Heterogeneous Firm, Financial Market Integration and International Risk Sharing

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Overview

- **International risk sharing** – productivity increases in country H, and then the benefits transmit to country F. Both countries may share risk each other while facing a shock.
- International risk sharing can be measured by the relative **consumptions**, $\boldsymbol{C}/\boldsymbol{C}^*$, and relative **outputs** $\boldsymbol{Y}/\boldsymbol{Y}^*$, or co-movement between **consumption *C*** and **real exchange rate** ($\boldsymbol{Q} = \mathrm{S} \times \mathrm{P}^*/\mathrm{P}$)
- **Puzzle** – empirical studies usually don't support this fundamental theory proposed by the international macroeconomist
- **Why?**

Overview (cont.)

- What were the possible causes? **Non-tradable** goods sectors by Tesar (1993), **financial markets** not complete Hamano (2015), price adjustments, Corsetti *et al.* (2008), …
- We find that the **wealth effects** in heterogeneous firms with financial market integration can play a key role to explain the international risk sharing

Overview (cont.)

- In general, we build a **two-country**, **two-sector DSGE model** to explore international risk sharing
- **Tradable** sector: Heterogeneous productivity shocks (**Ghironi & Melitz, 2005**)
- A firm draws an idiosyncratic productivity shock from a given distribution
- **Non-tradable** sector: Firms face homogeneous shocks with identical goods production

Overview (cont.)

- **Financial market integration** (**Hamano, 2015**)
- Some alternative cases (Hamano, 2015) : Financial autarky, partly financial integration, and fully financial integration
- In the work, two alternatives models: 1) Financial autarky - assets cannot trade across border; 2) fully financial integration - both bonds & shares may trade abroad

Two Theoretical Models

- **A benchmark model**:
- Tradable sector only, and financial autarky

- **The full model**:
- Tradable and **non-tradable** sectors: Fully **financial integration** with different **asset adjustment costs**

A Benchmark Model

- We build simple framework of two-country dynamic stochastic general equilibrium (DSGE) model.
- One **tradable sector** with **heterogeneous firms**
- Goods are allowed to trade across border
- Financial market **autarky** (neither bonds nor stocks can trade abroad)

A Benchmark Model (cont.)

- **Household** - expected intertemporal utility
- $E_t \sum_{s=t}^{\infty} \beta^{s-t} U(C_s)$,

  consumption C_t as: $U_t = \frac{C_t^{1-\gamma}}{1-\gamma}$,
- Consumption basket is home produced ($C_{H,t}$) and foreign produced ($C_{F,t}$) goods:

  $$C_t = \left[(\alpha_H)^{\frac{1}{\varphi}} \left(C_{H,t}\right)^{1-\frac{1}{\varphi}} + (1-\alpha_H)^{\frac{1}{\varphi}} \left(C_{F,t}\right)^{1-\frac{1}{\varphi}} \right]^{\frac{1}{1-\frac{1}{\varphi}}}$$

  where φ the **elasticity of substitution** between **H & F produced goods**

A Benchmark Model (cont.)

- **A Specific Firm** - the home firm z (Ghironi and Melitz, 2005):
- To served the **domestic market**

  $y_{D,t}(z) = Z_{T,t} z l_{D,t}(z)$
- To export to the **foreign market**

  $y_{X,t}(z) = \frac{1}{\boldsymbol{\tau_t}} Z_{T,t} z l_{X,t}(z)$

  where $Z_{T,t}$ the aggregate factor productivity; z specific productivity level; $l(z)$ labor demand; $\boldsymbol{\tau_t}(\geq 1)$ **melting-iceberg trade cost**

A Benchmark Model (cont.)

- **Firm Average -**
- A **mass $N_{D,t}$** of firms producing domestically has a distribution of productivity levels by $G(z)$
- $\boldsymbol{G(z)}$ is a **Pareto** distribution with minimum productivity level $\boldsymbol{z_{min}}$

  $G(z) = 1 - \left(\frac{z_{min}}{z}\right)^{\kappa}$

- Domestically producing firms as $\tilde{z}_D = \left(\frac{\kappa}{\kappa-\theta+1}\right)^{\frac{1}{\theta-1}} z_{min}$

A Benchmark Model (cont.)

