Exchange Rates, Prices, and Trade: Theory and Microdata

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Dynamic Trade Models with PPP Failures

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Introduction

- International macro models typically have 2-countries without serious “geography”, limited I/O structure

- Trade models typically static, no capital and ignore the future

- Often, this is fine. But what if need dynamic and realistic sector-country linkages? For example, what if wish to study distribution of trade imbalances?

- In what follows, much of the “geography” embedded via PPP failures.
  - Based on Eaton, Kortum, Neiman, Romalis (AER 2016): Global Trade Collapse
  - Based on Eaton, Kortum, and Neiman (JEDC 2016): Obstfeld-Rogoff’s 6 puzzles
  - But will highlight shortcomings and other recent papers/developments at the end
Agenda

- Simplified Model
  - Less Sectors
  - No Intermediates
  - No I/O Heterogeneity

  (See Note and Code.)

- Key Equations (Fast!)

- Application (EKNR) to Global Trade Collapse of 2008

- Shortcomings / Related Literature
Simplified Economy: Technology and Preferences

- Multiple countries $n = 1, ..., N$.

- Good $S$ ("Services") is a CES bundle of varieties $z \in [0, 1]$. Nontraded and used for consumption.

- Good $D$ ("Durables") is a CES bundle of varieties $z \in [0, 1]$. Traded and used for investment.

- Country $n$ may import durable variety from $i$, subject to $d_{ni,t}$.

- Complete markets, no uncertainty, perfect competition
Simplified Economy: Technology and Preferences

- Production in country \( n \) of variety \( z \) in sector \( j \in \{D, S\} \):
  \[
y_{j,n,t}(z) = a_{j,n,t}(z) B \left( L_{j,n,t}(z) \right)^{\beta_L} \left( K_{j,n,t}(z) \right)^{\beta_K}
  \]

- Efficiencies \( a_{j,n,t}(z) \) drawn from:
  \[
  \Pr \left[ a_{j,n,t}(z) \leq a \right] = \exp \left( - \left( \frac{a}{\gamma A_{j,n,t}} \right)^{-\theta} \right)
  \]

- Factors of production are constrained by:
  \[
  K_{n,t} = \int_0^1 K_{n,t}^D(z) dz + \int_0^1 K_{n,t}^S(z) dz
  \]
  \[
  L_{n,t} = \int_0^1 L_{n,t}^D(z) dz + \int_0^1 L_{n,t}^S(z) dz
  \]
Simplified Economy: Technology and Preferences

- Capital accumulation:

\[ K_{n,t+1} = \chi_{n,t} \left( \frac{I_{n,t}}{K_{n,t}} \right)^\alpha K_{n,t} + (1 - \delta)K_{nt} \]

- Investment:

\[ I_{n,t} = \left( \int_0^1 \chi_{n,t}^D(z)^{(\sigma-1)/\sigma} \, dz \right)^{\sigma/(\sigma-1)}, \]

where \( \chi_{n,t}^D(z) \) is absorption in \( n \) of variety \( z \) of good \( D \).
Demand shocks allow for changes in relative spending:

\[ U_n = \sum_{t=0}^{\infty} \rho^t \phi_{n,t} \ln C_{n,t} \]

Consumption:

\[ C_{n,t} = \left( \int_0^1 x_{n,t}^S(z)^{(\sigma-1)/\sigma} \, dz \right)^{\sigma/(\sigma-1)} \]

where \( x_{n,t}^S(z) = y_{n,t}^S(z) \) is absorption in \( n \) on vty \( z \) of good \( S \).
Simplified Economy: Planner’s Problem

- We solve Planner’s problem. Planner uses weights $\omega_n$.

- We impose a restriction so demand has no global component:

$$\sum_{n=1}^{N} \omega_n \phi_{n,t} = 1$$

- We interpret shadow prices as competitive prices. For example, we replace $\lambda_{n,t}^K$ with $r_{n,t}$. 
Simplified Economy: First Order Conditions

► Price of Consumption Good:

\[ p_{n,t}^S = \left( \frac{(w_{n,t})^{\beta_L}}{A_{n,t}^S} \right) \left( \frac{(r_{n,t})^{\beta_K}}{K_{n,t}^j} \right) \]

► Capital Rental Rates:

\[ r_{n,t} = p_{n,t}^j \beta_K \frac{y_{n,t}^j}{K_{n,t}^j} \]

► Labor Rental Rates:

\[ w_{n,t} = p_{n,t}^j \beta_L \frac{y_{n,t}^j}{L_{n,t}^j} \]
Simplified Economy: First Order Conditions

- Price of Investment Good:

\[ p_{n,t}^D = \left[ \sum_{i=1}^{N} \left( \frac{(w_{i,t})^{\beta_L} (r_{i,t})^{\beta_K} d_{ni,t}}{A_{i,t}^D} \right)^{-\theta} \right]^{-1/\theta} \]

- Bilateral Trade Shares:

\[ \pi_{ni,t} = \left( \frac{(w_{i,t})^{\beta_L} (r_{i,t})^{\beta_K} d_{ni,t}}{p_{n,t}^D A_{i,t}^D} \right)^{-\theta} \]
Simplified Economy: Consumption

