TRADE AND INDUSTRIAL POLICY SUBTLETIES WITH INTERNATIONAL LICENSING

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Introduction

- Various hybrid forms of organization and competition among rivals
  - Cooperation in some phases of production and competition in other phases
    - Technology transfer
      - Licensing
      - Key inputs
    - Joint venture
    - Service provisions

Introduction

- Technology transfer between rivals
  - Mitsubishi Motors Co. → Proton (Malaysian automaker) and Hyundai Motor Co.
  - Japanese steelmakers → POSCO (Korean steelmaker)
  - Japanese and European electronics companies → Samsung Electronics Co.
  - Toyota Motor Co. → Ford Motor Company
  - Samsung Electronics Co. → Apple Inc.

Introduction

- Why firms have incentive to transfer technologies to (potential) rivals?

→ One reason : (Potential) rivals may acquire technologies through R&D

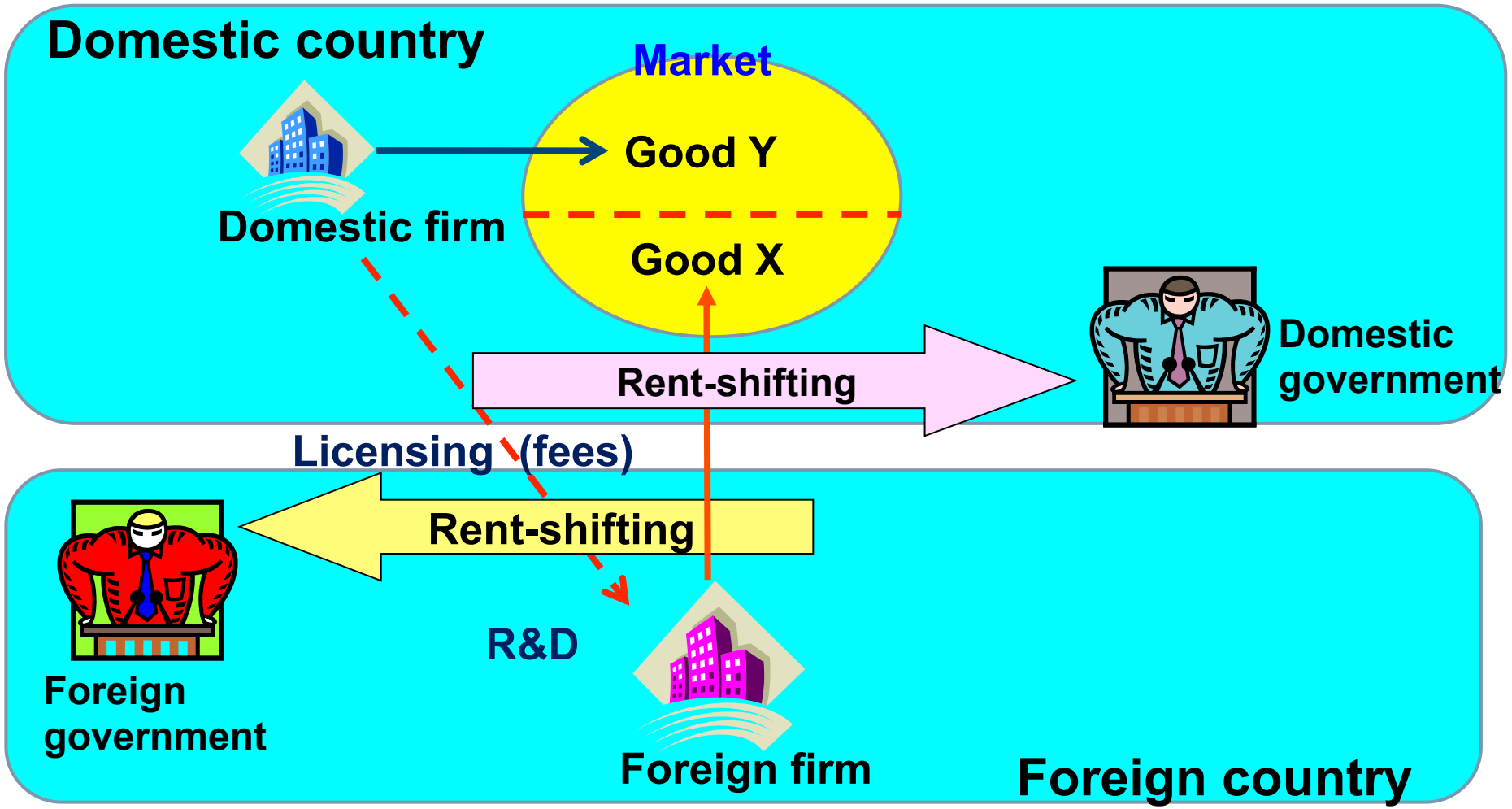
- Which is better for firms with advanced technologies, technology transfer to rival or rival's R&D?

