ECO 745: Theory of International Economics

Jack Rossbach

Fall 2015 - Lecture 2

Last Lecture: DFS

Dornbusch, Fischer, and Samuelson (1979):

- Ricardian model: 2 countries, 1 factor of production, continuum of goods

Strengths:

- Simple and intuitive. Can be used to think about effects of trade policy and trade costs.

Weaknesses:

- No explanation for why countries differ in productivity for producing goods

- Not straightforward to extend model to multiple countries

Application: Tariff Wars

Opp (2010):

- Similar model setup: 2 countries, continuum of goods, labor only factor of production

- Constant Elasticity of Substitution (CES) preferences

$$U = \left(\int_0^1 \theta(z)^{\frac{1}{\sigma}} \left(c(z) \right)^{\frac{\sigma-1}{\sigma}} dz \right)^{\frac{\sigma}{\sigma-1}}$$

Note: $\sigma = 1 \Rightarrow$ Cobb-Douglas

Question: What is the optimal tariff rate schedule?

Tariff Wars and the Prisoner's Dilemma

Holding fixed partner‘s tariff: optimal tariff is non-zero

- Partner may retaliate and charge non-zero tariffs in return
- Global welfare always maximized by free trade

Two subquestions:

1. Without committment to free trade, what is the Nash equilibrium for tariff rates?
2. When, if ever, will one of the countries prefer the above to free trade?

Optimal Tariffs: Propositions

1. Optimal tariffs schedule is uniform across goods

2. Lerner (1936) Symmetry: Import tariff is equivalent to export tax

3. Unique interior NE in tariff rates that dominates any no-trade NE

4. NE tariff rates are increasing in degree of comparative advantage and decreasing in transportation costs

Optimal Tariffs: Main Result and Intuition

If a country is sufficiently large (productivity adjusted labor), it will prefer NE tariffs to free trade

Tradeoffs of having tariffs:

+Intensive Margin: Gain from terms-of-trade effects (relative price of exports to imports)

-Extensive margin: Lose from having to produce goods that could have been imported

If country is large enough, terms-of-trade effects dominate

- Implications for self-regulating free trade agreements

Extension: Learning-by-doing Spillovers and Growth

Young (1991): Dynamic extension of the Ricardian model with a continuum of goods

- Express set of goods on interval $z \in [0, \infty)$
- Dynamic model, but no saving ⇒ consumer's problem independent across periods
- Non-homothetic period preferences

$$u_i(c,t) = \int_0^\infty \log(c_i(z,t) + 1)dz$$

Therefore not every good will necessarily be consumed

Production Technology

Labor still only factor of production

$$y_i(z,t) = \frac{l_i(z,t)}{a_i(z,t)}$$

But now allow $a_i(z,t)$ to change over time via learning-by-doing spillovers.

Learning-by-doing

Part 1: Impose a minimal bound on unit labor requirements for each good

$$a_i(z,t) \geq \bar{a}(z) = e^{-z}$$

Part 2: Assume learning-by-doing spillovers if producing a good which hasn't hit bound

$$\frac{\dot{a}_i(z,t)}{a_i(z,t)} = -\int_0^\infty b_i(z',t) l_i(z',t) dz' \ , \qquad if\ a_i(z,t) > \bar{a}(z)$$

and $= 0$ if $a_i(z,t) > \bar{a}(z)$. Here $\dot{a}_i(z,t) \coloneqq \partial a_i(z,t)/\partial t$, and ($b > 0$):

$$b_i(z',t) = \begin{cases} b, & if\ a_i(z',t) > \bar{a}(z') \\ 0, & if\ a_i(z',t) = \bar{a}(z') \end{cases}$$

Initial State

At $t_0 = 0$ let there be $z_{i,0}$ such that

$$a_i(z,0) = \begin{cases} \bar{a}(z), & if\ z \leq z_{i,0} \\ e^{z-2z_{i,0}}, & if\ z > z_{i,0} \end{cases}$$

