14.581 International Trade
— Lecture 24: Trade Policy Theory (III)—

Today's Plan

1. Political-Economy Motives
2. Tax Neutrality
3. Other Issues

1. Political-Economy Motives

Economic Environment

Endowment economy

- We consider a simplified version of Grossman and Helpman (1994)
  - Endowment rather than specific-factor model
- To abstract from TOT considerations, GH consider a small open economy
  - If governments were welfare-maximizing, trade taxes would be zero
- There are $n + 1$ goods, $i = 0, 1, ..., n$, produced under perfect competition
  - good 0 is the numeraire with domestic and world price equal to 1
  - p_i^w and p_i denote the world and domestic price of good i, respectively
- Individuals are endowed with 1 unit of good $0 + 1$ unit of another good $i \neq 0$
  - we refer to an individual endowed with good i as an i-individual
  - α_i denote the share of i-individuals in the population
  - total number of individuals is normalized to 1

Economic Environment (Cont.)

Quasi-linear preferences

- All individuals have the same quasi-linear preferences

$$U = x_0 + \sum_{i=1}^{n} u_i \left(x_i\right)$$

- Indirect utility function of i-individual is therefore given by

$$V_i \left(\mathbf{p}\right) = 1 + p_i + t \left(\mathbf{p}\right) + s \left(\mathbf{p}\right)$$

where:

$$\begin{aligned} t \left(\mathbf{p}\right) & \equiv & \text{government's transfer [to be specified]} \\ s \left(\mathbf{p}\right) & \equiv & \sum_{i=1}^{n} u_i \left(d_i(p_i)\right) - \sum_{i=1}^{n} p_i d_i(p_i) \end{aligned}$$

- **Comment:**
    - Given quasi-linear preferences, this is *de facto* a partial equilibrium model

- For all goods $i = 1, ..., n$, the government can impose an ad-valorem import tariff/export subsidy t_i

$$p_i = (1 + t_i)\, p_i^w$$

- We treat $\mathbf{p} \equiv (p_i)_{i=1,...,n}$ as the policy variables of our government
- The associated government revenues are given by

$$t(\mathbf{p}) = \sum_{i=1}^{n} (p_i - p_i^w)\, m_i(p_i) = \sum_{i=1}^{n} (p_i - p_i^w)\, [d_i(p_i) - \alpha_i]$$

- Revenues are uniformly distributed to the population so that $t(\mathbf{p})$ is also equal to the government's transfer, as assumed before

Political Environment

Lobbies

- An *exogenous* set L of sectors/individuals is politically organized
  - we refer to a group of agents that is politically organized as a *lobby*
- Each lobby i chooses a schedule of contribution $C_i(\cdot) : (\mathbb{R}^+)^n \to \mathbb{R}^+$ in order to maximize the total welfare of its members net of the contribution

$$\max_{C_i(\cdot)} \alpha_i V_i\left(\mathbf{p}^0\right) - C_i\left(\mathbf{p}^0\right)$$

$$\text{subject to:} \qquad \mathbf{p}^0 = \arg\max_{\mathbf{p}} G(\mathbf{p})$$

where $G(\cdot)$ is the objective function of the government [to be specified]

Political Environment

Government

- Conditional on the contribution schedules announced by the lobbies, government chooses the vector of domestic prices in order to maximize a weighted sum of contributions and social welfare

$$\max_{\mathbf{p}} G(\mathbf{p}) \equiv \sum_{i \in L} C_i(\mathbf{p}) + aW(\mathbf{p})$$

where

$$W(\mathbf{p}) = \sum_{i=1}^{n} \alpha_i V_i(\mathbf{p}) \text{ and } a \geq 0$$

- **Comments:**
  - GH (1994) model has the structure of *common agency problem*
  - Multiple principals≡ lobbies; one agent≡ government
  - We can use Bernheim and Whinston's (1986) results on *menu auctions*