→ Technology transfer

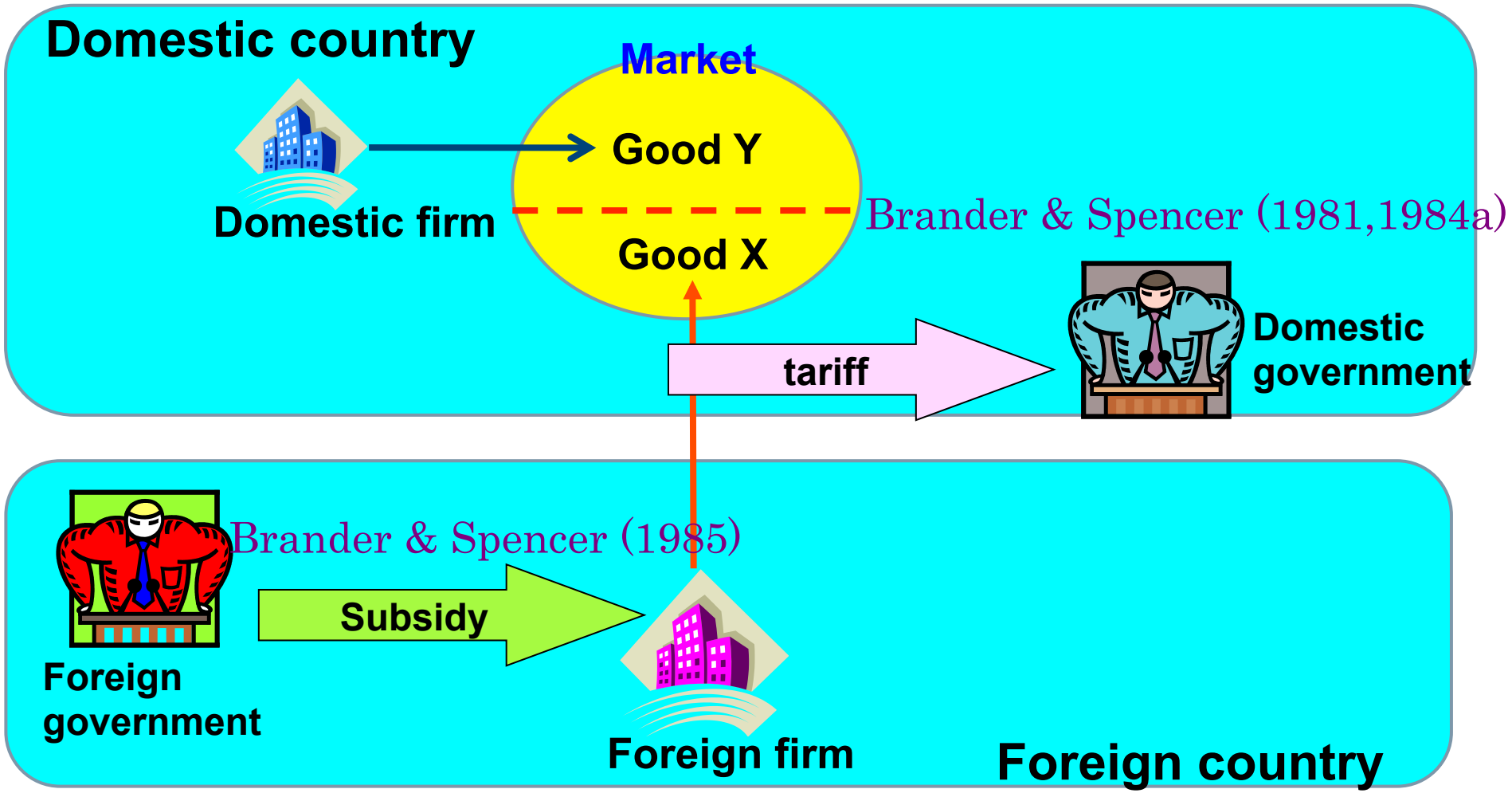
Purpose

1. To theoretically explore how the availability of both R&D and technology transfer affects optimal trade and industral policies
   - in the framework of international duopoly
2. To obtain the optimal license fees
   - Non-linear fees (fixed fee + royalty)

Basic structure



Standard model (Model without interdependency)



Features

- International duopoly
  - Imperfect substitutes
- Foreign production
  - R&D or international licensing
- Intervention
  - Domestic government → tariff
  - Foreign government → export (production) subsidy

Interesting results

In the case of international licensing

- Domestic government may provide import subsidy instead of tariff
- Foreign government can shift rent from domestic firm
  - by export tax on foreign firm instead of subsidy
  - by R&D subsidy → no subsidy payment in equilibrium

Related literature

- Trade policy with technology transfer between rivals
  - Kabiraj & Marjit (*EER*,2003)
  - Mukherjee & Pennings (*EER*,2006)
  - Horiuchi & Ishikawa (*RIE*,2009)
  - Gosh & Saha (*RIE*,2008)
- Trade policy with R&D
  - Spencer & Brander (*RES*,1983)
  - Bagwell & Staiger (*JIE*,1994)

Related literature

- License fees
  - Fixed fee vs royalty
    - Wang (*JEB*,2002)

Model: international Cournot duopoly with product differentiation

- Two goods
  - Good X: foreign firm (*firm f*)
  - Good Y: domestic firm (*firm d*)
- Utility function

$$U = \alpha x + \beta y - \frac{(x)^2+(y)^2}{2} - \phi xy + m$$

- Inverse demand

$$p_x = \alpha - x - \phi y$$
$$p_y = \beta - y - \phi x$$

- Profits with R&D

$$\pi^f = (p_x - c_x)x - F$$
$$\pi^d = (p_y - c_y)y$$

Stage game

1. Licensing stage
2. Competition stage: Cournot competition

Licensing

- Licensing from *firm d* to *firm f*
  - License fees
    - Take-it-or-leave-it licensing offer
    - Outside option: R&D
    - Patent or key input

Proposition 1 (License fees)

- Profits with licensing
  (non-linear pricing: $r \geqq 0$, $R \geqq 0$)

$$\pi^f = (p_x - c_x)x - (R + rx)$$

$$\pi^d = (p_y - c_y)y + (R + rx)$$

- $\pi_L^d \equiv \max_{r,R} \pi^d; s.t.\ \pi^f \geq \pi_R^f, r \geq 0, R \geq 0$
- 3 cases
  1. Fixed fee ($R=F>0$) and per-unit royalty ($r = 0$)
  2. Fixed fee ($R=0$) and per-unit royalty ($r > 0$)
  3. Fixed fee ($R>0$) and per-unit royalty ($r > 0$)

Proposition 1 (License fees)

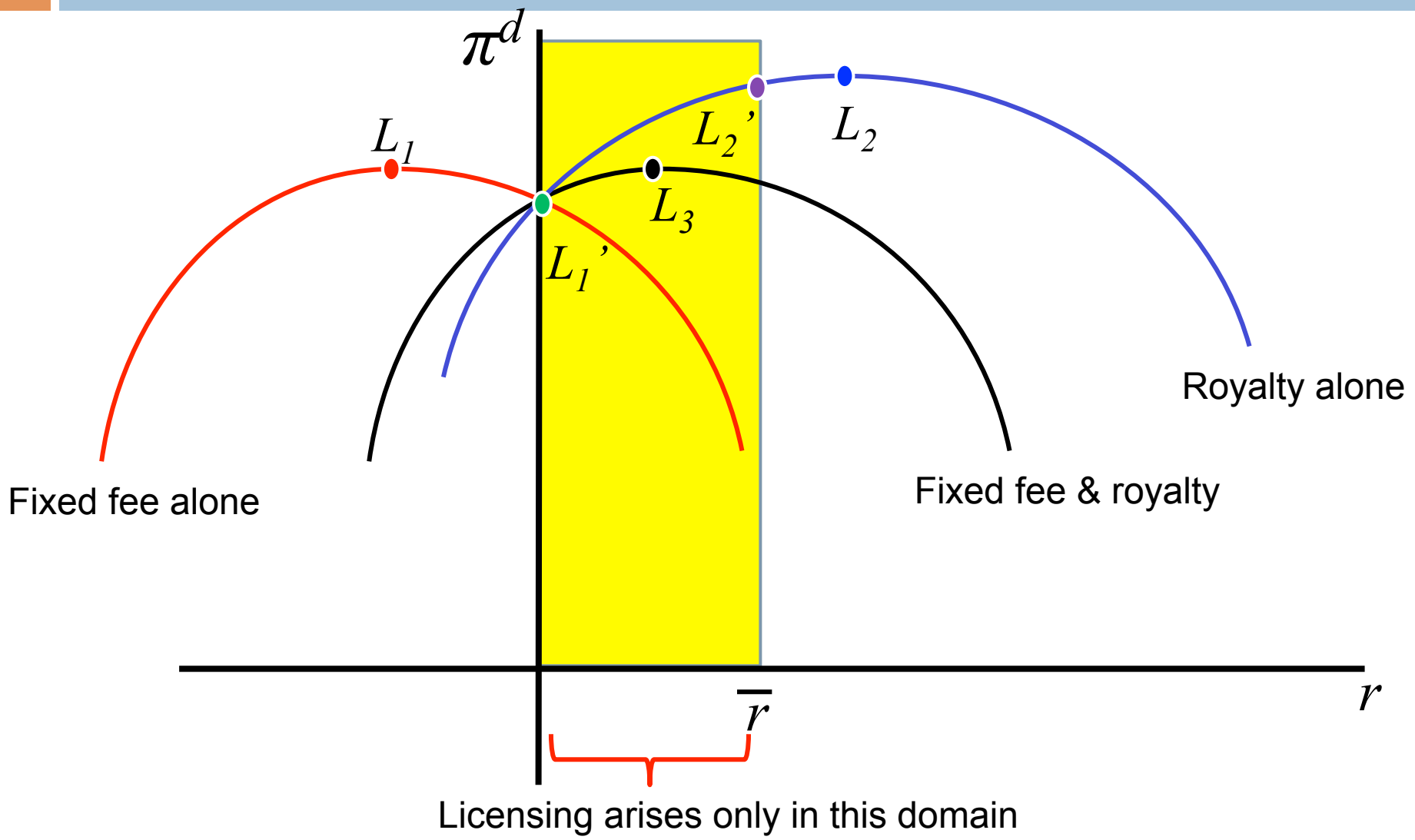
- *When* $\phi(4B + B\phi^2 - 4A\phi) \leqq 0$ ($A \equiv \alpha - c_y$, $B \equiv \beta - c_x$)
  - $r = 0$, $R = F$
- *When* $\phi(4B + B\phi^2 - 4A\phi) > 0$
  - $r = \bar{r}$, $R = 0$ *if* $r^* \geqq \bar{r}$

$$r^* \equiv \frac{-\phi\left(4B + B\phi^2 - 4A\phi\right)}{2\left(3\phi^2 - 4\right)},$$

$$\bar{r} \equiv A - \frac{1}{2}B\phi + \frac{1}{2}\sqrt{\pi_R^{f*}(\phi^2 - 4)},$$

$$R^* \equiv \left(\frac{2(A - r^*) - \phi B}{4 - \phi^2}\right)^2 - \pi_R^{f*}.$$