Where again $\bar{a}(z) = e^{-z}$

Equilibrium

1. Given prices, consumers maximize utility
2. Given prices, firms maximize profits
3. Markets clear in every period

Consumer's Problem

Maximize discounted utility:

$$\max \int_0^\infty e^{-\rho t} \left[\int_0^\infty \log(c_i(z,t) + 1) dz \right] dt$$

Subject to budget constraint in each period

$$\int_0^\infty p_i(z,t) c_i(z,t) dz = w_i(t) L_i(t) , \qquad \forall t$$

Firm's Problem

Maximize profits in each period t:

$$\max p_i(z,t)y_i(z,t) - w_i(t)l_i(z,t)$$

Subject to technology

$$y_i(z,t) = \frac{l_i(z,t)}{a_i(z,t)}$$

Markets Clear

Goods market clears in each period (here we're in autarky)

$$c_i(z,t) = y_i(z,t), \qquad \forall t$$

Labor market clears

$$\int_0^\infty l_i(z,t)dz = L_i(t)$$

Equilibrium Allocation

For any given period t, there will be cutoff goods $M_i(t)$ and $N_i(t)$ ($M_i(t) < N_i(t)$) such that

$$y_i(z,t) = 0, \qquad if\ z < M_i(t)$$

$$y_i(z,t) > 0, \qquad if\, M_i(t) \le z \le N_i(t)$$

$$y_i(z,t) = 0, \qquad if\ z > N_i(t)$$

and we can use FOC of consumers problem to get

$$y_i(z,t) = \frac{a_i\left(\bar{z}_{i,t}, t\right)}{a_i(z,t)} - 1, \qquad \forall z \in [M_i(t), N_i(t)]$$

Noting that $\bar{a}\big(M_i(t)\big) = a_i(N_i(t), t)$

Symmetry and Range of Products Consumed

Let $T_i(t)$ be the maximal good such that $a(T_i(t), t) = \bar{a}\big(T_i(t)\big)$

Then we have symmetry around that point such that $T_i(t) - M_i(t) = N_i(t) - T_i(t)$.
Let $\tau_i(t) = \frac{N_i(t) - M_i(t)}{2}$ be the “radius” of the range of goods consumed. We have two results:

1. From the learning by doing equation: $\frac{dT_i(t)}{dt} = \int_{T_i(t)}^{N_i(t)} l(z,t)dz$

2. From symmetry around $T_i(t)$: $e^{T_i(t)} = 2(\tau_i(t) - 1)e^{\tau_i(t)} + 2$

From these, have that $T_i(t)$ increases over time, and as it increases the range of goods increases and moves to the right.

Growth

Can examine growth rate at time t:

$$g(t) \coloneqq \frac{\int_0^\infty p_i(z,t)\left(\frac{\partial y_i(z,t)}{\partial t}\right)dz}{\int_0^\infty p_i(z,t)y_i(z,t)\,dz} - \frac{\left(\frac{dL_{i,t}}{dt}\right)}{L_{i,t}}$$

which, by Leibnitz' rule (normalize $w_i(t) = 1$):

$$= \frac{\int_0^\infty \left(-\frac{\partial a_i(z,t)}{\partial t}\right) y_i(z,t)dz}{L_{i,t}}$$

$$= \frac{-\int_{T_i(t)}^{N_i(t)} \left(-b\int_{T_i(t)}^\infty l(z',t)dz'\right) a(z,t)y(z,t)dz}{L_{i,t}} = \frac{bL_{i,t}}{4}$$

Growth rate is proportional to labor supply (scale effects)

International Trade

Now suppose there are two countries that can engage in free trade

Goods market clearing condition becomes:

$$c_1(z,t) + c_2(z,t) = y_1(z,t) + y_2(z,t), \qquad \forall z,t$$

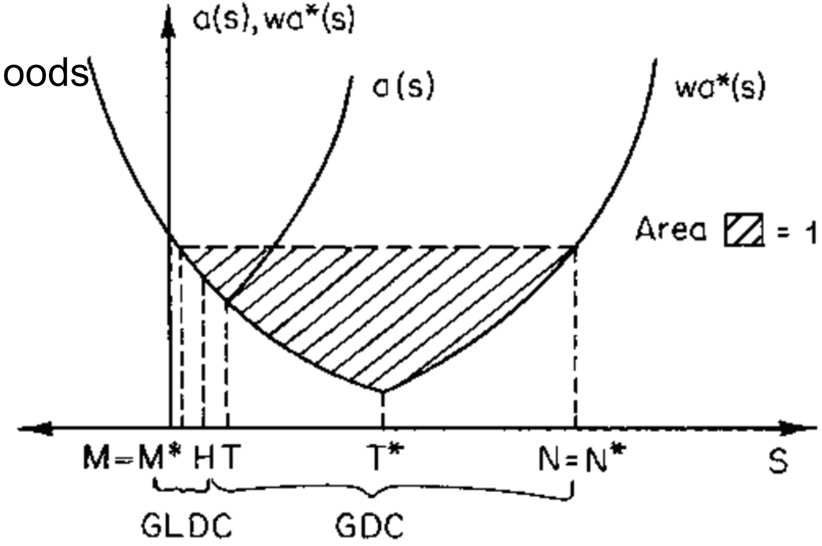
Equilibrium with Trade

Different cases depending on initial states before opening to free trade. Drop subscripts and time indices: denote variable $X_1(t)$ as X for country 1 and $X_2(t)$ as X^* for country 2.

Assume country 2 is more advanced that country 1: $T^* > T$. (Call country 2 the "rich country")

Case 1: $w^*/w = 1$ (following pictures all from Young (1991))

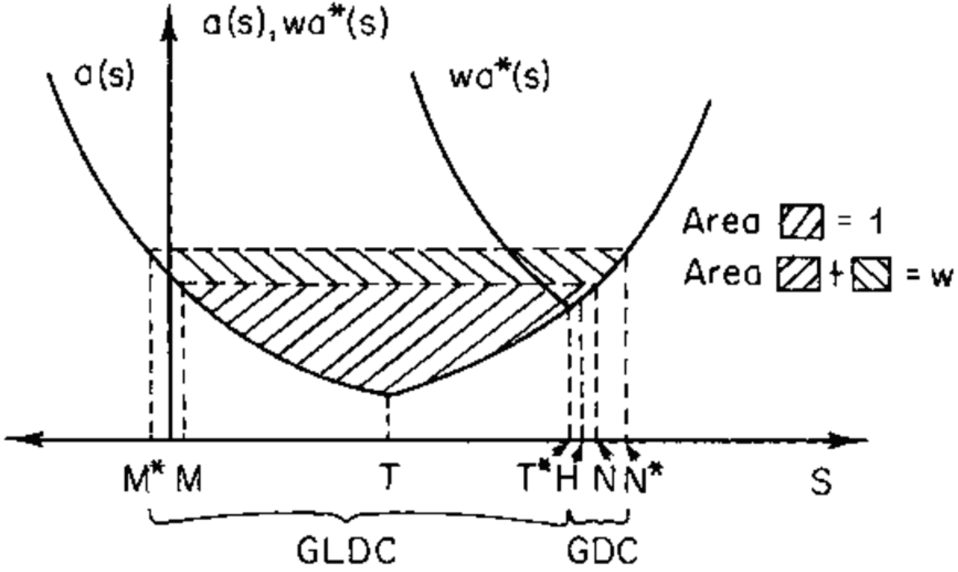
- Both countries consume same range of goods
- Rich country (Country 2) produces everything above T



Equilibrium with Trade

Case 2: $w^*/w = e^{2(T^*-T)}$

- Rich country consumes a wider variety of goods
- Rich country produces everything to the right of T^*

