\Gamma}_i^T \mathbf{Y}_i\right),$$

  using data on sectoral value added.

- Deficits from data.

- Head-Ries and d_{ni}:

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

  To get directional d_{ni}'s:

$$\left(\hat{d}_{ni}^{j}\right)^{-\theta^{j}} = \frac{\hat{\pi}_{ni}^{j}}{\hat{\pi}_{ii}^{j}} \left(\frac{\hat{p}_{i}^{j}}{\hat{p}_{n}^{j}}\right)^{\theta^{j}}$$

  using trade and price data.

- Calculate:

$$\hat{A}_{i}^{j} = \left(\hat{\pi}_{ii}^{j}\right)^{1/\theta^{j}} \hat{w}_{i}^{\widetilde{\beta}_{i}^{j}} \left(\hat{p}_{i}^{j}\right)^{\widetilde{\gamma}_{i}^{jj}(1-\widetilde{\beta}_{i}^{j})-1} \left(\hat{p}_{i}^{l}\right)^{\widetilde{\gamma}_{i}^{jl}(1-\widetilde{\beta}_{i}^{j})}.$$

The Shocks in the Data

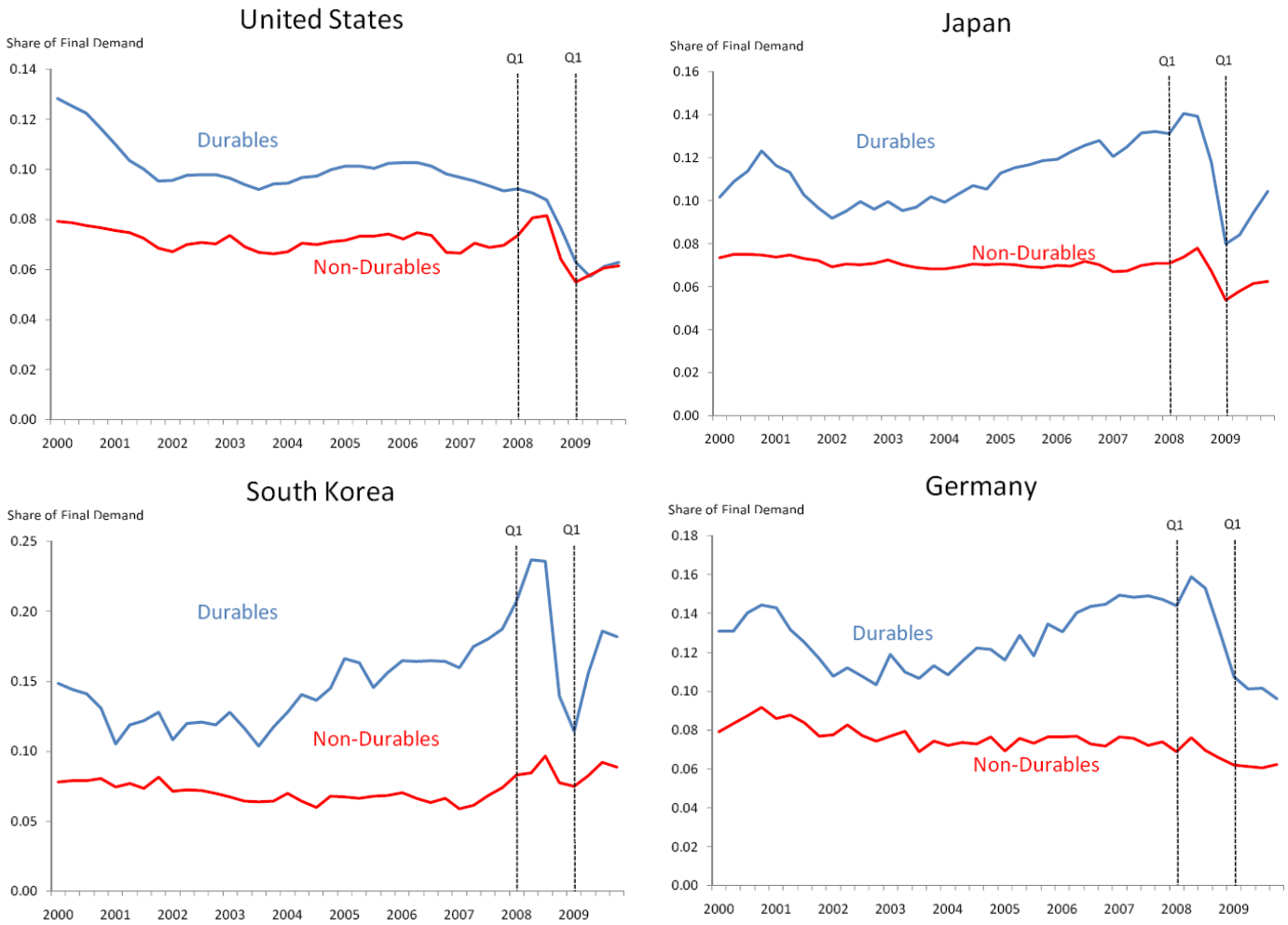


Figure 5: Shares of Manufacturing in Final Demand

Notes: Generated using interpolation procedure with elasticities set to equal one.

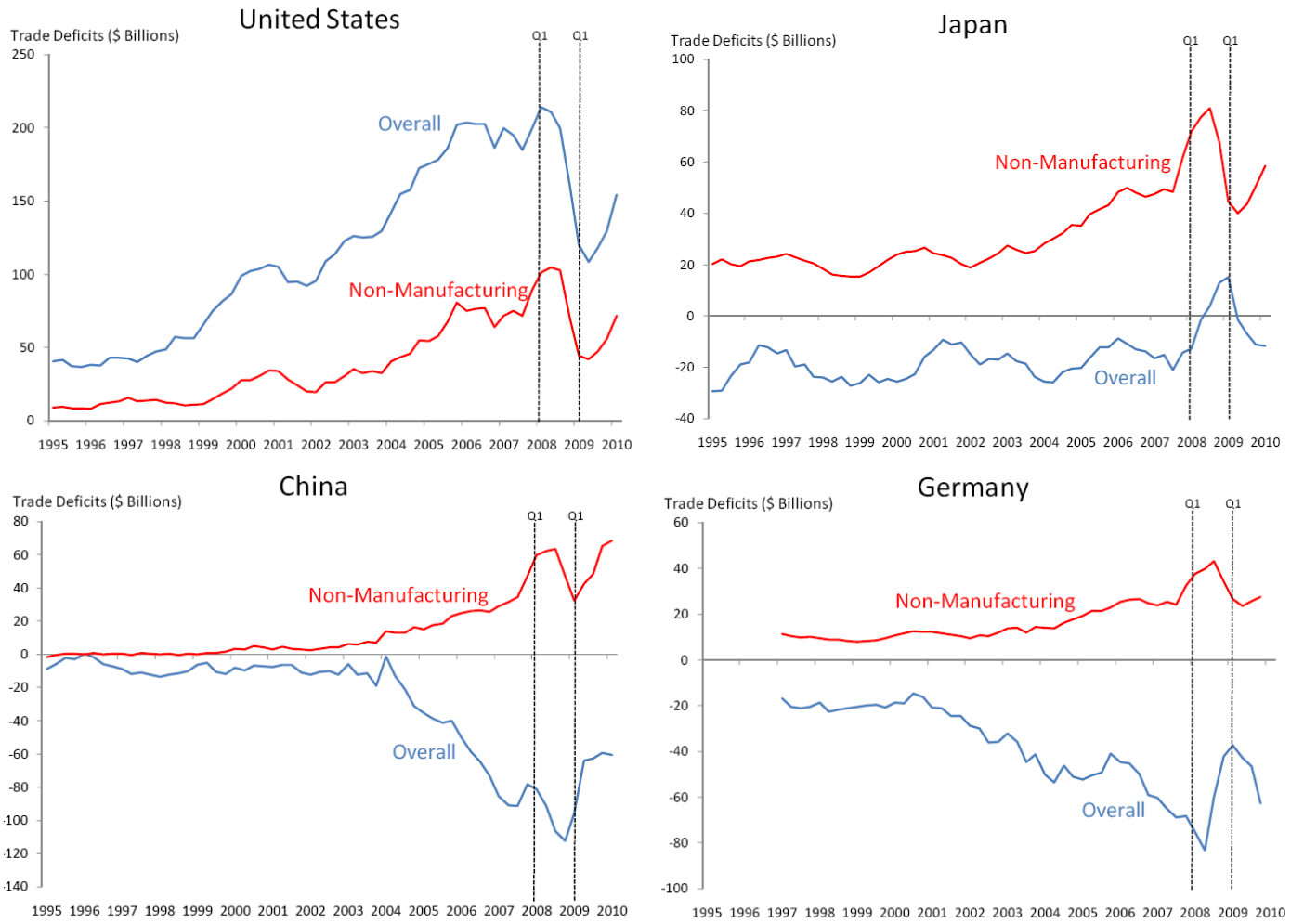


Figure 6: Overall and Non-Manufacturing Trade Deficits

Notes:

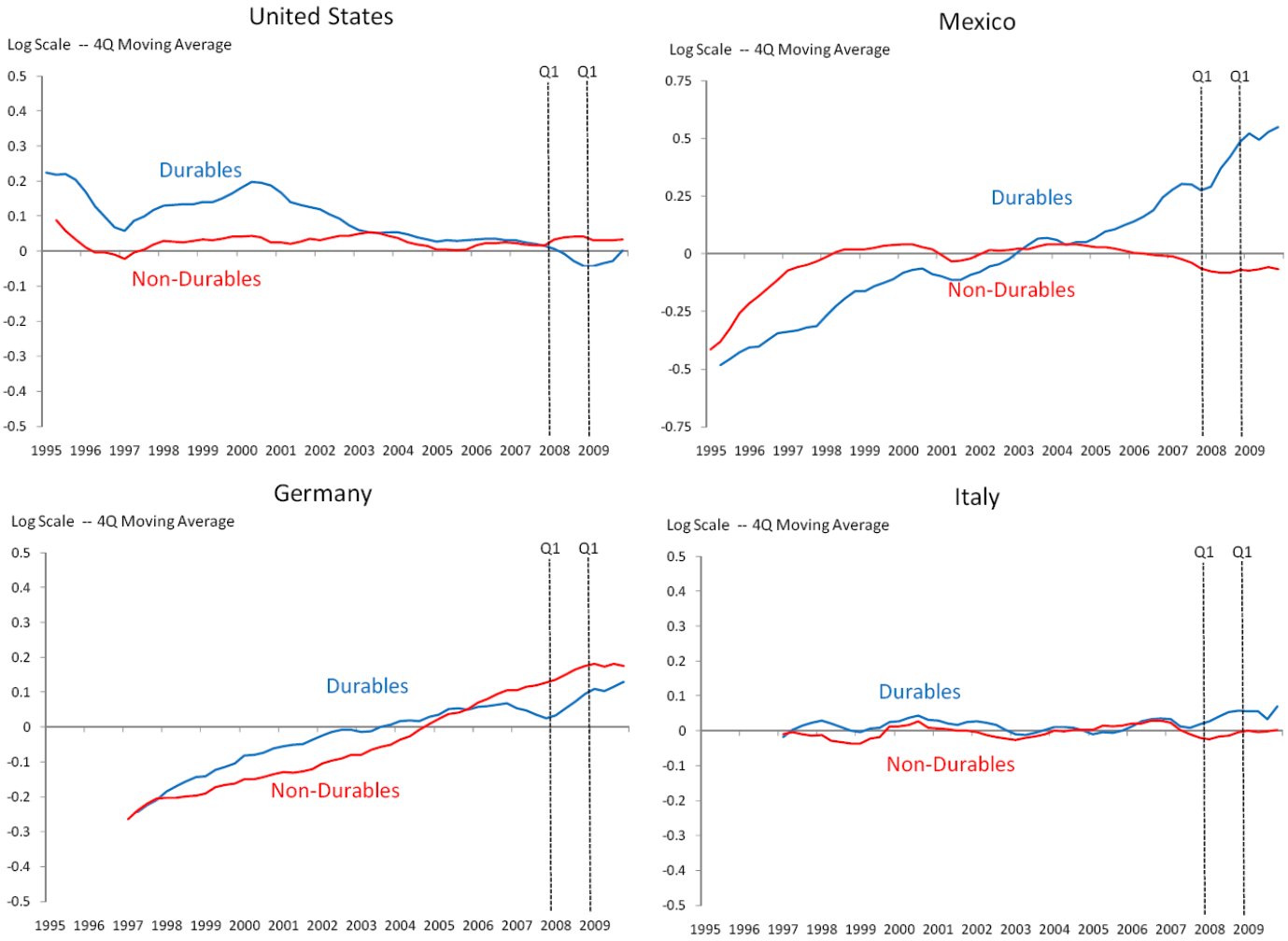


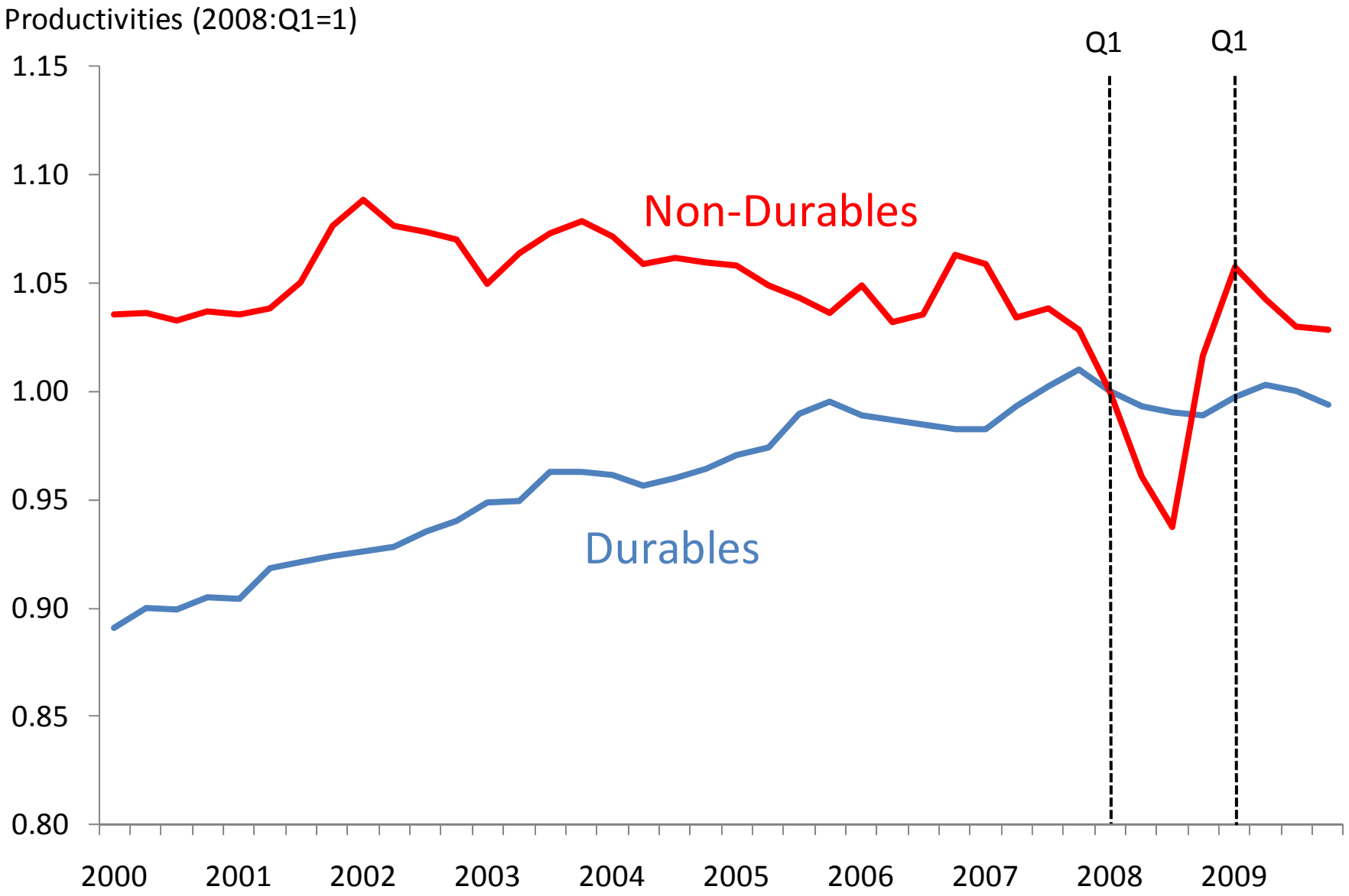
Figure 7: Countries without Large Negative Shock to Trade Frictions

Notes: Generated using interpolation procedure with endogenous elasticites.