Equilibrium Contributions

- We denote by $\left\{ \left(C_i^0 \right)_{i \in L}, \mathbf{p}^0 \right\}$ the SPNE of the previous game
  - we restrict ourselves to interior equilibria with differentiable equilibrium contribution schedules
  - whenever we say "in any SPNE", we really mean "in any interior SPNE where C^0 is differentiable"
- **Lemma 1** *In any SPNE, contribution schedules are locally truthful*

$$\nabla C_i^0 \left(\mathbf{p}^0 \right) = \alpha_i \nabla V_i \left(\mathbf{p}^0 \right)$$

- **Proof:**
  1. $\mathbf{p}^0$ optimal for the government $\Rightarrow \sum_{i \in L} \nabla C_i^0 \left(\mathbf{p}^0 \right) + a \nabla W \left(\mathbf{p}^0 \right) = 0$
  2. $C_i^0 (\cdot)$ optimal for lobby $i \Rightarrow$ $\alpha_i \nabla V_i \left(\mathbf{p}^0 \right) - \nabla C_i \left(\mathbf{p}^0 \right) + \sum_{i' \in L} \nabla C_{i'}^0 \left(\mathbf{p}^0 \right) + a \nabla W \left(\mathbf{p}^0 \right) = 0$
  3. 1+2 $\Rightarrow \nabla C_i^0 \left(\mathbf{p}^0 \right) = \alpha_i \nabla V_i \left(\mathbf{p}^0 \right)$

Equilibrium Trade Policies

- **Lemma 2** *In any SPNE, domestic prices satisfy*

$$\sum_{i=1}^{n} \alpha_i \left(I_i + a \right) \nabla V_i \left(\mathbf{p}^0 \right) = 0,$$

where $I_i = 1$ *if* i *is politically organized and* $I_i = 0$ *otherwise*

- **Proof:**
  1. $\mathbf{p}^0$ optimal for the government $\Rightarrow \sum_{i \in L} \nabla C_i^0 \left(\mathbf{p}^0 \right) + a \nabla W \left(\mathbf{p}^0 \right) = 0$
  2. 1 + Lemma 1 $\Rightarrow \sum_{i \in L} \alpha_i \nabla V_i \left(\mathbf{p}^0 \right) + a \nabla W \left(\mathbf{p}^0 \right) = 0$
  3. Lemma 2 directly derives from this observation and the definition of $W \left(\mathbf{p}^0 \right)$

- **Comment:**
  - In GH (1994), everything is *as if* governments were maximizing a social welfare function that weighs different members of society differently

Equilibrium Trade Policies (Cont.)

- **Proposition 2** *In any SPNE, trade policies satisfy*

$$\frac{t_i^0}{1+t_i^0} = \frac{I_i - \alpha_L}{a + \alpha_L}\left(\frac{z_i^0}{e_i^0}\right) \text{ for } i = 1, ..., n, \quad (1)$$

where $\alpha_L \equiv \sum_{i' \in L} \alpha_{i'}$, $z_i^0 \equiv \alpha_i / m_i$, *and* $e_i^0 \equiv d \ln m_i \left(p_i^0\right) / d \ln p_i^0$

- **Proof:**
  1. Roy's identity + definition of $V_i\left(\mathbf{p}^0\right) \Rightarrow$

$$\frac{\partial V_{i'}\left(\mathbf{p}^0\right)}{\partial p_i} = \left(\delta_{i'i} - \alpha_i\right) + \left(p_i^0 - p_i^w\right) m_i'\left(p_i^0\right)$$

     where $\delta_{ii'} = 1$ if $i = i'$ and $\delta_{ii'} = 0$ otherwise
  2. 1 + Lemma 2 $\Rightarrow$ for all $i' = 1, ..., n$,

$$\sum_{i'=1}^{n} \alpha_{i'}\left(I_{i'} + a\right)\left[\delta_{i'i} - \alpha_i + \left(p_i^0 - p_i^w\right) m_i'\left(p_i^0\right)\right] = 0$$

  3. 2 + definition of $\alpha_L \equiv \sum_{i' \in L} \alpha_{i'} \Rightarrow$

$$\left(I_i - \alpha_L\right)\alpha_i + \left(p_i^0 - p_i^w\right) m_i'\left(p_i^0\right)\left(\alpha_L + a\right) = 0$$

Equilibrium Trade Policies (Cont.)

