MARKET STRUCTURE AND TRADE POLICY

- **Standard result is that in presence of perfect competition, where country is small, first-best outcome is free trade, i.e., tariffs are not optimal**

- **Countries may be large enough, however, to influence their terms of trade, i.e., even if markets are perfectly competitive, country may have *monopsony*/*monopoly* power**

- **Tariffs may be used to exploit such market power – Johnson (1954/54), Mayer (1981), and Dixit (1987)**

- **Assume a home (foreign) country, with 2 goods x and y, where home (foreign) imports x (y), t (t^*) is home (foreign) *ad valorem* tariff rate[(1)]**

  (p_x, p_y) and (p_x^*, p_y^*) are prices in the two countries, where $p_x = p_x^*(1+t)$, and $p_y^*=p_y(1+t^*)$

  Let $\pi = p_x^*/p_y$ be prices on the world market, i.e., international terms of trade, such that a decrease in π improves (worsens) the home (foreign) country's terms of trade

- **Home (foreign) country import demand is $M(\pi,t)$ [$M^*(\pi, t^*)$], and home (foreign) country welfare is $U(\pi, t)$ [$(U^*(\pi, t^*)$]**

(1) Negative values of t are subsidies, lower bound being -1

- **Given trade balance condition, $\pi M(\pi, t) = M^*(\pi, t^*)$, π can be expressed as a function of t, t^***

- **Substituting into welfare expressions, these can also be expressed in terms of t, t^*, $W(t, t^*) = U(\pi(t, t^*), t)$ and $W^*(t, t^*) = U^*(\pi(t, t^*), t^*)$**

  Assuming Marshall-Lerner stability condition [(2)] holds, each country's tariff improves its terms of trade, i.e., $\delta\pi/\delta t < 0$ and $\delta\pi/\delta t^* > 0$, while other country's tariff hurts a country's welfare, i.e., $\delta W/\delta t^* < 0$ and $\delta W^*/\delta t < 0$

- **Tariff equilibrium can be illustrated in (t, t^*) space, as in Figure 1, where W and W^* are home and foreign country welfare contours respectively**

- **Horizontally (vertically) lower contours correspond to higher home (foreign)-country welfare, and assumed that:**

  (i) W (W^*) has unique maximum with respect to t for a given t^*, locus of these maxima RR (R^*R^*), where $\delta W/\delta t = 0$ ($\delta W^*/\delta t^* = 0$), is home (foreign) country's reaction function

  (ii) RR and R^*R^* have a unique intersection at N, the Nash equilibrium of a non-cooperative tariff game, the free trade point F being preferred

(2) Sum of elasticities of import demands exceeds 1

- **Locus *EE** traces out Pareto-efficient combinations of tariff policies – requires relative price of *x* to stay the same in both countries, so that $\pi(1+t) = \pi/(1+t^*)$, or $(1+t)(1+t^*)=1$**

  Free trade point is on *EE, but there is a continuum of policies where one country or the other subsidizes their imports**

  Points on *CC preferred by both countries to *N*, free-trade point lying in range *CC***

- ***AA** is locus of tariff combinations eliminating trade – define p_a, the autarkic relative price of *x*, as value of $\pi(1+t)$ reducing *M* to zero, and $p_a^* = \pi/(1+t^*)$ when $M^*=0$, then $(1+t)(1+t^*)=p_a/p_a^*$**

  p_a/p_a^* exceeds 1, as home country imports *x*, i.e., principle of comparative advantage, so autarky locus *AA lies above Pareto-efficient locus *EE**, and everywhere along *AA**, each country's welfare is constant**

- **If *AA** meets axes at $Q = (t_a,0)$ and $Q^* = (0,t_a^*)$, there are two other curves, *QB* and *Q*B** meeting *EE** at *L* and *L** respectively – in region *A*Q*B** (*AQB*) home (foreign) country is worse off than it would be in autarky – it is subsidizing imports too heavily**

- **Consider tariff rates (t, t^*), where $t \geq t_a$, and $t^* \geq t_a^*$, this is also a Nash equilibrium of tariff game**

  Each country's tariff is so high, no trade occurs even if other country sets a zero tariff, so countries are locked into autarky

- **Implies non-uniqueness of tariff equilibrium – although Dixit (1987) claims in a one-shot game, point *N* will emerge with positive trade, i.e., it is preferred by both countries, and it is a stable equilibrium in a non-cooperative game**

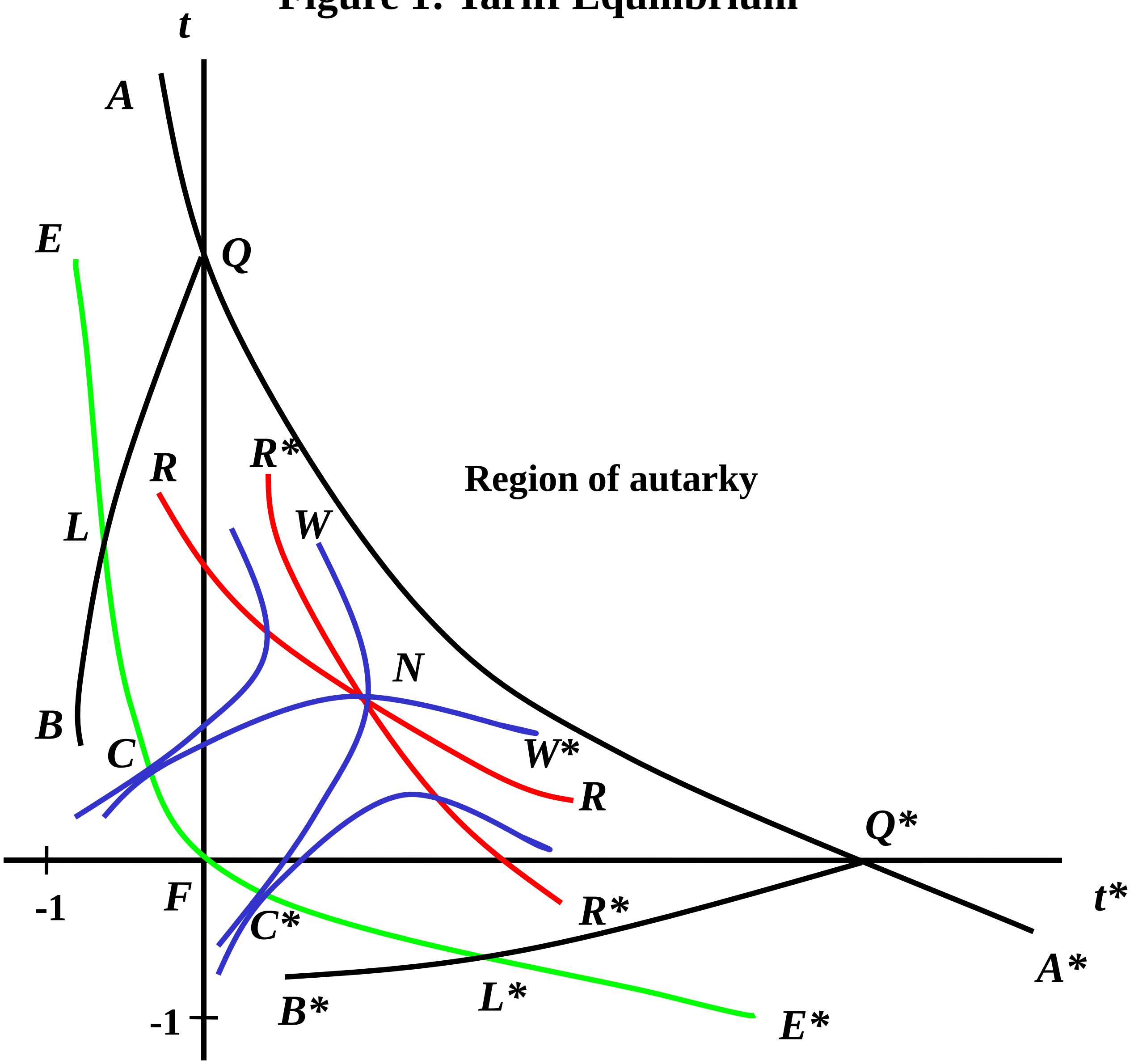
  In a repeated-game context, existence of autarky equilibrium implies a costly outcome if either country deviates from cooperative outcome along *CC, i.e., reversion to *A* is a stronger threat than *N***