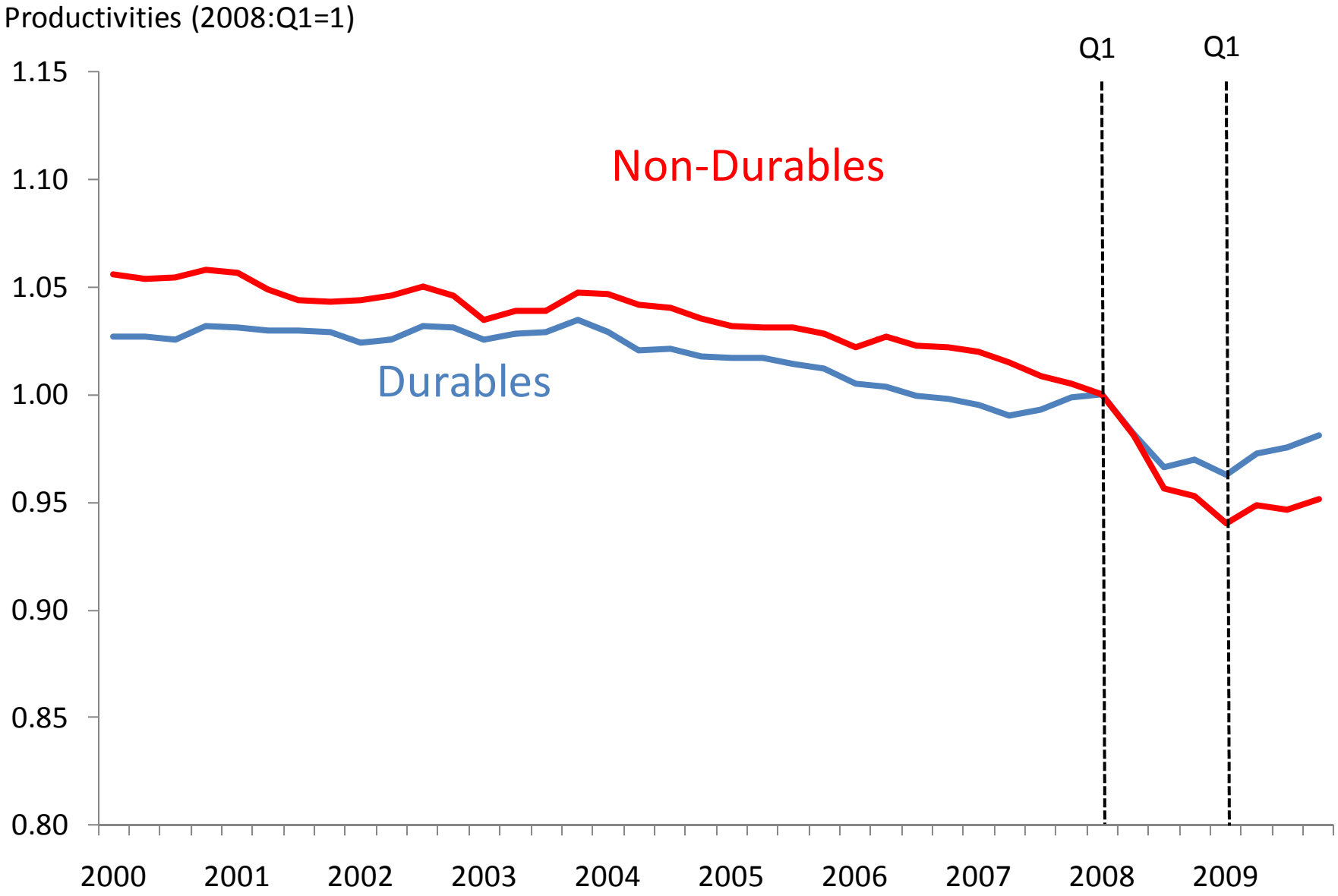
Figure 8: Countries with Large Negative Shock to Trade Frictions

Notes: Generated using interpolation procedure with endogenous elasticites.