- **Firm Average (cont.) -**
- Exporters $\tilde{z}_{X,t} = \left(\frac{\kappa}{\kappa-\theta+1}\right)^{\frac{1}{\theta-1}} z_{X,t}$

- Average real profits among all firms are given by
  $\tilde{d}_t = \tilde{d}_{D,t} + \tilde{d}_{X,t}$
- Average export profits must satisfy:
  $\tilde{d}_{X,t} = \frac{\theta-1}{\kappa-\theta+1}\frac{w_t}{z_t} f_{X,t}$

A Benchmark Model (cont.)

- **Firms' Entry and Exit -**
- Prospective entrants compute the expected profits $\{\tilde{d}_s\}_{s=t+1}^{\infty}$
- Expected post-entry value:

  $\tilde{v}_t = E_t\left[\sum_{s=t+1}^{\infty}[\beta(1-\delta)]^{s-t}\left(\frac{C_s}{C_t}\right)^{-\gamma}\tilde{d}_s\right]$
- The **free-entry condition**:

  $\tilde{v}_t = \frac{w_t}{Z_{T,t}} f_E,$

  where f_E an entry cost (units of effective labor)

A Benchmark Model (cont.)

- **Changes in the Consumption**
- Log-linearizing consumption around the symmetric S-S yields

$$\widehat{C_t} = (1-\varphi)s_D\left(\widehat{\rho_{H,t}} - \widehat{\rho_{F,t}}\right) + \left(\widehat{N_{X,t}} + \widehat{\tilde{d}_{X,t}}\right)$$

- Similar expressions for country F given as follows:

$$\widehat{C_t^*} = (1-\varphi)s_{D,t}\left(\widehat{\rho_{F,t}^*} - \widehat{\rho_{H,t}^*}\right) + \left(\widehat{N_{X,t}^*} + \widehat{\tilde{d}_{X,t}^*}\right)$$

A Benchmark Model (cont.)

- **Numerical Solutions of the Benchmark Model**
- The numerically solved with given parameters shown Table 1.
- Figures 1 & 2 show the responses (percent deviations from steady-state) to a permanent 1% increase in the home productivity.