- ***N* is not efficient, there being joint policy choices, with lower tariffs, that will leave both countries better off, free trade *F* being one such point**

  However, in a one-shot game, each country pursues its own self-interest, leading to *N*, i.e., a Prisoners' Dilemma – resolution of this inefficiency will require cooperation, e.g., the GATT/WTO (Bagwell and Staiger, 1999)

- **Results also hold if each country has market power in terms of exports (Lerner symmetry theorem)**

Figure 1: Tariff Equilibrium



OLIGOPOLY AND TRADE POLICY

- **Once there is oligopoly in trade models, what happens if trade policies are introduced?**

- **A literature has grown up around this, often described as “strategic trade” theory, producing some non-traditional results, e.g., an export subsidy may improve national welfare**

- **The literature tends to be full of a lot of special cases, changes in basic assumptions often reversing results, making it difficult to generalize**

- **As Dixit (1987) notes, a critical feature of the theory is the emphasis on interactions between rational agents such as firms and policymakers**

- **Strategic trade theory can be characterized in terms of non-cooperative, static and simultaneous- move games in the sense that agents do not coordinate their actions, the game is played once, and agents make their moves at the same time**

- **A critical feature of the analysis is that one agent, the policymaker, can make a move before other agents, which introduces the notion of pre-commitments**

- **Consider a situation where an international market is characterized as a duopoly, firms *i* =1, 2. Equilibrium concept is Nash equilibrium, where each firm simultaneously sets its relevant strategy variable s_i (output or price) in order to maximize profits, given action of the rival firm, s_j**

- **Given profits are π_i, a set of strategic actions is a Nash equilibrium, if, for all *i* and any feasible action s_i:**

$$\pi_i = (s_i^*, s_j^*) \geq (s_i, s_j^*)$$

i.e., the set of actions, s_i^*, is an equilibrium if neither firm can change its action to increase profits, given its rival's action

- **In the absence of government intervention, this equilibrium is consistent with free trade, neither firm being able to unilaterally improve its payoff**

- **If government *i* announces it will pay firm *i* an export subsidy before firm *i* selects its optimal strategy, this alters the level of potential profits π_i and hence the behavior of firm *i* in equilibrium**

- **This captures essence of strategic trade theory: in imperfectly competitive markets, firms act strategically, and government credibly pre-commits to trade policies that change the final market equilibrium**

- **Government *i* has to have some reason for wanting to provide firm *i* with a subsidy at the first stage of the game**

- **The standard argument is that there are positive economic profits to be earned by firm *i*, and if these enter government *i*'s objective function, it has an incentive to pre-commit to policies that increase firm *i*'s profits**

- **Assuming government *j* is not active with respect to firm *j*, then the increase in firm *i*'s profits can be thought of in terms of profit-shifting**

OPTIMAL TRADE POLICY AND OLIGOPOLY

- **Following Eaton and Grossman (1986), formally characterize optimal trade policy in the presence of oligopolistic competition among domestic and foreign firms in international market**

- **Firms produce single product, competition being specified in terms of quantities with arbitrary *conjectural variations***

  Single home firm competes with single foreign firm in the international market, with no domestic consumption

  Home government can tax or subsidize exports of home firm, assuming absence of policy by foreign government, objective being to maximize national product, equal weight being placed on firm profits and tax revenue

- **Output of home (foreign) firm is x (X), $c(x)$ [$C(X)$] is home (foreign) production cost, with $c'(x)>0$ [$C'(X)>0$].**

  Pre-tax revenue of home and foreign firms given by $r(x,X)$ and $R(x,X)$ respectively, satisfying these conditions:

$$r_2(x,X) = \frac{\partial r(x,X)}{\partial X} \leq 0$$

$$R_1(x,X) = \frac{\partial R(x,X)}{\partial x} \leq 0$$

  i.e., increase in output of competing product lowers revenue of each firm

- **After-tax profits of home and foreign firms are:**

$$\pi = (1 - t)r(x, X) - c(x)$$

$$\Pi = R(x, X) - C(X)$$

where t is an *ad valorem* tax

- **The home (foreign) firm's conjecture about the foreign (home) firm's output response to changes in its own output given by parameter γ (Γ)**

Nash equilibrium, given home policy, determined by the first-order conditions:

(1) $(1 - t)[r_1(x, X) + \gamma r_2(x, X)] - c'(x) = 0$

(2) $R_2(x, X) + \Gamma R_1(x, X) - C'(X) = 0$

- **Theorem 1:**

A positive (negative) export tax can yield higher national welfare than laissez-faire (t=0) if home firm conjectures a change in foreign output in response to an increase in its own output that is larger (smaller) than the actual response

- **Proof:**

National product w is given as:

(3) $(1 - t)r(x, X) - c(x) + tr(x, X) = r(x, X) - c(x)$

Change in w from a small change in tax rate t is:

(4) $$\frac{dw}{dt} = [r_1(x,X) - c'(x)]\frac{\partial x}{\partial t} + r_2(x,X)\frac{\partial X}{\partial t}$$

Substituting in from first-order condition (1):

(5) $$\frac{dw}{dt} = \left[-\gamma r_2 - \frac{tc'}{1-t}\right]\left(\frac{\partial x}{\partial t}\right) + r_2\left(\frac{\partial X}{\partial t}\right)$$

where arguments of revenue and cost functions dropped for brevity

(2) implicitly defines X as a function of x, denote this as $\psi(x)$. As t is not an argument of this function, then we can write, $dX/dt = \psi'(x)(dx/dt)$, and then define a term g that measures the slope of the foreign firms' reaction function, $g \equiv (dX/dt)/(dx/dt) = \psi'(x)$, i.e., its actual reaction to changes in x.

