Graduate Trade (II): ECON 8433

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Plan

Week	Topic
Week 1	Introduction to Structural Gravity Equation
Week 2	Calibration and Estimation
Week 3	Mapping Models to the Data
Week 4	Designing Counterfactual Experiments in General Equilibrium
Week 5	Presentations (I) and Catch-up
Week 6	Heterogeneous Firms (I)
Week 7	Heterogeneous Firms (II)
Week 8	Ricardian Models
Week 9	Multi-Sector Models
Week 10	Global Value Chains
Week 11	Presentations (II) and Catch-up
Week 12	Extensions: Demand Side
Week 13	Extensions: Supply Side
Week 14	Extensions: Migration and Geography
Week 15	Presentations (III) and Catch-up

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Presentations Next Week

Introductory presentation

- Your questions should be precise
- Why is it interesting?
- What are the most closely related papers in the established literature?
  - What are their drawbacks?
  - How are you planning to improve upon or add to the existing work?
  - What data/models are needed to approach the question?
- What is the timeline of your research project?

Introductory presentation

- Presentation: 5-10 min
- Discussion/Questions: 5-10 min
- Sign up at: https://docs.google.com/spreadsheets/d/1bO8pBjVWRYPNJBk9LAho_HOKO8JZKdZZSyRQV9bagAA/edit?usp=sharing
- Sign up before Friday (otherwise I will sign you up myself)
- Upper-year students can present (part) of the dissertation/JMP as long as it is in progress

Counterfactual Experiments

Counterfactual Experiments

- So far, we have seen several ways of calibrating/estimating general equilibrium models of international trade
- As I have argued before, testing models of international trade is problematic – often we can match the data, e.g., on trade flows, almost perfectly
- So why do we calibrate/estimate models?

Counterfactual Experiments

The main reason for calibrating models (to the actual data) is to ask and answer various questions. There are several advantages of using calibrated models for economic analysis:

- Don't have to care about endogeneity. The model will *always* produce general equilibrium and theory-consistent results
- Possible to ask and answer many different questions
- Possible to provide quantitative rather than qualitative answers that can be taken seriously

Generally, your questions would be in the *"what if/imagine that"* form:

- Imagine that all Free Trade Agreements are abandoned
- Imagine that all trade costs decrease by 10%

Counterfactual Experiments

Using calibrated models in quantitative analysis also has certain disadvantages:

- The quality of your predictions will depend on how closely your model describes a particular aspect of the real world
- The magnitude of the answers depends a lot on the functional form assumptions

Be very careful when you interpret predictions produced by your models!

Outcomes of interest

Outcomes of interest

While we may be interested in many outcomes, there are two important outcomes that we usually care about:

- Change in trade
- Change in welfare

Today, we will see a very convenient way to calculate counterfactual changes in those variables given any changes in trade costs.

Hat Algebra

I have mentioned before that the Armington model has fundamental limitations:

- Fundamentally unobservable parameters: σ, A_i, a_{ij}, τ_{ij}
- Variables potentially measured with error: w_i and P_j

Can we calculate counterfactual outcomes without explicitly defining A_i, a_{ij}, τ_{ij} and without measuring w_i, P_j?

Hat Algebra

It turns out that there is a general approach of calculating counterfactual outcomes that does not require certain fundamentals!

- The approach is very general and can be applied to any *continuous* model in international trade
- All models in Arkolakis, Costinot and Rodriguez-Clare (2012)
- Today, I will use the Armington model to illustrate the principles but the approach will apply to many models we will consider this semester

Hat Algebra

The hat algebra approach is a fairly old approach sometimes called:

- Jones hat algebra after Jones (1965) technique
- Exact hat algebra first coined by Dekle, Eaton, and Kortum (2008)
- This technique has been known for quite some time and in CGE is called "calibrated share form"

Hat Algebra

"Rather than estimating such a model in terms of levels, we specify the model in terms of changes from the current equilibrium. This approach allows us to calibrate the model from existing data on production and trade shares. We thereby finesse having to assemble proxies for bilateral resistance (for example, distance, common language, etc.) or inferring parameters of technology."

Dekle, Eaton and Kortum (2008)

Hat Algebra

The idea behind the hat algebra is very straightforward.

