Stanford Economics 266: International Trade
— Lecture 18: Trade Policy (Theory I)—

Trade Policy Literature

A Brief Overview

- **Key questions**:
  1. Why are countries protectionist? Can protectionism ever be "optimal"? Can we explain how trade policies vary across countries, industries, and time?
  2. How should trade agreements be designed? Can we explain the main institutional features of actual trade agreements (e.g. WTO, NAFTA, EU)?
- In order to shed light on these questions, one needs to take a stand on:
  1. **Economic environment:** What is the market structure? Are there distortions, e.g. unemployment or pollution?
  2. **Political environment:** What is the objective function that governments aim to maximize, e.g. social welfare, welfare of the median voter, political support? What are the trade policy instruments, e.g. import tariffs, quotas, product standards? Are trade policy instruments the only instruments available?
  3. **Constraints on the set of feasible contracts:** Do trade agreements need to be self-enforcing? How costly is it "to complete" contracts?

This Lecture

- We will restrict ourselves to environments such that:
  1. All markets are perfectly competitive
  2. There are no distortions
  3. Governments only care about welfare
- Only motive for trade protection is **price manipulation**
  - Consumers and firms are price-takers on world markets
  - Governments internalize that exports and imports affect prices
- We will be focusing on three questions:
  1. How should trade taxes vary across countries and industries?
  2. Quantitatively how important are the gains from such manipulation?
  3. What is the rationale for trade agreements in this environment?

1. A First Look at Unilaterally Optimal Tariffs

Economic Environment

- Consider a world economy with 2 countries, $c = 1, 2$
- There are two goods, $i = 1, 2$, both produced under perfect competition
  - good 2 is used as the numeraire, $p_2^w = 1$
- **Notations:**
  - $p^c \equiv p_1^c / p_2^c$ is relative price in country c
  - $p^w \equiv p_1^w / p_2^w$ is "world" (i.e. untaxed) relative price
  - $d_i^c \left(p^c, p^w\right)$ is demand of good i in country c
  - $y_i^c \left(p^c\right)$ is supply of good i in country c

Economic Environment (Cont.)

- Country 1 (2) is a natural importer of good 1 (2):

$$
\begin{aligned}
m_1^1\left(p^1, p^w\right) &\equiv d_1^1(p^1, p^w) - y_1^1\left(p^1\right) > 0 \\
m_2^2\left(p^2, p^w\right) &\equiv d_2^2(p^2, p^w) - y_2^2\left(p^2\right) > 0 \\
x_2^1\left(p^1, p^w\right) &\equiv y_2^1(p^1) - d_2^1\left(p^1, p^w\right) > 0 \\
x_1^2\left(p^2, p^w\right) &\equiv y_1^2(p^2) - d_1^2\left(p^2, p^w\right) > 0
\end{aligned}
$$

- Trade is balanced:

$$
\begin{aligned}
p^w m_1^1\left(p^1, p^w\right) &= x_2^1\left(p^1, p^w\right) \\
m_2^2\left(p^2, p^w\right) &= p^w x_1^2\left(p^2, p^w\right)
\end{aligned}
$$

- Market clearing for good 2 requires:

$$
x_2^1\left(p^1, p^w\right) = m_2^2\left(p^2, p^w\right) \tag{1}
$$

- Both governments can impose an ad-valorem tariff t^c on their imports

$$\begin{aligned} p_c^c &= (1 + t^c)\, p_c^w \\ p_{-c}^c &= p_{-c}^w \end{aligned}$$

- Tariffs create a wedge between the world and local prices which implies

$$p^1 = \left(1 + t^1\right) p^w \tag{2}$$

$$p^2 = p^w / \left(1 + t^2\right) \tag{3}$$

- **Comments:**
  - If the only taxes are import tariffs, then local prices faced by consumers and producers are the same, as implicitly assumed in our previous slides
  - Equations (1)-(3) implicitly define $p^w \equiv p^w\left(t^1, t^2\right)$ and $p^c \equiv p^c\left(t^c, p^w\right)$