Incorporating g into (5) and finding maximum dw/dt=0:

(6) $$-r_2(g-\gamma) = tc'/(1-t)$$

As $r_2 < 0$, both sides of (6) have same sign if $1 > t > 0$ and $g > \gamma$, or $t < 0$ and $g < \gamma$. The term $(g - \gamma)$ is difference between actual response of X to change in $x, \psi'(x)$, and home firms conjectural variation, γ. When $g > \gamma$, an export tax yields more than laissez-faire, conversely when $g < \gamma$

- **Pre-commitment to policy by home government allows home firm to set output as if it were a Stackelberg leader with respect to foreign firm. If $g > \gamma$, without pre-commitment, equilibrium involves more home output than at Stackelberg as home firm does not fully account for foreign firm's reaction to an increase in its output when choosing its own output. Conversely if $g < \gamma$.**

- **<u>Cournot Conjectures</u>**

  Under Cournot, each firm conjectures that when it changes its output, other firm holds output fixed, so $\gamma = \Gamma = 0$, and (6) becomes:

  (7) $$-gr_2 = tc'/(1-t)$$

  Totally differentiating (1) and (2) to solve for g, (7) can be written as:

  (8) $$r_2 R_{21}/(R_{22} - C'') = tc'/(1-t)$$

  Second-order condition of foreign firms' profit maximization ensures left-hand side of (8) has sign of R_{21}

  Proposition 1: In a Cournot duopoly with no domestic consumption, optimal export tax t^*=sgn R_{21}

- **Proposition 1 is Brander-Spencer (1985) argument for an export subsidy: policy raises home welfare by shifting profits to home firm (Figures 2-5)**

  Figure 2, isoprofit loci for home firm given by π, lower curves corresponding to higher profits, Cournot reaction function rr connecting maxima of isoprofit loci, slope of rr being given by sign of r_{12}

  RR found similarly in Figure 3, its slope being determined by R_{21}. Linear demand necessarily implies $r_{12} < 0$ and $R_{21} < 0$, and most other demand specifications

  Nash-Cournot equilibrium at N-C in Figure 4, home firm earning profit of π^C. Along RR, highest level of profit would be at π^S, equilibrium level of profit if home firm could credibly pre-commit to being a Stackelberg leader – however, unable to do this (see Table 1)

  Home government can achieve this in a Nash equilibrium (Figure 5), if it can shift home firm's reaction function tangent to RR at S

  Optimal policy will be an export subsidy under Cournot assumption, provided RR is downward-sloping, i.e., $R_{21} < 0$ - downward-sloping foreign reaction function RR implies output level in Cournot equilibrium less than Stackelberg