- **Proof (Cont.):**
  4. $3 + t_i^0 = \left(p_i^0 - p_i^w\right) / p_i^w \Rightarrow$

$$t_i^0 = \frac{I_i - \alpha_L}{a + \alpha_L}\left(-\frac{\alpha_i}{p_i^w m_i'\left(p_i^0\right)}\right) = \frac{I_i - \alpha_L}{a + \alpha_L}\left(-\frac{z_i m_i\left(p_{i'}^0\right)}{p_i^w m_i'\left(p_{i'}^0\right)}\right)$$

  5. Equation (1) directly derives from 4 and the definition of z_i^0 and e_i^0

- According to Proposition 2**:**
  1. Protection only arises if some sectors lobby, but others don't: if $\alpha_L = 0$ or 1, then $t_i^0 = 0$ for all $i = 1, ..., n$
  2. Only organized sectors receive protection (they manage to increase price of the good they produce and decrease the price of the good they consume)
  3. Protection decreases with the import demand elasticity e_0 (which increases the deadweight loss)
  4. Protection increases with the ratio of domestic output to imports (which increases the benefit to the lobby and reduces the cost to society)

2. Tax Neutrality

Economic Environment

- We follow Costinot and Werning (2017)
- Arrow-Debreu economy with:
  - many countries
  - many commodities
  - many firms (may produce and sell commodities in multiple countries)
  - many households (may work and consume around the world)
- All markets are perfectly competitive
- There are no nominal rigidities

Taxes

- $t_{ij}^{k}(n)$ = ad-valorem tax imposed by country j on a local buyer n who purchases commodity k from a seller producing in country i.
  - Buyer n may be either a firm or a household
  - If $i \neq j$, then $t_{ij}^{k}(n) \geq 0$ corresponds to an import tariff, whereas $t_{ij}^{k}(n) \leq 0$ corresponds to an import subsidy.
- $s_{ij}^{k}(n)$ = ad-valorem tax imposed by country i on a local seller n who produces commodity k in that country and sells it in country j.
  - Seller n may be either a firm or a household
  - If $i \neq j$, then $s_{ij}^{k}(n) \geq 0$ corresponds to an export subsidy, whereas $s_{ij}^{k}(n) \leq 0$ corresponds to an export tax.
- Tax revenues in each country i are rebated lump-sum to the set of households, H_i, who are resident of that country.
  - $\tau(h)$ = lump-sum transfer to household h.

Firms

- Firm f's profit maximization problem is

$$\pi(f) \equiv \max_{(m(f),y(f)) \in \Omega(f)} p(1+s(f)) \cdot y(f) - p(1+t(f)) \cdot m(f), \qquad (2)$$

where:

- $m(f) \equiv \{m_{ij}^k(f)\} \geq 0 =$ input vector
- $y(f) \equiv \{y_{ij}^k(f)\} \geq 0 =$ output vector
- $\Omega(f) =$ firm f's production set
- $p(1+s(f)) \equiv \{p_{ij}^k(1+s_{ij}^k(f))\}$
- $p(1+t(f)) \equiv \{p_{ij}^k(1+t_{ij}^k(f))\}$

Households

- Household h's utility maximization problem of household h is

$$\max_{(c(h),l(h))\in\Gamma(h)} \quad u(c(h) - l(h); h)$$
$$p(1 + t(h)) \cdot c(h) = p(1 + s(h)) \cdot l(h) + \pi \cdot \theta(h) + \tau(h) \tag{3}$$

where:
  - $c(h) \equiv \{c_{ij}^k(h)\} \geq 0 =$ consumption vector
  - $l(h) \equiv \{l_{ij}^k(h)\} \geq 0 =$ supply of services
  - $\Gamma(h) =$ set of feasible bundles
  - $\pi \equiv \{\pi(f)\} =$ vector of firms' profits
  - $\theta(h) \equiv \{\theta(f, h)\} =$ firms' shares by household h