3 types of licensing (Fig. 1)



Intuition

$$\pi^d = (p_y - c_y)y + (R + rx)$$

- r ↑ → 1st term: profits from producing good Y ↑
  - 2nd term: license revenue from fixed payment ↓
  - 3rd term: license revenue from royalty ?
- $\phi\,(4B + B\,\phi^2 - 4A\,\phi) \leqq 0$

→ the effective market size for good Y (B) is small relative to that for good X (A)

→ effect on the 1st term is small

→ set $r=0$ (*firm d* actually wants to set $r<0$ which is not allowed)

R&D equilibrium vs Licenisng equilibrium

Suppose MCs of production are identical between R&D and licensing

- Licensing increases profits of *firm d* relative to R&D
  - Revenue from licensing
  - *firm f*'s effective MC ↑ if $r > 0$
- Consumer surplus (CS)
  - $r > 0$ → prices of both goods ↑ → CS ↓

Proposition 2 (welfare comparison without intervention: licensing vs R&D)

- If $0 \leq r < 2A/3$, then domestic welfare is higher under licensing than under R&D
  - Tradeoff: domestic firm vs domestic consumers
- Foreign welfare is the same between the licensing case and the R&D case

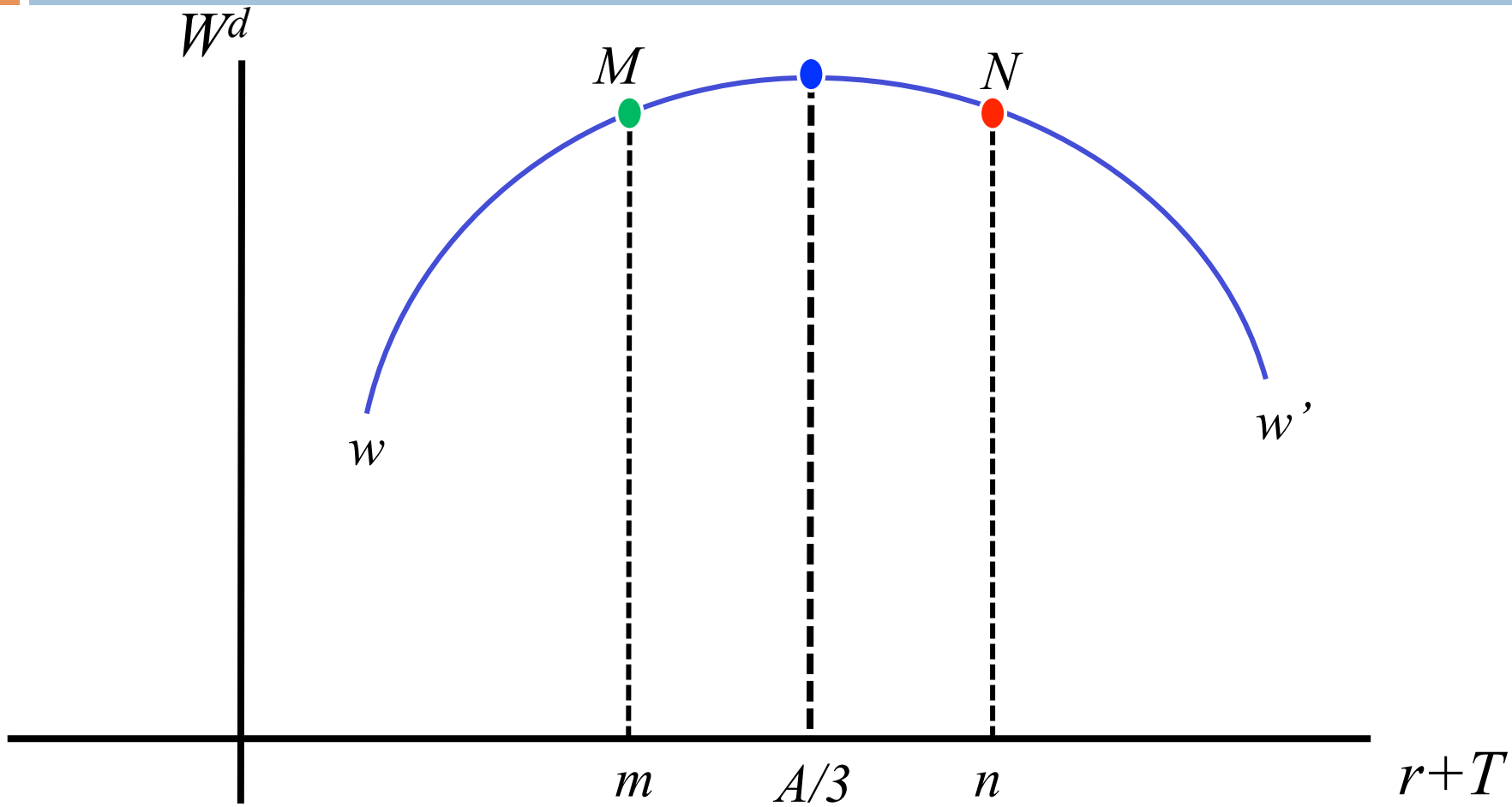
Stage game with rent-shifting

1. Government intervention stage
    1. Only domestic government intervenes
    2. Only foreign government intervenes
    3. Both governments intervene
2. Licensing stage
3. Competition stage: Cournot competition

Proposition 3 (Optimal intervention by domestic government alone)

- Fixed fee ($R=F>0$) and per-unit royalty ($r = 0$)
  - Import subsidy
    - $r \geqq 0$, $R \geqq 0$ → Subsidy makes the situation just like $r<0$
- Fixed fee ($R=0$) and per-unit royalty ($r > 0$)
  - A royalty and a tariff are perfect substitutes: $r + T = \bar{r}$ → Optimal tariff is not unique
  - R&D could be better than licensing → Set a tariff so that R&D arises
- Fixed fee ($R>0$) and per-unit royalty ($r > 0$)
  - Import subsidy

Figure 2: Optimal tariff with licensing with royalty alone



Proposition 4 & 5 (Optimal intervention by foreign government alone)

Proposition 4

- R&D → export (production) subsidy
- Licensing → export (production) tax

Proposition 5

- Rent-shifting through
  - R&D subsidy
  - Tax on license fees

Export tax on *firm f*

- Reduce room for arbitrage

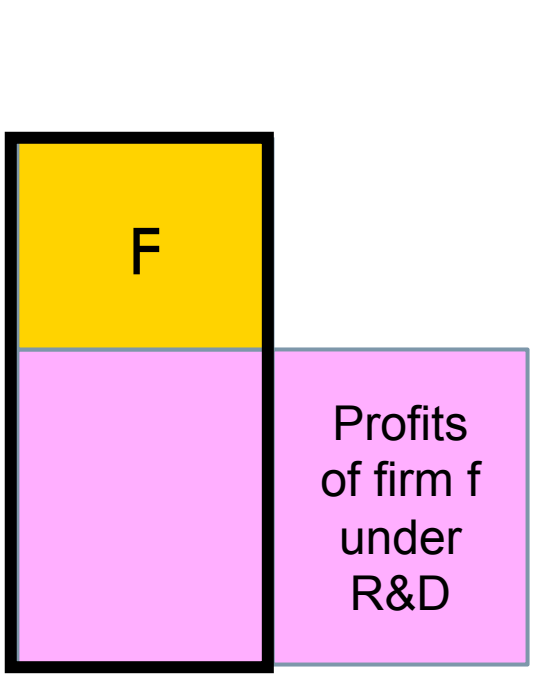
  → indirect rent-shifting

  $$\pi^d_{L\tau} \equiv \max_{r,R} \pi^d; s.t.\ \pi^f - \tau x_L \geq \pi^f_R, r \geq 0, R \geq 0$$