Figure 2: Output Choices for Home Firm

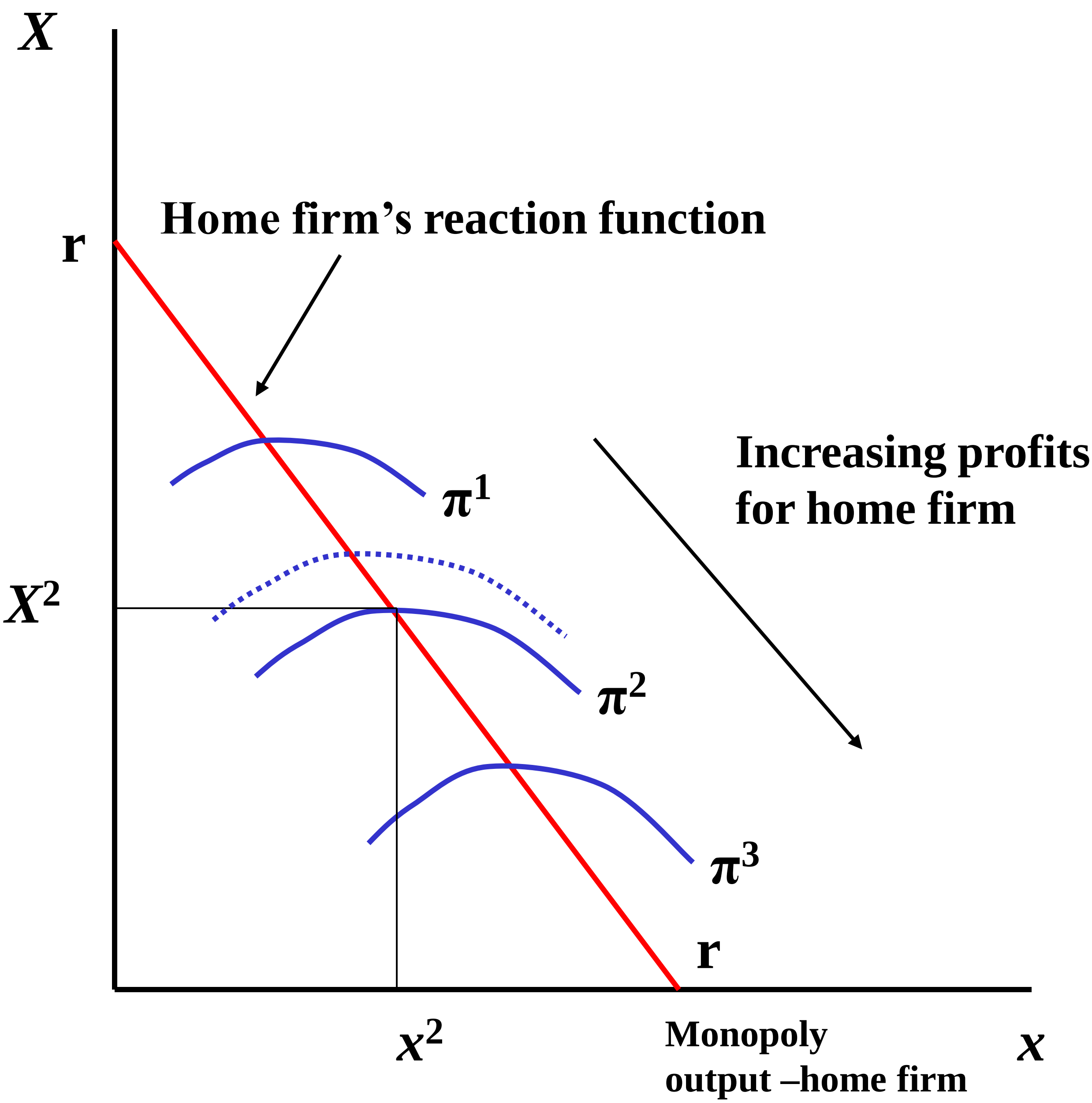


Figure 3: Output Choices for Foreign Firm

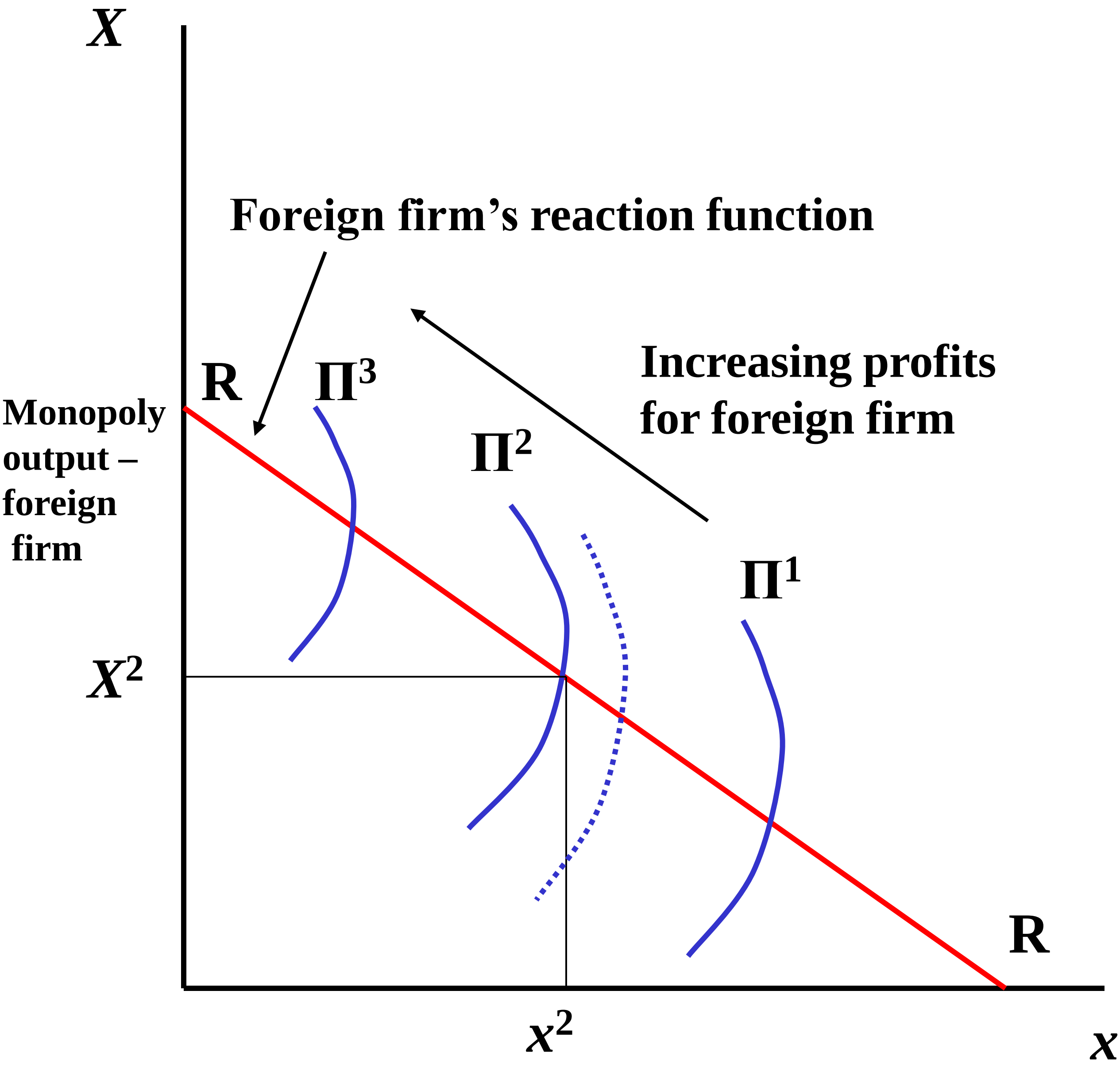


Figure 4: Nash-Cournot Equilibrium

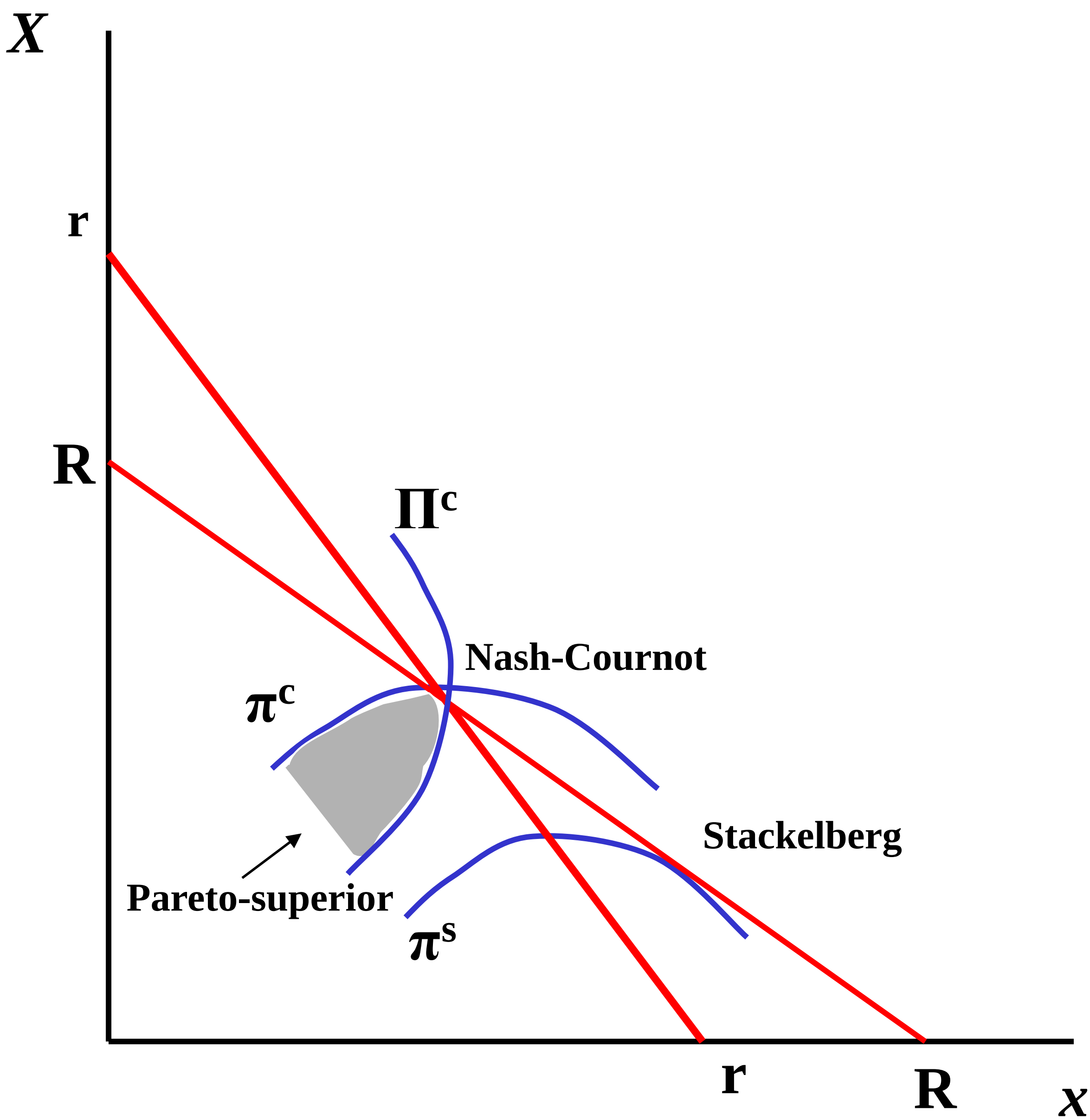


Table 1: Nash-Cournot Strategies

Home Firm

	s_h / s_f	Low output	High output
Foreign Firm	Low output	15, 15 C	20, 5 S_h
	High output	5, 20 S_f	10, 10 N-C

