

DISCUSSION PAPER SERIES

Discussion paper No.118

Economic Integration, Quality Choice, and Monopoly

Tsuyoshi Toshimitsu

School of Economics, Kwansai Gakuin University

May, 2014



SCHOOL OF ECONOMICS

KWANSEI GAKUIN UNIVERSITY

1-155 Uegahara Ichiban-cho
Nishinomiya 662-8501, Japan

Economic Integration, Quality Choice, and Monopoly

Tsuyoshi TOSHIMITSU[†]

School of Economics, Kwansai Gakuin University

Abstract

Applying a standard model of endogenous quality choice to the case of multiple national markets (i.e., a developed and a less developed country), we consider the effect of an economic integration (i.e., a movement from segmented markets into a single integrated market through the removal of trade barriers) on price, quality, and consumer surplus. We show that the effect depends on the difference between the consumer distributions of the two countries and the degree of trade barrier costs. In particular, if the difference between the consumer distributions of them is large (small) and/or the degree of trade barrier costs is low (high), an economic integration decreases (increases) the quality level and the welfare of the two countries.

Keywords: segmented market; integrated market; trade barrier costs; economic integration; price discrimination, uniform price; quality choice; demand dispersion; monopoly

JEL classification: D42, L12

[†] School of Economics, Kwansai Gakuin University, 1-155, Nishinomiya, 662-8501, Japan
Tel. +81 798 54 6440, Fax. +81 798 51 0944, E-mail. ttsutomu@kwansai.ac.jp

1. Introduction

At present, negotiations regarding regional free trade and economic partnership agreements (e.g., Trans Pacific Partnership) are progressing among many countries. About 50 years ago, Balassa (1961a, b) pointed out that the term “economic integration” was not clear, even in the economic literature. Therefore, Balassa defined the concept of economic integration and considered the static and the dynamic effects of an economic integration, and also the problems with the harmonization of social, fiscal, and monetary policies. Since then, many researchers have analyzed different issues regarding an economic integration in various contexts. For a survey of regional economic integration, see, for example, Baldwin and Venables (1995). Furthermore, Sapir (2011) reviews developments in the economic literature and in the process of European integration since the publication of Balassa’s book.

In this paper, we first note that: “Economic integration entails a movement, through the removal of tariff and nontariff measures, from segmented national markets towards a single integrated market” (Ishikawa, 2004, p. 706). This definition is given in the context of international economics. Accordingly, we consider how a significant change in an international market structure affects the behavior of firms and their decisions on price, output, and investment, and also the welfare in each country.

In this paper, using a standard model of endogenous quality choice by a monopoly, we analyze the effect of an economic integration on the price and quality decisions of the monopoly and on the consumer surplus in the countries involved. In particular, in the situation of segmented national markets with trade barrier costs before an economic integration, the monopoly imposes

price discrimination in each national market and, thus, decides the quality level under a regime of discriminated pricing. On the other hand, in the situation of a single integrated market without any trade barrier costs after an economic integration, the monopoly sets a uniform price and chooses the quality level under the regime of uniform pricing through pressure from price arbitrage. Therefore, comparing the equilibrium outcomes, i.e., price, output, quality, and welfare in each situation, we consider the effect of an economic integration. In other words, we show the conditions necessary to sustain an economic integration that is Pareto improving for the countries involved.

We review papers that are related to our monopoly framework model in which we exploit three-degree price discrimination and parallel trade analysis. Layson (1994) analyzed the effect of market opening under price discrimination, and identified the factors that favor markets opening under price discrimination. One is that the price elasticities in the two markets are far apart. Conversely, an economic integration between the two countries with this condition harms the consumers and, thus, leads to a Pareto welfare loss. As noted below, the price elasticity in our model depends on the distribution of consumers in each country and the quality level of the product. In this case, if the difference in consumer distributions between the two countries is very large, an economic integration decreases their welfare. Furthermore, the quality level is affected by trade barrier costs under the regime of price discrimination in the case of segmented markets. Thus, if the degree of trade barrier costs is very small, an economic integration also decreases the welfare of the two countries.