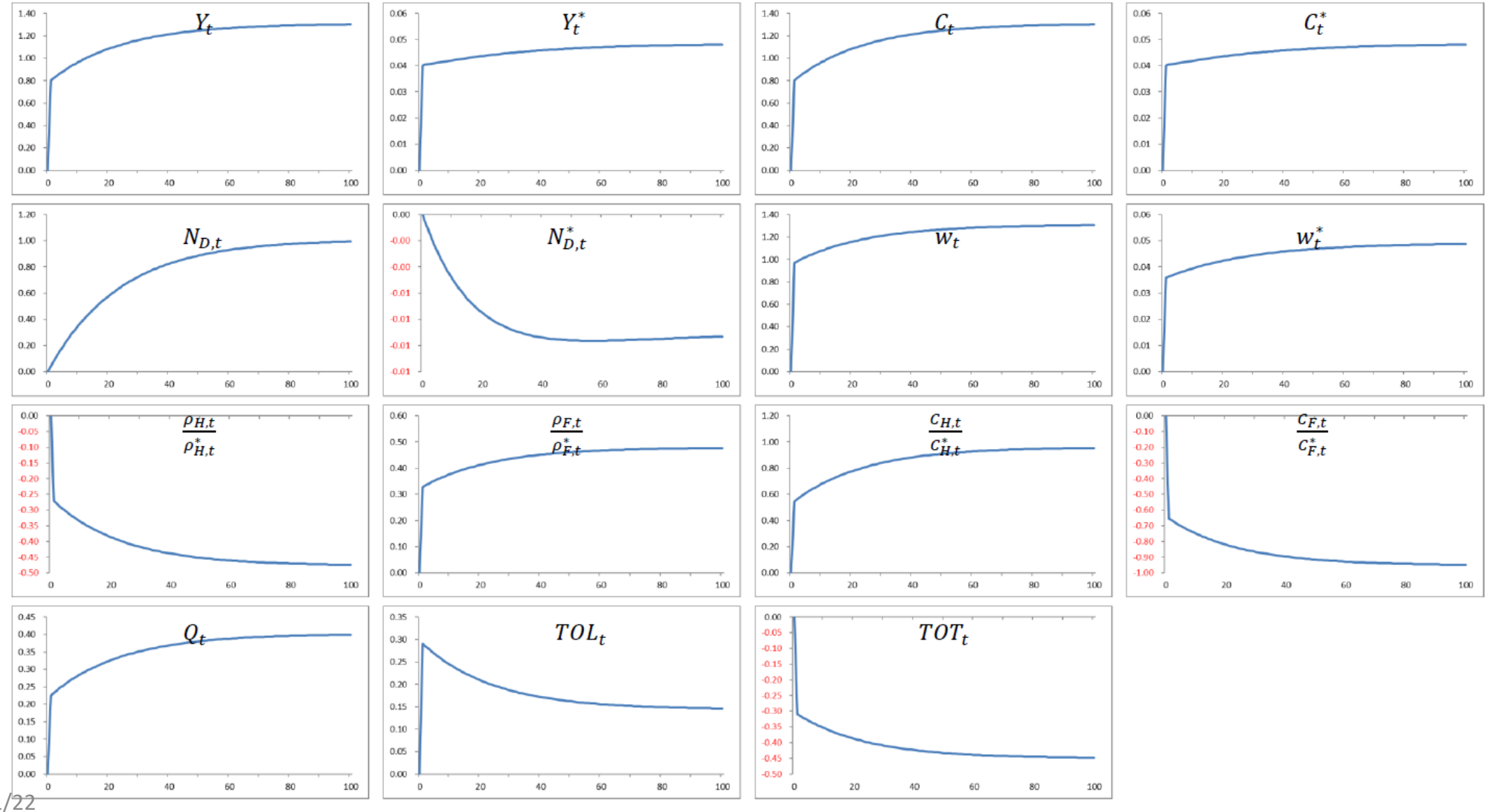
Parameter values

Parameter	Description	Value
α_T	Share of tradeable goods	0.58
α_H	Share of domestically produced goods	0.85
β	Discount factor	0.99
γ	Constant risk aversion	2
δ	Death shock	0.025
θ	Elasticity of substitution among varieties	3.8
$\boldsymbol{\kappa}$	**Shape parameter**	**3.4**
λ	Frisch elasticity of labor supply	2
$\boldsymbol{\varphi}$	**Elasticity of substitution between H & F produced goods**	**2**
$\boldsymbol{\psi}$	**Elasticity of substitution between tradable and non-tradable goods**	**0.74**