- Let Y and Y' denote current and counterfactual values of GDP, respectively
- We know that in one sector Armington model $Y = Lw$
- However, we usually observe Y but not L and w

It turns out that we can calculate Y' without L and w.

Hat Algebra

Note that we can specify the relationship between Y' and Y as follows:

$$\frac{Y'}{Y} = \frac{L'w}{Lw}$$

Recall that L is exogenous such that $L = L'$. Then, the following must hold:

$$\frac{Y'}{Y} = \frac{w'}{w},$$

Define the RHS variable usng *hat notation* to get:

$$Y' = \widehat{w}\, Y,$$

where $\widehat{w}$ is the relative change in w that will be determined by the structure of the model.

Hat Algebra and Armington

Recall equations that describe the Armington model:

$$
\begin{aligned}
Y_j &= w_j L_j \\
P_j &= \left(\sum_{i \in S} a_{ij} A_i^{\sigma-1} \left(\tau_{ij} w_i \right)^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \\
\pi_{ij} &= \left(A_i^{\sigma-1} w_i^{1-\sigma} \right) \times \left(a_{ij} \tau_{ij}^{1-\sigma} \right) \times P_j^{\sigma-1} \\
w_i &= \sum_{j \in S} \pi_{ij} Y_J / L_i
\end{aligned}
$$

Let us reformulate the model using hat algebra!

Hat Algebra and Armington

- To get counterfactual results we need to observe: Y_i, π_{ij}
- We also need to specify a counterfactual shock: τ_{ij}

Let us reformulate each equation:

$$\begin{aligned} Y_j &= w_j L_j \\ Y_j' &= Y_j \widehat{w}_j \end{aligned}$$

Hat Algebra and Armington

Next, the price index:

$$P_j^{1-\sigma} = \sum_{i \in S} a_{ij} A_i^{\sigma-1} \left(\tau_{ij} w_i\right)^{1-\sigma}$$

$$\left(P_j'\right)^{1-\sigma} = \sum_{i \in S} a_{ij} A_i^{\sigma-1} \left(\tau_{ij}' w_i'\right)^{1-\sigma}$$

Note that the following holds:

$$\begin{aligned}
\left(P_j'\right)^{1-\sigma} &= \sum_{i \in S} a_{ij} A_i^{\sigma-1} \left(\tau_{ij}' w_i'\right)^{1-\sigma} \left(\frac{\tau_{ij} w_i}{\tau_{ij} w_i}\right)^{1-\sigma} \frac{P_j^{1-\sigma}}{P_j^{1-\sigma}} \\
\widehat{P}_j^{1-\sigma} &= \sum_{i \in S} \pi_{ij} \left(\widehat{\tau}_{ij} \widehat{w}_i\right)^{1-\sigma}
\end{aligned}$$

Hat Algebra and Armington

Trade shares in the benchmark are:

$$\pi_{ij} \quad = \quad \left(A_i^{\sigma-1} w_i^{1-\sigma}\right) \times \left(a_{ij}\tau_{ij}^{1-\sigma}\right) \times P_j^{\sigma-1},$$

and the counterfactual trade shares can be specified as:

$$\pi'_{ij} \quad = \quad \pi_{ij}(\widehat{\tau}_{ij}\widehat{w}_i)^{1-\sigma}\,\widehat{P}_j^{\sigma-1}$$

Hat Algebra and Armington

Given a shock $\widehat{\tau}_{ij}$, we can calculate counterfactual outcomes by solving:

$$\begin{aligned} Y_j' &= Y_j \widehat{w}_j \\ \widehat{P}_j^{1-\sigma} &= \sum_{i \in S} \pi_{ij} (\widehat{\tau}_{ij} \widehat{w}_i)^{1-\sigma} \\ \pi_{ij}' &= \pi_{ij} (\widehat{\tau}_{ij} \widehat{w}_i)^{1-\sigma} \widehat{P}_j^{\sigma-1} \\ \widehat{w}_i &= \sum_{j \in S} \pi_{ij}' Y_j \widehat{w}_j / Y_i \end{aligned}$$

Counterfactual trade and welfare are:

$$X' = \pi_{ij}' Y_j'$$
$$\widehat{r}_i = \widehat{w}_i / \widehat{P}_i$$

Hat Algebra and Armington

- Use WIOD data for 2009 (total trade)
- Calculate how trade and welfare would change if there was a 10% reduction in international trade costs
- Present your results