Related to this point, Layson (1994), Malueg and Schwartz (1994), and others show the case where the monopoly does not provide the product to the country with a weak demand (i.e., a low

willingness to pay for the product or a high price elasticity of demand) in the regime of a single integrated market by an economic integration, if there is a large difference in the demand structure between the two countries. This is because the profit of the monopoly decreases in the regime of uniform pricing under a single integrated market. In this paper, we present the condition for such a situation to occur.

Furthermore, Ishikawa (2004) examined the effect of an economic integration in a monopoly framework and showed the case where according to the extent of arbitrage and the shape of the marginal cost curve, neither consumers nor the monopoly gain from an economic integration.

Introducing a model of endogenous quality choice into the basic framework of these related papers, we examine how an economic integration affects the quality decision, that is, the quality-improving R&D investment, as well as the price setting, of the monopoly.

The remainder of this paper is organized as follows. In Section 2, based on a standard model of endogenous quality choice, we present the demand functions in the cases of segmented national markets and a single integrated market and the cost function of quality. In Section 3, we first derive the equilibrium outcomes in the cases of segmented national markets and a single integrated market. Then, comparing the equilibrium outcomes in these cases, we consider the effect of an economic integration on the monopoly and the consumers in each country. Finally, in Section 4, we summarize the results and indicate problems that need to be addressed.

2. The model

We apply a standard monopoly model of an endogenous quality choice in the case of two segmented national markets (countries), i.e., market (country) A and market (country) B , where the preferences and income levels of individual consumers differ. That is, there is a continuum of consumers in each national market, indexed by $\theta_i \in [0, \bar{\theta}_i], i = A, B$, associated with a utility function: $u_i(\theta_i|q) = q\theta_i$. Quality, $q \in [0, \infty)$, is modeled as a one-dimensional strategic variable. The monopoly provides the product with the same quality level to the markets.

To simplify, we assume that consumers in each national market are uniformly distributed and that an individual consumer purchases either one unit or no units of the product. Hence, the net surplus of consumer $\theta_i, i = A, B$ is expressed as $v_i = \max\{q\theta_i - p_i, 0\}$, where $p_i, i = A, B$ is the price in each national market. Accordingly, the index of the marginal consumer who has the same net surplus from purchasing one unit or no units of the product is given by $\hat{\theta}_i \equiv \frac{p_i}{q}, i = A, B$. In our analysis, we make the following assumption with respect to the characteristics of the national markets.

Assumption (Szymanski and Valletti, 2005, Section 3.2)

(i) *The upper limit of the consumers in each national market is given by: $\bar{\theta}_A = 1, \bar{\theta}_B = b, 0 < b < 1$.*

(ii) *The density of consumers in each national market is given by: $f(\theta_A) = 1, f(\theta_B) = \frac{1}{b}$.*

Parameter b expresses the difference between the distribution of the income level and the preference of consumers in the two countries.¹ In this case, as the value of b approaches zero, the difference in consumer distributions between the two countries increases, and the demand structure between them becomes more discrepant. Thus, the difference between the price elasticity of demand in the two countries becomes greater. In this paper, we assume that country A (B) is a developed (a relatively less developed) country.

Given the above assumption, the demand functions in the regime of price discrimination under segmented national markets are given by:

$$x_A = 1 - \frac{p_A}{q}, \quad (1)$$

$$x_B = \frac{1}{b} \left(b - \frac{p_B}{q} \right) = 1 - \frac{p_B}{bq}. \quad (2)$$

In the regime of uniform pricing, i.e., $p_A = p_B = p$, under a single integrated market, the monopoly provides the product to countries A and B , given the same price and quality level of the product. Hence, the total demand function is given by:²

$$X \equiv x_A + x_B = 2 - \frac{1+b}{b} \frac{p}{q}. \quad (3)$$

¹ Alternatively, parameter b implies the strength of the willingness to pay in country B (e.g., Ikeda and Toshimitsu, 2010). If the value of parameter b is small, the strength of the willingness to pay is weak in country B .