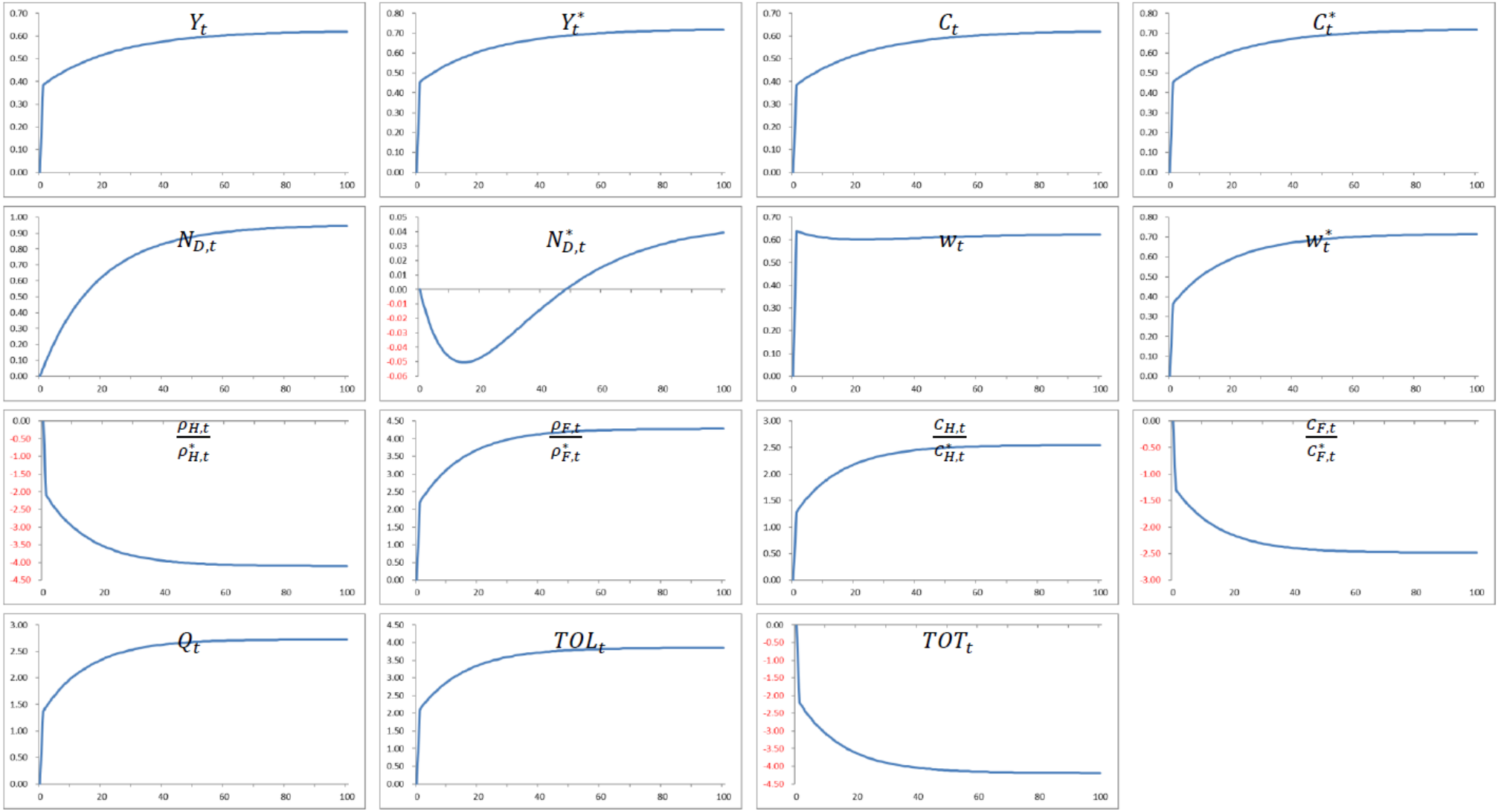
A Benchmark Model (cont.)

- First of all we are analyze the effects of technology progress in country A under $\varphi > 1$ in first Figure
- Second figure, the case under $\varphi < 1$, consumption in the home country increase but consumption in the foreign country decrease

Response to Permanent Z_T Shock ($\varphi > 1$)



Response to Permanent Z_T Shock ($\varphi < 1$)



The Full Model

- **The Firms**
- Tradable sector is all the same
- **Non-tradable goods** firm: $y_{N,t} = Z_{N,t} l_{N,t}$
- where $\boldsymbol{Z_{N,t}}$ the **common productivity level** to all non-tradable firms that produce in country H

The Full Model (cont.)

- **The Financial Market**
- Agents can trade not only **bonds** but also **shares** domestically and internationally
- However, agents must **pay costs** to local financial intermediaries when **adjusting their asset holdings**

The Full Model (cont.)

- The **adjustment cost** is higher when domestic assets are traded in the foreign market, and setup in **budget constraint**
- Adjustment cost for trading **shares**:

  $\frac{\eta_F}{2}\left(x_{F,t+1}\right)^2 N_{H,t}^* \tilde{v}_t^*$
- Adjustment cost for trading **bonds**:

  $\frac{\eta_F}{2}\left(B_{F,t+1}\right)^2$

The Full Model (cont.)