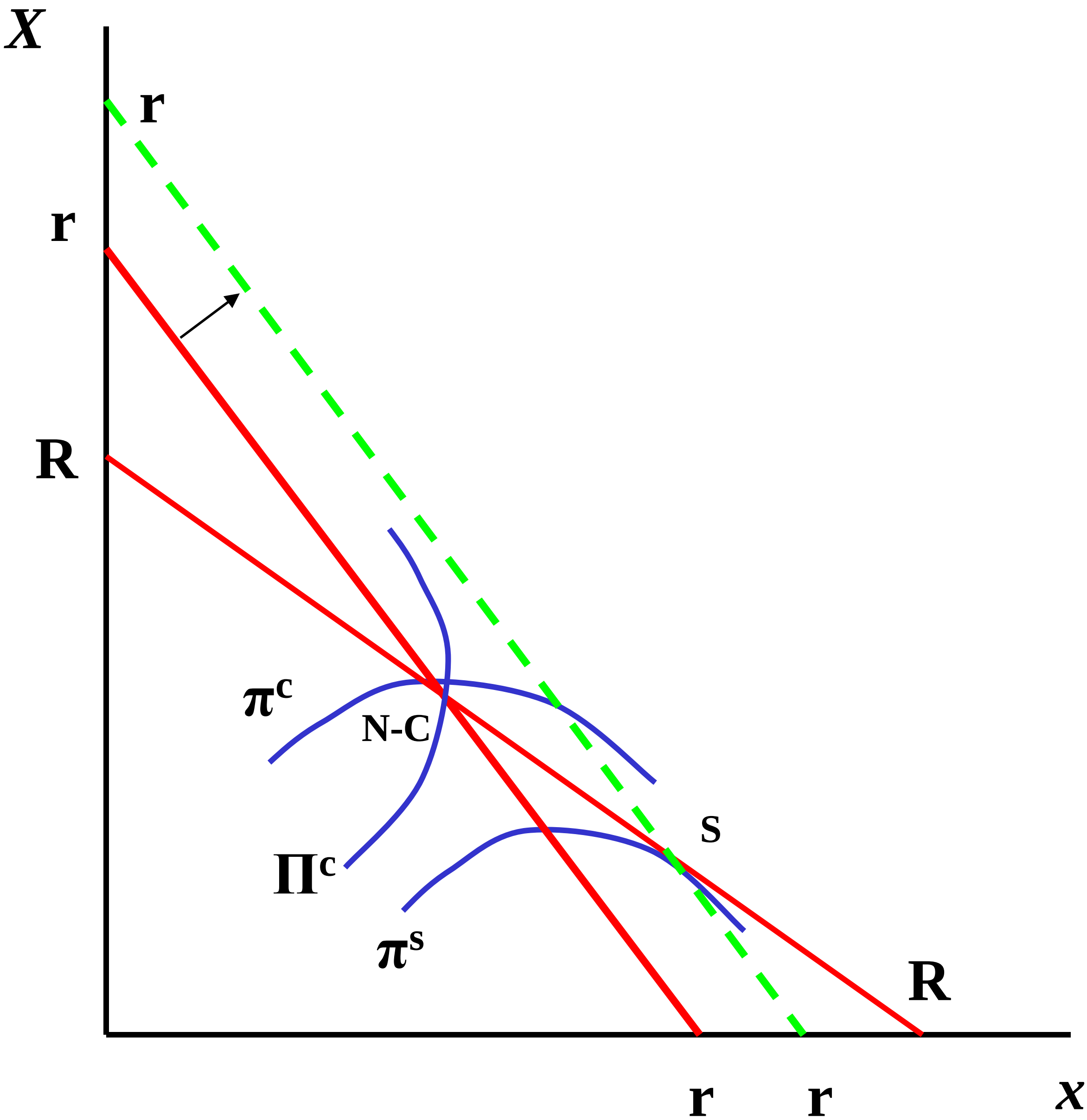
N-C = Nash-Cournot equilibrium

S_h = Home firm is Stackelberg leader

S_f = Foreign firm is Stackelberg leader

C = Collusive outcome

Figure 5: Export Subsidy to Home Firm



- **Optimal export subsidy under Cournot, benefits home firm and country, at expense of foreign firm – profit-shifting outweighs any losses from decline in terms of trade, and world welfare increases as prices fall**

- **<u>Bertrand Conjectures</u>**

Eaton and Grossman (1986) show Brander and Spencer result is sensitive to game played by firms – what happens if firms play Bertrand?

Under Bertrand, each firm conjectures rival will hold price fixed in response to any changes in its own price

Define *direct* demand functions for output of home and foreign firms as $d(p,P)$ and $D(p,P)$ respectively, total profits of two firms being:

$$\pi(p,P) = (1-t)pd(p,P) - c(d(p,P))$$

$$\Pi(p,P) = PD(p,P) - C(D(p,P))$$

Each firm sets price to maximize profit, taking other price as constant, first-order conditions being:

(9) $$\pi_1 = (1-t)(d + pd_1) - c'd_1 = 0$$

(10) $$\Pi_2 = D + (P - C')D_2 = 0$$

Actual and conjectured price responses can be translated into output responses by totally differentiating demand functions:

$$\begin{bmatrix} dx \\ dX \end{bmatrix} = \begin{bmatrix} d_1 & d_2 \\ D_1 & D_2 \end{bmatrix} \cdot \begin{bmatrix} dp \\ dP \end{bmatrix}$$

Bertrand conjecture on part of home firm implies response given by:

(11) $$\gamma = \left(\frac{dX}{dp} \Big/ \frac{dx}{dp} \right) \Bigg|_{dP=0} = \frac{D_1}{d_1}$$

Actual response being:

$$g = \frac{dX}{dp} \Big/ \frac{dx}{dp} = \frac{D_1 - D_2 \Pi_{21} / \Pi_{22}}{d_1 - d_2 \Pi_{21} / \Pi_{22}}$$

It can be shown that term (g- γ) is positive only if $\Pi_{21} > 0$, i.e., foreign firm responds to a price cut by cutting its price. Applying Theorem 1,

Proposition 2: In a Bertrand duopoly with no home consumption, $t^* = \text{sgn}\ \Pi_{21}$

If products are substitutes, $d_2 > 0$ and $D_1 > 0$, and returns to scale are decreasing, $c'' \geq 0, C'' \geq 0$, then $\Pi_{21} > 0$ – necessarily holds with either perfect substitutes or linear demands

Consequently, sign of optimal trade intervention under Bertrand is opposite to Cournot case – an export tax is required

- **Figures 6-9 illustrate Proposition 2. Isoprofit loci in price space in Figure 6 for home firm are π, higher curves corresponding to higher profits, the home firm reaction function being rr, and similarly RR for foreign firm in Figure 7, slopes corresponding to π_{12} and Π_{21} respectively**

  Without any policy intervention, Bertrand equilibrium at intersection of reaction functions at B, home firm earning profit of π^B, but along RR, a higher profit could be reached at S where home firm charges a higher price (Figure 8)

  Unless home firm can pre-commit to being a Stackelberg leader, S is unattainable (see Table 2)

  Home government can achieve this by setting an appropriate export tax such that home firm reaction function is shifted to intersect at S (Figure 9)

  Bertrand equilibrium where $\Pi_{21} > 0$, involves a lower price, and therefore higher domestic output than at Stackelberg equilibrium – in contrast to Cournot

  Also, implementation of optimal policy by home government also raises profits of foreign firm by *facilitating collusion*, resulting in a decline in world welfare