² For equation (3), we derive: (i) if $p \geq q$, $X = 0$; (ii) if $q > p \geq bq$, $X = x_A = 1 - \frac{p}{q}$; and

(iii) if $bq > p > 0$, $X = x_A + x_B = 2 - \frac{1+b}{b} \frac{p}{q}$.

Next, we assume that the monopoly decides the quality level of the product before setting the price. In other words, the monopoly must undertake an investment in R&D to improve the quality and to build a product line and facility to produce the product associated with the new quality level. In this case, we assume that the cost function of quality is given by:

$$G = G(q) = \frac{g}{2}(q)^2, g > 0. \quad (4)$$

Furthermore, to simplify the model, we assume that the marginal cost of production is independent of quality and is zero.

3. The effect of economic integration on consumers and the monopoly

3.1 Equilibrium under segmented markets: price discrimination and trade barrier costs

We assume that a monopoly locates in country *A*, and that there are trade barrier costs between the two countries (e.g., a tariff, a non-tariff barrier, a transportation cost, and a transaction cost). Thus, the monopoly is burdened by the costs to provide the product to country *B* unless the two countries become integrated into a single market.

Under these circumstances, we consider the price discrimination and quality decision of the monopoly in the case of segmented national markets where the monopoly is burdened by an *ad valorem* trade barrier cost, i.e., $\tau \in [0,1)$. Based on equations (1), (2), and (4), the profit function of the monopoly can be expressed by:

$$\begin{aligned}
\Pi &= \pi_A + \pi_B - G(q) = p_A x_A + (1-\tau)p_B x_B - G(q) \\
&= p_A \left(1 - \frac{p_A}{q}\right) + (1-\tau)p_B \left(1 - \frac{p_B}{bq}\right) - \frac{g}{2}(q)^2.
\end{aligned} \tag{5}$$

From the first-order condition to maximize the profit given by equation (5), we derive the equilibrium prices, outputs, and quality level as follows:

$$p_{AD} = \frac{q_D}{2}, \quad p_{BD} = \frac{bq_D}{2}, \quad x_{AD} = x_{BD} = \frac{1}{2}, \quad q_D = \frac{1+(1-\tau)b}{4g}, \tag{6}$$

where subscript D denotes the regime of price discrimination under segmented national markets.

Furthermore, the profit is given by: $\Pi_D = \frac{\{1+(1-\tau)b\}^2}{32g}$.

3.2 Equilibrium under an integrated market: uniform price and zero trade barrier costs

We assume that an economic integration between the two countries has taken place, i.e., trade barriers between the two countries have been removed. In other words, because trade barrier costs are zero, i.e., $\tau = 0$, the monopoly sets a uniform price under the pressure of price arbitrage.

In this case, from equations (3) and (4), the profit function is given by:

$$\begin{aligned}
\Pi &= \pi_A + \pi_B - G(q) = pX - G(q) \\
&= p \left(2 - \frac{1+b}{b} \frac{p}{q}\right) - \frac{g}{2}(q)^2.
\end{aligned} \tag{7}$$

Thus, from the first-order condition, we derive the equilibrium price, outputs, and quality level as follows:

$$p_U = \frac{bq_U}{1+b}, \quad x_{AU} = \frac{1}{1+b}, \quad x_{BU} = \frac{b}{1+b}, \quad q_U = \frac{b}{(1+b)g}, \quad (8)$$

where subscript U denotes the regime of uniform pricing under a single integrated market.

Furthermore, the profit is given by: $\Pi_U = \frac{1}{2g} \left(\frac{b}{1+b} \right)^2$.

