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, $C/C^*$, and relative outputs $Y/Y^*$, or co-movement between consumption $C$ and real exchange rate $(Q = S \times P^*/P)$

• 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:

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

  where \( \phi \) 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**
    \[ y_{X,t}(z) = \frac{1}{\tau_{t}} Z_{T,t} z l_{X,t}(z) \]

  where $Z_{T,t}$ the aggregate factor productivity; $z$ specific productivity level; $l(z)$ labor demand; $\tau_{t} (\geq 1)$ **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 $G(z)$

• $G(z)$ is a Pareto distribution with minimum productivity level $z_{min}$

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

• 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:\n\[ \tilde{z}_{X,t} = \left( \frac{\kappa}{\kappa - \theta + 1} \right)^{-\frac{1}{\theta - 1}} Z_{X,t} \]

• 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:
\[ \tilde{d}_{X,t} = \frac{\theta - 1}{\kappa - \theta + 1} w_t f_{X,t} Z_t \]
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:
  \[
  \tilde{v}_t = E_t \left[ \sum_{s=t+1}^{\infty} \left[ \beta (1 - \delta) \right]^{s-t} \left( \frac{C_s}{C_t} \right)^{-\gamma} \tilde{d}_s \right]
  \]
- 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

\[ \hat{C}_t = (1 - \varphi)S_D(\hat{\rho}_{H,t} - \hat{\rho}_{F,t}) + \left( \hat{N}_{X,t} + \hat{d}_{X,t} \right) \]

• Similar expressions for country F given as follows:

\[ \hat{C}^*_t = (1 - \varphi)S_{D,t}(\hat{\rho}_{F,t}^* - \hat{\rho}_{H,t}^*) + \left( \hat{N}_{X,t}^* + \hat{d}_{X,t}^* \right) \]
• **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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
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<tbody>
<tr>
<td>$\alpha_T$</td>
<td>Share of tradeable goods</td>
<td>0.58</td>
</tr>
<tr>
<td>$\alpha_H$</td>
<td>Share of domestically produced goods</td>
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<td>$\beta$</td>
<td>Discount factor</td>
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<td>$\gamma$</td>
<td>Constant risk aversion</td>
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<td>$\delta$</td>
<td>Death shock</td>
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<td>$\theta$</td>
<td>Elasticity of substitution among varieties</td>
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<td>$\kappa$</td>
<td><strong>Shape parameter</strong></td>
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<td>$\lambda$</td>
<td>Frisch elasticity of labor supply</td>
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<tr>
<td>$\varphi$</td>
<td>Elasticity of substitution between H &amp; F produced goods</td>
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<tr>
<td>$\psi$</td>
<td>Elasticity of substitution between tradable and non-tradable goods</td>
<td>0.74</td>
</tr>
</tbody>
</table>
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 ($\phi > 1$)
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 $Z_{N,t}$ 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**:
\[
\frac{\eta_F}{2} \left(x_{F,t+1}\right)^2 N_{H,t}^* \tilde{\nu}_t^*
\]

• 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:

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

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

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

\[
Y_t = N_{D,t} \left( \tilde{p}_{D,t} \tilde{y}_{D,t} + Q_t \tilde{p}_{X,t} \tilde{y}_{X,t} \right) + \rho_{N,t} Y_{N,t}
\]
The Full Model (cont.)

• Calibration

• Parameter values similar to Ghironi and Melitz (2005)

• Frisch elasticity of the labor supply (\(\lambda\)) is from Hamano (2015)

• Weights of traded goods, \(\alpha_T\), are chosen by Stockman and Tesar (1995)

• Weights of domestically produced goods in the tradable basket, \(\alpha_H\), 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 $AR(1)$ process:

$$Z' = \xi Z + \mu,$$

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

has
The Full Model (cont.)

• **Variance-covariance matrix** $V(\mu)$ and $\xi$ is a $4 \times 4$ 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

<table>
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<th>Adjusting costs of asset holdings ($\eta$)</th>
<th>shape parameter ($\kappa$)</th>
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</table>
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