Figure 6: Price Choices for Home Firm

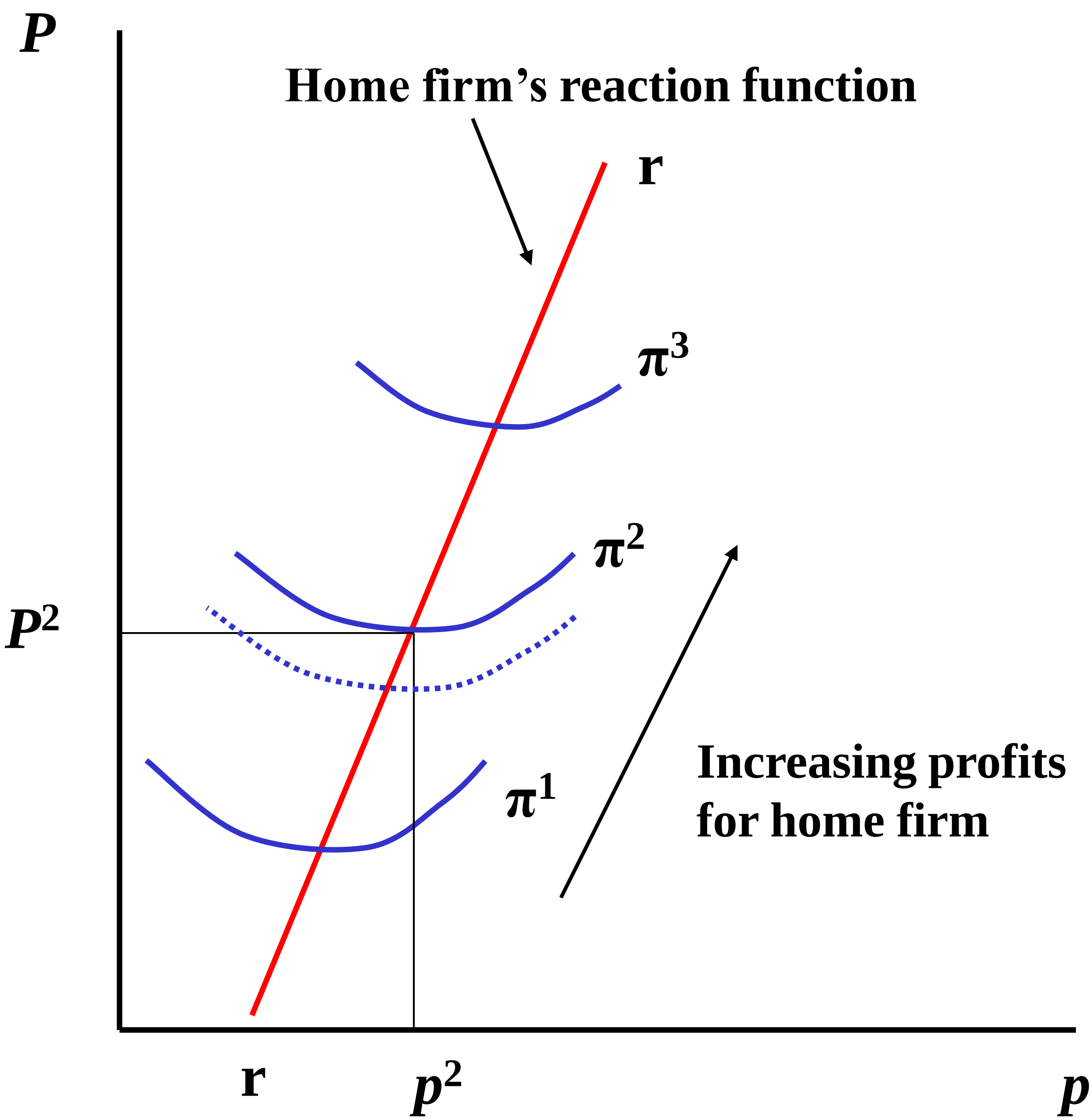


Figure 7: Price Choices for Foreign Firm

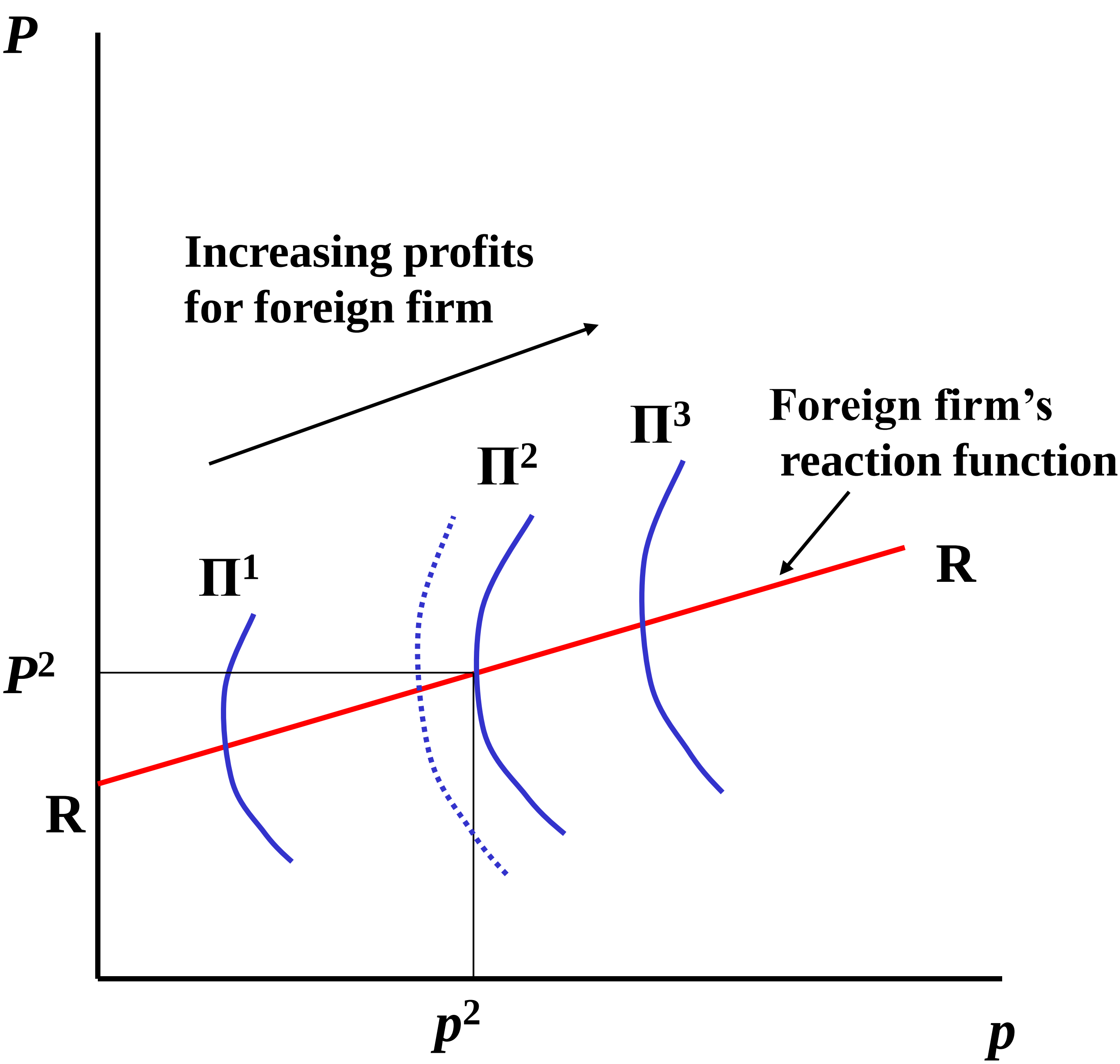


Figure 8: Nash-Bertrand Equilibrium

