Economic Effects of Standards Harmonization between Technologically Asymmetric Countries

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Very Preliminary Draft

Motivation

- Since the fostering of trade liberalization in the 1990s, tariff rates have been dropping steadily
  - While the varieties and volume of Non-tariff measures (NTMs) have increased

- Under the GATT regime, member countries are unable to impose higher tariff rates than the bound rates
  - NTMs has been practiced as trade barriers in many countries

Motivation

- Standards, which is one of the NTMs, may also serve as de facto trade barriers
  - The U.S. Federal Motor Vehicle Safety Standards (FMVSS) VS. The United Nations Economic Commission for Europe (UNECE)
  - lithium-iron phosphate (LFP) battery VS. nichel-manganese-cobalt (NMC) battery

- It discriminates foreign producers by incurring conversion costs to satisfy domestic standards

- Moreover, in some industries, technology level may affect such conversion costs

Motivation

- WTO Agreement on Technological Barriers to Trade (the TBT Agreement)
  - ensure that the standards do not create unnecessary obstacles
  - However, due to the characteristics of multilateral agreement, it is not easy to satisfy all the member countries needs

- The TBT chapter in Free Trade Agreements (FTA TBT agreement) or Standards Union
  - set out specific trade obligations and measures reflecting the characteristics of each member country.
  - can participate in the member countries' process of developing standards-related measures.

- Examines the economic effect of standards harmonization and government's strategic standardization policy

Literature Review

- Standards can work as barriers to trade

  - Minimum quality standards
    (e.g. Boom, 1995; Lutz, 1996)

  - Compatibility standards
    (e.g. Jensne and Thursby, 1991; Gandal and Shy, 2001; Chen et al., 2006)

- Examines the impact of standards harmonization under the existence of technology asymmetries among countries

The Model

- There are three countries—L, M, and H, and Each country has its representative firm l, m, and h, respectively.

- Firms produce horizontally differentiated products and sell them to all three countries.

- The markets are segmented, and thus the firms can charge different prices in different countries.