Market Clearing

- For all commodities, supply is equal to demand. In vector notation:

$$\sum_f y(f) + \sum_h l(h) = \sum_h c(h) + \sum_f m(f). \tag{4}$$

Government

- In any country i, the government's budget is balanced,

$$\sum_{j,k} p_{ji}^k \Big(\sum_h t_{ji}^k(h) c_{ji}^k(h) + \sum_f t_{ji}^k(f) m_{ji}^k(f)\Big) - \sum_{j,k} p_{ij}^k \Big(\sum_h s_{ij}^k(h) l_{ij}^k(h) + \sum_f s_{ij}^k(f) y_{ij}^k(f)\Big) = \sum_{h \in H_i} \tau(h). \quad (5)$$

Competitive Equilibrium

Definition: *A competitive equilibrium with taxes,* $t \equiv \{t_{ij}^k(n)\}$ *and* $s \equiv \{s_{ij}^k(n)\}$*, and lump-sum transfers,* $\tau \equiv \{\tau(h)\}$*, corresponds to* $c \equiv \{c(h)\}$*,* $l \equiv \{l(h)\}$*,* $m \equiv \{m(f)\}$*,* $y \equiv \{y(f)\}$*, and* $p \equiv \{p_{ij}^k\}$ *such that:* (i) $(m(f), y(f))$ *solves (2) for all* f*;* (ii) $(c(h), l(h))$ *solves (3) for all* h*; and* (iii) *conditions (4) and (5) hold.*

A General Lerner Symmetry Theorem

- Fix some country i_0 with:
  - ad-valorem taxes on buyers: $t_{i_0} \equiv \{t^k_{ji_0}(n)\}$
  - ad-valorem taxes on sellers: $s_{i_0} \equiv \{s^k_{i_0 j}(n)\}$
  - domestic lump-sum transfers, $\tau_{i_0} \equiv \{\tau(h)\}_{h \in H_{i_0}}$ and sellers
- **Definition:** *Given taxes and lump-sum transfers in the rest of the world, a tax reform from* (t_{i_0}, s_{i_0}) *to* $(\tilde{t}_{i_0}, \tilde{s}_{i_0})$ *in* i_0 *is neutral if there exist domestic lump-sum transfers,* $\tilde{\tau}_{i_0}$*, s.t. the set of equilibrium allocations* (c, l, m, y) *is the same under* $(t_{i_0}, s_{i_0}, \tau_{i_0})$ *and* $(\tilde{t}_{i_0}, \tilde{s}_{i_0}, \tilde{\tau}_{i_0})$*.*

A1. *For any firm f, production possibilities in country i_0 are independent of possibilities in other countries,*

$$\Omega(f) = \Omega_{i_0}(f) \times \Omega_{-i_0}(f),$$

where:

- $\Omega_{i_0}(f)$ = *set of feasible input-output vectors,* $(\{m^k_{ji_0}(f)\}, \{y^k_{i_0 j}(f)\})$, *in country* i_0
- $\Omega_{-i_0}(f)$ = *set of feasible input-output vectors,* $(\{m^k_{ji}(f)\}_{i \neq i_0}, \{y^k_{ij}(f)\}_{i \neq i_0})$, *in other countries.*

Three Conditions

No tourism and migration

A2. *For any domestic household $h \in H_{i_0}$, there is no consumption or employment abroad,*

$$c_{ij}^{k}(h) = l_{ji}^{k}(h) = 0 \text{ for any } i\text{, any } k\text{, and any } j \neq i_0,$$

and for any foreign household $h \notin H_{i_0}$, there is no consumption or employment in country i_0,

$$c_{ii_0}^{k}(h) = l_{i_0 i}^{k}(h) = 0 \text{ for any } i \text{ and any } k.$$

Three Conditions

No foreign asset at home

A3. *For any foreign household $h \notin H_{i_0}$, the net value of assets held in country i_0 is zero,*

$$\pi_{i_0} \cdot \theta(h) = 0,$$

where $\pi_{i_0} \equiv \{\pi_{i_0}(f)\}$ = vector of profits deriving from production in i_0,

$$\pi_{i_0}(f) \equiv \sum_{j,k} [p^k_{i_0 j}(1 + s^k_{i_0 j}(f)) y^k_{i_0 j}(f) - p^k_{j i_0}(1 + t^k_{j i_0}(f)) m^k_{j i_0}(f)]$$