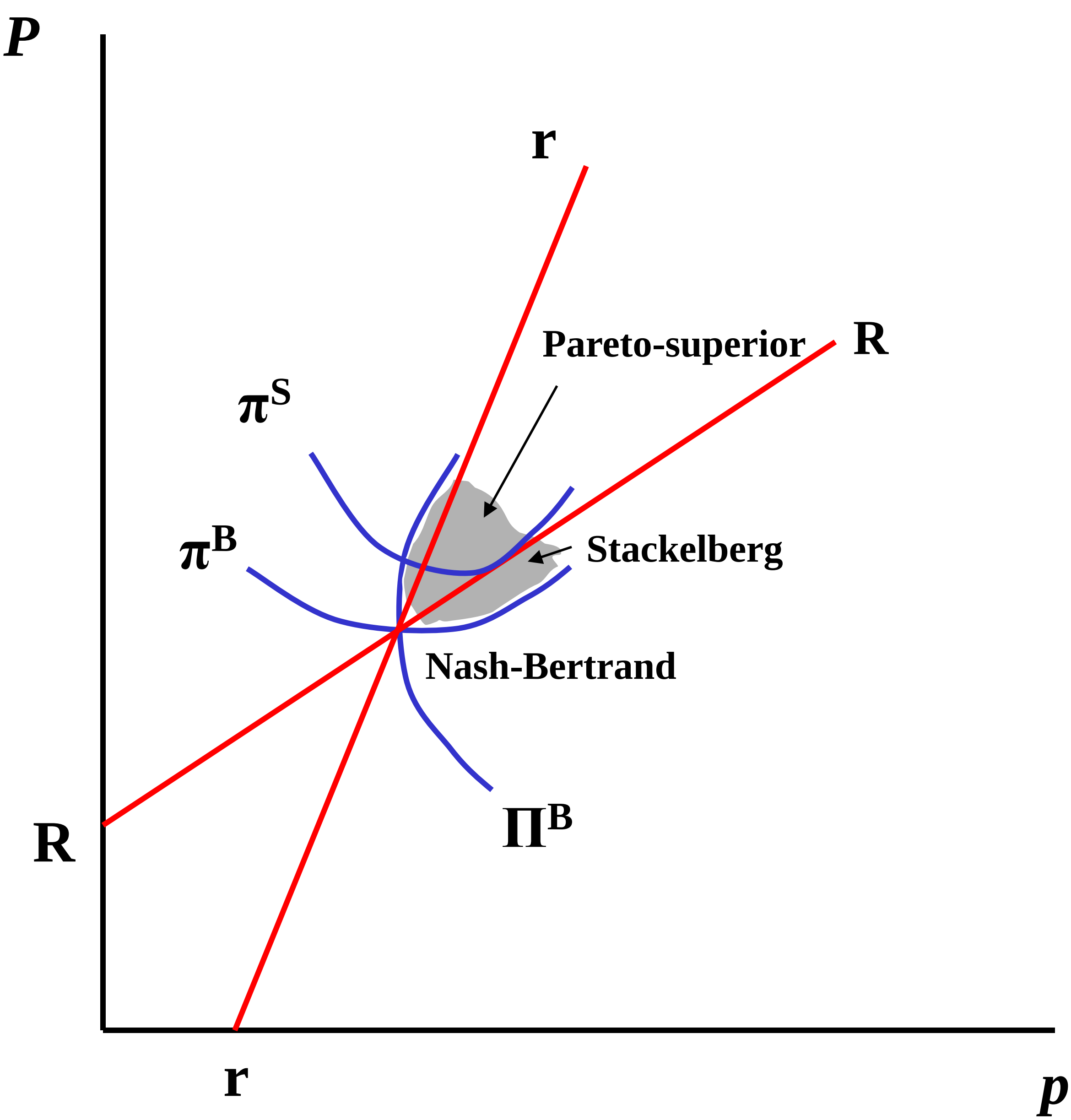


Table 2: Nash-Bertrand Strategies

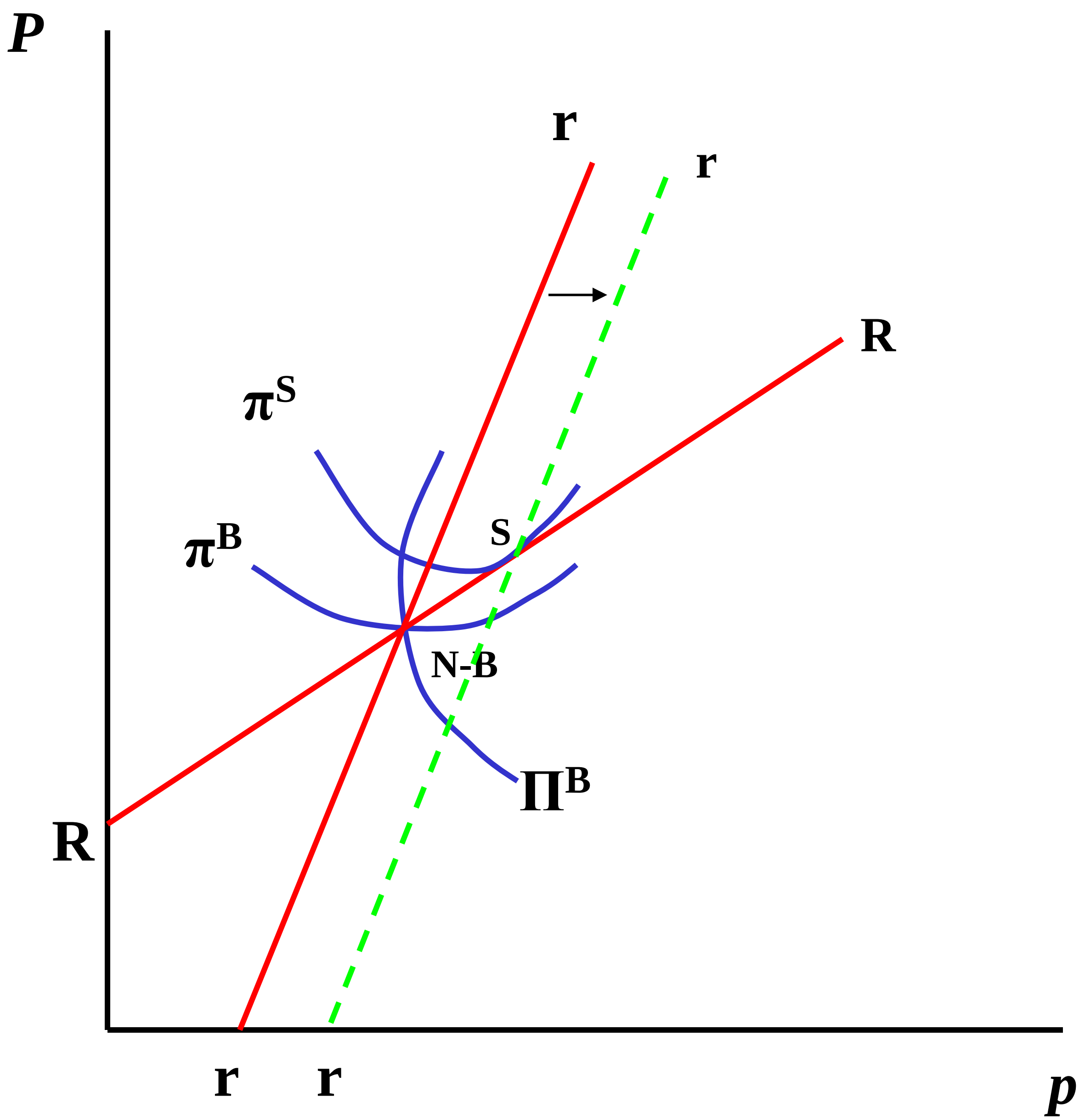
Home Firm

	s_h / s_f	High price	Low price
Foreign Firm	High price	15, 15 C	20, 5
	Low price	5, 20	10, 10 N-B