- Consumption Spending and Production:

\[ X_{n,t}^S = Y_{n,t}^S = p_{n,t}^S C_{n,t} = \omega_n \phi_{n,t} \]

- Numeraire is world consumption expenditure:

\[ \sum_{n=1}^{\mathcal{N}} Y_{n,t}^S = \sum_{n=1}^{\mathcal{N}} X_{n,t}^S = \sum_{n=1}^{\mathcal{N}} p_{n,t}^S C_{n,t} = \sum_{n=1}^{\mathcal{N}} \omega_n \phi_{n,t} = 1 \]
Simplified Economy: Investment Euler

- Investment Euler \( (X_{n,t}^D = p_{n,t}^D I_{n,t}) \):

\[
\frac{p_{n,t}^D}{\alpha \chi_{n,t}} \left( \frac{X_{n,t}^D}{p_{n,t}^D K_{n,t}} \right)^{1-\alpha} = \rho r_{n,t+1} + \rho \frac{p_{n,t+1}^D}{\alpha \chi_{n,t+1}} \left( \frac{X_{n,t+1}^D}{p_{n,t+1}^D K_{n,t+1}} \right)^{1-\alpha} \times \\
\left[ \chi_{n,t+1} (1 - \alpha) \left( \frac{X_{n,t+1}^D}{p_{n,t+1}^D K_{n,t+1}} \right)^{\alpha} + (1 - \delta) \right]
\]

- Setting \( \alpha = 1 \) and rearrange to get more standard form:

\[
\frac{p_{n,t}^D}{\chi_{n,t}} = \rho \frac{\phi_{n,t+1}}{\phi_{n,t}} \frac{U'(C_{n,t+1})}{U'(C_{n,t})} \left[ \frac{p_{n,t+1}^D}{p_{n,t}^S} \frac{1}{p_{n,t+1}/p_{n,t}^S} (1 - \delta) + \frac{r_{n,t+1}}{p_{n,t+1}/p_{n,t}^S} \right]
\]
Simplified Economy: Production, GDP, Factor Payments

- Durable production $Y_{n,t}^D$ must be globally absorbed $X_{n,t}^D$:

$$Y_{i,t}^D = \sum_{n=1}^{N} \pi_{ni,t} X_{n,t}^D$$

- GDP:

$$Y_{n,t} = Y_{n,t}^D + Y_{n,t}^S$$
Non-Simplified Model Used in Applications

- Many sectors that contribute differentially to investment/consumption
- Production combines these many sectors as intermediates.
- Shares are country-sector specific: $\beta_{ik}, \beta_{ij}, \text{ and } \beta_{jl}$, taken from OECD
- Use quarterly data in levels on:
  1. Sectoral production $Y_{n,t}$
  2. Bilateral trade shares in each sector $\pi_{ni,t}$
  3. Services deficits $D_{n,t}$
- Use quarterly data in changes on:
  1. Sectoral prices $\hat{p}_{n,t}$
  2. Growth in labor supply $\hat{l}_{ni,t}$
Step 1: Find $\hat{K}_{tE+1}$
Backing Out Shocks

Step 2: Find \( \{ \hat{K}_t \} \)

\[ \hat{K} \]

Data Available

Shocks Not Changing (Assumption)

\( t^E \)

1.0
What To Do Now? Lots of Options

- What do shocks like like over time? Sectors? Countries?
- Counterfactuals from the past?
- Guesses about the future?
### EKNR: Backed-Out Shock Values

<table>
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<tr>
<th></th>
<th>Prior Period</th>
<th>Global Recession</th>
<th>Recovery Period</th>
<th>Prior Period</th>
<th>Global Recession</th>
<th>Recovery Period</th>
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<th>Country</th>
<th>$\hat{A}_i^C$ Prior Recession</th>
<th>$\hat{A}_i^D$ Prior Recession</th>
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<td>Rest of World</td>
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EKNR: Country Trade Counterfactuals

Trade Friction Shocks

Inv. Efficiency in Durables Shocks

Inv. Efficiency in Structures Shocks

Demand Shocks
EKNR: Country GDP Counterfactuals

Trade Friction Shocks

Inv. Efficiency in Durables Shocks

Inv. Efficiency in Structures Shocks

Demand Shocks
EKNR: Impact of Non-DEU Shocks

- **Imports**
- **Exports**
- **Production**
- **GDP**
Shortcomings and Related Literature

- **Shortcoming:** Net foreign asset position changes unrealistically
  For improvement, see: Reyes-Heroles (2016); For calibration: use GCAP?

- **Shortcoming:** CES substitution patterns
  For improvement, see: Baqaee and Farhi (2019 and others)

- **Shortcoming:** Computational efficiency
  For improvement, see: Ravikumar, Spossi, Santacreu (JIE 2019)

- **Shortcoming:** Exogenous Labor
  For improvement, see: Caliendo, Dvorkin, and Parro (ECMA 2019)

- **Shortcoming:** No nominal rigidity/currency and no asymmetry (DCP)
  For improvement, see: Nothing yet

- Dynamics and quantitative trade more generally: See great work by George Alessandria, Kim Ruhl, Esteban Rossi-Hansberg, Mike Waugh, and others