- Both governments are welfare-maximizer. They simultaneously set t^c in order to maximize utility of representative agent

$$\max_{t^c} V^c\left(p^c, I^c\right) \equiv V^c\left[p^c, R^c\left(p^c\right) + T^c\left(p^c, p^w\right)\right] \tag{4}$$

where:

$$R^c(p^c) \equiv \max_y \left\{p_1^c y_1 + p_2^c y_2 | y \text{ feasible}\right\}$$
$$T^c\left(p^c, p^w\right) \equiv t^c p_c^w m_c^c\left(p^c, p^w\right) = \begin{cases} \left(p^1 - p^w\right) m_1^1\left(p^1, p^w\right) & \text{if } c = 1 \\ \left(p^w / p^2 - 1\right) m_2^2\left(p^2, p^w\right) & \text{if } c = 2 \end{cases}$$
p^1, p^2, p^w satisfy Equations $(1) - (3)$

Unilaterally Optimal Tariffs

- **Proposition 1** *For both countries, unilaterally optimal (Nash) tariffs satisfy*

$$t^c = \frac{1}{\varepsilon^{-c}}, \text{ where } \varepsilon^{-c} \equiv \frac{d \ln x^{-c}}{d \ln p^w}$$

- **Proof:**

1. For expositional purposes we focus on country 1. FOC $\Rightarrow$

$$\left(\frac{V_p^1}{V_I^1}\right)\left(\frac{dp^1}{dt^1}\right) + \left(\frac{dR^1}{dp^1}\right)\left(\frac{dp^1}{dt^1}\right) + \left(\frac{dp^1}{dt^1} - \frac{\partial p^w}{\partial t^1}\right) m_1^1\left(p^1, p^w\right) + t^1 p^w \frac{dm_1^1\left(p^1, p^w\right)}{dt^1} = 0$$

2. Roy's identity $\Rightarrow \frac{V_p^1}{V_I^1} = -d_1^1(p^1, p^w)$
3. Perfect competition $\Rightarrow \frac{dR^1}{dp^1} = y_1^1(p^1, p^w)$
4. 1+2+3 $\Rightarrow t^1 = \left(\frac{\partial \ln p^w}{\partial t^1}\right) / \left(\frac{d \ln m_1^1\left(p^1, p^w\right)}{dt^1}\right)$
5. 4 + market clearing, $m_1^1\left(p^1, p^w\right) = x_1^2\left(p^2, p^w\right) \Rightarrow t^1 = 1/\varepsilon^2$

How Should Tariffs Vary Across Countries (and Industries)?

- Proposition 1 offers a simple theory of tariff formation:
  - **tariffs≡ inverse of the elasticity of foreign export supply**
  - this is true whether or not the other government is imposing its Nash tariff
  - though other government's tariff does affect elasticity of foreign export supply
- In the case of a small open economy, $\frac{\partial p^w}{\partial t^1} = 0 \Rightarrow \varepsilon^2 = +\infty$
  - a small open economy never has an incentive to impose a tariff
- Import tariffs are intimately related to countries' market power
  - it is countries' ability to improve their terms-of-trade that lead to strictly positive tariffs
- **Potential concerns about Proposition 1 as a positive theory:**
  1. Do we really believe that governments maximize welfare?
  2. How many countries are "large" enough to affect their terms-of-trade?
  3. Do trade negotiators really care about their terms-of-trade?

2. The Primal Approach

The Primal Approach

- So far we have focused on a specific policy instrument: import tariffs
- It is often easier to proceed in two steps:
  1. Solve for the optimal allocation assuming that governments can directly choose output and consumption
  2. Show how that allocation can be implemented using trade taxes
- Formally, the planning problem of country 1 can be expressed as:

$$\max_{m_1^1, m_2^1, y_1^1, y_2^1} U^1 \left(m_1^1 + y_1^1, m_2^1 + y_2^1 \right)$$

subject to:

$$\begin{aligned} p^w \left(m_1^1 \right) m_1^1 + m_2^1 &= 0 \\ F \left(y_1^1, y_2^1 \right) &\leq 0 \end{aligned}$$