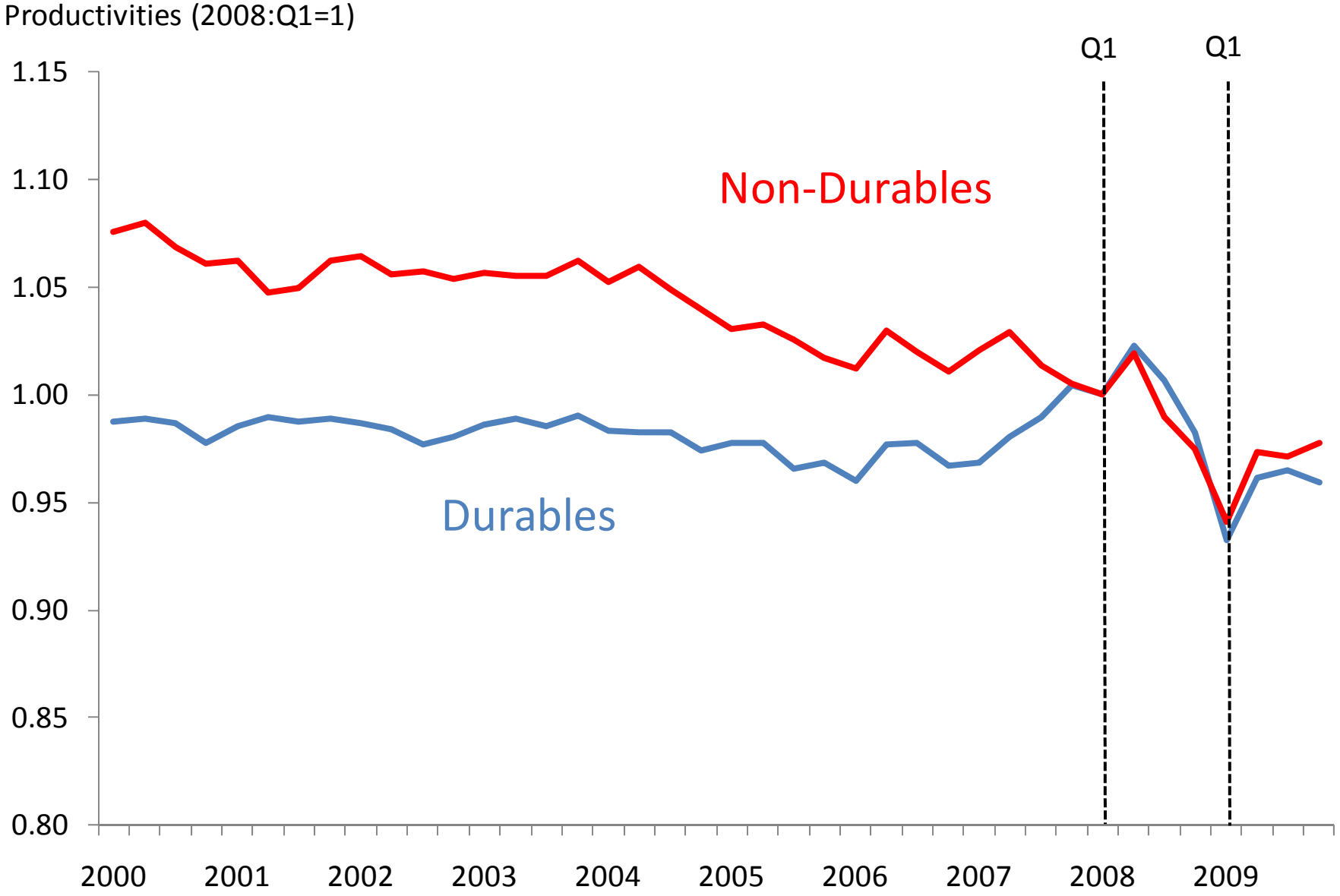
United States



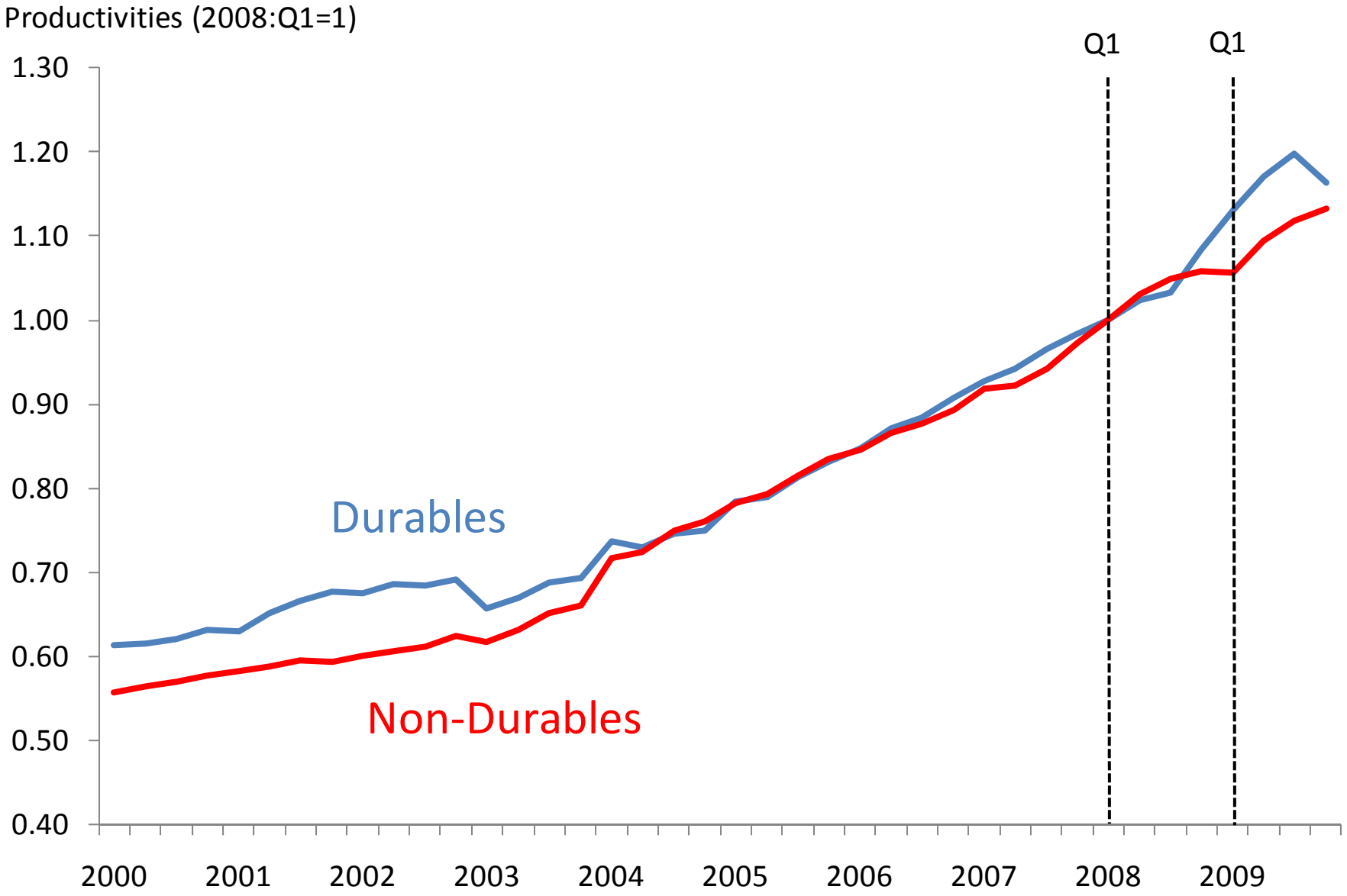
Japan


Productivities (2008:Q1=1)
Q1
Q1
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
Non-Durables
Durables
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009

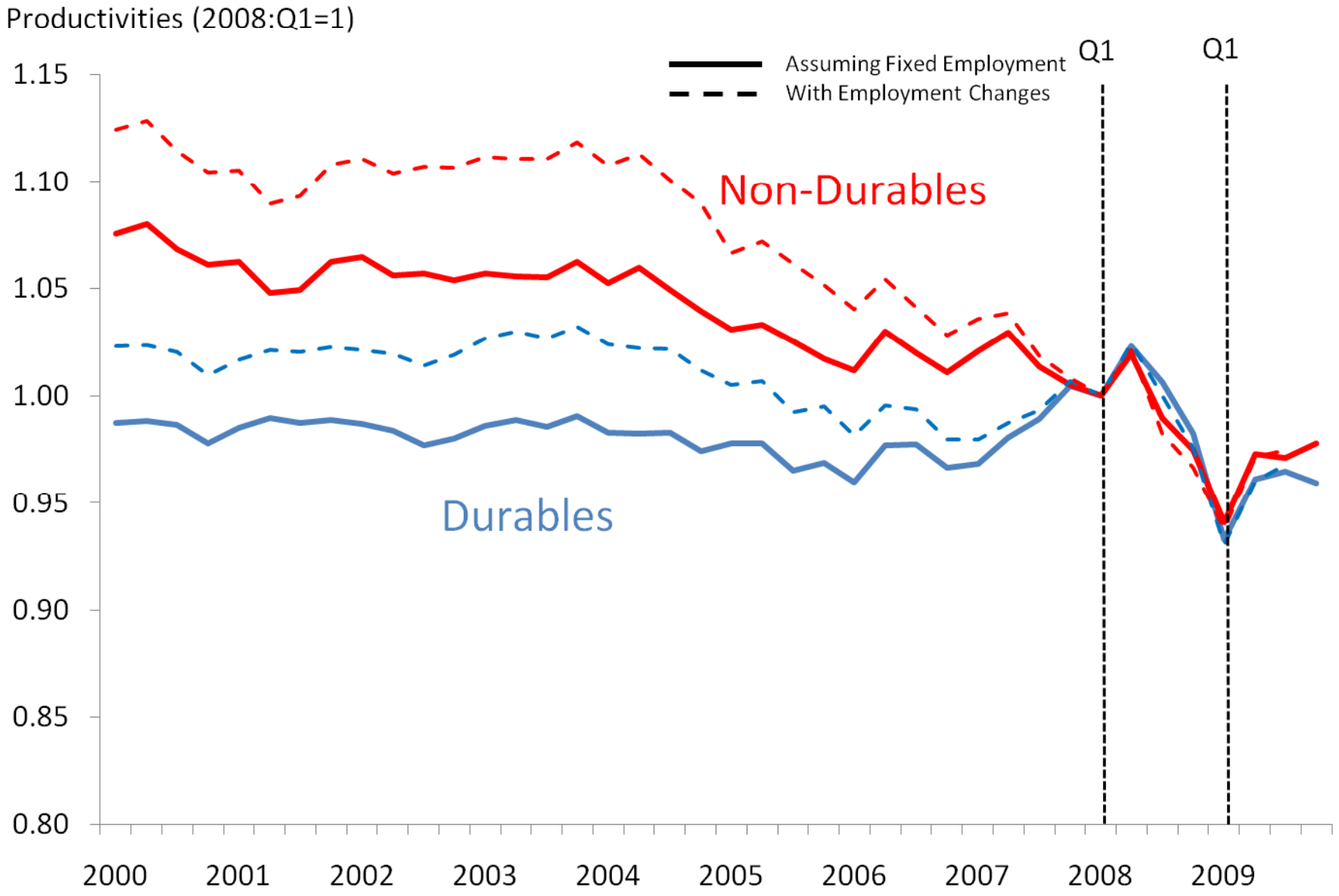
Germany

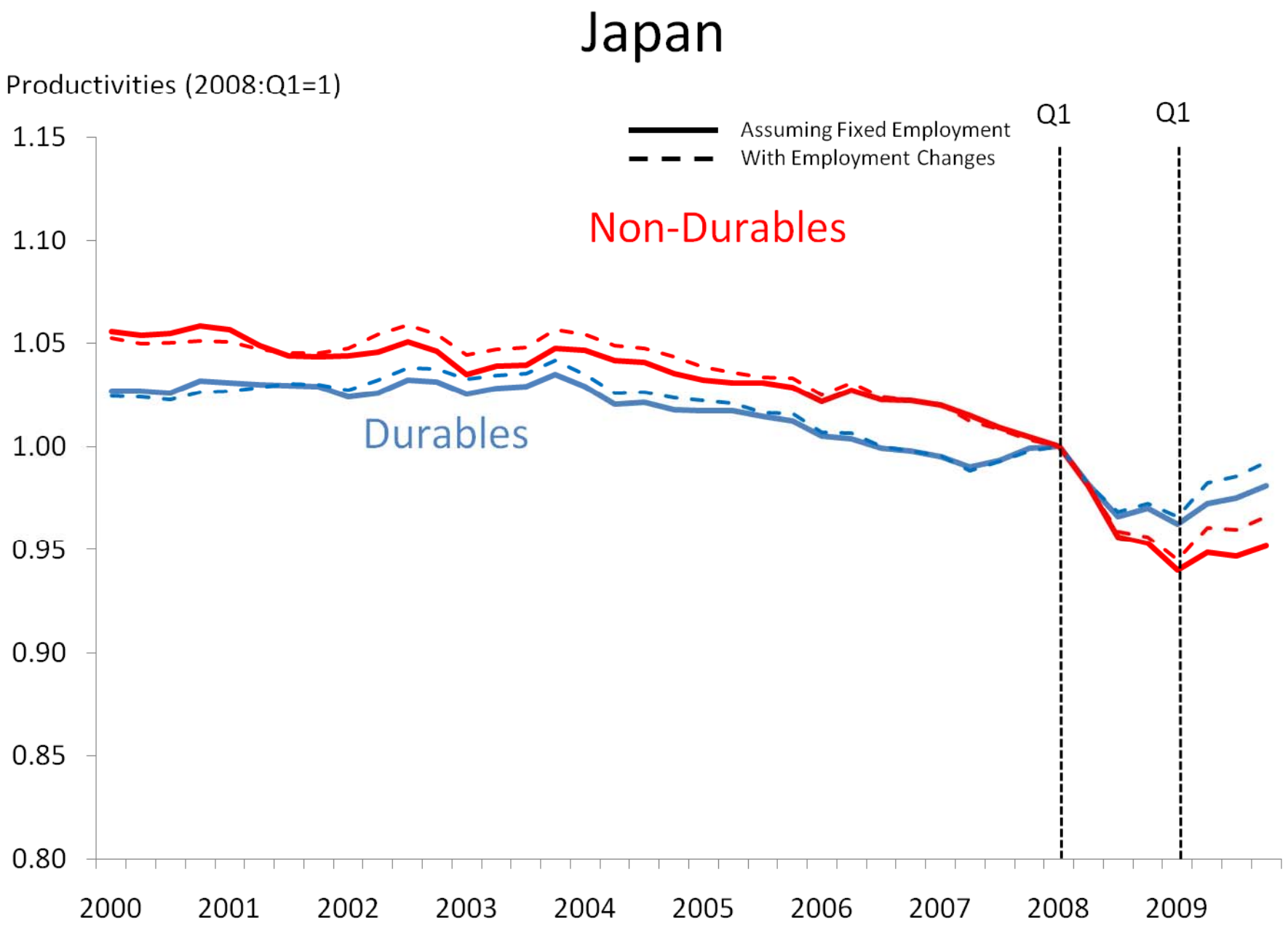

Productivities (2008:Q1=1)
Q1
Q1
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
Non-Durables
Durables
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009