The Model
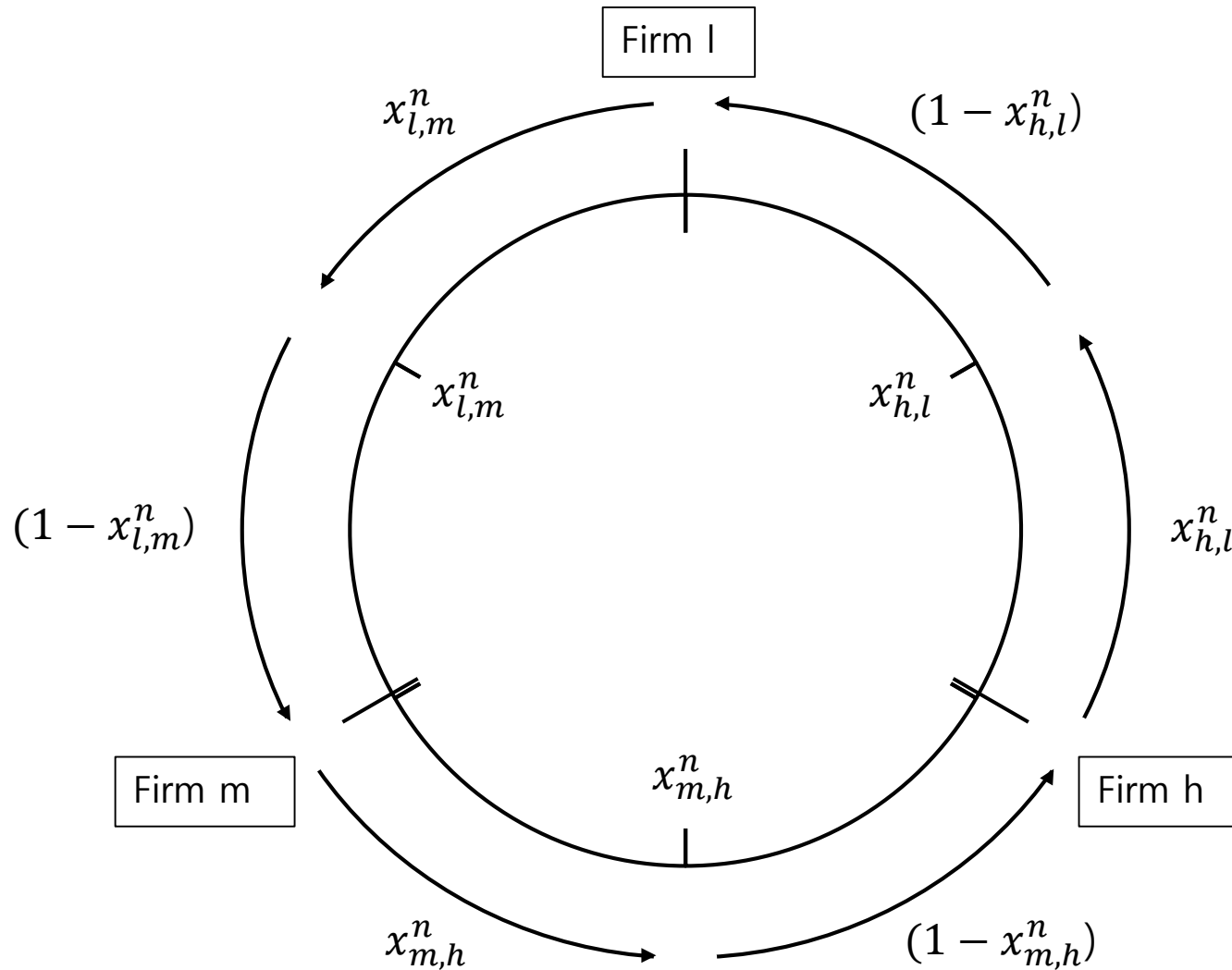
The Model

- Consumer's utility function

  $$U_x = V_i - p_i - [d_i(x)]^2 \qquad \text{where, } V_i = V \text{ and } [d_i(x)]^2 = x^2$$

- Production costs are the same for all firms and set to be zero

- Each of three countries has adopted different standards
  - the domestic firms produces products according to the domestic standards
  - It thus incurs standard conversion costs for the foreign firms in order to satisfy local standards

The Model

- Technology differences among the three nations
  - Technology gap is reflected in the marginal conversion costs($c_h < c_m < c_l$)
  - $c_h = c - \gamma, \ c_m = c$ and $c_l = c + \gamma$

- the production costs are the same for all firms, and set to zero.

The Model

- The inverse demand function that each firm faces in country m's market

$$x_{i,j}^n + 1 - x_{k,i}^n = 1 + \frac{p_j^n + p_k^n - 2p_i^n}{2}, \text{ where, } i, j, k \in \{l, m, h\}, \ i \neq j \neq k$$

- the profit function of firm i in country n

$$\pi_i^n = (p_i^n - c_i^n)(x_{i,j}^n + 1 - x_{k,i}^n) = (p_i^n - c_i^n)\left(1 + \frac{p_j^n + p_k^n - 2p_i^n}{2}\right)$$

- The Nash equilibrium price, outputs and profits of firm i in country n can be obtained
  - where, $c_l^L = c_m^M = c_h^H = 0$

The Model

- the profit functions of the three countries' firms are expressed as follows:

$$\pi_l = \pi_l^L + \pi_l^M + \pi_l^H = \frac{14}{25}\gamma^2 + \frac{6}{25}\gamma c - \frac{12}{5}\gamma + \frac{6}{25}c^2 + 3,$$

$$\pi_m = \pi_m^L + \pi_m^M + \pi_m^H = \frac{2}{25}\gamma^2 + \frac{6}{25}c^2 + 3,$$

$$\pi_h = \pi_h^L + \pi_h^M + \pi_h^H = \frac{14}{25}\gamma^2 - \frac{6}{25}\gamma c + \frac{12}{5}\gamma + \frac{6}{25}c^2 + 3$$

- the social welfare of each country can be summarized as follows:

$$W^L = \frac{16}{25}\gamma^2 + \frac{4}{25}\gamma c - \frac{7}{5}\gamma + \frac{8}{25}c^2 - 2c + 3V - \frac{1}{4},$$

$$W^M = \frac{8}{25}\gamma^2 + \frac{8}{25}c^2 - 2c + 3V - \frac{1}{4},$$

$$W^H = \frac{16}{25}\gamma^2 - \frac{4}{25}\gamma c + \frac{7}{5}\gamma + \frac{8}{25}c^2 - 2c + 3V - \frac{1}{4}.$$

