

## Cultural Barriers in International Trade and the Protection and Promotion of Culture\*

Jaeok Park\*\*

*I present a model of international trade with cultural barriers and cultural learning. There are two countries that can produce a manufacturing good and cultural goods and can trade with each other. Due to cultural difference, consumers in a country have difficulty in appreciating cultural goods produced in the other country, which creates cultural barriers, and consumers can overcome these barriers by investing in cultural learning. I first study trade equilibrium given cultural barriers in the two countries, and then I analyze decisions on cultural learning under three different scenarios and compare them. Based on the analysis, I provide economic explanations for countries' policies to protect and promote their own cultures at home and abroad.*

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### I. Introduction

Today's advanced information and transport technology has made cultures spread easily across borders. In the face of cultural globalization, countries take different positions regarding their willingness to accept foreign cultures. Some countries like those in the Middle East try to limit the influence of foreign cultures and maintain their cultural heritage, whereas others like Singapore actively adopt foreign cultures and standards. Meanwhile, countries make various efforts to protect and promote their cultures at home and abroad. France and South Korea enforce

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\*\* Assistant Professor, School of Economics, Yonsei University, 50 Yonsei-ro, Seodaemun-gu, Seoul 03722, Korea. (e-mail: jaeok.park@yonsei.ac.kr).

the screen quota system to foster domestic film production, and Canada maintains a similar quota system for its media to promote Canadian cultural production. Germany and Japan operate the Goethe-Institut and the Japan Foundation, respectively, throughout the world offering cultural exchange and language programs.

In this paper, I aim to provide an economic rationale behind these policies regarding cultural goods. In the real world, consumers face a lot of differentiated cultural goods such as movies, songs, and novels, and the import of foreign cultural goods can potentially benefit consumers by increasing variety. However, cultural goods are valued differently by consumers belonging to different cultures, and in order to fully appreciate foreign cultural goods, consumers need to invest their time in learning foreign cultures.<sup>1</sup> In other words, cultural difference creates cultural barriers, which can be overcome by cultural learning. I incorporate these features of cultural goods in otherwise a fairly standard international trade model based on Krugman (1980), and I study interaction between cultural barriers and cultural production as well as decisions on cultural learning.

In the new trade theory, scale economies and love for variety make trade beneficial even if countries have identical tastes, technologies, and factor endowments. The literature in the new trade theory has studied the effects of trade barriers on trade patterns and welfare. Typically the existing models in the literature considered trade barriers arising from transport costs or tariffs.<sup>2</sup> In contrast, I introduce trade barriers due to consumers' inability to fully appreciate foreign cultural goods, namely cultural barriers, into a new trade model. A novelty of this paper from a theoretical point of view is to incorporate trade barriers induced by consumers' preferences (i.e., demand-side barriers) into a new trade model rather than those imposed by producers or governments due to technological or political reasons. In order to model cultural barriers, I assume that there are two types of consumers, those with local tastes (called local consumers) and those with global tastes (called global consumers). Due to cultural difference between two countries, a local consumer can enjoy only domestic cultural goods while a global consumer can enjoy both domestic and foreign cultural goods. For instance, French moviegoers who only enjoy watching French movies are local consumers, while those who enjoy not only French movies but also Hollywood movies are global consumers. A

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<sup>1</sup> Some cultural goods such as movies and novels are offered to foreign consumers in translated form to facilitate their understanding. Even when translation is available, learning foreign cultures will help consumers understand delicate aspects in cultural pieces at a deeper level. Furthermore, if a consumer has good knowledge of foreign cultures and languages, he can consume cultural goods that are not translated and thus can enjoy a wider variety of cultural goods. For simplicity, I ignore the possibility of firms offering translated versions of their products in my model.

