

# China's Imbalances: Trade Integration in a DSGE Model

George Alessandria

Horag Choi

Dan Lu

Rochester

Monash

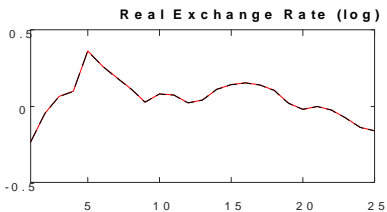
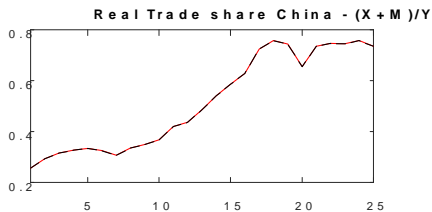
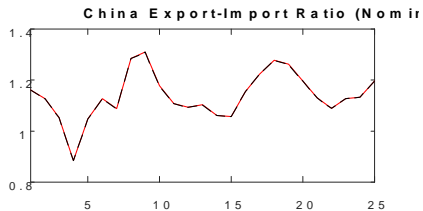
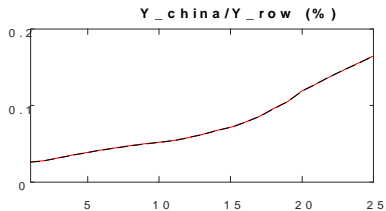
Rochester

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[https://sites.google.com/site/georgealessandria2/  
ACL-201606.pdf](https://sites.google.com/site/georgealessandria2/ACL-201606.pdf)

# Introduction

- China's growth & integration definitive economic event of last twenty-five years
- Uneven process - characterized by swings in real exchange rate, trade balance, and accumulation of substantial foreign assets and trade integration.
  - ▶ Additionally, pace of trade integration has slowed.



Period is 1990 to 2014

# Introduction

- China's growth & integration definitive economic event of last twenty-five years
- Uneven process - characterized by swings in real exchange rate, trade balance, and accumulation of substantial foreign assets and trade integration.
  - ▶ Additionally, pace of trade integration has slowed.
- Build unified model to account for borrowing/lending, trade integration, and growth.
  - ▶ Emphasize the role of changes in various trade barriers in the accumulation of assets.

# Preview of Main Findings

- Persistent trade cost "shocks" key to China's foreign assets
  - ▶ Symmetric  $\Delta$  in trade barriers lead to lending
  - ▶ Asymmetric  $\Delta$  in trade barriers lead to lending
- Trade integration (% of gdp): fall common barriers (49%), Chinese export barriers (19%), and China growth (18%)
- Trade slowdown primarily reflects lack of additional integration shocks rather than reversals
  - ▶ Current expectations about future trade cost path similar to when China joined WTO.

# Outline

- Model
- Estimation
- Results - decomposition of
  - ▶ Net Foreign Assets
  - ▶ Trade Integration
  - ▶ Trade Slowdown

# Model

- Two countries, final NT consumption good, non-contingent bond
- Heterogeneous producers with dynamic exporting decision (sunk cost)
  - ▶ SR/LR trade adjustment (Alessandria/Choi 07, 15)
- Pricing-to-market: exporter's demand elasticity depends on RER and relative income.
- Aggregate shocks: productivity, trade costs, and discount factor (China-specific & global)

# Consumers

$$\max E_0 \sum_{t=0}^{\infty} \Theta_t \frac{[C^\gamma (1-L)^{1-\gamma}]^{1-\sigma}}{1-\sigma},$$

subject to

$$P_t C_t + P_t Q_t B_t = W_t P_t L_t + P_t B_{t-1} + \Pi_t,$$

$$\ln(\Theta_{t+1}/\Theta_t) = \ln \beta_t = (1 - \rho_b) \ln \bar{\beta} + \rho_b \ln \beta_{t-1} + \varepsilon_\beta,$$

- Discount factor shocks capture "savings glut" story



# Aggregators and Prices

Final good produced by competitive retail sector/aggregator

$$C_t = \left( Y_{Ht}^{\frac{\rho-1}{\rho}} + a^{\frac{1}{\rho}} Y_{Ft}^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}},$$

$$Y_{Ht} = \left( \int_0^1 Y_{hit}^{\frac{\theta-1}{\theta}} di \right)^{\frac{\theta}{\theta-1}},$$

$$Y_{Ft} = \left( \int_{i \in \mathcal{E}_t^*} Y_{fit}^{\frac{\theta_t-1}{\theta_t}} di \right)^{\frac{\theta_t}{\theta_t-1}}.$$