3.3 The effect of economic integration

Given equations (6) and (8), we obtain the following relationship for the quality level:

$$q_D > (\leq) q_U \Leftrightarrow \Omega_q(b) > (\leq) \tau, \quad (9)$$

where $\Omega_q(b) \equiv \frac{(1-b)^2}{b(1+b)}$. It holds that $\Omega_q(b) \geq (<) 1 \Leftrightarrow b \leq (>) \frac{1}{3}$ and $\Omega_q(b)' < 0$ for $0 < b < 1$.

Furthermore, we define: $b_q(\tau) = \{b | \Omega_q(b) = \tau\}$, where $b_q(\tau)' < 0$ for $0 < \tau < 1$. Therefore, we obtain the following proposition:

Proposition 1

(i) If $0 < b \leq b_q(\tau)$, then $q_D \geq q_U$; and

(ii) If $b_q(\tau) < b < 1$, then $q_U > q_D$.

Suppose that $\tau = 0$ in the case of segmented national markets. Hence, by a well-known result in the third-degree price discrimination analysis, we conclude that the monopoly always has an incentive to improve the quality level of the product by price discrimination. However, if $\tau \neq 0$ in this case, the removal of the trade barrier costs affects the decision of quality choice by

the monopoly. That is, if the consumer distribution of the two countries is sufficiently different, i.e., $0 < b \leq b_q(\tau)$, then even though the trade barrier costs are removed by an economic integration, the monopoly does not improve the quality level compared with that in the case of segmented national markets. Contrarily, if the consumer distribution of the two countries is not very different, i.e., $b_q(\tau) < b < 1$, then the more similar the consumer distribution of the two countries, the stronger the effect of the removal of the trade barrier costs, and thus the more the monopoly has an incentive to improve the quality level.

Related to this result, we obtain the effect of an economic integration on the monopoly's profit as follows: $\Pi_D > (\leq) \Pi_U \Leftrightarrow b < (\geq) b_q(\tau)$. Thus, we understand that an economic integration affects the monopoly's profit in a similar way to the effect on the quality level. In other words, an economic integration is preferable for the monopoly if the consumer distributions in the two countries are similar and/or the trade barrier costs are large. This implies that the effect of the removal of trade barrier costs is stronger than that of price discrimination.

We now investigate the effect on prices. If the quality levels in the cases of price discrimination and uniform pricing are assumed to be identical, i.e., $q_D = q_U = \bar{q}$, it holds that $p_{AD} > p_U > p_{BD}$, according to the degree of price elasticity of demand in each national market. However, because of the endogenous quality choice by the monopoly, and the presence of trade barrier costs, we consider the effect of the quality level chosen and the removal of costs on prices.

Based on equation (6) and (8), regarding the price effect in country A , where the price elasticity is small, we obtain the following relationship:

$$p_{AD} > (\leq) p_U \Leftrightarrow P_A(b) > (\leq) \tau, \quad (10)$$

where $P_A(b) \equiv \frac{(1+b)^3 - 8b^2}{b(1+b)^2} (> 0)$, $P_A(b) \geq (<) 1 \Leftrightarrow b \leq (>) \frac{2\sqrt{2}+1}{7}$, and $P_A(b)' < 0$ for $0 < b < 1$. Here, we define the following: $b_{pA}(\tau) = \{b | P_A(b) = \tau\}$, where $b_{pA}(\tau)' < 0$ for $0 < \tau < 1$. Therefore, we derive: if $0 < b \leq b_{pA}(\tau)$, then $p_{AD} \geq p_U$; if $b_{pA}(\tau) < b < 1$, then $p_U > p_{AD}$.