<sup>2</sup> For example, Helpman and Krugman (1985, Ch. 10) study the effects of transport costs, and Helpman and Krugman (1989, Ch. 7) analyze the effects of tariffs in the presence of iceberg-type transport costs.

country with a large proportion of local consumers can be considered as having a high level of cultural barriers in that foreign cultural goods are not appealing in the country.<sup>3</sup>

In my model, there are two countries that can trade with each other in the presence of cultural barriers. First I analyze trade equilibrium given the levels of cultural barriers in the two countries. In trade equilibrium under some assumptions on parameters, the two countries have the same wage rate, the total number of cultural varieties in the world is independent of the proportions of local consumers in the two countries, and the number of cultural varieties produced in a country is proportional to its share of local consumers in the world. Hence, the utility of a global consumer who can consume all varieties in the world is independent of cultural barriers, while that of a local consumer who can consume only local varieties increases as there are relatively more local consumers in his country. As an example, consider the film industry in France and the US. As American consumers become more global in that they are more able to enjoy French movies and as French consumers become less global in that more of them are watching only French movies, more cultural production shifts to France. This benefits local consumers in France, while it hurts local consumers in the US who now have less American movies to enjoy. Thus, if local consumers are politically influential in France, France has an incentive to make its consumers less global and to make American consumers more global in order to induce more movie production in France. This observation provides an economic explanation for policies to protect a country's cultural heritage by restricting the influence of foreign cultures and to promote its culture abroad.

Later in this paper I endogenize the levels of cultural barriers in the two countries by introducing cultural learning. I consider a scenario where a consumer is born with local tastes and can develop global tastes by incurring a learning cost.<sup>4</sup> For example, an individual who is not familiar with American football and American culture in general will have difficulty in enjoying a Super Bowl game, and the individual may learn the rules of American football and familiarize himself with American culture in order to better enjoy a Super Bowl game.<sup>5</sup> I define the welfare

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<sup>3</sup> As pointed out by Conley and Driskill (2013), literal interpretation of Dixit-Stiglitz models is often problematic. Likewise, I find figurative interpretation of my model more natural. We can imagine a representative agent in each country which is a conglomeration of individuals residing in the country. Rather than interpreting that each individual is either local or global, we can regard the proportion of global consumers in a country as a measure of the country's overall openness to foreign cultures. Individuals' propensity will determine this measure, while the government can affect it through policies.

<sup>4</sup> Cultural learning can be done while consuming cultural goods (i.e., learning by consuming). Brito and Barros (2005) model a learning-by-consuming process and study the dynamics of the demand for cultural goods.

<sup>5</sup> In this paper, I assume that the costs of cultural learning are entirely borne by consumers. In reality,

of a country as total utility minus total learning costs of its population, and study the decisions on cultural learning under three different scenarios. In the first scenario, there is a world social planner who maximizes total welfare in the world. In the second scenario, each country has its own social planner who maximizes its welfare. In the third scenario, each consumer chooses whether to learn the culture of the other country or not. I show that the cultural learning level is the lowest in the second scenario. The logic can be explained as follows using the previous example of the film industry in France and the US. As French consumers become more global, local consumers in the US get better off while those in France get worse off. If the world social planner decides the proportion of global consumers in France, he takes into account these two effects on local consumers in both countries. If the social planner for France determines the proportion of global consumers in France, he takes into account only the negative effect on French local consumers. If French consumers individually decide whether to develop global tastes or not, they take into account neither effect. As a result, the social planner for France would choose a lower proportion of global consumers than the world social planner or French consumers would choose. This result again provides an explanation for policies to restrain the effect of foreign cultures. An argument often used to support cultural protectionism is the importance of maintaining cultural identity. In this paper, I do not incorporate cultural identity into the model; a local consumer is willing to become a global consumer because it will enable him to enjoy a wider variety of cultural goods. This allows me to focus on economic incentives behind protectionist policies while setting aside emotional aspects.