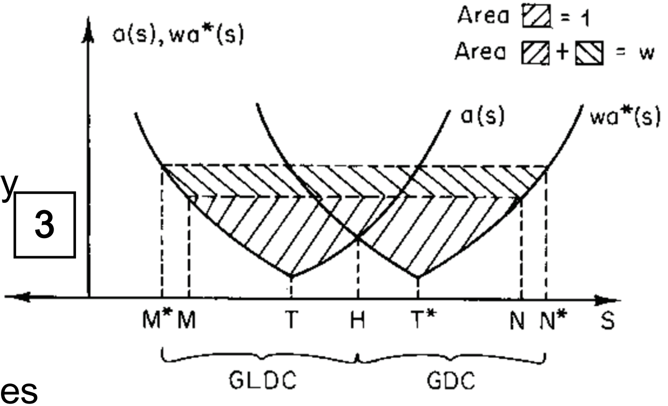


Equilibrium with Trade

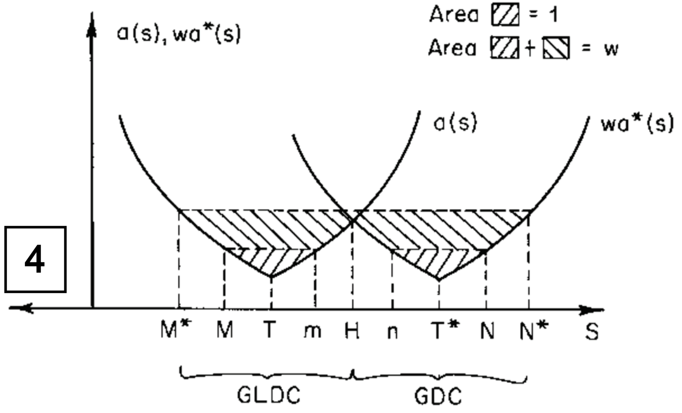
Case 3/4/5: $e^{2(T^*-T)} > w^*/w > 1$

- Rich country consumes a wider variety of goods
- Curves intersect: all above intersection produced by rich country
- Case 4: middle range of goods not consumed by poor country
- In case 5, middle range of goods not consumed by both countries

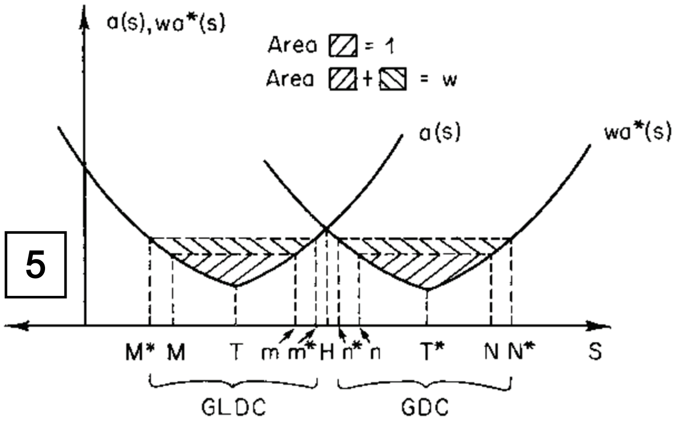
3



4



5



Effect of Trade on Growth

Learning by doing spillovers are still only on goods produced (same as before):

$$\frac{\dot{a}_i(z,t)}{a_i(z,t)} = -\int_0^\infty b_i(z',t) l_i(z',t) dz' \ , \qquad if\ a_i(z,t) > \bar{a}(z)$$

and $= 0$ if $a_i(z,t) > \bar{a}(z)$. Here $\dot{a}_i(z,t) \coloneqq \partial a_i(z,t)/\partial t$, and ($b > 0$):

$$b_i(z',t) = \begin{cases} b, & if\ a_i(z',t) > \bar{a}(z') \\ 0, & if\ a_i(z',t) = \bar{a}(z') \end{cases}$$

How does trade affect learning by doing growth rates?

- If a country exports goods it has already hit the bound on while importing goods it hasn't, its growth rate will slow ⇒ the less developed country grows slower under free trade than autarky
- Despite this: Welfare is higher under trade even for less developed country

Ricardian Trade Topic: Revealed Comparative Advantage

How can we tell if a country has a comparative advantage in a good? Balassa (1965):

$$\text{RCA Index} = \frac{\left(\frac{Country\ i:\ Exports\ in\ good\ z}{Country\ i:\ Exports\ in\ all\ goods}\right)}{\left(\frac{World: Exports\ in\ good\ z}{World: Exports\ in\ all\ goods}\right)}$$

If $RCA\ Index > 1$, then country i has a revealed comparative advantage in good z

Lots of issues, but simple and somewhat commonly used