Similarly, regarding the price effect in country B , where the price elasticity is large, we obtain the following relationship:

$$p_{BD} > (\leq) p_U \Leftrightarrow P_B(b) > (\leq) \tau, \quad (11)$$

where $P_B(b) \equiv \frac{(1+b)^3 - 8b}{b(1+b)^2}$. In this case, it holds that $P_B(b) \geq (<) 0 \Leftrightarrow b \leq (>) \sqrt{5} - 2$ and $P_B(b)' < 0$ for $0 < b < \sqrt{5} - 2$. If $\sqrt{5} - 2 \leq b < 1$, then it holds that $P_B(b) \leq 0$. Thus, we have $p_U > p_{BD}$. That is, even though there are no trade barrier costs, if the difference in the consumer distributions of the two countries is not very large, then an economic integration raises the price in country B .

Furthermore, we have $P_B(b) \geq (<) 1 \Leftrightarrow b \leq (>) 3 - 2\sqrt{2}$. Here, we define the following: $b_{pB}(\tau) = \{b | P_B(b) = \tau\}$, where $b_{pB}(\tau)' < 0$ for $0 < \tau < 1$. Therefore, we derive the following relationships: if $0 < b \leq b_{pB}(\tau)$, then $p_{BD} \geq p_U$; and if $b_{pB}(\tau) < b < 1$, then $p_U > p_{BD}$.

Taking equation (10) and (11) into account, it follows that $P_A(b) > P_B(b)$ for $0 < b < 1$. Thus, we have $b_{pB}(\tau) < b_{pA}(\tau)$, given τ . We summarize the effects on prices in the following corollary.

Corollary

- (i) If $0 < b < b_{pB}(\tau)$, then it holds that $p_{AD}, p_{BD} > p_U$;
- (ii) If $b_{pB}(\tau) < b < b_{pA}(\tau)$, then it holds that $p_{AD} > p_U > p_{BD}$; and
- (iii) If $b_{pA}(\tau) < b < 1$, then it holds that $p_U > p_{AD}, p_{BD}$.

If the difference in the consumer distributions of the two countries is large (small), that is, parameter b is close to zero (unity), then an economic integration lowers (raises) the price compared with that in the case of segmented markets. From another viewpoint, we interpret these results as follows: prices depend on the price elasticity of demand in each situation in the international market (i.e., segmented national markets or a single integrated market) and on the quality level. Here, we define the price elasticity of demand in each country: $\eta_{ik} \equiv -\frac{\partial x_{ik}}{\partial p_{ik}} \frac{p_{ik}}{x_{ik}}$,

$i = A, B$, $k = D, U$, where $p_{AU} = p_{BU} = p_U$, and subscript $k = D (U)$ denotes the regime of price discrimination under segmented national markets (the regime of uniform pricing under a single integrated market).

Taking account of equations (1), (2), (6), and (8), we derive the price elasticity of demand at the equilibrium in the cases of segmented national markets and a single integrated market as follows: $b = \eta_{AU} < \eta_{AD} = 1 = \eta_{BD} < \eta_{BU} = \frac{1}{b}$. That is, the price elasticity of demand at the equilibrium in the two countries in the case of segmented national markets is equal to a unity. However, the price elasticity of demand at the equilibrium in country $A (B)$ decreases (increases)

in the case of a single integrated market. This implies that the amount of consumption in country A (B) increases (decreases) through an economic integration, compared with that in the case of segmented national markets.

Finally, we consider the effect on consumer surplus in each country. Consumer surplus in each country is expressed as:

$$CS_{Ak} = \int_{\hat{\theta}_A}^1 (q_k \theta_A - p_{Ak}) d\theta_A = \frac{q_k}{2} (x_{Ak})^2 \quad (12)$$

and

$$CS_{Bk} = \frac{1}{b} \int_{\hat{\theta}_B}^b (q_k \theta_B - p_{Bk}) d\theta_B = \frac{bq_k}{2} (x_{Bk})^2, \quad (13)$$

where $k = D, U$. It is clear from equations (12) and (13) that consumer surplus is decided by the amount of consumption and the quality level. In view of equations (6) and (8), the amount of consumption in country A (B) increases (decreases) through an economic integration. This is because, with respect to the quality-adjusted price, it holds that $\frac{P_{AD}}{q_D} > \frac{P_U}{q_U} > \frac{P_{BD}}{q_D}$. On the other

hand, as shown in *Proposition 1*, the quality level in each case depends on the difference in the consumer distributions of the two countries, i.e., $b(<1)$, and the degree of trade barrier costs, i.e., $\tau(<1)$.