- **Households -**
- C_t tradable ($C_{T,t}$) and non-tradable ($C_{N,t}$) goods:

$$C_t = \left[(\alpha_T)^{\frac{1}{\psi}}\left(C_{T,t}\right)^{1-\frac{1}{\psi}} + (1-\alpha_T)^{\frac{1}{\psi}}\left(C_{N,t}\right)^{1-\frac{1}{\psi}}\right]^{\frac{1}{1-\frac{1}{\psi}}}$$

- Traded goods $C_{T,t}$ is of home produced ($C_{H,t}$) and foreign produced ($C_{F,t}$) goods:

$$C_{T,t} = \left[(\alpha_H)^{\frac{1}{\varphi}}\left(C_{H,t}\right)^{1-\frac{1}{\varphi}} + (1-\alpha_H)^{\frac{1}{\varphi}}\left(C_{F,t}\right)^{1-\frac{1}{\varphi}}\right]^{\frac{1}{1-\frac{1}{\varphi}}}$$

The Full Model (cont.)

- **General Equilibrium and Net Foreign Asset -**
- **Labor** demand includes the fixed costs of tradable firm creation and for the production of tradable and non-tradable goods

$$L_t = N_{E,t}\frac{f_{E,t}}{Z_{T,t}} + N_{D,t}\left(\tilde{l}_{D,t} + \tilde{l}_{X,t}\right) + L_{N,t}$$

- Aggregate **output** of all firms is given by

$$Y_t = N_{D,t}\left(\tilde{\rho}_{D,t}\tilde{y}_{D,t} + Q_t\tilde{\rho}_{X,t}\tilde{y}_{X,t}\right) + \rho_{N,t}Y_{N,t}$$

The Full Model (cont.)

- **Calibration**
- Parameter values similar to **Ghironi and Melitz** (**2005**)
- Frisch elasticity of the labor supply (λ) is from **Hamano** (**2015**)
- Weights of traded goods, α_T, are chosen by **Stockman and Tesar** (**1995**)
- Weights of domestically produced goods in the tradable basket, α_H, are set following **Corsetti et al.** (**2008**)

The Full Model (cont.)

- **Risk-sharing and Financial Integration**
- Following Corsetti *et al*. (2008), we assume that disturbances to technology follow a trend-stationary $\boldsymbol{AR(1)}$ **process**:

  $\boldsymbol{Z'} = \xi \boldsymbol{Z} + \boldsymbol{\mu}$,

  $\boldsymbol{Z} \equiv \{Z_T, Z_T^*, Z_N, Z_N^*\}'$, $\boldsymbol{\mu} \equiv \{\mu_T, \mu_T^*, \mu_N, \mu_N^*\}'$ has