- $\theta_t = \theta(q, y/y^*)$  captures pricing-to-market

# Producers - standard sunk cost model (Dixit, 89)

$$V_t(\eta, m) = \max_{m', p, p^*} p c_t(p) + m' p^* c_t(\zeta^* p^*) - W_t \\ - m' W f_{m,t} + Q_t E V_{t+1}(\eta', m')$$

- $m_{it}$ : exporting status
- $y_{it} = e^{z_t + \eta_{it}} l_{it}$ ,  $\eta_{it} \stackrel{iid}{\sim} N(0, \sigma_\eta^2)$
- $\zeta_t^* > 1$ : variable trade costs for home exporters
- $W_t f_{0,t}$ : sunk cost to start
- $W_t f_{1,t}$ : sunk cost to continue.

# Export Entry and Exit Thresholds

$$W_t f_{0,t} - \pi_t^* (\eta_{0t}) = Q_t E_t \Delta V_{t+1} (\eta')$$

$$W_t f_{1,t} - \pi_t^* (\eta_{1t}) = Q_t E_t \Delta V_{t+1} (\eta')$$

$$\Delta V_t (\eta) = V_t (\eta, 1) - V_t (\eta, 0)$$

- Endogenous entry/exit & hysteresis ( $\eta_{1t} < \eta_{0t}$  when  $f_1 < f_0$ )
- Distribution of exporters is state variable & gradual entry
- With iid shocks,

$$N_{t+1} = \Pr(\eta \geq \eta_{1t}) N_t + \Pr(\eta \geq \eta_{0t}) (1 - N_t)$$

# Aggregate Shocks - Productivity

$$\ln z_t^* = \rho_z^* \ln z_{t-1}^* + \varepsilon_{zt}^*, \quad \varepsilon_{zt}^* \stackrel{iid}{\sim} N(0, \sigma_z^*)$$

$$\ln z_{dt} = \rho_z^d \ln z_{dt-1} + \varepsilon_{zt}^d, \quad \varepsilon_{zt}^d \stackrel{iid}{\sim} N(0, \sigma_z^d)$$

$$\ln z_t = \ln z_t^* + \ln z_{d,t} - \bar{z}$$

- $z_t^*$  : Global productivity
- $z_{d,t}$ : China-specific productivity
- $\bar{z}$  : China's productivity disadvantage.

# Aggregate Shocks - Variable Trade Costs

$$\ln \tilde{\zeta}_t = \ln \tilde{\zeta}_{ct} + \frac{1}{2} \ln \tilde{\zeta}_{dt},$$

$$\ln \tilde{\zeta}_t^* = \ln \tilde{\zeta}_{ct} - \frac{1}{2} \ln \tilde{\zeta}_{dt}.$$

$$\ln \tilde{\zeta}_{ct} = \left(1 - \rho_{\tilde{\zeta}_c}\right) \ln \bar{\zeta}_c + \rho_{\tilde{\zeta}_c} \ln \tilde{\zeta}_{ct-1} + \ln \tilde{\zeta}_{gt-1} + \varepsilon_{\tilde{\zeta}_c t},$$

$$\ln \tilde{\zeta}_{gt} = \rho_{\tilde{\zeta}_g} \ln \tilde{\zeta}_{gt-1} + \varepsilon_{\tilde{\zeta}_g t},$$

$$\ln \tilde{\zeta}_{dt} = \left(1 - \rho_{\tilde{\zeta}_d}\right) \ln \bar{\zeta}_d + \rho_{\tilde{\zeta}_d} \ln \tilde{\zeta}_{dt-1} + \varepsilon_{\tilde{\zeta}_d t}.$$

- $\tilde{\zeta}_{ct}$ : common shock
- Transitory and trend shocks. Trend shocks have news aspect
- $\tilde{\zeta}_{dt}$ : differential shocks

# Aggregate Shocks - Fixed Trade Costs

$$\ln f_{0t} = (1 - \rho_{f0}) \ln f_0 + \rho_{f0} \ln f_{0t-1} + \varepsilon_{f0,t},$$

$$\ln f_{1t} = (1 - \rho_{f1}) \ln f_1 + \rho_{f1} \ln f_{1t-1} + \varepsilon_{f1,t}.$$