Comparing consumer surpluses of countries A and B in the case of segmented national markets with those in the case of a single integrated market, we obtain the following relationships:

$$CS_{AD} > (\leq) CS_{AU} \Leftrightarrow \Gamma_A(b) \equiv \frac{(1+b)^4 - 16b}{b(1+b)^3} > (\leq) \tau \quad (14)$$

and

$$CS_{BD} > (\leq) CS_{BU} \Leftrightarrow \Gamma_B(b) \equiv \frac{(1+b)^4 - 16b^3}{b(1+b)^3} > (\leq) \tau. \quad (15)$$

Furthermore, because total consumer surplus is given by $CS_k \equiv CS_{Ak} + CS_{Bk}$, $k = D, U$, we obtain the following relationship:

$$CS_D > (\leq) CS_U \Leftrightarrow \Gamma(b) \equiv \frac{(1+b)^5 - 16b(1+b^3)}{b(1+b)^4} > (\leq) \tau. \quad (16)$$

Based on equations (14), (15), and (16), we define as follows: $b_A(\tau) = \{b | \Gamma_A(b) = \tau\}$, where $b_A(\tau)' < 0$; $b_B(\tau) = \{b | \Gamma_B(b) = \tau\}$, where $b_B(\tau)' < 0$; and $b(\tau) = \{b | \Gamma(b) = \tau\}$, where $b(\tau)' < 0$. See the Appendix for the properties of the functions given by equations (14), (15), and (16). Thus, we have the following results, stated in Proposition 2.

Proposition 2

- (i) If $0 < b < b_A(\tau)$, then it holds that $CS_{AD} > CS_{AU}$, $CS_{BD} > CS_{BU}$, and $CS_D > CS_U$;
- (ii) If $b_A(\tau) \leq b < b(\tau)$, then it holds that $CS_{AD} \leq CS_{AU}$, $CS_{BD} > CS_{BU}$, and $CS_D > CS_U$;
- (iii) If $b(\tau) \leq b \leq b_B(\tau)$, then it holds that $CS_{AD} < CS_{AU}$, $CS_{BD} \geq CS_{BU}$, and $CS_D \leq CS_U$; and
- (iv) If $b_B(\tau) < b < 1$, then it holds that $CS_{AD} < CS_{AU}$, $CS_{BD} < CS_{BU}$, and $CS_D < CS_U$.

Based on *Propositions 1 and 2*, we state that if the difference between the consumer distributions of the two countries is large (small), i.e., parameter $b (< 1)$ is small (large), and/or the degree of trade barrier costs, i.e., $\tau (< 1)$, is low (high), then an economic integration

decreases (increases) the quality level and the welfare of the two countries. Thus, an economic integration is a Pareto improvement for the two countries, if the demand structures for the two countries are very similar and/or if the degree of trade barrier costs is sufficiently large.

From the point of view of the monopoly, if the demand structures of the two countries are very similar, the strength of an incentive to invest in quality improvement R&D is not very different between the case of segmented national markets and that of a single integrated market. Conversely, even though the demand structures of the two countries are different, if the degree of trade barrier costs is sufficiently large, then the removal of trade barrier costs by an economic integration helps the monopoly have an incentive to invest in quality improvement R&D.

3.4 Large demand dispersion

As considered in Layson (1994), Malueg and Schwartz (1994), and others, if there is large demand dispersion and market asymmetry between the two countries, the monopoly located in country *A* might not export the product to country *B*, even though trade barrier costs are removed by an economic integration.