As mentioned in the opening paragraph, there are countries that pursue globalization actively, in contrast to countries that are reluctant to accept foreign cultures. Although I relegate the discussion to an appendix, I show that free trade may lead to a small country not producing cultural goods at all when learning costs are small. That is, it may happen that all consumers in a small country learn the culture of the larger country and they rely on imports for cultural consumption. This result is related to the point made by proponents of cultural protectionism (Acheson and Maule, 2006, Sec. 3). Without protection, countries with small domestic markets are overwhelmed by imports from larger markets due to scale economies, which will lessen cultural diversity. So this result can be interpreted differently depending on whether one acknowledges a per se value of cultural diversity. If one derives no per se value from maintaining cultural identity, as in the

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however, producers of cultural goods also invest in marketing to encourage foreign consumers to consume their products. For example, professional sport organizations as well as teams make marketing efforts to popularize their games abroad by setting up websites in various languages, playing games in other parts of the world, signing foreign players, and so on. I do not incorporate these aspects explicitly in my model, but they can be analyzed in a model with heterogeneous firms that incur an export cost when they decide to sell their products in foreign markets, as in Melitz (2003).

welfare function used in this paper, this result can be used to support cultural openness as countries may benefit from globalization. On the other hand, if one stresses the importance of cultural identity, this result can justify the need for cultural protectionism as without it we would live in a world with less cultural diversity.

This paper is related to the recently growing literature on the relationship between culture and trade. Guiso *et al.* (2009) and Lohmann (2011) present empirical evidence that cultural differences act as a deterrent to trade between countries. Cultural barriers have been incorporated into various international trade models in different forms. A closely related paper to mine is Francois and van Ypersele (2002). They show that a tariff on the trade of cultural goods can be Pareto improving by making local varieties viable. The claim may sound similar to the one given in this paper, but there are fundamental differences between the two papers. First, they study the role of tariffs given cultural barriers, while I do not consider tariffs in this paper. Second, they assume two kinds of cultural goods, a global good (a Hollywood movie in their example) that can be consumed by consumers in both countries and a local good (French and US auteur cinema) that can be consumed by domestic consumers only, whereas I have two kinds of consumers. Third, they conclude that a tariff on the import of a global good may benefit both countries by making their local goods produced, while I show that increasing cultural barriers in a country may benefit the country and hurt the other country by attracting more cultural production to the country. Thus, the two papers cast light on different aspects of the production and trade of cultural goods.

There are papers that examine cultural learning in the international trade context focusing on a different role of culture. Choi (2002) studies the impact of trade on language learning with the assumption that bilingual interpreters are required to facilitate trade between countries. Kónya (2006) analyzes cultural learning decisions in an international trade model where learning by either party of trade can eliminate cultural costs in trade. Choi (2002) and Kónya (2006) mainly view culture and language difference as causing transactions costs by obstructing communication between trading parties. In their models, learning by one party is sufficient for both parties to communicate and thus eliminates the need for the other to learn. On the contrary, I focus on the aspect of culture and language difference as creating difficulty in appreciating foreign cultural goods. Hence, in my model, a consumer in a country needs to learn the culture and language of the other country in order to fully appreciate foreign cultural goods, regardless of the learning decisions in the other country.

Finally, there are attempts to incorporate cultural identity formally into an international trade model. Bala and Long (2005) view culture as different types of preferences and study the evolution of preferences when trade occurs. Janeba (2007) and Rauch and Trindade (2009) model cultural identity as a consumption

externality and analyze the effects of free trade in the presence of consumption externalities. Olivier *et al.* (2008) and Maystre *et al.* (2014) endogenize the choice of cultural identity and study its dynamics in an international trade model. In this paper, I do not model cultural identity explicitly. In my model, benefits of belonging to a certain cultural group depend on the number of local varieties produced and the relative wage rate. In other words, cultural groups experience no direct consumption externalities but only indirect effects.

The rest of this paper is organized as follows. In Section II, I describe the model and analyze trade equilibrium given cultural barriers. In Section III, I study decisions on cultural learning, analyzing and comparing the three scenarios. In Section IV, I conclude the paper.

## II. Trade with Cultural Barriers

### 2.1. Description of the Model

I consider two economies, the home country and the foreign country, each of which has two sectors, the manufacturing sector (sector M) and the cultural goods sector (sector C). There is a single aggregate good produced in sector M, referred to as the manufacturing good, while there are a large number of potential goods that can be produced in sector C, referred to as cultural goods. The two countries can trade with each other. There are no conventional trade barriers such as transport costs and tariffs, but I introduce trade barriers that stem from difference in the two countries' cultures, namely cultural barriers. There are two types of individuals in each country, consumers with local tastes and those with global tastes. Consumers with local tastes, or simply local consumers, are those who have difficulty in appreciating cultural goods produced in a different culture, while consumers with global tastes, or simply global consumers, are those who have overcome such difficulty. For simplicity, I assume that local consumers extract no utility from the consumption of cultural goods produced in the other country while global consumers obtain the same level of satisfaction from cultural goods produced in either country.<sup>6</sup> That is, cultural goods produced in the two countries enter symmetrically in a global consumer's utility function, while only domestic cultural goods enter in a local consumer's utility function.