- 1st constraint$\equiv$ Trade balance; 2nd constraint$\equiv$PPF
- $p^w \left(m_1^1 \right) \equiv$ inverse of country's 2 export supply curve, i.e., world price at which country 2 is willing to export m_1^1 units of good 1 to country 1

The Primal Approach

Optimal Wedges

- FOC associated with m^1 imply

$$U_1^1 = \lambda \left(p^w + m_1^1 \frac{dp^w}{dm_1^1} \right)$$
$$U_2^1 = \lambda$$

- **Intuition:**
  - Country 1 has monopsony power
  - MC of imports $\equiv p^w$ + price increase infra-marginal units $m_1^1 \frac{dp^w}{dm_1^1}$
- At the optimum, there is a "wedge" between MRS and world price

$$\frac{U_1^1}{U_2^1} = p^w \left(1 + \frac{d \ln p_1^w}{d \ln m_1^1} \right)$$

- The more elastic world prices are, the bigger the wedge is

- In a competitive equilibrium, $U_1^c / U_2^c \equiv$ domestic price in country 1
  - so optimum can be implemented by creating a wedge of size $1 + \frac{d \ln p_1^w}{d \ln m_1^1}$ between the domestic price and the world price
- **Two natural candidates:**
  - Import tariff $t^1 = \frac{d \ln p_1^w}{d \ln m_1^1} = \frac{1}{\varepsilon^2}$ $\left(\Rightarrow \left(\frac{U_1^1}{U_2^1}\right)_{optimum} = p^w \left(1 + t_1\right)\right)$
  - Export tax equal to $\tau_1 = \frac{1}{1+\varepsilon^2}$ $\left(\Rightarrow \left(\frac{U_1^1}{U_2^1}\right)_{optimum} = p^w / \left(1 - \tau_1\right)\right)$
- **Many other possible instruments:**
  - Any combination of import tariffs and export taxes s.t. $\left(1 + t_1\right) / \left(1 - \tau_1\right) = 1 + \frac{d \ln p_1^w}{d \ln m_1^1}$ (Lerner Symmetry)
  - Identical consumption and production taxes
  - Quantitative restrictions

The Primal Approach

Foreign Export Supply versus Foreign Import Demand

- Same result applies if we focus on country 2's import demand curve
- Let $\tilde{p}^w\left(m_2^1\right) \equiv$ inverse of country 2's import demand curve
  - $p^w(\cdot)$ and $\tilde{p}^w$ satisfy $p^w\left(-m_1^2\left(p^w\right)\right) = m_2^2\left(p^w\right)$
  - The elasticities of foreign export supply, $\varepsilon^2 \equiv \frac{d\ln\left(-m_1^2\right)}{d\ln p^w}\left(= \frac{1}{d\ln p^w / d\ln m_1^1}\right)$, and import demand, $\eta^2 \equiv \frac{d\ln\left(m_2^2\right)}{d\ln p^w}\left(= \frac{1}{d\ln \tilde{p}^w / d\ln m_2^1}\right)$ thus satisfy $1 + \varepsilon^2 = \eta^2$.
- Using the same logic as before, one can show that

$$\frac{U_1^1}{U_2^1} = \frac{p^w}{1 - \left(d\ln\tilde{p}^w / d\ln m_2^1\right)}$$

- Thus optimal export tax should be equal to

$$\tilde{\tau}_1 = \frac{d\ln\tilde{p}^w}{d\ln m_2^1} = \frac{1}{\eta^2} = \frac{1}{1+\varepsilon^2} = \tau_1.$$

The Primal Approach

Beyond Two-ness

- Two-good model is simple because only one relative price to keep track of
- How do the previous insights generalize to many goods?
  - If p_i^w only depends on m_i, then results trivially extend (e.g. quasi-linear preferences abroad + specific factor model)
  - But in general, one would need to take into account that world price of good i may also depend on imports of other goods (Dixit 1985, Bond 1990)
  - In such situations, export subsidies may be optimal (Feenstra 1986)
- Two simple cases that can be work out analytically:
  - Additive separability (natural in macro context)+ endowment economy; see Costinot, Lorenzoni, and Werning (2013)
  - CES preferences (natural in trade?) + Ricardian economy; see Costinot, Donaldson, Vogel, and Werning (2013)