Standards Harmonization

- Two countries harmonize standards by forming FTA TBT agreement or standards union
  - both member countries set common standards
  - The conversion costs are eliminated between member countries
  - Focus on the technologically middling country m

- M harmonizes standards with H

- M harmonizes standards with L

Standards Harmonization with H

|	Before the harmonization	After the harmonization	Welfare effects of standards harmonization
Consumer surplus of M	$\dfrac{6}{25}\gamma^2 + \dfrac{2}{25}c^2 - 2c + 3V - \dfrac{13}{4}$	$\dfrac{2}{25}\gamma^2 + \dfrac{4}{25}\gamma c - \gamma + \dfrac{2}{25}c^2 - c + 3V - \dfrac{13}{4}$	$\Delta CS^M > 0$ $\dfrac{\partial \Delta CS^M}{\partial \gamma} < 0$
Producer surplus of M	Total PS: $\dfrac{2}{25}\gamma^2 + \dfrac{6}{25}c^2 + 3$	Total PS: $\dfrac{3}{25}\gamma^2 + \dfrac{3}{25}c^2 + \dfrac{6}{25}\gamma c + \dfrac{2}{5}\gamma + \dfrac{2}{5}c + 3$	$\Delta PS_m > 0$ $\dfrac{\partial \Delta PS_m}{\partial \gamma} > 0$
	PS in the domestic market: $\dfrac{1}{25}(2c+5)^2$	PS in the domestic market: $\dfrac{1}{25}(\gamma + c + 5)^2$	$\Delta PS_m^M < 0$

Standards Harmonization with H

	Before the harmonization	After the harmonization	Welfare effects of standards harmonization
Producer surplus of M	PS in the member market, H: $\frac{1}{25}(\gamma - c + 5)^2$	PS in the member market, H: $\frac{1}{25}(\gamma + c + 5)^2$	$\Delta PS_m^M > 0$
	PS in the non-member market, L: $\frac{1}{25}(\gamma + c - 5)^2$	PS in the non-member market, L: $\frac{1}{25}(\gamma + c - 5)^2$	0
The social welfare of M	$\frac{8}{25}\gamma^2 + \frac{8}{25}c^2$ $-2c + 3V - \frac{1}{4}$	$\frac{1}{5}\gamma^2 + \frac{2}{5}\gamma c - \frac{3}{5}\gamma$ $+\frac{1}{5}c^2 - \frac{3}{5}c + 3V - \frac{1}{4}$	$\Delta W^M > 0$ $\frac{\partial \Delta W^M}{\partial \gamma} \gtreqless 0$

Standards Harmonization with H

- When the average conversion cost of the three firms is sufficiently large, the higher technological difference might improve the social welfare of M.

- When not, an increase of the technology gap might lower the social welfare of M.

$$\frac{\partial \Delta W^M}{\partial \gamma} = \frac{2}{5}c - \frac{6}{25}\gamma - \frac{3}{5} \gtreqqless 0, \text{ according to } c \gtreqqless \frac{3}{5}\gamma + \frac{3}{2}$$