Below I describe consumers' utility functions formally. Let  $n$  and  $n^*$  be the

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<sup>6</sup> Alternatively, I can assume that global consumers' satisfaction from foreign cultural goods is less than that of consumers in the originating country and that local consumers can extract some utility from foreign cultural goods (for example, by consuming translated versions) but to a lesser extent than global consumers do. This will complicate the analysis without adding much to qualitative results, and so I adopt the simplifying assumption in this paper.

numbers of cultural goods actually produced in sector C of the home country and the foreign country, respectively. The manufacturing good is indexed by  $m$  and the cultural goods by  $i$ , where cultural good  $i \in [0, n]$  is produced in the home country and cultural good  $i \in (n, n+n^*]$  is produced in the foreign country. A consumption bundle is written as  $c = (c_m, (c(i))_{i \in [0, n+n^*]})$ , where  $c_m$  is the consumption of the manufacturing good and  $c(i)$  is the consumption of cultural good  $i$ . A global consumer in either country has the following utility function:

$$U(c) = c_m^\rho \left\{ \left[ \int_0^{n+n^*} c(i)^\theta di \right]^{\frac{1}{\theta}} \right\}^{1-\rho},$$

where  $0 < \rho < 1$  and  $0 < \theta < 1$ . The utility function of a local consumer can be written similarly changing the interval of integration into  $[0, n]$  for the home country and  $(n, n+n^*]$  for the foreign country. The consumption of cultural goods is aggregated through a constant elasticity of substitution (CES) aggregator, while the consumption of the goods in the two sectors is evaluated using a Cobb-Douglas utility function. The parameter  $\rho$  can be interpreted as the share of sector M, as consumers spend  $\rho$  fraction of their income on the manufacturing good. The parameter  $\theta$  determines the elasticity of substitution as  $1/(1-\theta)$ . Substitutability among cultural goods increases as  $\theta$  becomes larger.

There is only one factor of production, labor. Each individual is endowed with one unit of labor, which yields the labor income  $w$  to him. Individuals maximize utility subject to the budget constraint  $p_m c_m + \int_0^{n+n^*} p(i) c(i) di \leq w$ , where  $p_m$  is the price of the manufacturing good and  $p(i)$  is the price of cultural good  $i$  for  $i \in [0, n+n^*]$ . The two countries may be of different sizes. The mass of individuals (or the labor force) in the home country is denoted by  $L$ , while that of the foreign country is denoted by  $L^*$ . The proportion of global consumers in the home country is denoted by  $\phi \in [0, 1]$ , while that in the foreign country is denoted by  $\phi^* \in [0, 1]$ . The proportion of local consumers in a country can be considered as the overall level of cultural barriers in that country.

Labor required to produce  $x_m$  units of the manufacturing good is given by

$$l_m = \gamma x_m,$$

where  $\gamma > 0$  denotes the marginal cost (in terms of labor) of producing the manufacturing good. Labor required to produce  $x(i)$  units of any cultural good  $i$  is given by

$$l(i) = \alpha + \beta x(i),$$

where  $\alpha > 0$  and  $\beta > 0$  denote the fixed cost and the marginal cost, respectively, (in terms of labor) of producing a cultural good. That is, the manufacturing good is produced with a constant returns to scale (CRS) technology, while a cultural good is produced with an increasing returns to scale (IRS) technology. There are a large number of firms in the economy that can enter and exit the two industries freely. The technologies are commonly available to firms, firms maximize profits, and firms operating in sector C can costlessly differentiate their cultural goods. I assume that the parameters in preferences and technologies,  $\rho$ ,  $\theta$ ,  $\gamma$ ,  $\alpha$ , and  $\beta$ , are identical across the two countries.