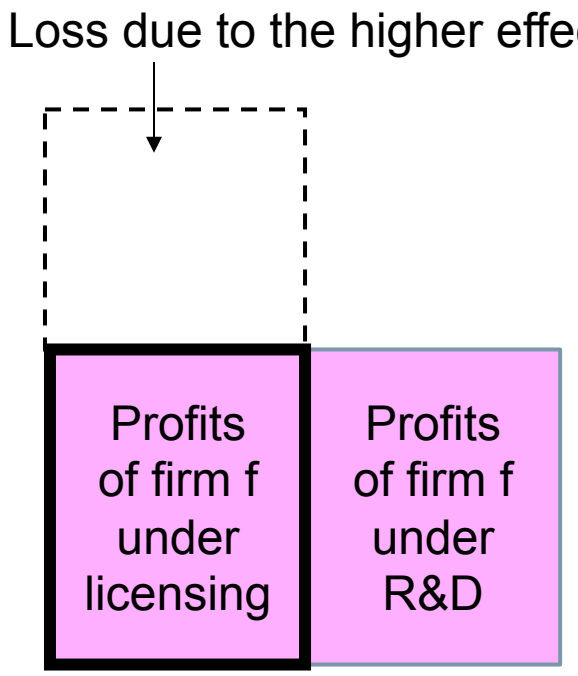
  - $\max_{\tau} \tau x_L; s.t. \pi^d_{L\tau} \geq \pi^d_R$

  - Suppose $\pi^f - \tau x_L = \pi^f_R \; at \; r = R = 0 \;\&\; \tau = \tau^*$
    - with $\tau = \tau^*$ *firm f*'s effective MC is
      $c^f + r + \tau = c^f + \tau^*$
      and hence $\pi^d_L > \pi^d_R$