China

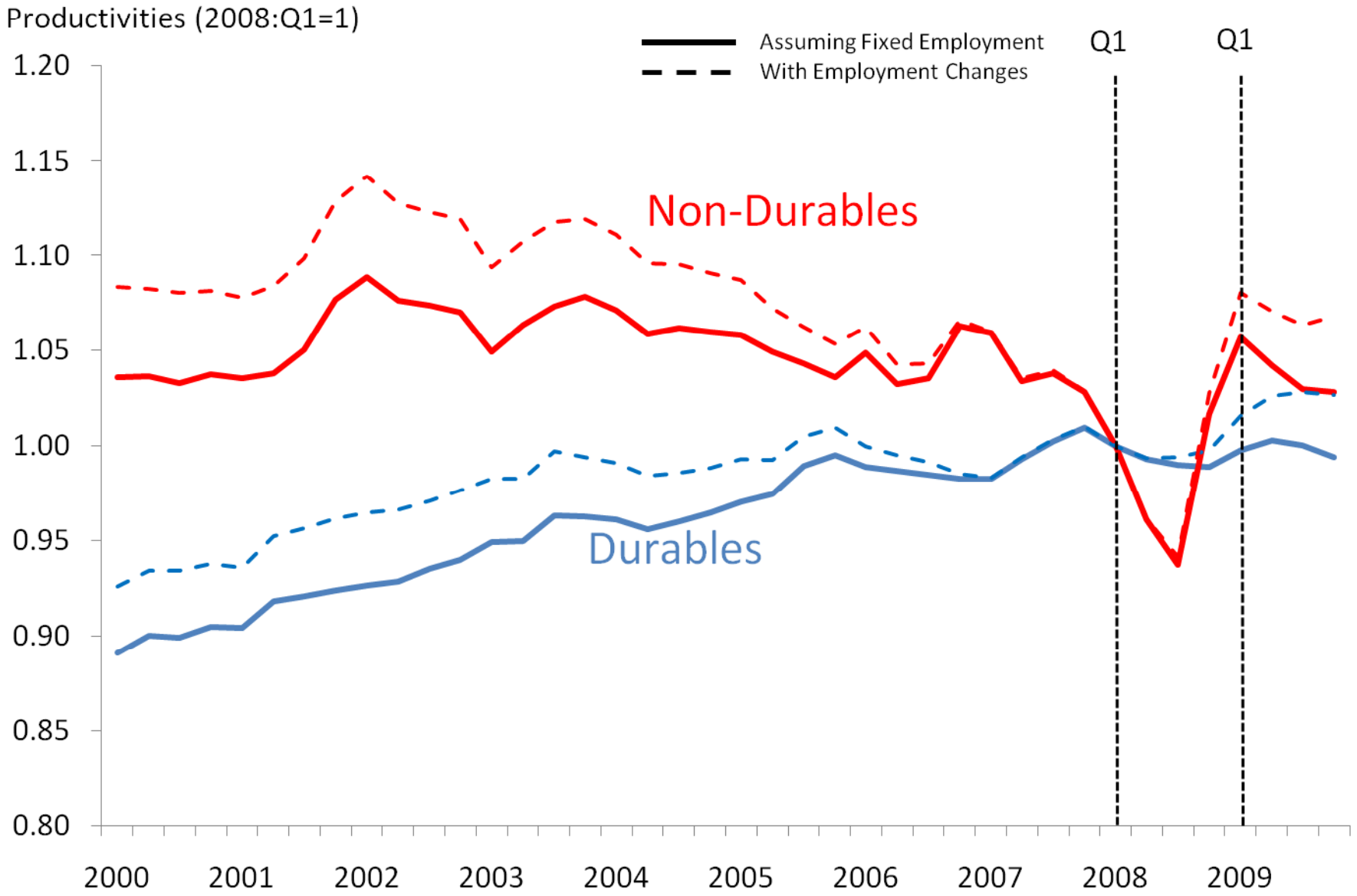

Productivities (2008:Q1=1)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
Q1
Q1
Durables
Non-Durables
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009

Germany


Productivities (2008:Q1=1)
Assuming Fixed Employment
With Employment Changes
Q1
Q1
Non-Durables
Durables
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009


Japan
Productivities (2008:Q1=1)
Assuming Fixed Employment
With Employment Changes
Q1
Q1
Non-Durables
Durables
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009

United States



Counterfactuals

- Set of all shocks:

$$\Xi' = \left\{ \left\{ \widehat{\alpha}_i^D \right\}, \left\{ \widehat{\alpha}_i^N \right\}, \left\{ \widehat{D}_i \right\}, \left\{ \widehat{D}_i^S \right\}, \left\{ \widehat{d}_{ni}^D \right\}, \left\{ \widehat{d}_{ni}^N \right\}, \left\{ \widehat{A}_i^D \right\}, \left\{ \widehat{A}_i^S \right\} \right\},$$

  for all countries $i, n \in I$. $\Xi' = \{1\}$ means no change, $\Xi' =$ "$data$" means change as in the data.

Accounting for the changes in trade over 2006-2009

- Annual changes from quarter to quarter 2006:Q1-2007:Q1 through 2008:Q4 to 2009:Q4.

- Feed in different types of shocks individually.

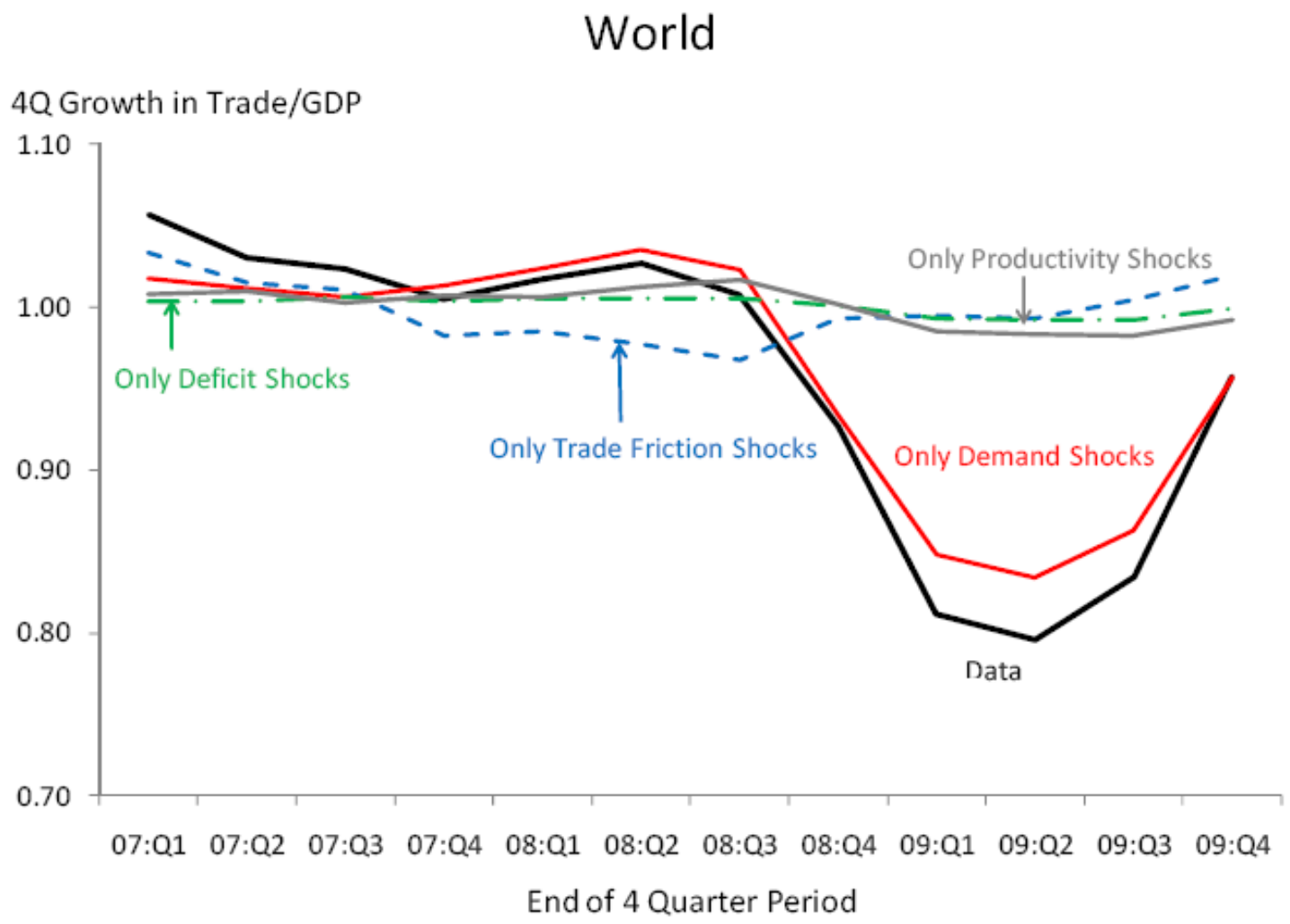


Figure 14: Global Trade/GDP Across Many Four-Quarter Periods in Data and Counterfactuals