Constrain  $\rho_{f1} = \rho_{f0} = \rho_f$

# Calibration/Estimation

## Fixed Parameters

$\beta$	$\zeta_b$	$\gamma$	$a_1$	$\theta$
0.96	0.0001	0.30	0.16	5

## Estimate

- Shock process:  $z_c, z_d, \bar{\zeta}_c, \bar{\zeta}_g, \bar{\zeta}_d, f_0, f_1, b$
- Level of trade costs  $(\bar{\zeta}_c, \bar{\zeta}_d, f_0, f_1)$  and technology  $(\bar{z}, \sigma_\eta)$
- Preferences  $(\sigma, \rho, \zeta_q, \zeta_y)$

# Estimation - Data

- 1 Ratio of China-ROW real income
- 2 Nominal export/import ratio
- 3 Real trade share in China
- 4 Real exchange rate
- 5 Real world output - detrended
- 6 Chinese exporters participation



Figure: Historical and Smoothed Series

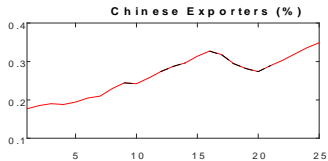
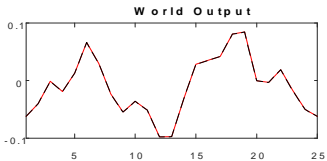
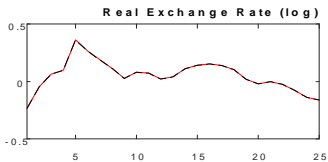
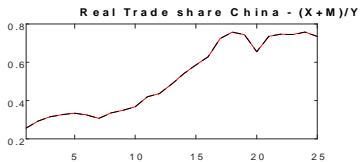
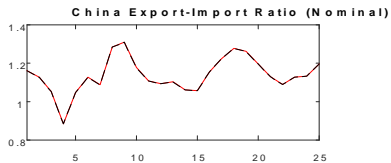
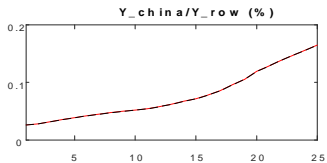
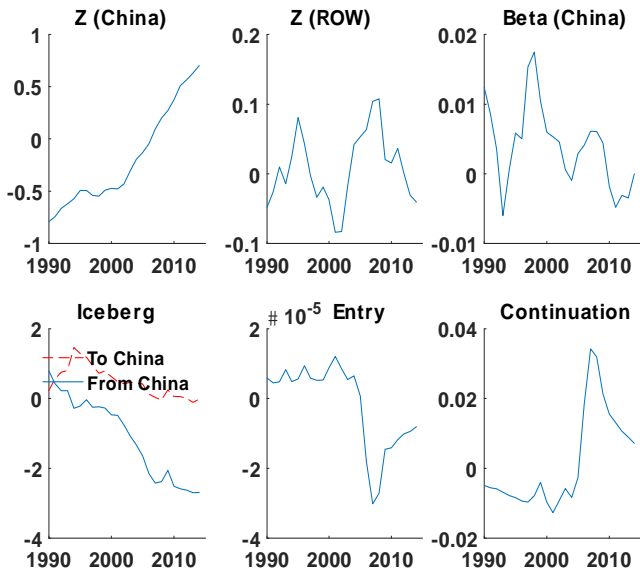


