

# Modeling International Trade

Short Course on CGE Modeling, University of the South Pacific

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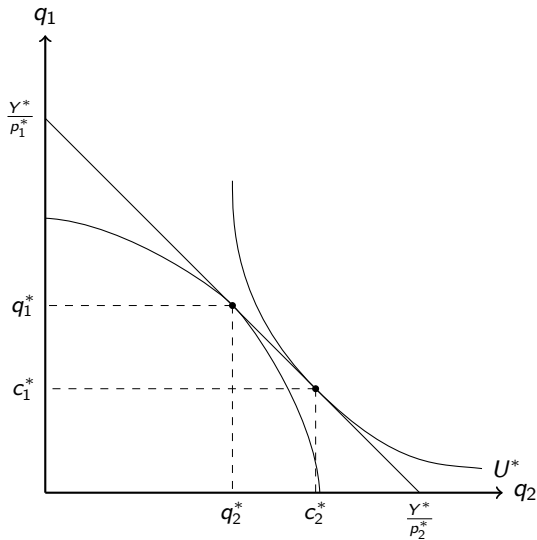
- We have now constructed the two main building blocks of a CGE model, a basic demand block and a production block (in a couple of flavors).
- Our next step is to bring the two together and thereby form a basic model of international trade.
- We'll start with a small country model, and then consider extensions to the large country case.

- 1 Building a model of a small open economy
- 2 Building a model of a large open economy

# Small Economy

- A small economy is defined as one for which the world prices are fixed.
- We already have the pieces we need to build a model of a small economy engaging in free trade.
- To do so, we use one of our models of production to model the supply side.
- The solution to the problem is the maximum value of income (GDP) at world prices.
- Given we can then solve the representative consumer's problem to characterize demand.
- International trade is the difference between the production and consumption bundles.

# Geometric Interpretation



- 1 Start with one of the models of production.
- 2 Add in the variables and parameters associated with consumption (ALPHA, BETA(I), C(I) and U).
- 3 Replace income (Y) with GDP at all occurrences.
- 4 Define a new variable X(I) (and corresponding initial value) to hold the trade flows. This should not be bounded.
- 5 Add a new equation to the model to determine the trade flows as  $X(I) = E = Q(I) - C(I)$ .
- 6 Set up the model and solve statements.

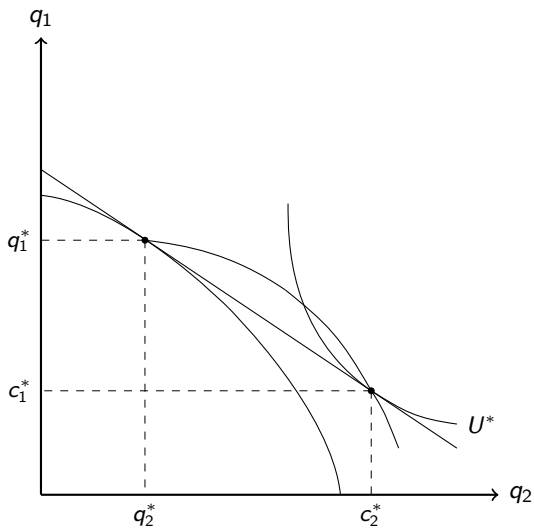
- Holding prices constant, what happens to net exports of each good as you increase the stock of capital in the economy? What if you increase the stock of labor?
- What is the numéraire here?
- How does the economy respond to a terms-of-trade shock?
- In this model we did not include a trade balance equation. Can you use the model results to show that trade balance is in fact implied by the other equations in the system?

# Large Economy

- A large economy is defined as one that is able to influence world prices.
- In other words, a large country model endogenizes world relative prices.
- This can be accomplished by adding a demand/supply curve for exports/imports.



# Geometric Interpretation



Allowing for a large country requires introducing a foreign demand/supply function for each good except the numéraire. The constant elasticity of demand/supply function is typical. This takes the form:

$$x_i = \xi_i p_i^{\varepsilon_i}$$

where  $\varepsilon_i$  is the trade elasticity (negative for exportables, positive for importables), and  $\xi_i$  is a constant (positive for exportables and negative for importables, since we have defined the latter as negative exports). The elasticities are free parameters. As  $\varepsilon_i \rightarrow -\infty$  for all exportables and  $\infty$  for all importables, the economy is effectively a small economy.

Under the sets, we explicitly define a subset of the goods to represent the numéraire, and then a subset holding all other goods:

```
SET N(I) Numeraire Good /1/;  
SET G(I) Other goods /2/;
```

Under PARAMETERS, we replace the exogenous price we used in the small country model with an initial value for the now endogenous prices, and we add names for the parameters of the export demand/import supply functions:

EPSILON(G)	Trade elasticities
XI(G)	Shifts on foreign offers
PO(I)	Initial prices

We then calibrate the parameters of the foreign demand function, using exception handling to ensure that they are defined only for the good that is not the numéraire:

```
EPSILON(G)$ (XO(G) > 0)=-3;  
EPSILON(G)$ (XO(G) < 0)=2;  
XI(G)=XO(G)/(PO(G)**EPSILON(G));
```

Next, under the `VARIABLES` heading, we have to add terms for the now endogenous prices:

`P(I) Prices`

As usual, the level for this variable is set with its initial value. We define a numéraire by fixing the value of one of the prices:

`P.FX(N)=1;`

Finally, under EQUATIONS we assign a name and define the foreign demand, using exception handling to ensure that it is defined only for the non-numéraire goods:

```
OFFER(G) .. X(G)=E=XI(G)*P(G)**EPSILON(G);
```

The rest of the model remains the same.

- What happens to world prices when the capital stock grows? What about when the stock of labor grows?
- Can you work out why we used the  $-3/ + 2$  pair for the export demand/import supply elasticities in the program?
- Is it possible to set up the model such that an increase in the capital stock in fact lowers economic welfare (as measured by the utility index) for the economy? Explain.
- Try setting the elasticities at a very large number (say  $-100$  and  $99$  for exports and imports, respectively). How do the results compare with the small country model?
- How would you model international transfers?



- To find out more about the potential effect of growth on the terms of trade, and how it may sometimes lower welfare, read the classic papers by Johnson (1955) and Bhagwati (1958).
- The GAMS examples are developed fully in Gilbert and Tower (2012), chapters 12 and 14.