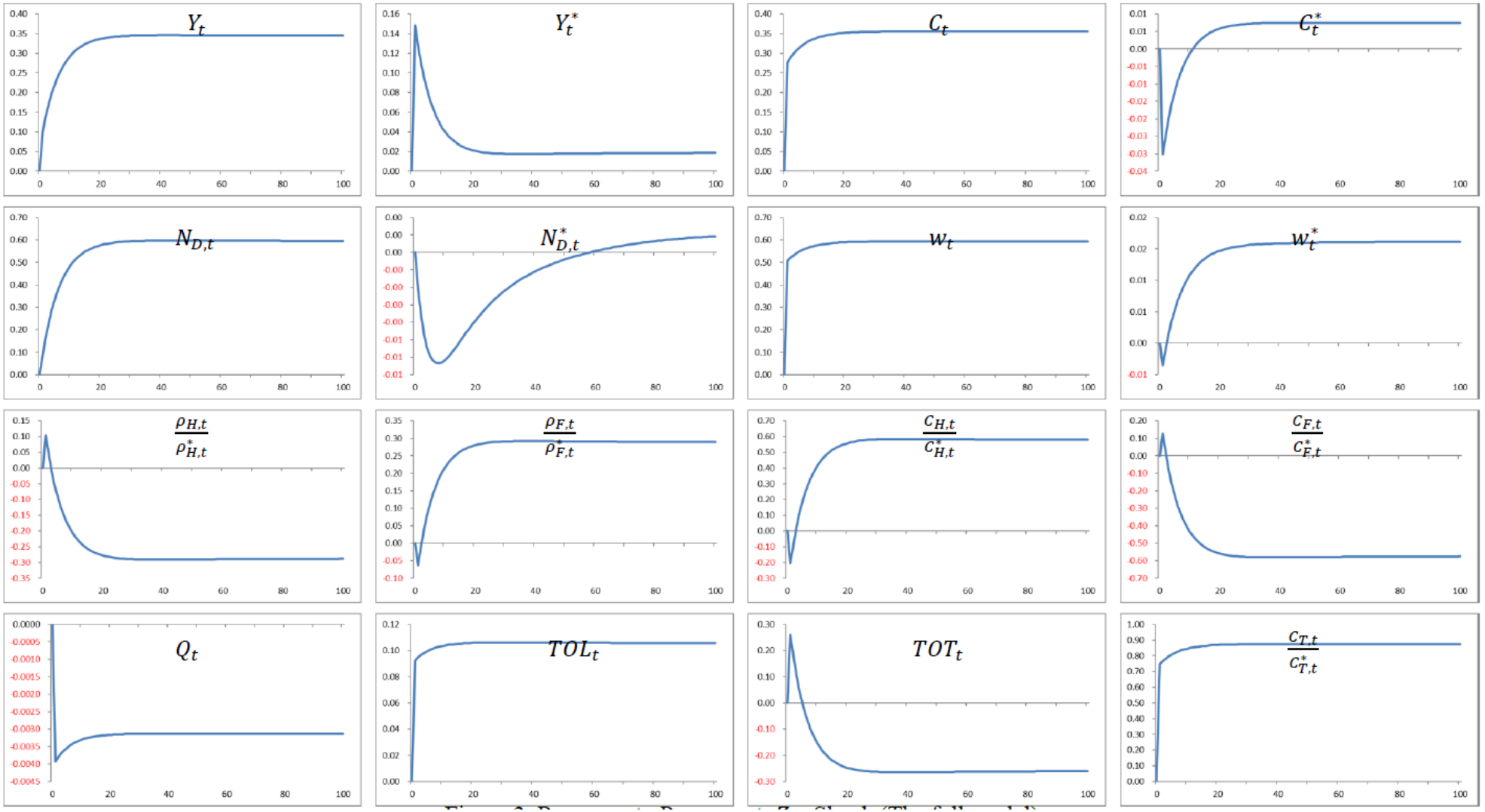
The Full Model (cont.)

- **Variance-covariance matrix** $V(\mu)$ and ξ is a 4×4 matrix of coefficients describing the autocorrelation properties of the shocks