With respect to monopoly pricing, we consider the case of large demand dispersion where parameter b is sufficiently small. Given the same quality level, comparing the profit of the monopoly providing the product to the two countries in the regime of uniform pricing under a single integrated market with that of the monopoly providing the product to country *A* only, we have the following relationship:

$$\begin{aligned}\Pi_U &= \frac{b}{1+b}q - \frac{g}{2}(q)^2 \geq (<) \pi_A = \frac{1}{4}q - \frac{g}{2}(q)^2 \\ \Leftrightarrow b &\geq (<) \frac{1}{3}.\end{aligned}\tag{17}$$

Equation (17) implies that the monopoly does not provide the product to country B because its profit decreases, even though there is potentially a positive demand in country B in the regime of uniform pricing, whenever there is a large demand dispersion between the two countries, i.e., $b < \frac{1}{3}$. Otherwise, the monopoly provides the product to the two countries under an economic integration. In this case only (i.e., $b \geq \frac{1}{3}$), the equilibrium outcomes shown in equation (8) are valid.

Therefore, in the large demand dispersion case, the price and the quality level are given by $p_A = \frac{q_A}{2}$ and $q_A = \frac{1}{4g}$. Also, the profit that the monopoly can obtain in country A only is given by $\Pi_A = \pi_A = \frac{1}{32g}$. Taking account of equation (6), we obtain the following results: $p_A < p_{AD}$, $q_A < q_D$, $\Pi_A < \Pi_D$, and $CS_A < CS_{AD}$. Furthermore, it holds that $CS_B = 0 < CS_{BD}$.

Paradoxically, if there exists a large demand dispersion between the two countries (or the consumer distributions of the two countries are sufficiently different), welfare in the two countries is sustained by the presence of trade barrier costs.

Here, related to this point, we discuss how an international market structure is endogenously determined by parameter b and trade barrier costs, τ , which is exogenously given in this paper. As analyzed in Wright (2003), we assume that a trade barrier cost is a tariff, which is

decided by policymakers in country B . In this case, if the market in country B is very small, i.e., $b < \frac{1}{3}$, the policymakers in country B set a positive tariff level to maximize welfare. As a result, segmented national markets remain between the two countries.

4. Conclusion

Applying the analysis of third-degree price discrimination based on a standard monopoly model of endogenous quality choice, we have considered the effects of an economic integration between two countries where the price elasticity of demand is different and depends on the distribution of consumers in each national market and the quality level of the product provided by a monopoly.

In our model, there are two ways in which an economic integration affects the price and quality decisions of the monopoly. First, there is a positive effect in that incentive to improve the quality level increases with the removal of trade barrier costs such as tariffs, non-tariff barriers, transportation costs, and other costs. Second, there is a negative effect in that the gain from price discrimination under segmented markets vanishes because of the pressure of price arbitrage under a single integrated market. Hence, the incentive to improve the quality level decreases by reducing the gain, which is negatively related to the difference between the consumer distributions of the two countries. Therefore, whenever the positive effect exceeds the negative effect, an economic integration enhances the welfare of the two countries.

We understand the specificity of our model. For example, we have assumed an *ad valorem*

trade barrier cost and zero marginal cost of production. Furthermore, we have assumed the cost function of quality is independent of the output (i.e., a fixed-type cost function). These specific assumptions are designed not only to focus on the effect of an economic integration on the quality improvement R&D decision of the monopoly, but also to simplify the model. However, they need to be generalized in future analysis. Furthermore, we intend to extend the model to the case of an international duopoly based on a model of vertical product differentiation.