Profits of *firm f* under licensing

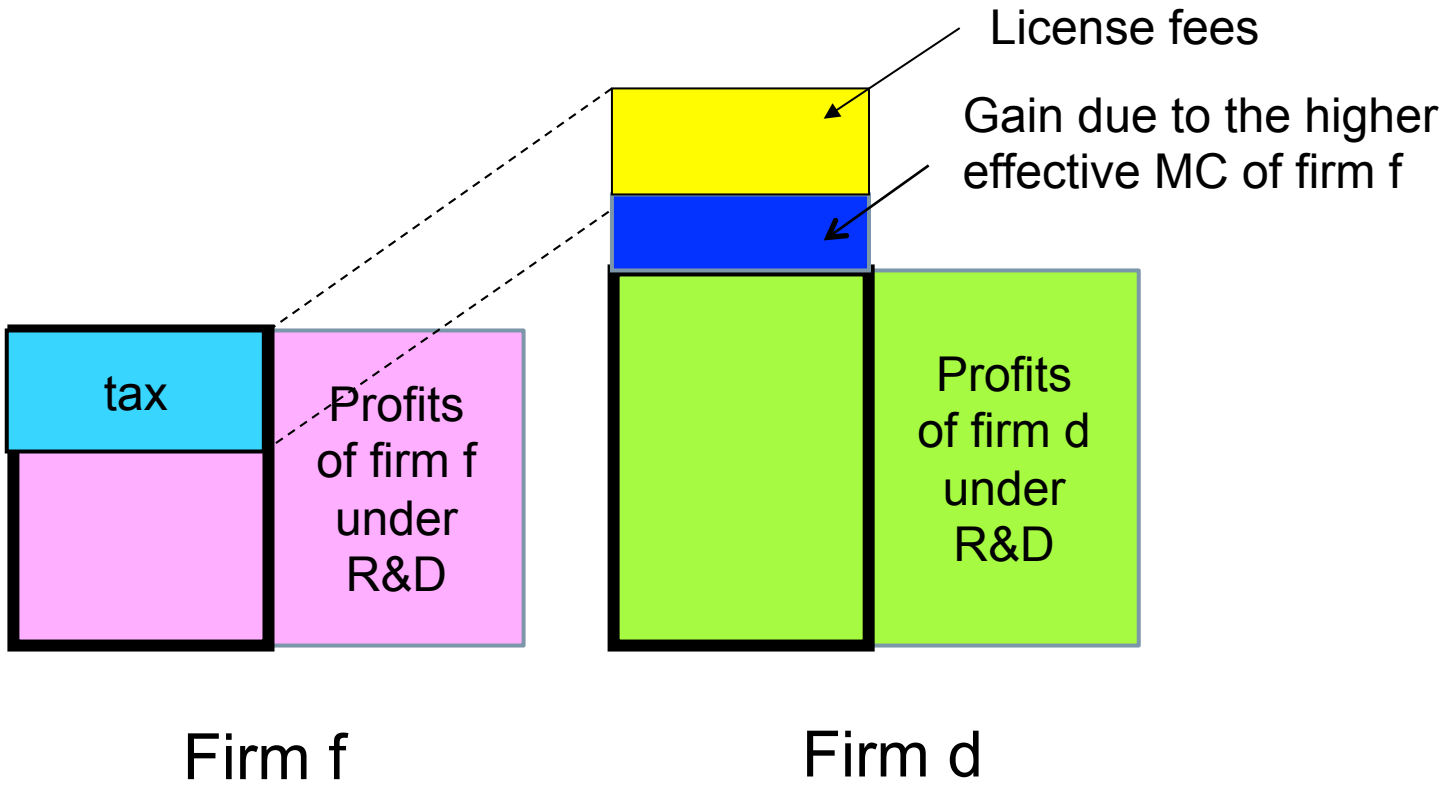


$$R = r = 0$$



$$r = \bar{r}, R = 0$$

Production tax under licensing



Commitment to an R&D subsidy to *firm f*

- $\pi_R^f < 0$ could hold
  - No incentive for R&D without subsidy

  → $\pi_R^f + S > 0$

  → incentive for licensing

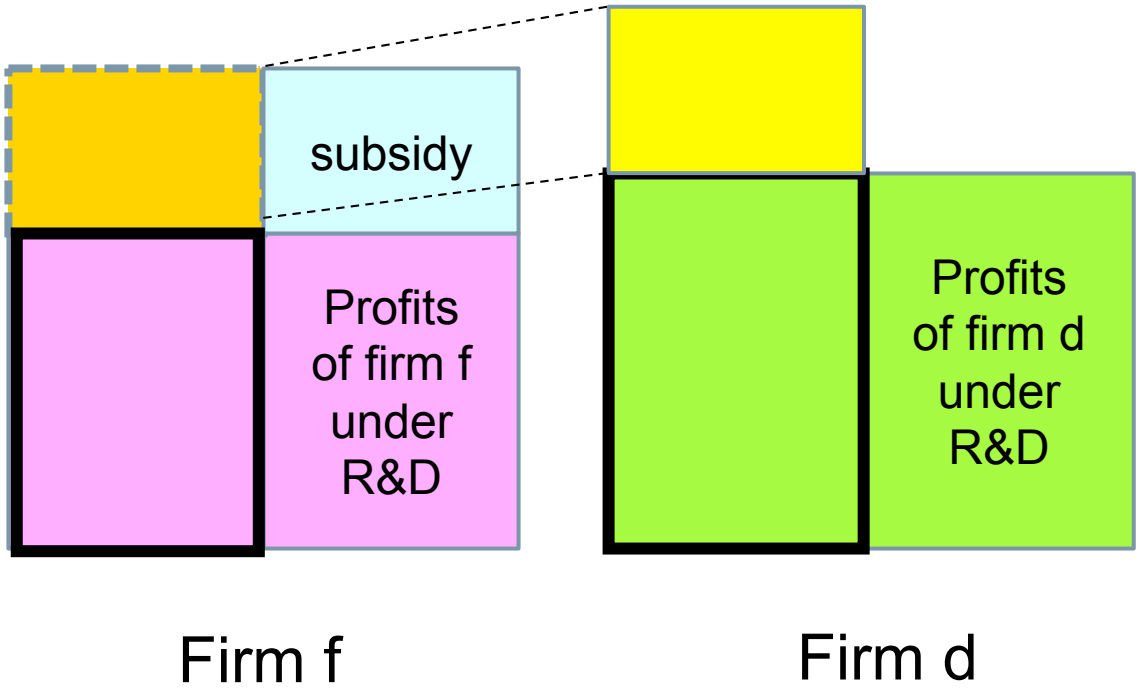
  → choose S such that

  $$\pi_{Ls}^d (\equiv \max_{r,R} \pi^d; s.t.\ \pi^f \geq \pi_R^f + S, r \geq 0, R \geq 0) \geq \pi_R^d$$

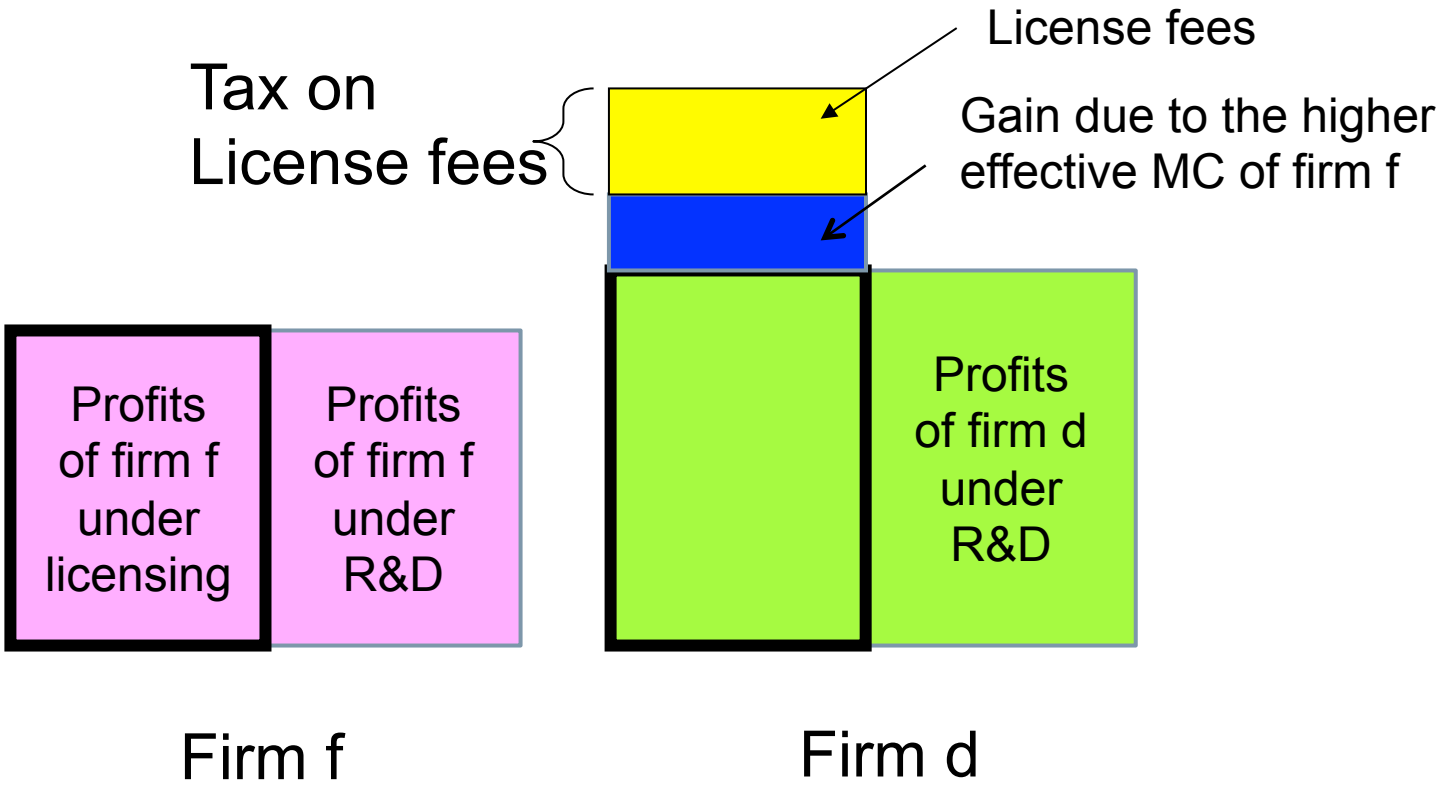
  → $S=F$

  → No subsidy payment
- Subsidy → Reduce room for arbitrage

Commitment to an R&D subsidy to *firm f*



Tax on license fees



License fees with foreign intervention

- License fees:

$$\pi_L^d \equiv \max_{r,R} \pi^d; s.t.\ \pi^f \geq \pi_R^f, r \geq 0, R \geq 0$$

1. $\max_{r,R} \pi^d - tx_L; s.t.\ \pi^f \geq \pi_R^f, r \geq 0, R \geq 0$
2. $\max_{r,R} \pi^d; s.t.\ \pi^f - \tau x_L \geq \pi_R^f, r \geq 0, R \geq 0$
3. $\max_{r,R} \pi^d; s.t.\ \pi^f \geq \pi_R^f + S, r \geq 0, R \geq 0$

Interventions by both governments

- Domestic government
  - Tariff
- Foreign government
  - Export tax
- Reaction correspondence (curve)