Figure: Deviations from Steady State of State Variables



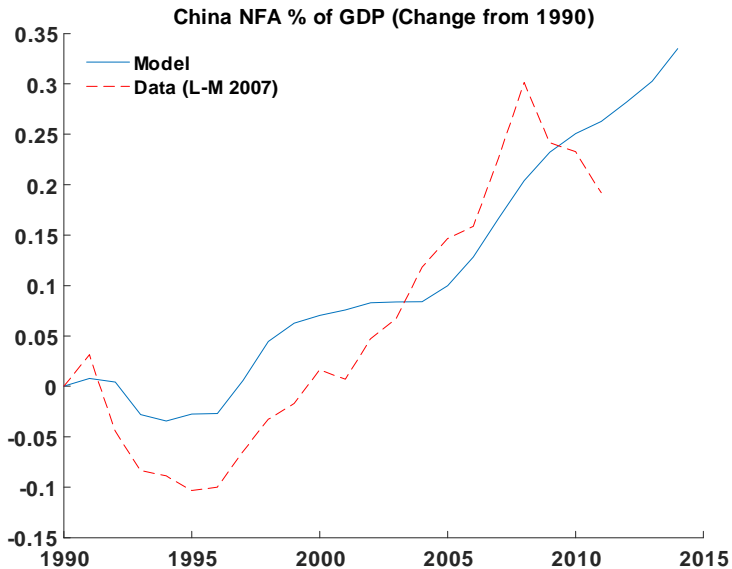
## Estimated Persistence of Shocks

	prior mean	posterior mean	posterior mode	90% HPD - interval	prior	prior std.dev.
$\rho_{z_d}$	0.95	0.996	0.999	0.9905 - 1	unif	0.5
$\rho_{z_c}$	0.7	0.747	0.731	0.5586 - 0.954	unif	0.5
$\rho_{\zeta_c}$	0.79	0.917	0.962	0.8099 - 0.9981	unif	0.5
$\rho_{\zeta_d}$	0.95	0.978	0.992	0.9578 - 0.9998	unif	0.5
$\rho_b$	0.945	0.948	0.953	0.9158 - 0.98	norm	0.025
$\rho_{\zeta_g}$	0.8	0.895	0.975	0.7423 - 0.9978	unif	0.5
$\rho_f$	0.9	0.820	0.853	0.666 - 0.9939	unif	0.5

Notes: Based on annual data from 1990 to 2014.

Shocks are persistent but not permanent - rationale for borrowing/lending

Figure 7: Decomposition of China Net Foreign Assets (Model)



## Contribution to Change in NFA

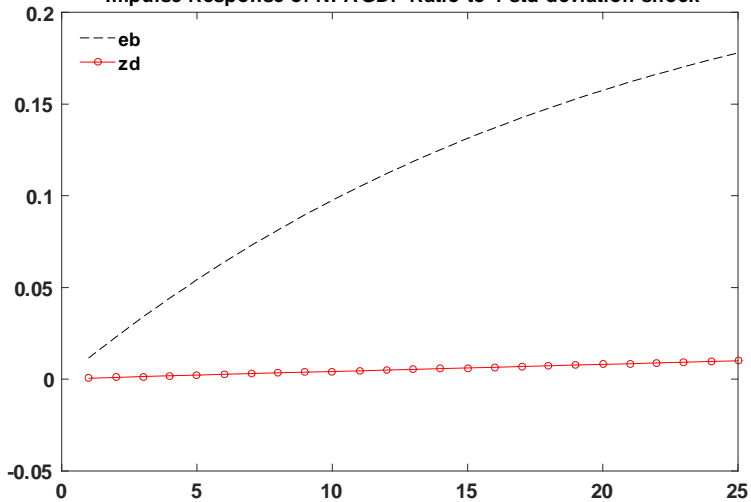


# Assets-GDP Ratio and Shocks

Consider 1 standard deviation shock

- Productivity shocks ( $\approx$ unit root): minor impact on assets
- Discount factor: increase in  $\beta$  leads to accumulation of foreign assets

Impulse Response of NFA-GDP Ratio to 1 std deviation shock



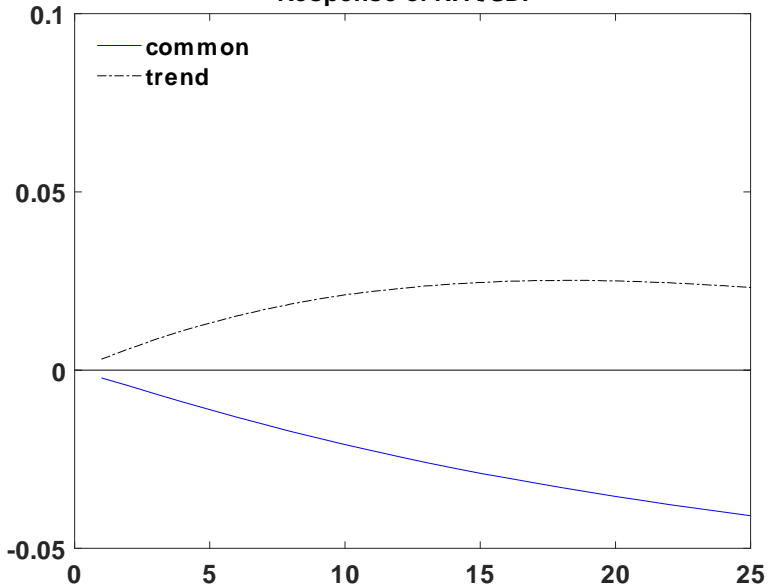
# Assets-GDP Ratio and Trade cost shocks