3. Quantitative Issues

Back to Armington Model

- The simplest place to start to get a sense of the quantitative importance of terms-of-trade motive is to go back to Armington model
- In line with previous analysis assume that:
  - there are only two countries, 1 and 2
  - country 1 is endowed with e^1 units of good 2 (so that it is still a natural importer of good 1)
  - country 2 is endowed with e^2 units of good 1 (so that it is still a natural importer of good 2)
- Representative agents have CES utility with elasticity σ:

$$U^c = \left(d_1^c\right)^{\frac{\sigma-1}{\sigma}} + \left(d_2^c\right)^{\frac{\sigma-1}{\sigma}}$$

- Trade between 1 and 2 is subject to iceberg trade costs $\delta^{12} \geq 1$

Unilaterally Optimal Tariff

- Armington model with two countries is special case of models studied before. So we only need to compute elasticity of country 2's export supply
- Given endowment and CES assumptions we have

$$x_1^2\left(p^w\right) = e^2 - \frac{\left(p^w e^2\right)\left(p^w\right)^{-\sigma}}{\left(\delta^{12}\right)^{1-\sigma} + \left(p^w\right)^{1-\sigma}} = \frac{e^2\left(\delta^{12}\right)^{1-\sigma}}{\left(\delta^{12}\right)^{1-\sigma} + \left(p^w\right)^{1-\sigma}}$$

- Country 2's export supply is thus given by

$$\varepsilon^2 = \frac{d \ln x_1^2}{d \ln p^w} = \frac{(\sigma - 1)\left(p^w\right)^{1-\sigma}}{\left(\delta^{12}\right)^{1-\sigma} + \left(p^w\right)^{1-\sigma}}$$

- Let $\lambda^2 \equiv \frac{p^w d_1^2}{p^w e^2} = \frac{\left(p^w\right)^{1-\sigma}}{\left(\delta^{12}\right)^{1-\sigma} + \left(p^w\right)^{1-\sigma}}$ denote country 2's share of expenditure on its own good
- Using this notation, the optimal tariff in country 1 is given by

$$t^1 = \frac{1}{(\sigma - 1)\lambda^2}$$

A First Look at Numbers

- Previous formula offers simple way to quantify optimal tariff:
  - From gravity equation we know that $\sigma - 1 \simeq 5$
  - From most countries, ROW is almost under autarky, $\lambda^2 \simeq 1$
  - Thus previous formula suggests $t^1 \simeq 20\%$
- Next we will go through quantitative results from Costinot and Rodriguez-Clare (2013) in more general gravity models
  - Results suggest that this is not a bad approximation
  - See also Alvarez and Lucas (2007) and Ossa (2011a, 2011b)
- Analytically, one can show that previous formula also applies to gravity models featuring monopolistic competition with homogeneous firms à la Krugman (1980); see Gros (1987) and Helpman and Krugman (1989)
  - Compared to analysis in ACR, we only have two countries, no firm heterogeneity, no tariff revenues in country 2. Not clear that equivalence would still hold without these strong assumptions

What Do Unilaterally Optimal Tariffs Look Like?

Costinot and Rodriguez-Clare (2013)

What Are the Welfare Consequences of 40% a Tariff?

Costinot and Rodriguez-Clare (2013)

How Important is Monopolistic Competition?

Costinot and Rodriguez-Clare (2013)

Summary of Welfare Effects in Gravity Models

- Welfare gains from unilateral import tariffs over surprisingly large range
  - In one-sector Armington model, unilaterally optimal tariff $\simeq 1/\text{trade elasticity}$
  - Trade elasticity of 5 implies optimal tariffs of 20% around the world
  - It takes import tariffs to be as high as 50% to get back to the welfare levels observed under free trade
- Welfare effects of large unilateral tariffs on other countries minimal
- **Questions:**
  - Are these numbers we can believe in?
  - Is there something in the data and absent from baseline gravity model that would dramatically affect these numbers?