Figure 3: Tariffs and export tax under R&D

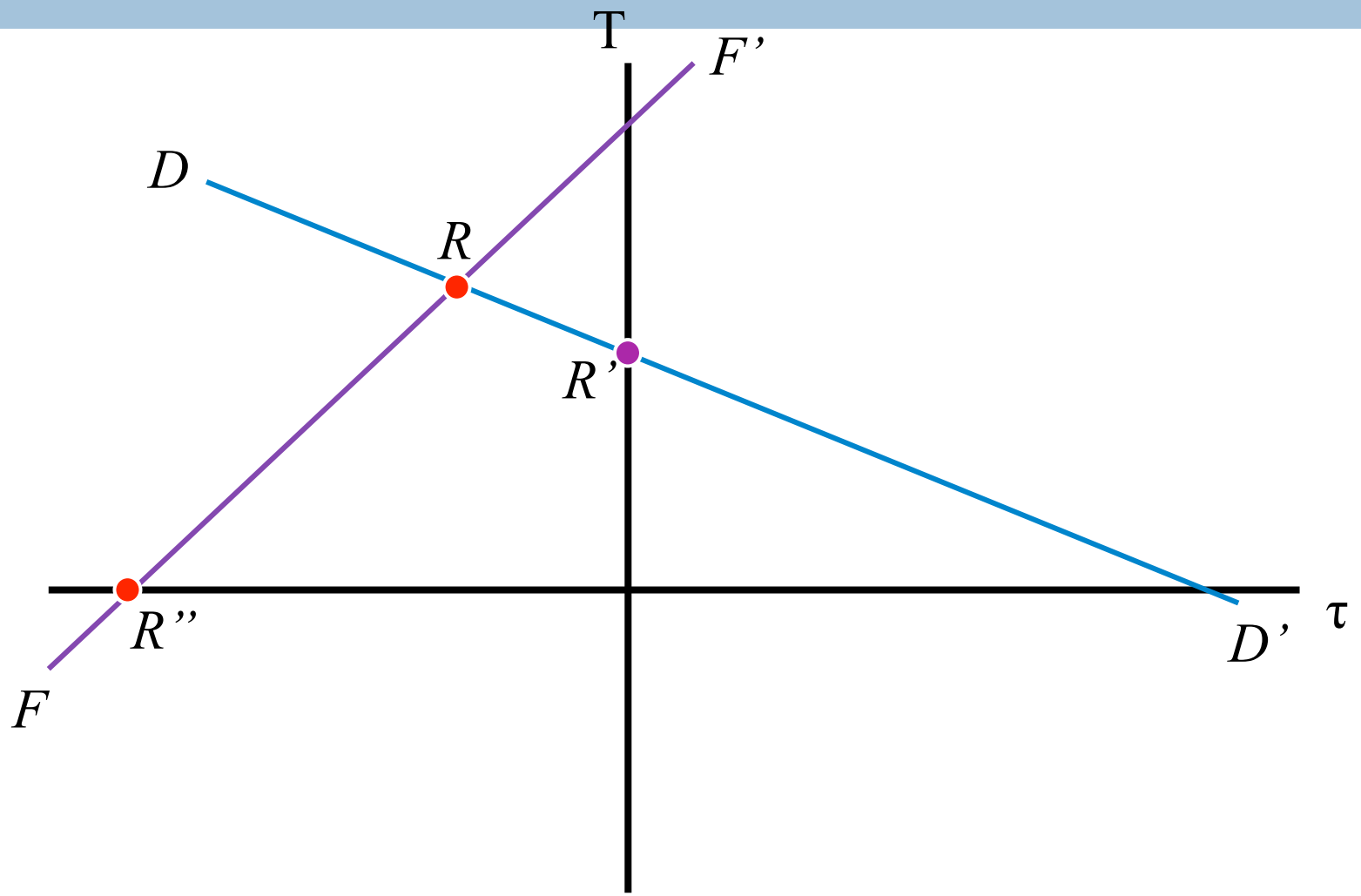


Figure 4: Tariffs and export taxes
under licensing with a fixed fee alone

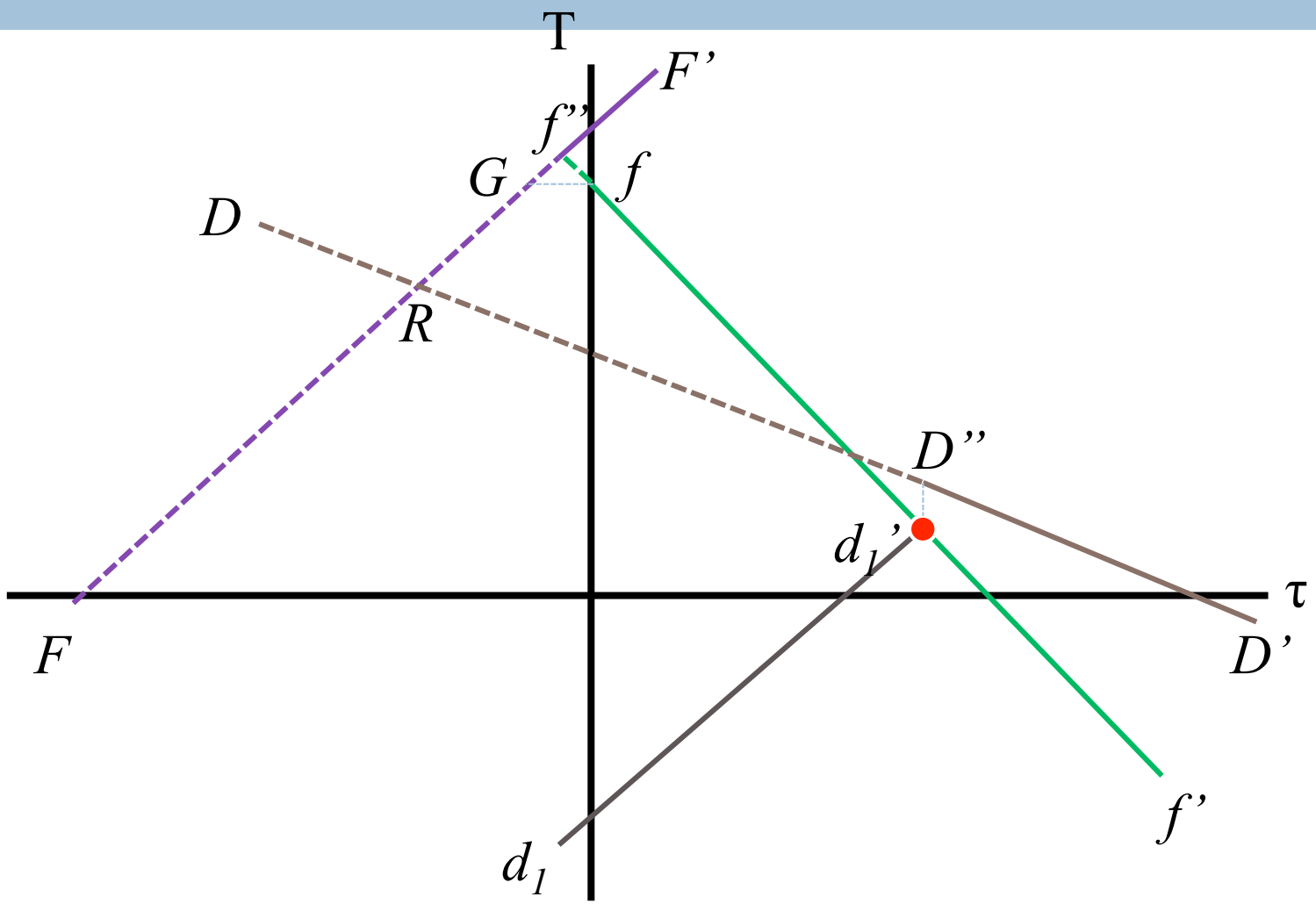


Figure 5: Tariffs and export taxes under licensing with a royalty alone
Panel (a)

