Globalization and Pandemics

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Motivation

- What is the relationship between globalization and pandemics?
  - Does globalization make societies more vulnerable to pandemics?
  - How do pandemics affect globalization (present and future)?

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  - Gravity model of trade
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- Health policy externalities between countries
  - Good domestic policy may not stem an epidemic in the face of bad foreign policy
  - But (in some cases): unilateral incentive to be open to country with bad foreign policy

Model: Trade

- Welfare of households in country i

$$W_i = \left(\sum_{j \in \mathcal{J}} \int_0^{n_{ij}} q_{ij}(k)^{\frac{\sigma-1}{\sigma}} \, dk \right)^{\frac{\sigma}{\sigma-1}} - \frac{c}{\phi} \sum_{j \in \mathcal{J}} \mu_{ij} (d_{ij})^{\rho} \times (n_{ij})^{\phi},$$

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- Gravity equation for human contacts and trade flows

$$n_{ij} = (c(\sigma-1)\mu_{ij})^{-1/(\phi-1)} (d_{ij})^{-\frac{\rho+(\sigma-1)\delta}{\phi-1}} \left(\frac{t_{ij} w_j}{Z_j P_i} \right)^{-\frac{\sigma-1}{\phi-1}} \left(\frac{w_i}{P_i} \right)^{1/(\phi-1)}$$

$$\pi_{ij} = \frac{(w_j/Z_j)^{-\frac{\phi(\sigma-1)}{\phi-1}} \times (\mu_{ij})^{-\frac{1}{\phi-1}} (d_{ij})^{-\frac{\rho+\phi(\sigma-1)\delta}{\phi-1}} (t_{ij})^{-\frac{\phi(\sigma-1)}{\phi-1}}}{\sum_{\ell \in \mathcal{J}} (w_\ell/Z_\ell)^{-\frac{(\sigma-1)\phi}{\phi-1}} \times (\Gamma_{i\ell})^{-\varepsilon}}$$

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- Welfare gains from trade (at household level)

$$W_i = \frac{\phi(\sigma-1)-1}{\phi(\sigma-1)} \times (\pi_{ii})^{-\frac{(\phi-1)}{\phi(\sigma-1)-1}} \times \left(\frac{(Z_i)^{\phi(\sigma-1)}}{c(\sigma-1)} (\Gamma_{ii})^{-\varepsilon(\phi-1)} \right)^{\frac{1}{\phi(\sigma-1)-1}}$$

Model: Pandemic

- Dynamics of infection in two-country SIR model

$$\begin{bmatrix} \dot{I}_1 \\ \dot{I}_2 \end{bmatrix} = \underbrace{\begin{bmatrix} 2\alpha_1 n_{11} S_i & (\alpha_2 n_{12} + \alpha_1 n_{21})\, S_1 \\ (\alpha_2 n_{12} + \alpha_1 n_{21})\, S_2 & 2\alpha_2 n_{22} S_2 \end{bmatrix}}_{F} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} - \underbrace{\begin{bmatrix} \gamma_1 & 0 \\ 0 & \gamma_2 \end{bmatrix}}_{V} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

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- R_0 determined by spectral radius of *next generation* matrix FV^{-1}

$$\mathcal{R}_0 = \frac{1}{2}\left(\frac{2\alpha_1 n_{11}}{\gamma_1} + \frac{2\alpha_2 n_{22}}{\gamma_2}\right) + \frac{1}{2}\sqrt{\left(\frac{2\alpha_1 n_{11}}{\gamma_1} - \frac{2\alpha_2 n_{22}}{\gamma_2}\right)^2 + 4\frac{(\alpha_2 n_{12} + \alpha_1 n_{21})^2}{\gamma_1 \gamma_2}}.$$