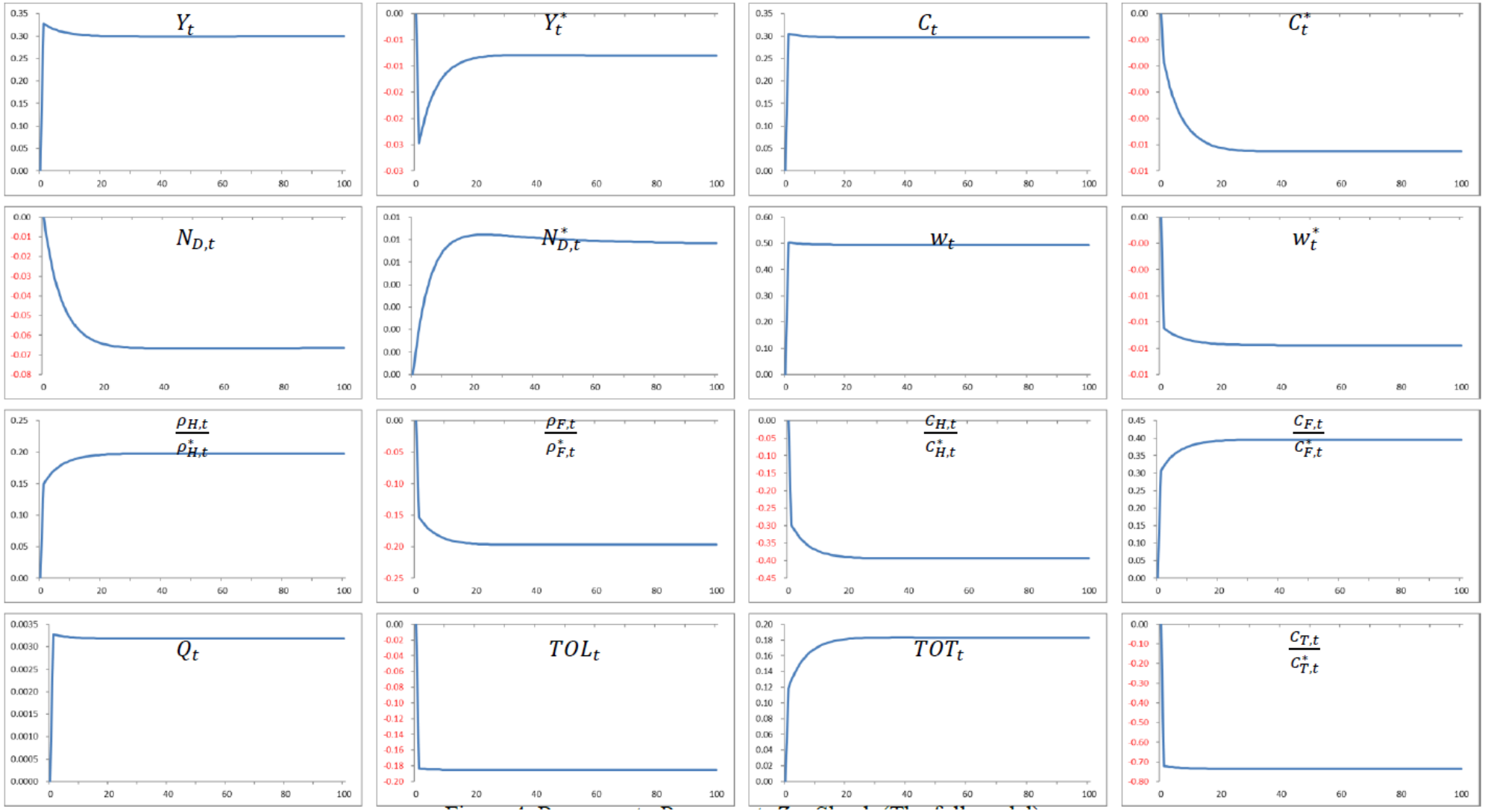
- $\xi = \begin{bmatrix} 0.82 & -0.06 & 0.10 & 0.24 \\ -0.06 & 0.82 & 0.24 & 0.10 \\ -0.02 & 0.02 & 0.96 & 0.01 \\ 0.02 & -0.02 & 0.01 & 0.96 \end{bmatrix}$

- $V(\mu) = \begin{bmatrix} 0.047 & 0.022 & 0.009 & 0.004 \\ 0.022 & 0.047 & 0.004 & 0.009 \\ 0.009 & 0.004 & 0.009 & -0.011 \\ 0.004 & 0.009 & -0.001 & 0.009 \end{bmatrix}$

Response to Permanent Z_T Shock



Response to Permanent Z_N Shock



Sensitivity Analysis: Correlations between H & F consumption

	shape parameter (κ)				
Adjusting costs of asset holdings (η)	3.06	3.23	***3.40***	3.57	3.74
0.0025	**0.71**	**0.68**	**0.66**	**0.65**	**0.64**
0.0075	0.68	0.65	**0.63**	0.62	0.61
0.0125	0.67	0.64	**0.62**	0.60	0.60
0.0175	0.66	0.63	**0.61**	0.59	0.58
0.0225	0.65	0.62	**0.60**	0.58	0.57

Conclusion

- The study builds a **two-country**, **two-sector DSGE model** to explore international risk sharing
- The *unique* of the work is to incorporate the **heterogeneous firms**, and **financial market integration** in the theoretical model
- We find that the **elasticity of substitution** between H & F produced goods play a role to interpret the risk sharing

Conclusion (cont.)

- Of importance, the **technology shocks** on heterogeneous firms can change the **risk sharing** while financial markets between H & F are integrated
- The causes of the **risk sharing increasing** is that profits increasing from heterogeneous firm's positive tech shock
- The **wealth effect** can spill over from country H to F via **stock trading** abroad so as to increase the degree of international sharing risk

Thank you