Notes:

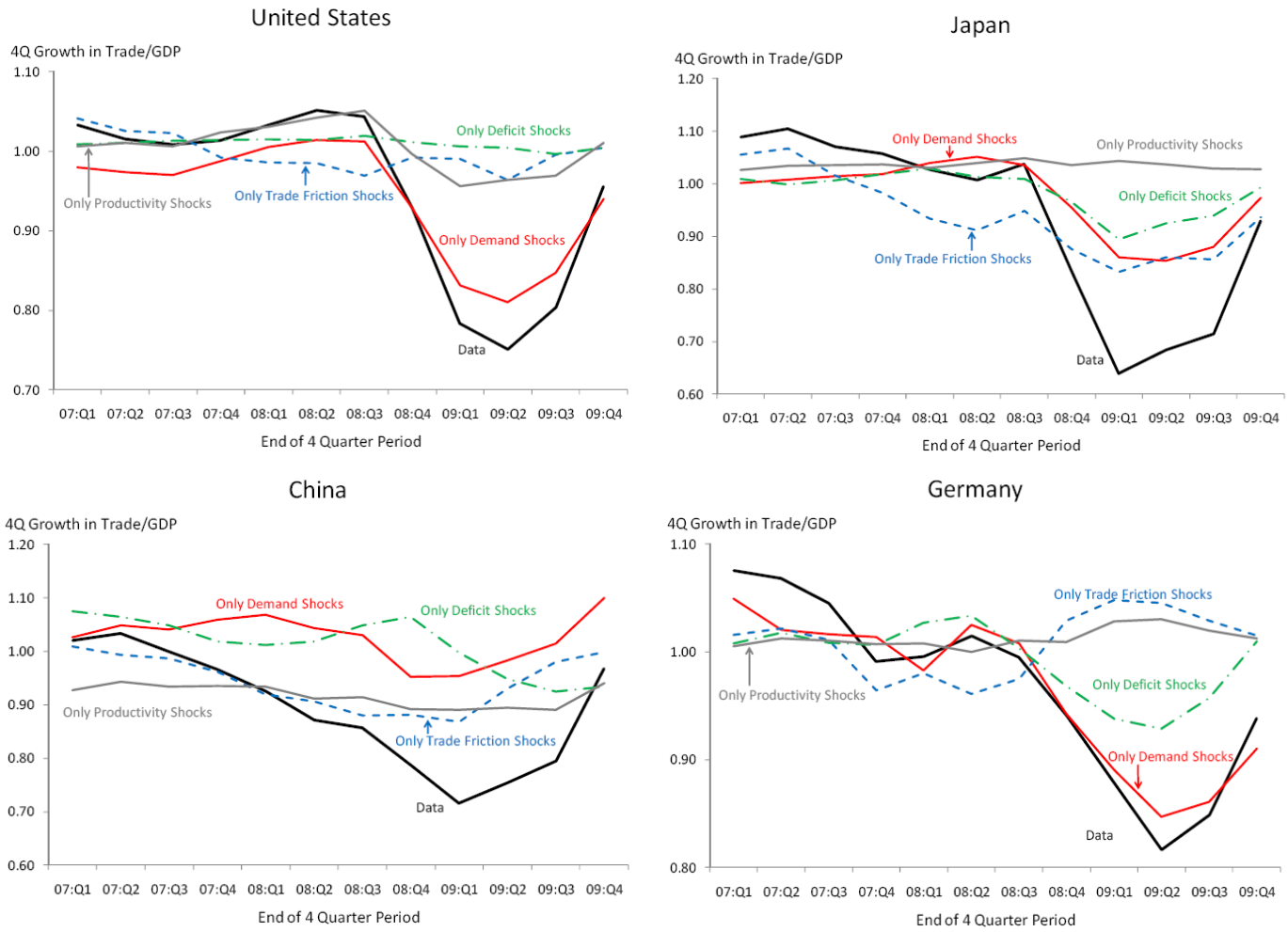


Figure 15: Country Trade/GDP Across Many Four-Quarter Periods in Data and Counterfactuals

Notes: $\theta^D = \theta^N = 2$

- For most countries (e.g., USA and Germany) and the world, α'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 ξ for country i as $\widehat{\xi}_i(\Xi') = \xi_i'/\xi_i^{08Q1}$ to represent its value when the system is solved using the set of shocks Ξ' relative to the value that was observed in the first quarter of 2008.

- Construct:

$$\upsilon\left(\Xi'\right) = \sum_i^I w_i \left(\widehat{\xi}_i\left(\Xi'\right) - \widehat{\xi}_i\left(\Xi^{09Q1}\right)\right)^2.$$

- Define:

$$\mathbb{V}\left(\Xi'\right) = 1 - \frac{\upsilon\left(\Xi'\right)}{\upsilon\left(\Xi^{08Q1}\right)}.$$