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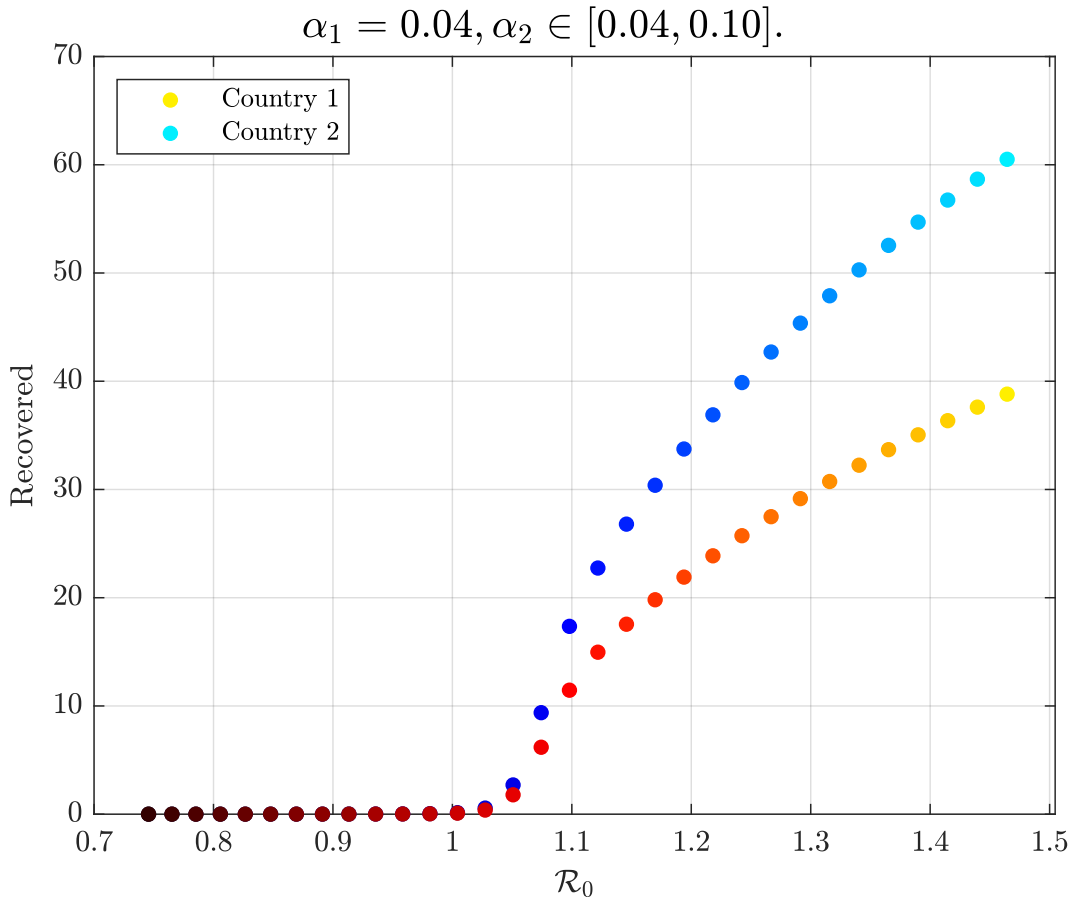
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- Disease can only be contained (stable pandemic-free equilibrium) if *both* countries domestic disease reproduction is less than one

$$\mathcal{R}_0 \geq \mathcal{R}_0|_{n_{12}=n_{21}=0} = \max\left\{\frac{2\alpha_1 n_{11}}{\gamma_1}, \frac{2\alpha_2 n_{22}}{\gamma_2}\right\}.$$

Model: Pandemic

- Gradually increase α_2 while holding $\alpha_1 = 0.04$ constant



Symmetric World

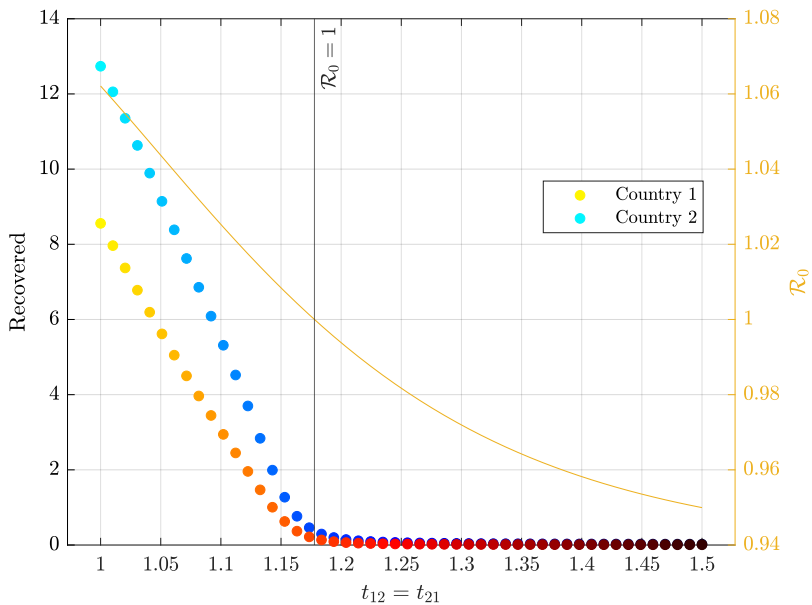
Proposition

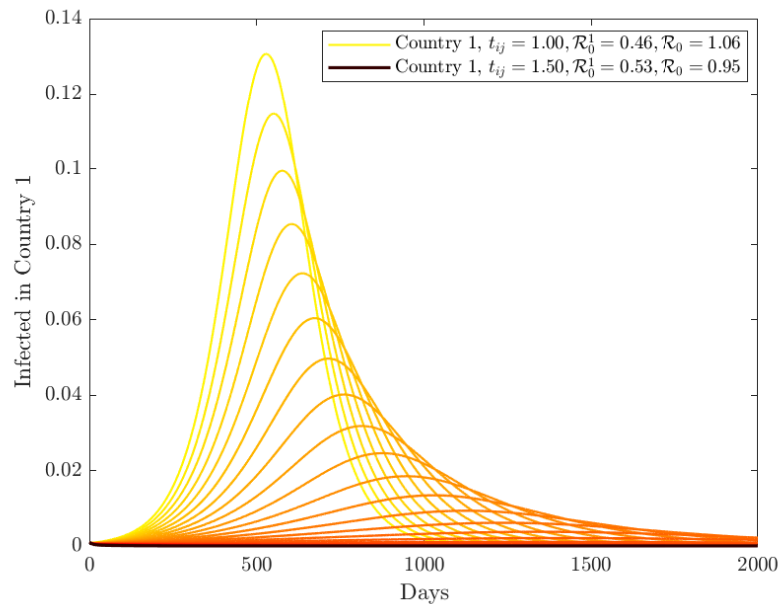
Suppose that countries are symmetric, in the sense that $L_i = L$, $Z_i = Z$, $\Gamma_{ij} = \Gamma$, $\alpha_i = \alpha$, *and* $\gamma_i = \gamma$ *for all* i. *Then, a decline in any (symmetric) international trade friction:*
(i) decreases the likelihood of a pandemic-free equilibrium being stable
(ii) increases the share of steady-state infected in both countries