Consider 1 standard deviation shock

- Persistent trade cost shocks  $\Delta$  assets.
- Common increase in trade cost affects China more since it is more open.
  - ▶ + transitory  $\rightarrow$  borrowing
  - ▶ + trend shock  $\rightarrow$  savings



### Response of NFA/GDP

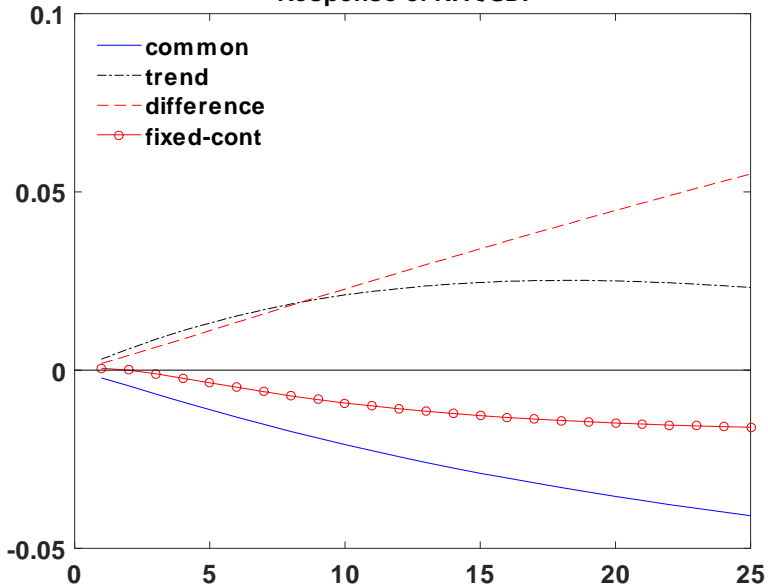


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  - ▶ + trend shock  $\rightarrow$  savings
- Differential shocks, temporarily cheaper for ROW to consume  $\rightarrow$  savings
- Fixed cost shock: temporarily more expensive for ROW to consume  $\rightarrow$  borrow

# Response of NFA/GDP



# Growth in Trade between China and ROW

- Focus on nominal trade share

$$tr = \frac{P_x X + P_m M}{P_y Y}$$

- Consider contribution of shocks to change
  - ▶ over whole period (90 to 14)
  - ▶ slow-down - compare 11-14 to 97-07

## Source of Change in ROW Trade-GDP (1990 to 2014)

	ROW	China
Initial	15.0%	38.7%
Productivity	18.1%	-45.0%
Trade		
Common	23.3%	70.1%
Difference	19.0%	-38.5%
Trend	25.7%	77.0%
Fixed	-1.2%	-2.1%
<b>Total</b>	<b>22.8%</b>	<b>23.8%</b>

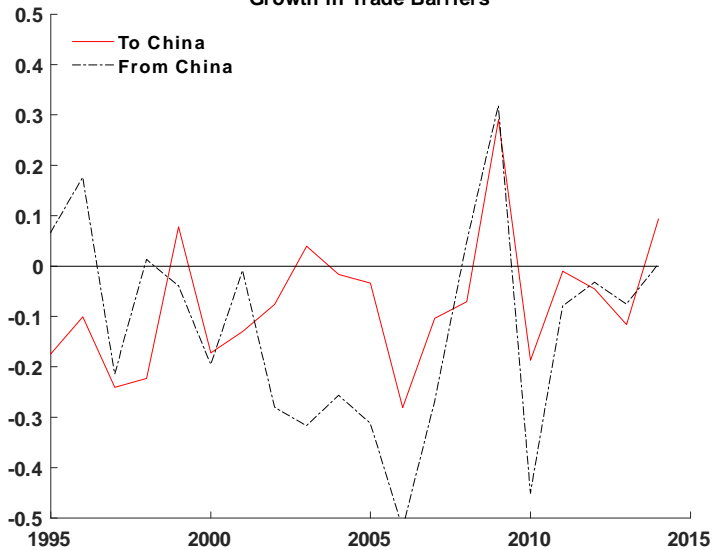
Each entry measures the share of the total change in nominal trade to GDP from 1990 to 2014 from that shock alone