A General Lerner Symmetry Theorem

Theorem *Suppose that A1-A3 hold. Then any tax reform from* (t_{i_0}, s_{i_0}) *to* $(\tilde{t}_{i_0}, \tilde{s}_{i_0})$ *is neutral if* (i) *cross-border taxes satisfy*

$$1 + \tilde{t}^k_{ji_0}(n) = \eta(1 + t^k_{ji_0}(n)) \text{ for all } j \neq i_0 \text{ and } k,$$
$$1 + \tilde{s}^k_{i_0 j}(n) = \eta(1 + s^k_{i_0 j}(n)) \text{ for all } j \neq i_0 \text{ and } k,$$

and (ii) *local taxes satisfy*

$$1 + \tilde{t}^k_{i_0 i_0}(n) = \lambda^k(1 + t^k_{i_0 i_0}(n)) \text{ for all } k,$$
$$1 + \tilde{s}^k_{i_0 i_0}(n) = \lambda^k(1 + s^k_{i_0 i_0}(n)) \text{ for all } k,$$

with $\eta > 0$ *and* $\lambda^k > 0$.

Proof

- Let us follow a guess and verify strategy.
- Given prices, $\{p_{ij}^k\}$, and lump-sum transfers, $\tau_{i_0}(h)$, in the original equilibrium with taxes (t_{i_0}, s_{i_0}), we construct:
  - new equilibrium prices such that for all k,

$$\tilde{p}_{ij}^k = p_{ij}^k/\eta \text{ if either } i \neq i_0 \text{ or } j \neq i_0,$$
$$\tilde{p}_{i_0 i_0}^k = p_{i_0 i_0}^k/\lambda^k, \text{ otherwise,}$$

  - new lump-sum transfers such that for all $h \in H_{i_0}$,

$$\tilde{\tau}(h) = p(1+\tilde{t}(h)) \cdot c(h) - p(1+\tilde{s}(h)) \cdot l(h) - \tilde{\pi} \cdot \theta(h),$$

  with $\tilde{\pi} \equiv \{\tilde{\pi}(f)\}$ = vector of firms' profits under new taxes,

$$\tilde{\pi}(f) = \sum_{i,j,k} [\tilde{p}_{ij}^k(1+\tilde{s}_{ij}^k(f))y_{ij}^k(f) - \tilde{p}_{ji}^k(1+\tilde{t}_{ji}^k(f))m_{ji}^k(f)].$$

- By construction, the after-tax prices faced by firms are either unchanged in country i_0 or divided by η in other countries.

Proof (Cont.)

1. A1 $\Rightarrow$ solution to the profit maximization problem, $(m(f), y(f))$, must be unchanged for all firms in all countries
2. A1 $\Rightarrow$ value of profits associated with production in country i_0 must be unchanged and divided by η in other countries.
3. Step 2 + A3 $\Rightarrow$ income of households in country $i \neq i_0$ must be divided by η.
4. Step 3 + A2 $\Rightarrow$ the solution to the utility maximization problem, $(c(h), l(h))$, must be unchanged for all $h \notin H_{i_0}$.
5. In country i_0, lump-sum transfers are constructed such that the budget constraint of any household still holds. Since prices are unchanged in country i_0, the solution to the utility maximization problem, $(c(h), l(h))$, must also be unchanged for any $h \in H_{i_0}$.
6. Steps 1, 4, and 5 $\Rightarrow$ good market clearing conditions and the government's budget balance in any country $i \neq i_0$ must hold.
7. Step 6 + Walras' law $\Rightarrow$ government's budget constraint holds in i_0.

Discussion

- In a general Arrow-Debreu economy, a proportional change in all taxes should leave the set of equilibrium allocations unchanged
  - See e.g. Diamond and Mirrlees (1971)
- Lerner Symmetry Theorem = alternative neutrality result that allows for more flexible tax reforms
  - In Lerner (1936), initial tax schedule = import tariff on the first commodity, $t^1_{ji_0}(n) = t$, with all other taxes being zero, whereas new tax schedule = export tax, $s^2_{i_0 j}(n) = s$, with all other taxes being zero.
  - If $1 + s = 1/(1 + t)$, Theorem states that such a reform, which corresponds to $\eta = 1/(1 + t)$, would be neutral.
  - For the exact same reason, starting from no taxes, a uniform increase in import tariff and export subsidy such that $1 + t = 1 + s = \eta$, is neutral.
- A stronger neutrality result, of course, requires stronger restrictions

Discussion (Cont.)