4. Rationale for Trade Agreements

Are Unilaterally Optimal Tariffs Pareto-Efficient?

- Following Bagwell and Staiger (1999), we introduce

$$W^c\left(p^c, p^w\right) \equiv V^c\left[p^c, R^c\left(p^c\right) + T^c\left(p^c, p^w\right)\right]$$

- Differentiating the previous expression we obtain

$$dW^c = \left[W^c_{p^c}\left(\frac{dp^c}{dt^c}\right) + W^c_{p^w}\left(\frac{\partial p^w}{\partial t^c}\right)\right] dt^c + W^c_{p^w}\left(\frac{\partial p^w}{\partial t^{-c}}\right) dt^{-c}$$

- The slope of the iso-welfare curves can thus be expressed as

$$\left(\frac{dt^1}{dt^2}\right)_{dW^1=0} = -\frac{W^1_{p^w}\left(\frac{\partial p^w}{\partial t^2}\right)}{W^1_{p^1}\left(\frac{dp^1}{dt^1}\right) + W^1_{p^w}\left(\frac{\partial p^w}{\partial t^1}\right)} \quad (5)$$

$$\left(\frac{dt^1}{dt^2}\right)_{dW^2=0} = -\frac{W^2_{p^2}\left(\frac{dp^2}{dt^2}\right) + W^2_{p^w}\left(\frac{\partial p^w}{\partial t^2}\right)}{W^2_{p^w}\left(\frac{\partial p^w}{\partial t^1}\right)} \quad (6)$$

Are Unilaterally Optimal Tariffs Pareto-Efficient?

- **Proposition 2** *If countries are "large," unilateral tariffs are not Pareto-efficient.*
- **Proof:**
  1. By definition, unilateral (Nash) tariffs satisfy

$$W^c_{p^c}\left(\frac{dp^c}{dt^c}\right) + W^c_{p^w}\left(\frac{\partial p^w}{\partial t^c}\right) = 0,$$

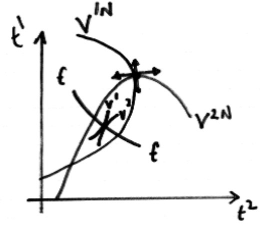
  2. If $\left(\frac{\partial p^w}{\partial t^1}\right)$ and $\left(\frac{\partial p^w}{\partial t^2}\right) \neq 0$, 1+ (5) and (6) $\Rightarrow$

$$\left(\frac{dt^1}{dt^2}\right)_{dW^1=0} = +\infty \neq 0 = \left(\frac{dt^1}{dt^2}\right)_{dW^2=0}$$

  3. Proposition 2 directly derives from 2 and the fact that Pareto-efficiency requires $\left(\frac{dt^1}{dt^2}\right)_{dW^1=0} = \left(\frac{dt^1}{dt^2}\right)_{dW^2=0}$

Are Unilaterally Optimal Tariffs Pareto-Efficient?

Graphical analysis (Johnson 1953-54)



- N corresponds to the unilateral (Nash) tariffs
- E-E corresponds to the contract curve
- If countries are too asymmetric, free trade may not be on contract curve

What is the Source of the Inefficiency?

- The *only* source of the inefficiency is the terms-of-trade externality
- Formally, suppose that governments were to set their tariffs ignoring their ability to affect world prices:

$$W^1_{p^1} = W^2_{p^2} = 0$$

- Then Equations (5) and (6) immediately imply

$$\left(\frac{dt^1}{dt^2}\right)_{dW^1=0} = -\left(\frac{\partial p^w}{\partial t^2}\right) \Big/ \left(\frac{\partial p^w}{\partial t^1}\right) = \left(\frac{dt^1}{dt^2}\right)_{dW^1=0}$$

- **Intuition:**
    - In this case, both countries act like small open economies
    - As a result, $t^1 = t^2 = 0$, which is efficient from a world standpoint
- **Question for next lecture:**
    - *How much does this rely on the fact that governments maximize welfare?*