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Asymmetries in Contagion and Recovery

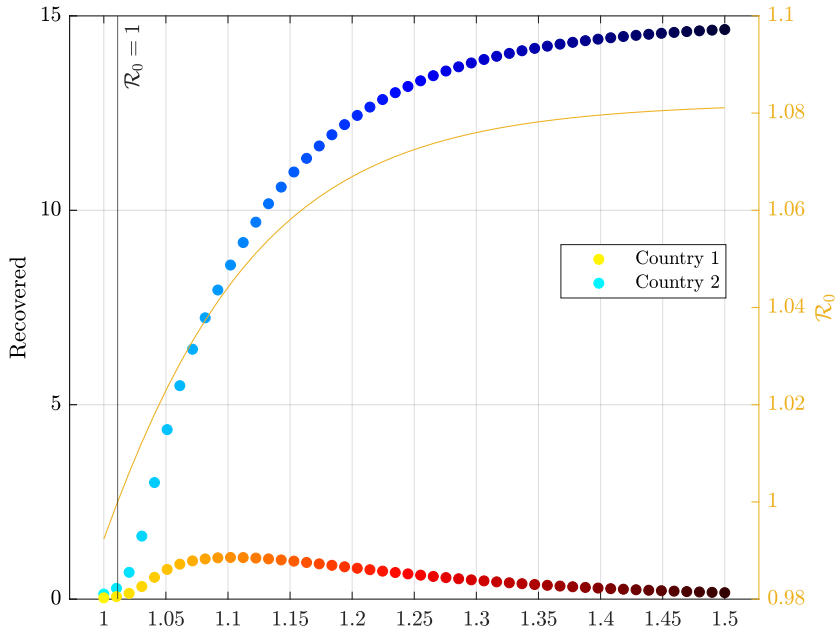
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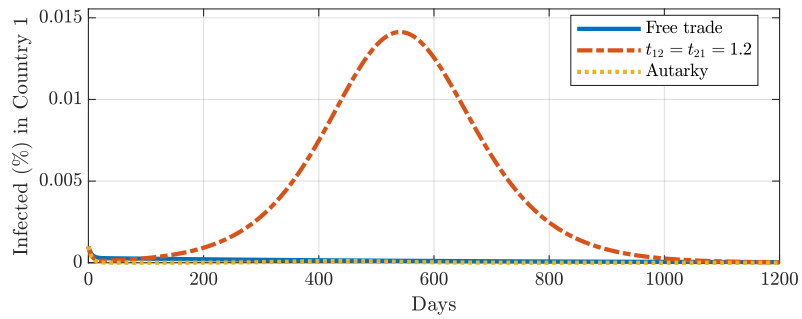
When the contagion rate α_i and the recovery rate γ_i vary sufficiently across countries, a decline in any international trade friction ***increases*** *the likelihood of a pandemic-free equilibrium being stable.*

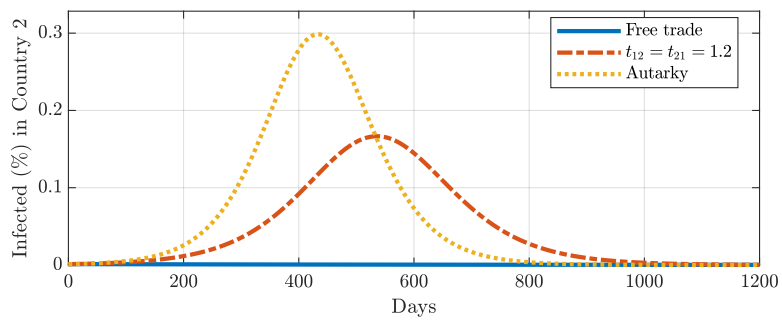
Asymmetries in Contagion and Recovery

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Other Results (Stay Tuned)

- Other results from our analysis
  - Multiple waves of infection in open economy without lock-downs
  - Characterize globalization and steady-state share of susceptibles
  - Incorporate terms of trade effects through endogenous labor supply
  - Dynamic forward-looking model of endogenous social distancing
  - Add adjustment costs - fear of future pandemics leads to slow recovery