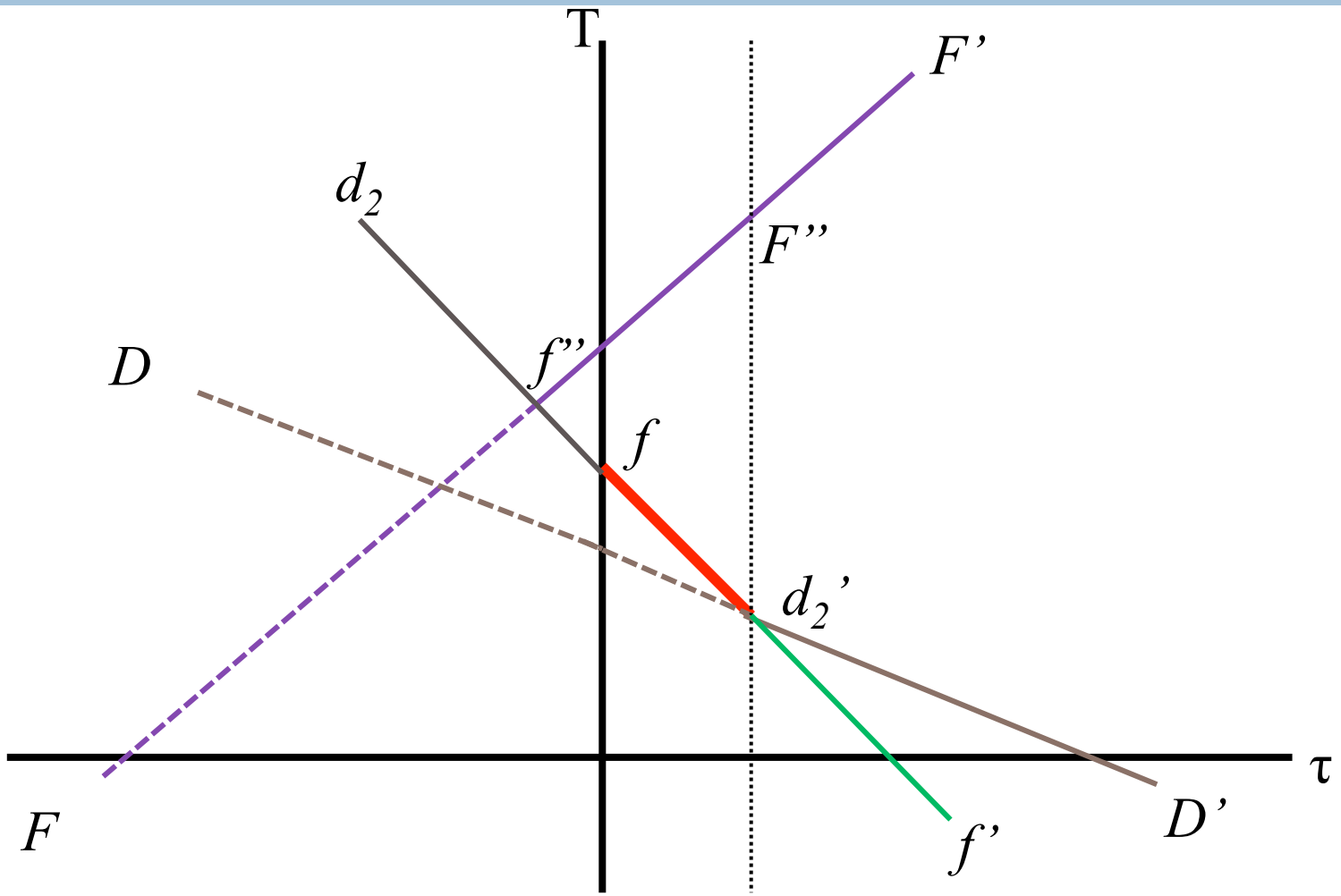


Figure 5: Tariffs and export taxes under licensing with a royalty alone
Panel (b)

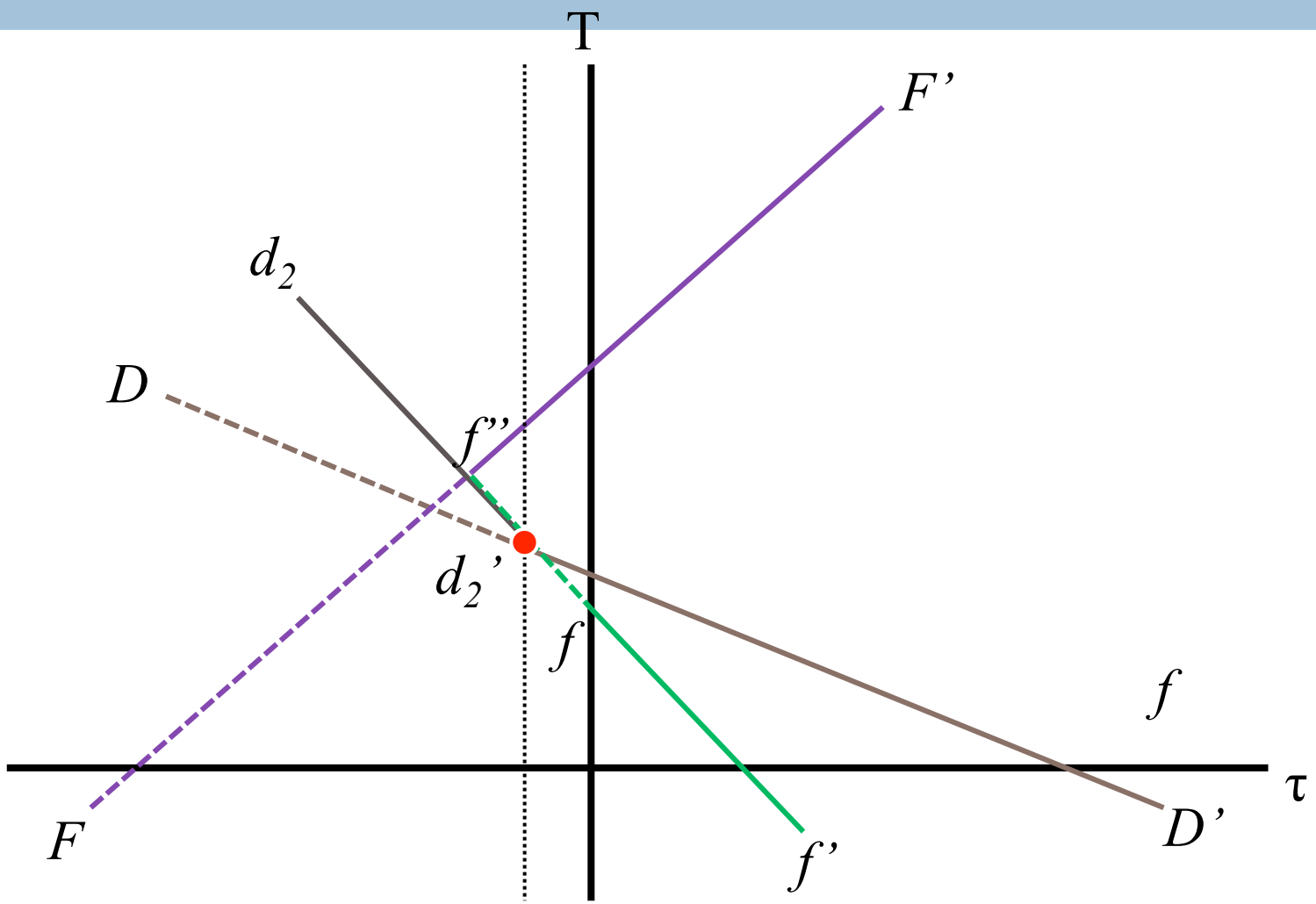


Figure 5: Tariffs and export taxes under licensing with a royalty alone
Panel (c)