## Source of the slow-down in 11-14 (comparing to 97-07)

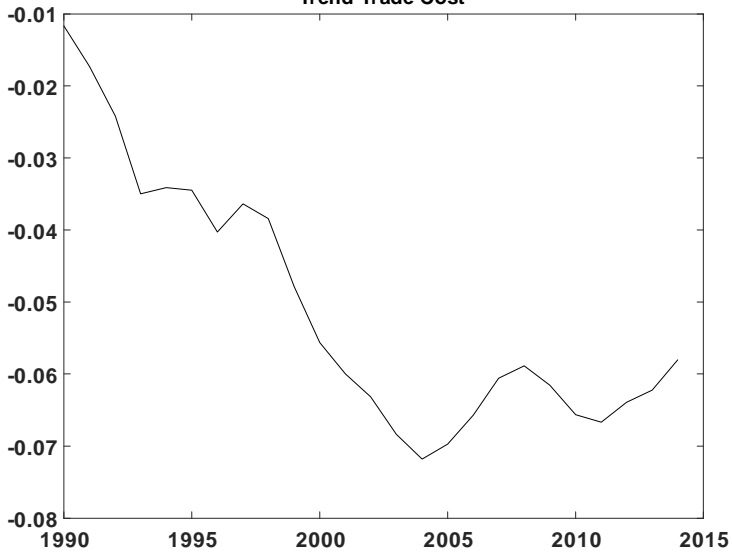
	ROW	China
Initial	6.4%	6.6%
Productivity	-10.6%	10.3%
Trade		
Common	80.9%	98.4%
Difference	14.9%	-14.0%
Trend	7.5%	-3.7%
Fixed	7.5%	6.6%
<b>Total</b>	<b>-0.94%</b>	<b>-2.43%</b>

Each entry measures the share of the difference in the average annual contribution from 2011 to 2014 minus that from 1997 to 2007

## Growth in Trade Barriers



Trend Trade Cost





# Summary

- Decline in trade barriers matter for China's savings
- Chinese trade integration attributed equally to trend, common, differential and productivity.
- Trade slow-down mostly reflects lack of barrier reductions, rather than reversal, and waning influence of past reforms.
  - ▶ Expectations for integration haven't diminished much.

## Estimated Preferences and Technology

	prior	posterior		90% HPD - interval	prior	prior
	mean	mean	mode			std.dev.
$\rho$	2	1.6964	1.7364	1.4745 - 1.9236	invg	1
$\sigma$	5	4.7231	4.3826	3.3182 - 5.9365	invg	1
$\bar{z}$	2.42	2.3378	2.368	2.1776 - 2.4633	norm	0.1
$\bar{\xi}_c$	0.5	0.4926	0.5026	0.4113 - 0.5683	norm	0.05
$\bar{\xi}_d$	0.1	0.1197	0.1	-0.0286 - 0.2856	norm	0.1
$\zeta_q$	-0.3	-0.3067	-0.2923	-0.5041 - -0.0797	norm	0.15
$\zeta_y$	-0.15	-0.156	-0.1633	-0.2827 - -0.034	norm	0.15
$f_0$	0.37	0.387	0.3728	0.3087 - 0.473	invg	0.05
$f_1$	0.039	0.0427	0.0407	0.031 - 0.0536	invg	0.01
$\sigma_\eta$	0.235	0.1959	0.1824	0.1662 - 0.2269	invg	0.05

Notes: Based on annual data from 1990 to 2014.

## Estimated Shock Std. Deviation

	prior	posterior		90% HPD - interval	prior	prior
	mean	mean	mode			std.dev.
$\sigma_{z_d}$	0.07	0.0699	0.0678	0.0527 - 0.0871	invg	0.025
$\sigma_{z_c}$	0.033	0.0355	0.0333	0.0267 - 0.043	invg	0.025
$\sigma_{\xi_c}$	0.2	0.1602	0.1549	0.1209 - 0.1984	invg	0.05
$\sigma_{\xi_d}$	0.124	0.1653	0.1531	0.1276 - 0.2018	invg	0.05
$\sigma_{\xi_g}$	0.016	0.0339	0.0118	0.0052 - 0.0692	invg	0.02
$\sigma_{f_0}$	0.01	0.007	0.0047	0.0025 - 0.0119	invg	0.05
$\sigma_{f_1}$	0.22	0.2213	0.2193	0.2075 - 0.2378	invg	0.01
$\sigma_b$	0.005	0.0055	0.0044	0.0029 - 0.0082	invg	0.01

Notes: Based on annual data from 1990 to 2014.