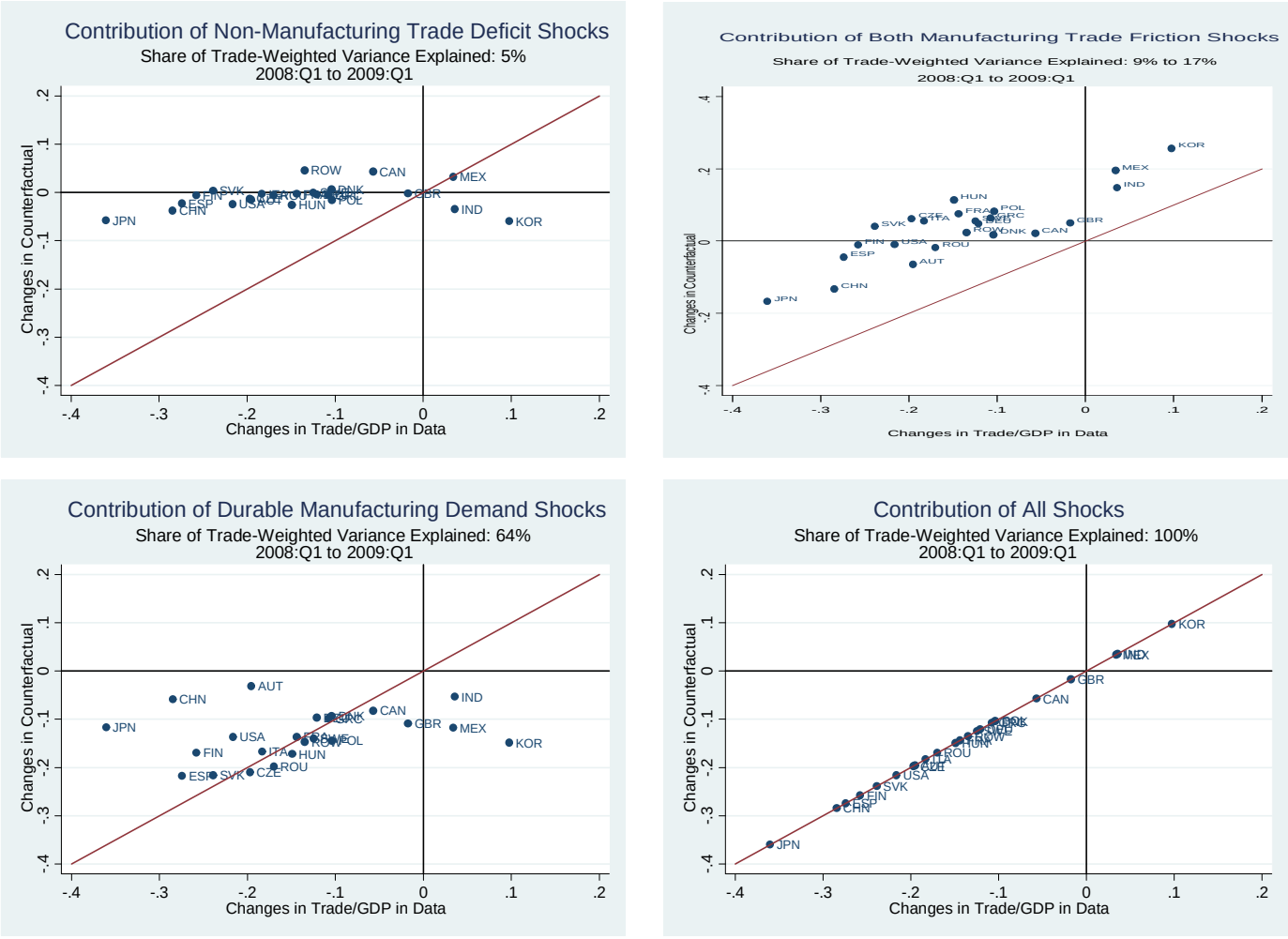
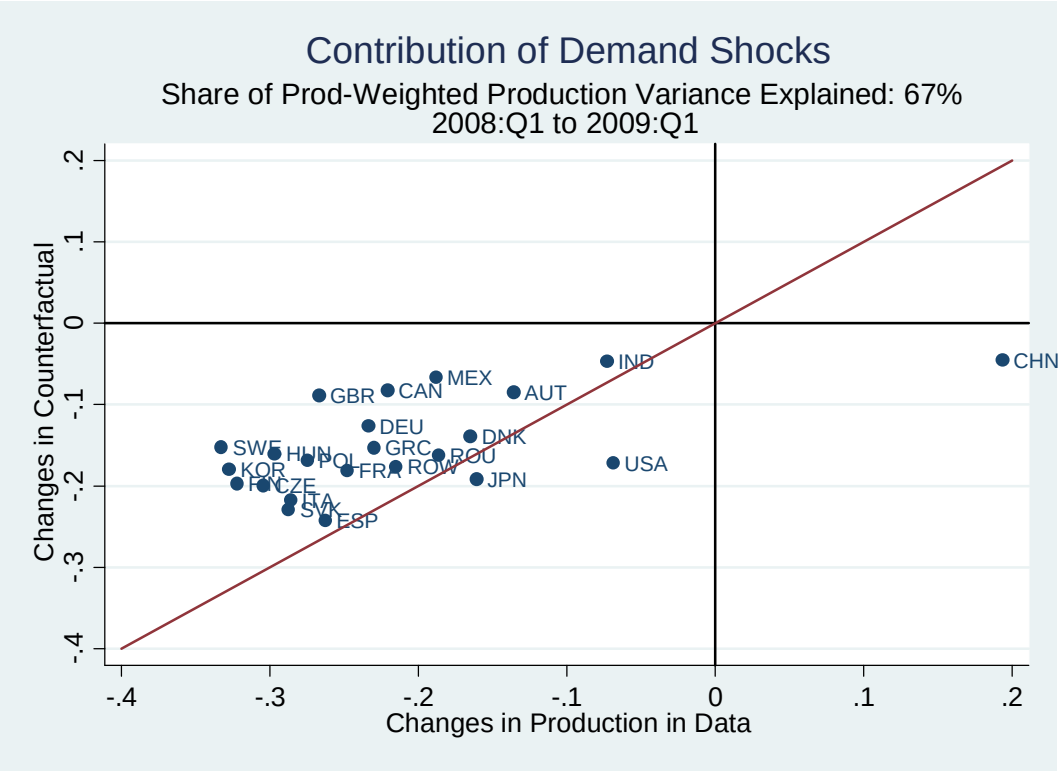
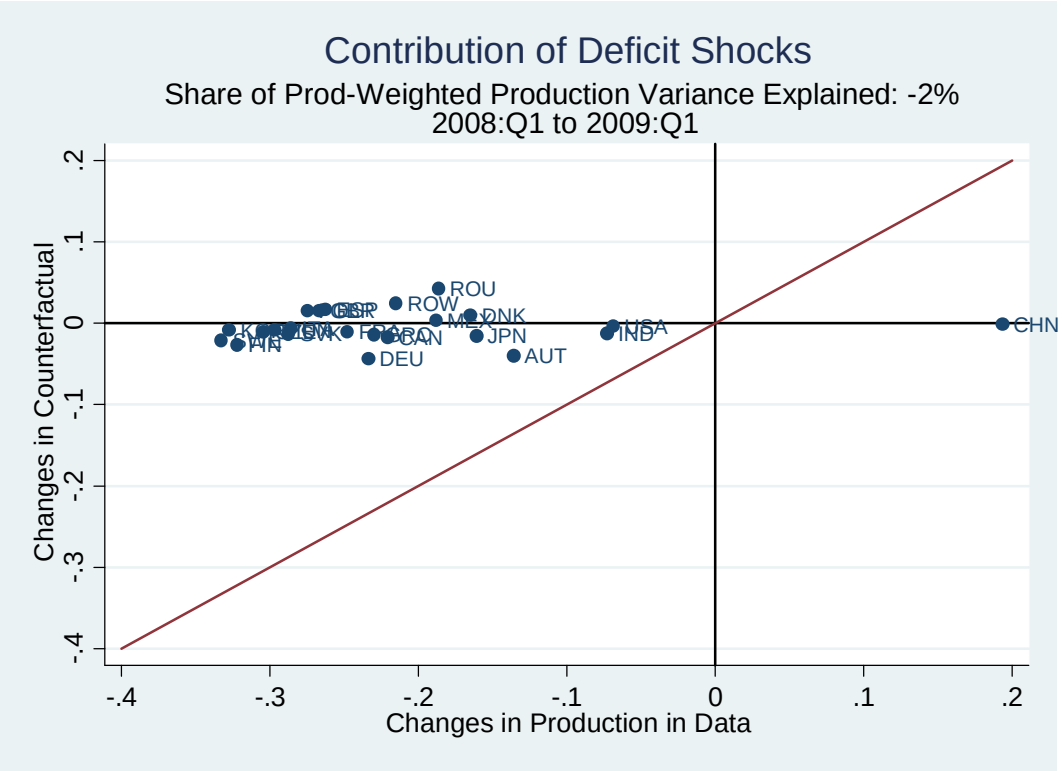


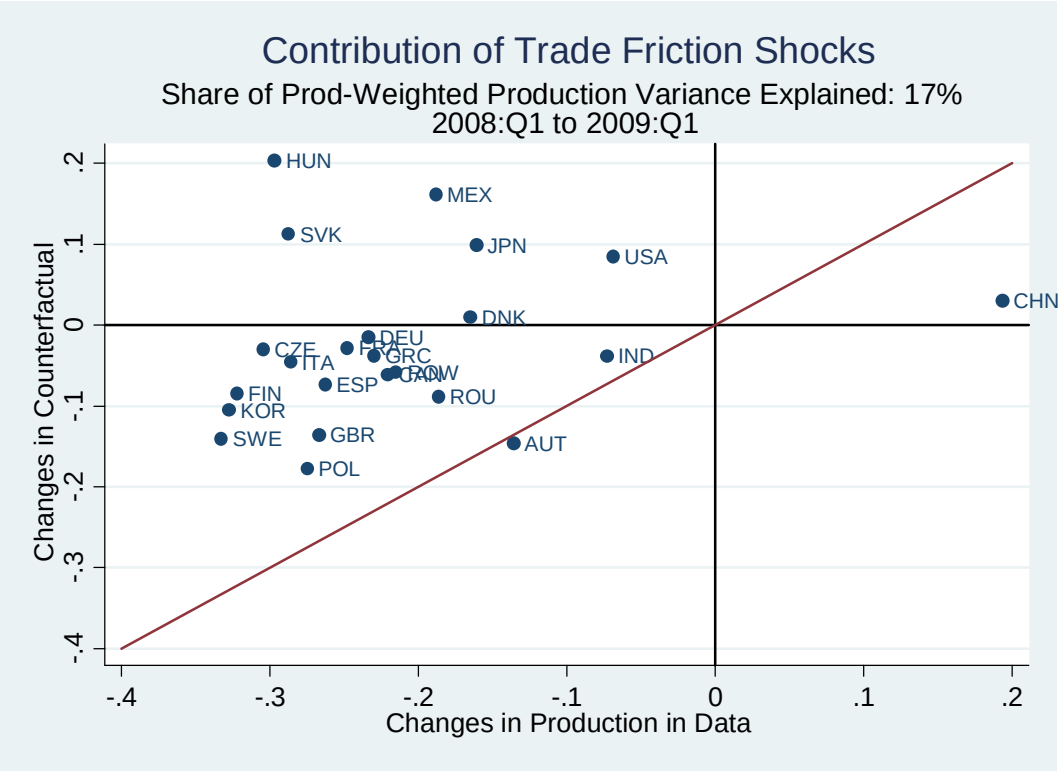
Figure 16: Cross-Sectional Explanatory Power of Various Shocks