Below are some remarks on the assumptions of the model.

*Remark 1.* It is more natural to regard the manufacturing sector and the manufacturing good as representing the aggregation of all other industries besides cultural industries and all other goods besides cultural goods, respectively, rather than interpreting them literally. The existence of the “outside” good and the CRS technology to produce it are assumed mainly for analytical tractability. The main role of sector M in this model is to equate wages in the two countries for a range of parameters: As long as both countries produce the manufacturing good, their wage levels are the same. Also, since the outside good is assumed to be homogeneous, there is no direct gain from importing the good. Trade of the outside good occurs just to achieve trade balance when there is net trade of cultural goods. This facilitates the analysis, as carried out in Sections 2.3.2 and 2.4. If there is only sector C in the model, the relative wage of the two countries is determined by the proportions of global consumers in the two countries while the numbers of cultural goods produced in the two countries are independent of them. Without sector M, the analysis becomes more complicated, and it is more difficult to derive the implications of the model. The focus of this paper is to study trade of cultural goods, and thus sector C is at the center of the model while sector M plays merely an auxiliary role.

*Remark 2.* One may wonder whether the model is unique to cultural goods or is applicable to other scenarios as well. For example, the production of manufactured goods such as smartphones and cars involves large fixed costs and thus exhibits IRS. Also, consumers in aggregate may have preference for variety. In this context, local consumers can be viewed as patriotic consumers who derive utility only from domestic products. However, there is a key difference between local consumers and patriotic consumers when it comes to cultural learning. A local consumer is unable to consume foreign cultural goods even though he likes to, and he is willing to become a global consumer in order to obtain higher utility from a wider range of variety. In contrast, a patriotic consumer wants to consume domestic products only and refuses to consume foreign products. Thus, patriotic consumers correspond to



consumers who value cultural identity, which is not captured in the model.

*Remark 3.* The model assumes that cultural goods are substitutes for each other. In particular, for global consumers, cultural goods produced in the two countries are substitutes. A real-world case that suggests the substitute relationship is the downfall of the Mexican film industry in the 1990s. Prior to signing the North American Free Trade Agreement (NAFTA) in 1994, Mexico produced about 100 movies annually in the late 1980s. However, after NAFTA, Hollywood movies became dominant in Mexico, reducing the number of Mexican movies produced each year below 30 (see Yecies, 2007). In other words, the escalation of Hollywood movies in Mexico crowded out Mexican movies. If the introduction of foreign movies increases people's overall tendency to watch movies, it can induce the production of more domestic movies. In this case, cultural goods produced in the two countries may have a complement relationship. Although this is a question to be investigated empirically, having a substitute relationship among cultural goods seems to be a reasonable assumption, given that consumers have limited resources (time, money, etc.) to be spent on cultural goods.

## 2.2. Equilibrium in a Closed Economy

Before studying trade equilibrium, I analyze equilibrium in a closed economy. Let us consider the home country in isolation. Solving consumers' utility maximization problem yields the following individual demands:

$$c_m = \frac{\rho w}{p_m} \quad \text{and} \quad c(i) = \frac{(1-\rho)w}{\left[ \int_0^n p(j)^{-\frac{\theta}{1-\theta}} dj \right] p(i)^{\frac{1}{1-\theta}}} \quad \text{for } i \in [0, n].$$

Since there is  $L$  mass of consumers in the home country, the aggregate demands for the two kinds of goods are given by

$$x_m = Lc_m = \frac{\rho w L}{p_m} \quad \text{and} \quad x(i) = Lc(i) = \frac{(1-\rho)w L}{\left[ \int_0^n p(j)^{-\frac{\theta}{1-\theta}} dj \right] p(i)^{\frac{1}{1-\theta}}} \quad \text{for } i \in [0, n].$$

Firms in sector M maximize profit while producing a positive amount only if  $p_m = \gamma w$ . This leads to  $x_m = \rho L / \gamma$  and  $c_m = \rho / \gamma$ . Since firms in sector C can costlessly differentiate their goods, each cultural good available in the market will be produced by only one firm. Provided that there are a large number of cultural goods produced, the price set by each firm in sector C has a negligible effect on the aggregate price  $\int_0^n p(j)^{-\frac{\theta}{1-\theta}} dj$ , and thus each firm faces an elasticity of demand