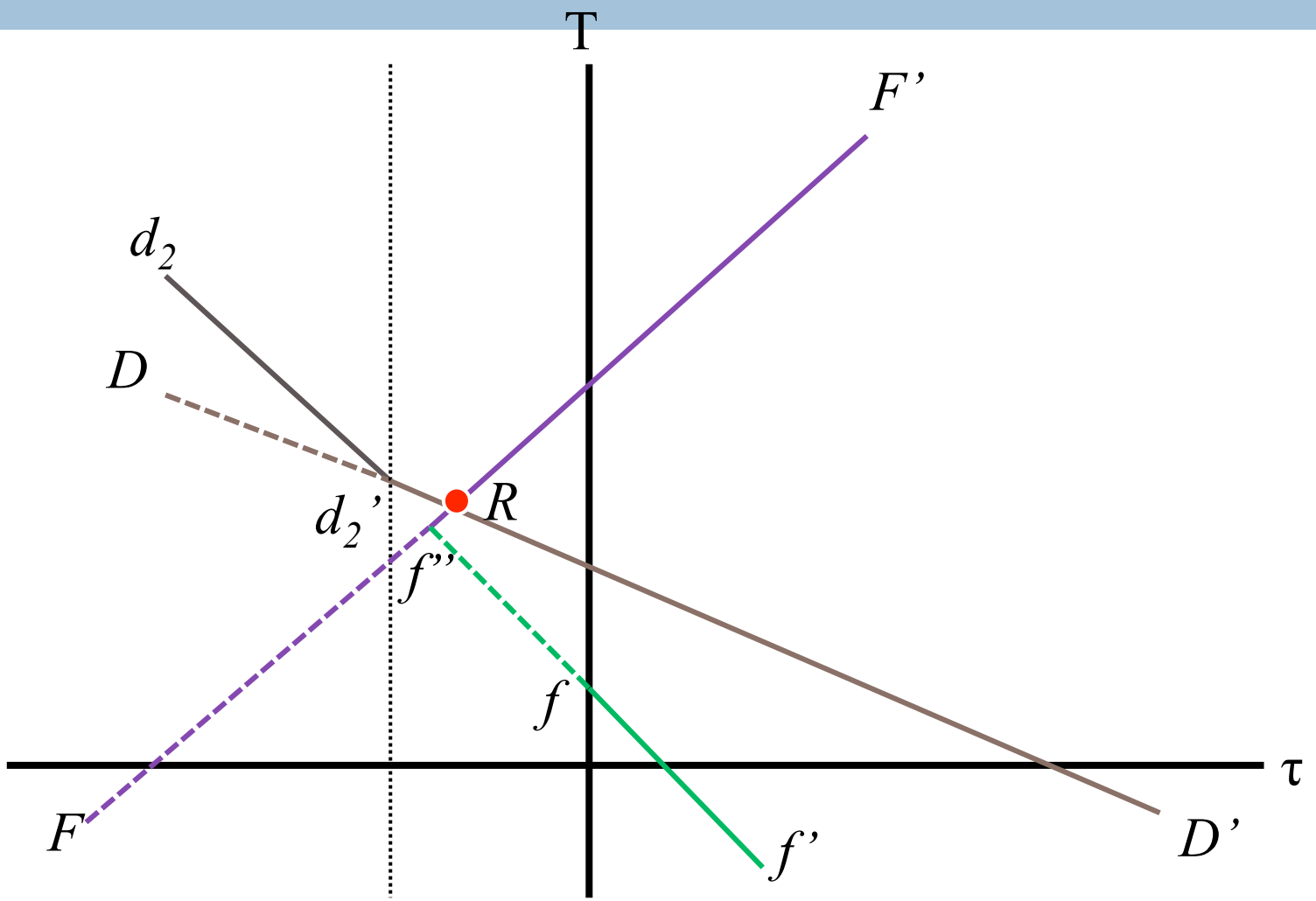
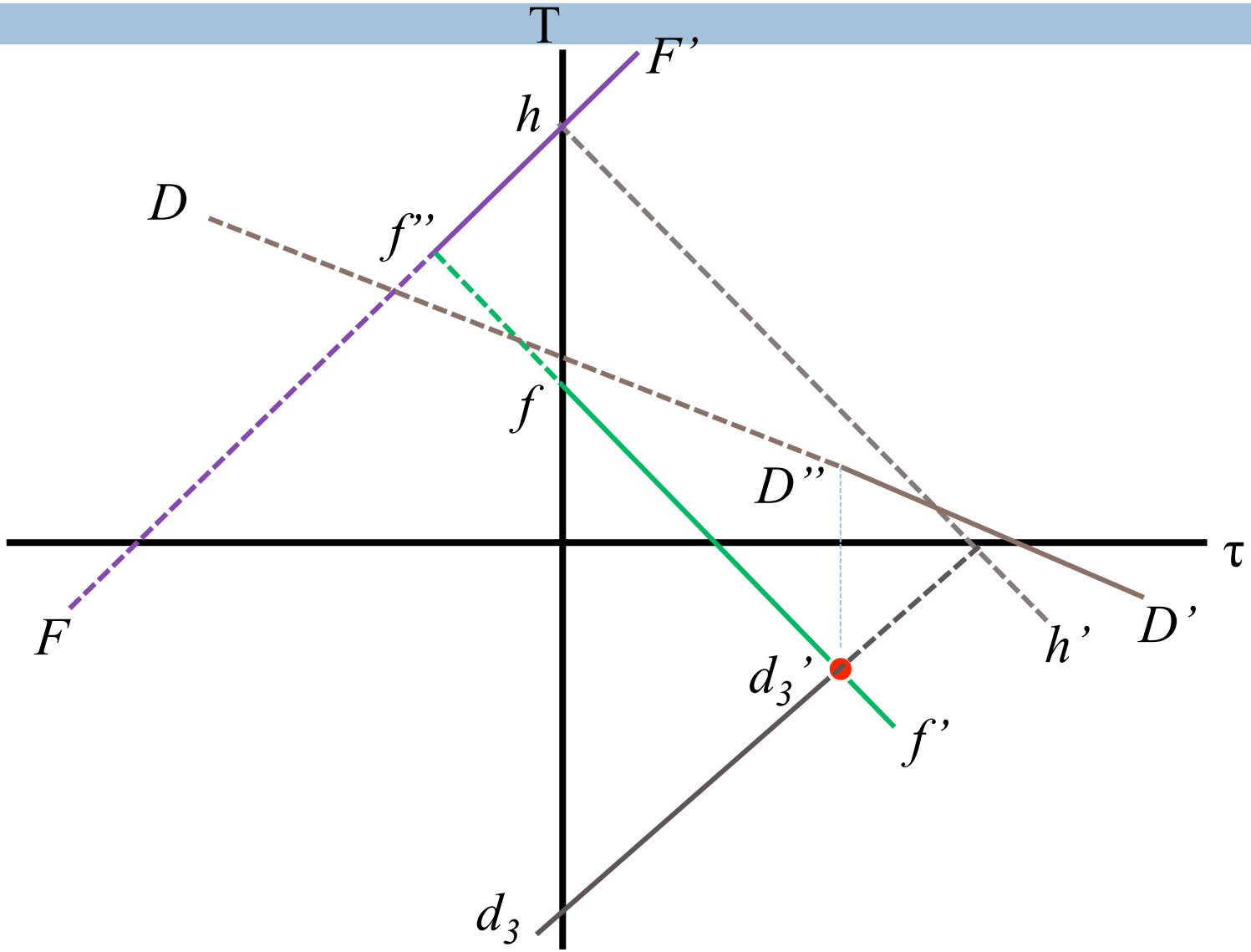


Figure 6: Tariffs and export taxes
under licensing with both a fixed fee and a royalty



Interesting results

In the case of international licensing

- Domestic government may provide import subsidy instead of tariff
- Foreign government can shift rent from domestic firm
  - by export tax on foreign firm instead of subsidy
  - by R&D subsidy → no subsidy payment in equilibrium

Remarks

- Other policies → rent-shifting
- Purchase of key intermediate inputs from rival firms instead of licensing
- R&D → externalities
- Bargaining power in the licensing stage
  - Some bargaining power by domestic firm
  - No bargaining power by domestic firm
    - Tiny fixed fee → tariff reduction

Remarks

- 3rd country market
  - Domestic policy: export subsidy → export tax
- Incentive to lower tariffs
  - To "benefit" domestic firm and raise domestic welfare