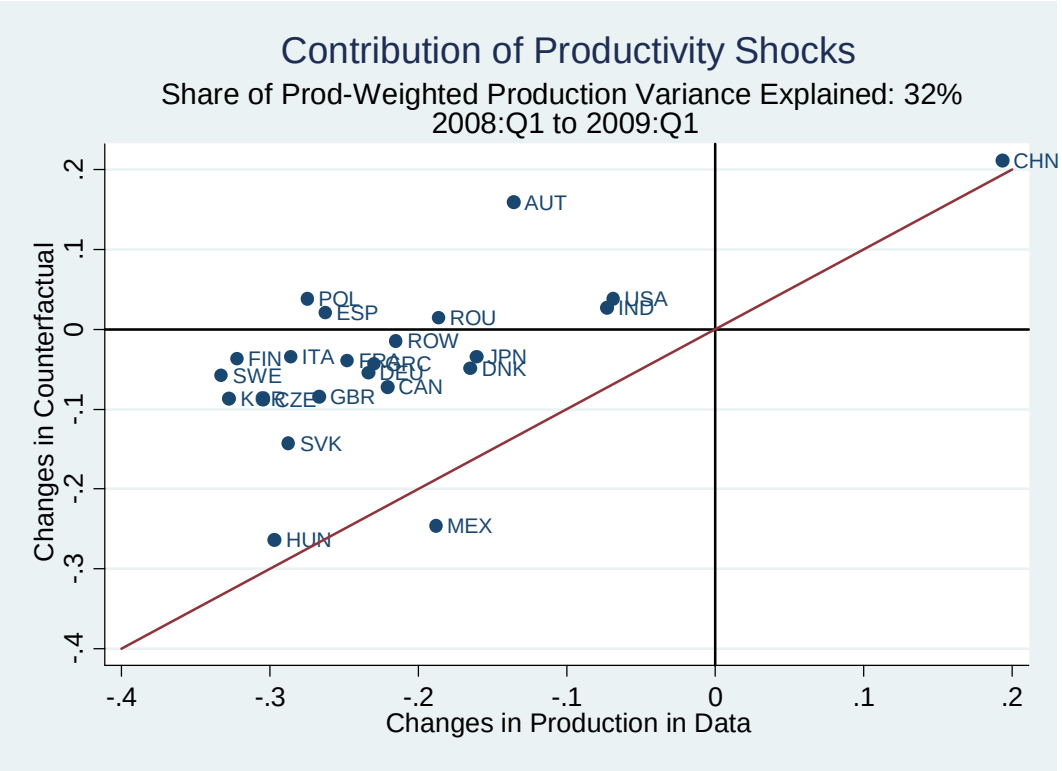
Notes: $\theta^D = \theta^N = 2$

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 Counterfactual
.2
.1
0
-.1
-.2
-.3
-.4
-.4
-.3
-.2
-.1
0
.1
.2
Changes in Production in Data
IND
CHN
MEX
GBR
CAN
AUT
DEU
DNK
SWE
HUN
GRC
ROU
POL
KOR
FRA
ROW
USA
JPN
CZE
ITA
SVK
ESP


Contribution of Deficit Shocks
Share of Prod-Weighted Production Variance Explained: -2%
2008:Q1 to 2009:Q1
Changes in Counterfactual
Changes in Production in Data
-.4
-.3
-.2
-.1
0
.1
.2
ROU
ROW
DNK
JPN
AUT
DEU
CHN
IND


Contribution of Trade Friction Shocks
Share of Prod-Weighted Production Variance Explained: 17%
2008:Q1 to 2009:Q1
Changes in Counterfactual
Changes in Production in Data
-.4
-.3
-.2
-.1
0
.1
.2
HUN
MEX
SVK
JPN
USA
CHN
DNK
DEU
CZE
FRA
GRC
IND
ITA
ESP
ROU
FIN
KOR
SWE
GBR
AUT
POL


Contribution of Productivity Shocks
Share of Prod-Weighted Production Variance Explained: 32%
2008:Q1 to 2009:Q1
Changes in Counterfactual
Changes in Production in Data
.2
.1
0
-.1
-.2
-.3
-.4
-.4
-.3
-.2
-.1
0
.1
.2
CHN
AUT
POL
ESP
ROU
USA
IND
ROW
FIN
ITA
JPN
SWE
DNK
DEU
CAN
GBR
SVK
MEX
HUN

The Role of International Transmission through Trade: Shutting Down Domestic Shocks

	Trade / GDP		GDP		Production	
	Actual (2008:Q1 - 2009:Q1)	Counterfactual (All Shocks From Other Countries)	Actual (2008:Q1 - 2009:Q1)	Counterfactual (All Shocks From Other Countries)	Actual (2008:Q1 - 2009:Q1)	Counterfactual (All Shocks From Other Countries)
Small Countries						
Denmark	0.90	0.99	0.95	0.88	0.84	0.87
Hungary	0.85	1.03	0.83	0.78	0.70	0.81
Mexico	1.03	1.05	0.83	0.90	0.81	0.91
Slovakia	0.76	0.98	1.01	0.85	0.71	0.84
Romania	0.83	0.95	0.88	0.85	0.81	0.81
Large Countries						
China	0.72	0.93	1.23	0.92	1.19	0.92
Japan	0.64	0.95	1.16	0.91	0.84	0.91
United States	0.78	0.95	1.11	0.93	0.93	0.93

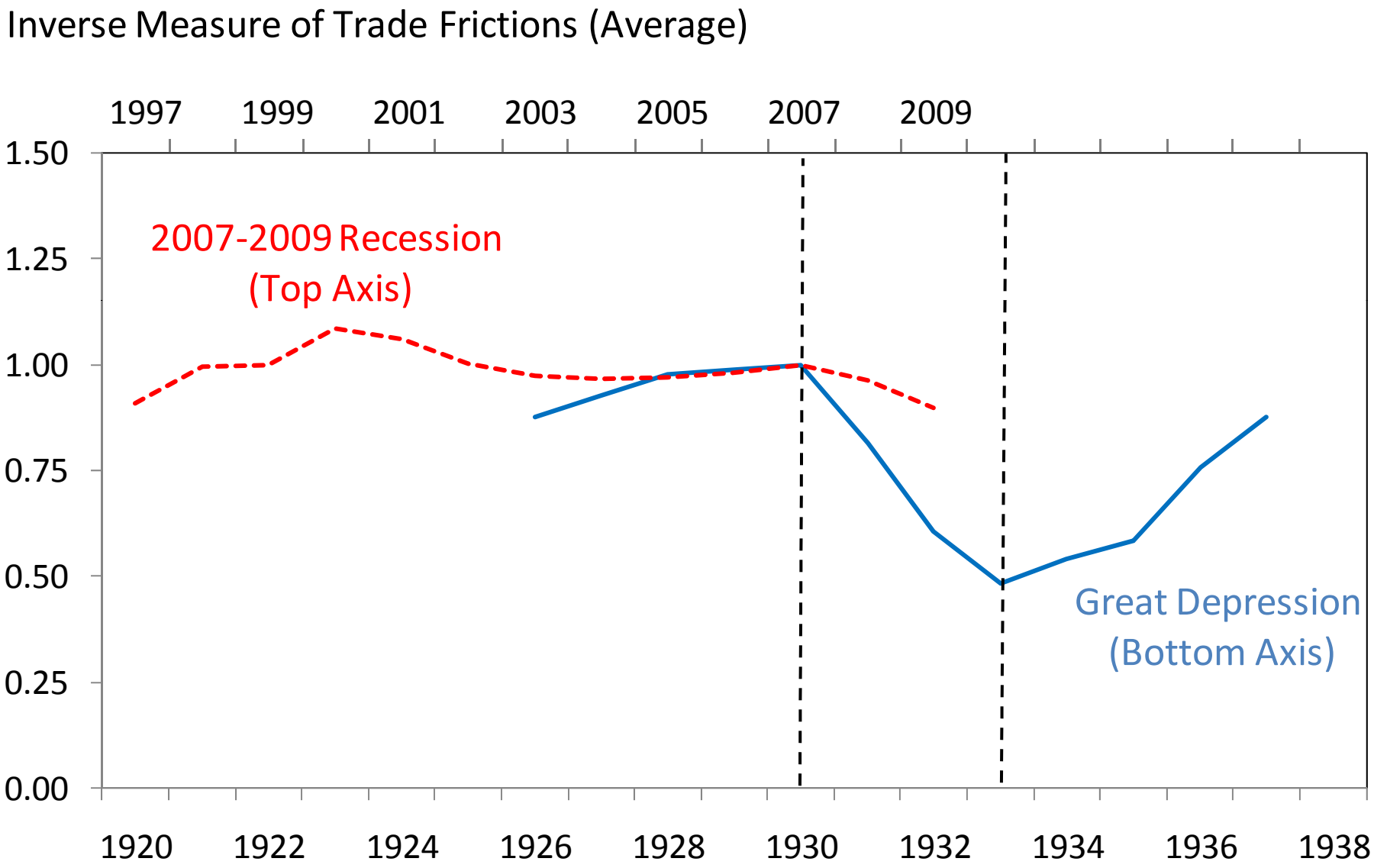
How did these shocks play out at the firm level?

- 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

United States and 8 Trade Partners



- 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.