$1/(1-\theta)$ . Hence, profit maximization in sector C yields  $p(i) = \beta w / \theta$  for all  $i \in [0, n]$ . This gives  $x(i) = (1-\rho)\theta L / n\beta$  and  $c(i) = (1-\rho)\theta / n\beta$  for all  $i \in [0, n]$ . Note that in equilibrium prices and quantities are the same for all cultural goods. Thus, I write the common values of  $p(i)$ ,  $x(i)$ , and  $c(i)$  as  $p$ ,  $x$ , and  $c$ , respectively. The remaining variable is the number of cultural goods produced,  $n$ . It can be determined by the zero-profit condition for firms in sector C:  $px - (\alpha + \beta x)w = 0$ . Solving this equation in terms of  $n$  yields

$$n = \frac{(1-\theta)(1-\rho)L}{\alpha}.$$

Using this, we can obtain the expressions for  $x$  and  $c$ :

$$x = \frac{\alpha\theta}{\beta(1-\theta)} \quad \text{and} \quad c = \frac{\alpha\theta}{\beta(1-\theta)L}.$$

I mention some properties of the equilibrium. First, the scale of production,  $x$ , in sector C is independent of the size of the economy,  $L$ , while the number of produced cultural goods,  $n$ , is proportional to it. Thus, the benefit of having a larger economy comes from a more variety of cultural goods. Second, the scale of production,  $x$ , and the consumption of each cultural good,  $c$ , increase with the fixed cost  $\alpha$  and decrease with the marginal cost  $\beta$ . As the fixed cost increases, the scale of production becomes larger in equilibrium in order to cover the higher fixed cost. On the other hand, as the marginal cost increases, prices increase as well, which reduces consumption as well as production. Lastly, consumption  $c$  decreases as the number of cultural goods,  $n$ , increases. This is due to the structure of the Dixit-Stiglitz utility function: The consumer maximizes his utility by consuming a bit of every available good. In reality, however, each consumer usually does not consume all available goods but only part of them. A possible interpretation of the theoretical result is to view this as the aggregate behavior of consumers with diverse preferences. Also, a recent paper by Conley and Driskill (2013) criticizes this modeling approach and proposes an alternative model.

## 2.3. Trade Equilibrium

Now I analyze equilibrium when the two countries trade with each other given their cultural barriers. In the analysis, I use variables with an asterisk to denote the variables of the foreign country.

### 2.3.1. All Local or All Global

As a benchmark, I first consider two simple cases where all consumers in the two

countries are local or global.

### ■ All Consumers are Local

First, suppose that every consumer is local, i.e.,  $\phi = \phi^* = 0$ . That is, cultural barriers in each country are at their maximum level. In this case, each consumer demands cultural goods produced only in his country, and thus there is no trade of cultural goods and no net trade of the manufacturing good. Since both countries produce the manufacturing good, the wage rates in the two countries must be the same.<sup>7</sup> Equilibrium does not exclude the possibility that the two countries trade the manufacturing good with each other, but there is no strict gain from doing so. Hence, given practical considerations such as transport costs, it is natural to have no trade of the manufacturing good either. Compared to the equilibrium in a closed economy, the equilibrium variables remain the same, and thus there are no gains from trade when cultural barriers prohibit trade of cultural goods.

### ■ All Consumers are Global

Next, suppose that every consumer is global, i.e.,  $\phi = \phi^* = 1$ . That is, there are no cultural barriers at all in either country. Given the symmetry of the preferences and technologies in the two countries, it can be shown that the equilibrium wage rates must be equal, i.e.,  $w = w^*$ . In other words, factor price equalization (FPE) holds. The prevailing price of the manufacturing good is  $\gamma w$ , which gives  $c_m = c_m^* = \rho / \gamma$ . Thus, we have  $x_m + x_m^* = \rho(L + L^*) / \gamma$ . By profit maximization and the zero-profit condition for firms in sector C, we have  $p = p^* = \beta w / \theta$  and  $x = x^* = \alpha \theta / \beta(1 - \theta)$ . Since each cultural good is consumed by all consumers in the two countries in the same amount, we have  $c = c^* = \alpha \theta / \beta(1 - \theta)(L + L^*)$ . The full employment conditions in the two countries and combining them with  $x_m + x_m^* = \rho(L + L^*) / \gamma$  yield the following equilibrium conditions for  $x_m$ ,  $x_m^*$ ,  $n$ , and  $n^*$ :