N-B = Nash-Bertrand equilibrium

C = Collusive outcome

Figure 9: Export Tax on Home Firm



- **Foreign Policy Response**

  Assumed so far that foreign government follows laissez-faire – instead assume a 2-stage game where both governments pre-commit to policies before firms play out duopolistic game in international market

  With a foreign *ad valorem* tax of *T*, foreign firm's first-order condition (2) becomes:

  $$(2') \qquad (1-T)[R_2(x,X) - \Gamma R_1(x,X)] - C'(X) = 0$$

  A Nash equilibrium in policies is a pair of policies (*t*,*T*), such that *t* maximizes *w* given *T*, and *T* maximizes $W \equiv R(x,X) - C'(X)$, given *t*, where (1) and (2′) determine *x* and *X*

  For *T*<1, presence of foreign tax does not affect previous results from Propositions 1 and 2. For example, under Cournot, (8) is replaced by:

  $$(8') \qquad \frac{r_2(1-T)R_{21}}{(1-T)R_{22} - C''} = \frac{tc'}{1-t'}$$

  t** remains sign of R_{21} – i.e., sign of optimal policy unaffected by presence of foreign export subsidy or tax, and likewise for level of *T* that maximizes *W* given *t

- **Under Cournot, with $r_{12} < 0$, and $R_{21} < 0$, perfect Nash equilibrium is for both governments to subsidize exports (see Tables 3 and 4)**

Table 3: Prisoners' Dilemma For Home and ForeignCountries

Home Country

Foreign Country

c_h / c_f	No export subsidy	Export subsidy
No export subsidy	10, 10 C_s	20, 5 S_1
Export subsidy	5, 20 S_2	7, 7 N

N = Nash equilibrium

C_s = Cooperation over no export subsidies

Table 4: Prisoners' Dilemma For Home and Foreign Countries

Home Country

Foreign Country

c_f \ c_h	Export tariff	No policy	Export subsidy
Export tariff	15, 15 C_t	20, 8	25, 3
No policy	8, 20	10, 10 C_s	20, 5 S_1
Export subsidy	3, 25	5, 20 S_2	7, 7 N

N = Nash equilibrium

C_s = Cooperation over no export subsidies

C_t = Cooperation over export tariffs

- **With Cournot behavior, both reaction loci are shifted outward, market becoming more competitive, benefiting consumers in international market (Figure 10)**

- **In the case of Bertrand competition, with $\pi_{12} > 0$ and $\Pi_{21} > 0$, perfect equilibrium is for both countries to tax exports, intervention moving firms towards profit-maximizing (collusive) equilibrium, exporters gaining, consumers losing in international market**

  Both reaction functions are shifted outward – each country improves its terms of trade, replicating result of optimal tariff under country monopoly power (Figure 11)

- **<u>Number of Firms</u>**

  If number of firms based in home country is increased, and their choice of strategic actions is quantity, Cournot outcome asymptotically approaches competitive equilibrium, and optimal policy intervention is a tax on exports (Dixit, 1984)

Figure 10: Export Subsidies to Home and Foreign Firms

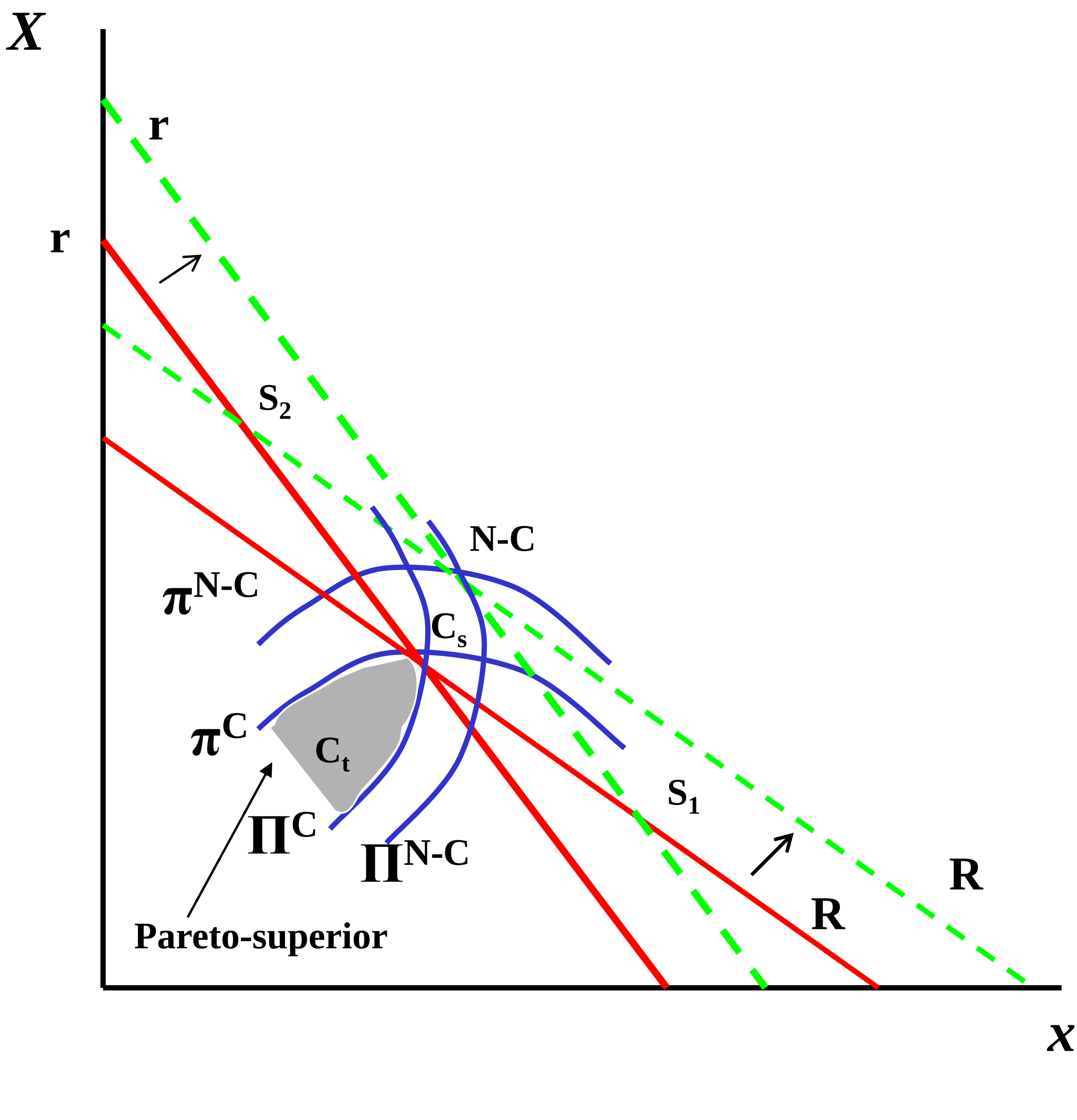


Figure 11: Export Taxes on Home and Foreign Firms