FTA TBT with H
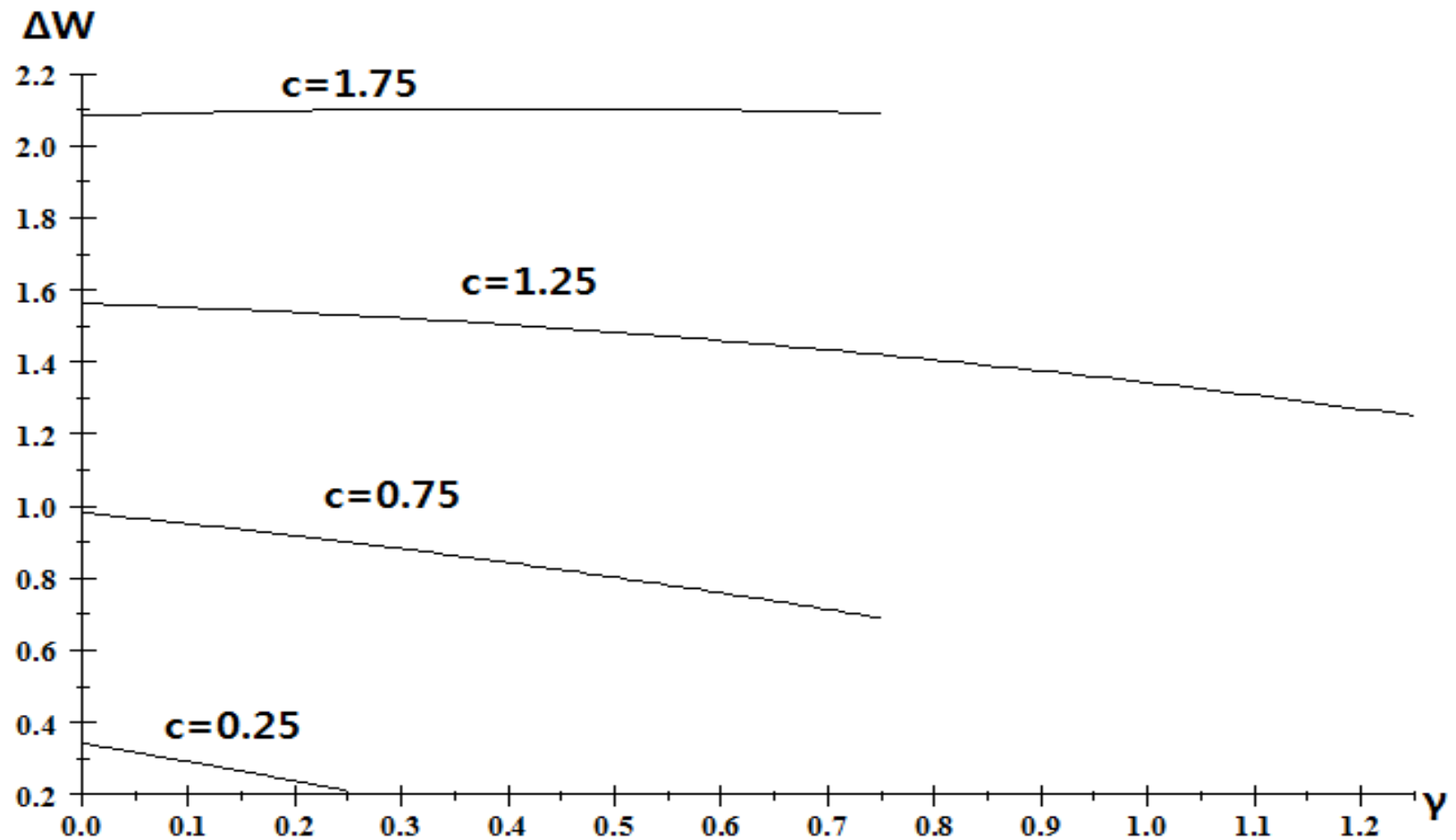
The Optimal Strategy for M

- M may have to set priorities between H and L

$$\Delta CS^M_{HAR_{MH}} - \Delta CS^M_{HAR_{ML}} = \frac{2\gamma(4c-25)}{25} < 0,$$

$$\Delta PS^M_{HAR_{MH}} - \Delta PS^M_{HAR_{ML}} = \frac{4\gamma(3c+5)}{25} > 0,$$

$$\Delta W^M_{HAR_{MH}} - \Delta W^M_{HAR_{ML}} = \frac{2\gamma(2c-3)}{5} \gtreqless 0$$

- If the average conversion cost is sufficiently large (i.e., c>3/2), prioritize the harmonization with H

- If the average conversion cost is sufficiently small (i.e., c<3/2), prioritize the harmonization with L

Incomplete Information

- To reach an agreement between countries with different disagreement payoffs, side payment is required

- The actual technology level of H is not known to M
  - M should set up an optimal side payment strategy considering each technology level report of the country H

Incomplete Information

- If the technology difference between two countries is large enough($\frac{1}{5} < \gamma$), then H has less welfare gains than M as the technology gap increases

$$\frac{\partial}{\partial \gamma}\left(\Delta W^H_{HAR_{MH}} - \Delta W^M_{HAR_{MH}}\right) = \frac{5 - 2c - 10\gamma}{25}$$

- H has an incentive to disclose the actual technology difference especially when it is small

Conclusions

- Technologically middling country needs to actively harmonize its standards with other country

- Technologically middling country needs to decide its harmonization partners strategically
  - Depending on the characteristics of firm or industry

Thank you