- A1 = Restriction on technology that requires the separability of firm's decision across markets.
  - It is as if all firms operating in country i_0 were "domestic" firms.
- A2 = Counterpart of A1 on the household side.
  - It would hold if households only derive utility from consumption of commodities in their country of residence.
  - when the U.S. taxes imports and subsidizes exports, this mimics a dollar devaluation, which, with flexible exchange rates, should be offset by an appreciation of the dollar.
  - For a U.S. resident who spends his vacation in France, such a dollar appreciation will not be neutral...
- A3 = No wealth effects.
  - the existence of trade imbalances is neither necessary nor sufficient for the tax reforms that we consider to be neutral.
  - there is an asymmetry between U.S. and foreign assets and liabilities.

Generalizations

- Imperfect competition
  - Sufficient condition = solution to PMP homogeneous of degree zero in taxes + profit functions being homogeneous of degree one.
  - Residual demand curves do not have to be perfectly elastic
- Behavioral agents
  - Sufficient condition = demand is homogenous of degree zero in prices and Walras' law hold, our formal argument still goes through.
  - Since neutrality can be achieved entirely by a movement of the nominal exchange rate, one can even let agents be subject to nominal illusion
- Nominal rigidities
  - Lerner Symmetry Theorem can allow price stickiness provided that exchange rate is not fixed.
  - Fixed exchange rate case = focus of the literature on fiscal devaluations (Keynes 1931, Farhi et al. 2014)

Application to Border Tax Adjustment

- Consider the profits of a firm f operating in US
  - Initially, profits are subject to an ad-valorem corporate tax, t_π
  - There are no other taxes.
- Before border tax adjustment:

$$\pi_{US}(f) = (1 - t_\pi) \sum_{j,k} [p^k_{USj} y^k_{USj}(f) - p^k_{jUS} m^k_{jUS}(f)].$$

- After the border tax adjustment:

$$\begin{aligned} \pi_{US}(f) =& (1 - t_\pi) \sum_{k} [p^k_{USUS} y^k_{USUS}(f) - p^k_{USUS} m^k_{USUS}(f)] \\ &+ \sum_{j \neq US, k} [p^k_{USj} y^k_{USj}(f) - p^k_{jUS} m^k_{jUS}(f)]. \end{aligned}$$

- Tax reform such that $\eta = 1/(1 - t_\pi)$ and $\lambda^k = 1$ for all k.
  - If Assumptions A1-A3 hold, this should be neutral.

3. Other Issues

Why Do Governments Use Trade Policy Instruments?

- Most papers analyzing trade policy start from ad-hoc restriction on the set of instruments (e.g. tariffs, quotas, export subsidies, no production subsidies)
- Conditional on this ad-hoc restriction, paper then explains why trade policy may look the way it does and what its consequences may be
- But why would governments use inefficient instruments in the first place?
  - In developing countries, this may be the "best feasible" way to raise revenues (Gordon and Li 2009)
  - Inefficient methods may reduce the *size of the pie*, yet increase the *share of the pie* going to those choosing the instruments (Dixit, Grossman and Helpman 1997, Acemoglu and Robinson 2001)

Understanding the WTO

- What are the implications of the self-enforcing nature of trade agreements?
  - Bagwell and Staiger (1990), Maggi (1996)
- What is the rationale for trade agreements in the presence of NTBs?
  - Bagwell and Staiger (2001) consider the case of product standards (and conclude that only terms-of-trade externality matters)
- How can we rationalize simple rigid rules (e.g. an upper bound on tariffs) within the WTO?
  - Amador and Bagwell (2013), Horn, Maggi, and Staiger (2010)
- Quantitatively, how large are the gains from the WTO?
  - Ossa (AER, 2014), Bagwell, Staiger, and Yurukoglu (2017)