Appendix: On the properties of the functions of parameter b

First, the function given by equation (14), i.e., $\Gamma_A(b) \equiv \frac{(1+b)^4 - 16b}{b(1+b)^3}$ for $0 < b < 1$, has the

following properties:

- 1) $\Gamma_A(b) \geq 1$ for $0 < b \leq 0.078$; $0 < \Gamma_A(b) < 1$ for $0.078 < b < 0.087$; and $\Gamma_A(b) \leq 0$ for $0.087 \leq b < 1$;
- 2) $\Gamma_A(b \rightarrow 0) \rightarrow \infty$ and $\Gamma_A(b \rightarrow 1) \rightarrow 0$; and
- 3) $\Gamma_A(b)' < 0$ for $0 < b < 0.212$; $\Gamma_A(b)' = 0$ for $b = 0.212$; and $\Gamma_A(b)' > 0$ for $0.212 < b < 1$.

Second, the function given by equation (15), i.e., $\Gamma_B(b) \equiv \frac{(1+b)^4 - 16b^3}{b(1+b)^3}$ for $0 < b < 1$, has

the following properties:

- 1) $\Gamma_B(b) \geq 1$ for $0 < b \leq 0.658$; and $0 < \Gamma_B(b) < 1$ for $0.658 < b < 1$;
- 2) $\Gamma_A(b \rightarrow 0) \rightarrow \infty$ and $\Gamma_A(b \rightarrow 1) \rightarrow 0$; and
- 3) $\Gamma_A(b)' < 0$ for $0 < b < 1$.

Third, for the function given by (16), i.e., $\Gamma(b) \equiv \frac{(1+b)^5 - 16b(1+b^3)}{b(1+b)^4}$ for $0 < b < 1$, has

the following properties:

- 1) $\Gamma(b) \geq 1$ for $0 < b \leq 0.087$; $0 < \Gamma(b) < 1$ for $0.087 < b < \sqrt{5} - 2$; and $\Gamma(b) \leq 0$ for $\sqrt{5} - 2 \leq b < 1$;
- 2) $\Gamma(b \rightarrow 0) \rightarrow \infty$ and $\Gamma(b \rightarrow 1) \rightarrow 0$; and
- 3) $\Gamma(b)' < 0$ for $0 < b < 0.2$; $\Gamma(b)' = 0$ for $b = 0.2$; and $\Gamma_A(b)' > 0$ for $0.2 < b < 1$.

Finally, based on the properties of the functions shown above, we can derive $\Gamma_A(b) < \Gamma(b) < \Gamma_B(b)$ for $0 < b < 1$. Therefore, we have $b_A(\tau) < b(\tau) < b_B(\tau)$, given $\tau(0 \leq \tau < 1)$.

References

- Balassa, Bela (1961a) "Towards a theory of economic integration," *Kyklos* 14: 1–17.
- Balassa, Bela (1961b) *The Theory of Economic Integration*, London: Richard D. Irwin, Inc.
- Baldwin, Richard E. and Anthony J. Venables (1995) "Regional economic integration," in Gene M. Grossman and Kenneth Rogoff (eds.), *Handbook of International Economics*, Vol. 3, 1597–664, Amsterdam: North-Holland.
- Ikedo, Takeshi and Tsuyoshi Toshimitsu (2010) "Third-degree price discrimination, quality choice, and welfare," *Economics Letters* 106: 54–56.
- Ishikawa, Jota (2004) "From segmented markets to integrated markets: an analysis of economic integration and antidumping legislation," *Review of International Economics* 12: 706–22.

- Layson, Stephen K. (1994) "Market opening under third-degree price discrimination," *Journal of Industrial Economics* 42: 335–40.
- Malueg, David A. and Marius Schwartz (1994) "Parallel imports, demand dispersion and international price discrimination," *Journal of International Economics* 37: 167–95.
- Sapir, André (2012) "European integration at the crossroads: A Review Essay on the 50th Anniversary of Bela Balassa's *Theory of Economic Integration*," *Journal of Economic Literature* 49: 1200–29.
- Szymanski, Stefan and Tommaso Valletti (2005) "Parallel trade, price discrimination, investment and price caps," *Economic Policy* 20: 705–49.
- Wright, Donald, J. (2003) "Some economics of integrated and segmented markets," *Review of International Economics* 11: 72–89.