$$\gamma x_m + \frac{\alpha}{1 - \theta} n = L, \quad (1)$$

$$\gamma x_m^* + \frac{\alpha}{1 - \theta} n^* = L^*, \quad (2)$$

$$n + n^* = \frac{(1 - \theta)(1 - \rho)(L + L^*)}{\alpha}, \quad (3)$$

$$x_m, x_m^*, n, n^* \geq 0. \quad (4)$$

<sup>7</sup> If a country, say the home country, has a lower wage than the other, the manufacturing good produced in the home country will have a lower price and there will be no demand for the manufacturing good produced in the foreign country. Thus, in equilibrium, only the home country will produce the manufacturing good.

That is,  $x_m$ ,  $x_m^*$ ,  $n$ , and  $n^*$  satisfying (1)-(4) are equilibrium variables. Lastly, we have  $p_m = p_m^* = \gamma w$ . Even when  $x_m = 0$ , we can have neither  $p_m < \gamma w$  nor  $p_m > \gamma w$ . If  $p_m < \gamma w$ , there will be positive demand for the manufacturing good produced in the home country, violating the market clearing condition. If  $p_m > \gamma w$ , firms will produce in sector M in the home country, contradicting  $x_m = 0$ . By a similar argument, we have  $p_m^* = \gamma w$ . Note that equilibrium pins down the total number of cultural goods produced in the two countries, but not the number of cultural goods produced in each country. As a result, there are multiple equilibria regarding how production is divided into the two countries, while consumers' utility in equilibrium is determined uniquely. One particular equilibrium has  $x_m = \rho L / \gamma$ ,  $x_m^* = \rho L^* / \gamma$ ,  $n = (1 - \theta)(1 - \rho)L / \alpha$ , and  $n^* = (1 - \theta)(1 - \rho)L^* / \alpha$ , in which each country produces the same number of cultural goods as in the equilibrium without trade and there is no net trade of the manufacturing good. From (3), it can be seen that the number of cultural goods that each consumer enjoys increases as a result of trade. Given the CES form in the utility function, consumers benefit from increased variety. Thus, there are gains from trade in both countries, and consumers in the smaller country benefit more than those in the larger country.

### 2.3.2. Some Local in Both Countries

Now I turn to the more interesting case where there are some local consumers in both countries, as expressed in the following assumption.

**Assumption 1.**  $\phi, \phi^* < 1$ .

Since there are some local consumers, there are profit opportunities from producing a cultural good in each country. As a result, in equilibrium there are firms operating in sector C in both countries (i.e.,  $n, n^* > 0$ ). Whether the manufacturing good is produced in both countries (and thus FPE holds) or only in one country will be determined by the degree of asymmetry between the two countries. In other words, if a country has a relatively large demand base for its cultural goods, it may specialize in sector C. In the following discussions, I will focus on the "non-specialization" case in which both countries produce the manufacturing good as well as cultural goods, while studying the specialization cases in Appendix A.<sup>8</sup> I impose the following assumption to obtain no specialization.

<sup>8</sup> Deardorff and Courant (1990) show that the likelihood of FPE reduces when nontraded goods are added in a Heckscher-Ohlin model. My results show that the likelihood of FPE reduces when cultural barriers are added. Note that in my model all cultural goods are tradeable although they are traded only for global consumers' consumption.

**Assumption 2.**  $(1-\phi)[\rho L - (1-\rho)L^*] + (1-\phi^*)L^* > 0$  and  $(1-\phi)L + (1-\phi^*)[\rho L^* - (1-\rho)L] > 0$ .

Note that Assumption 2 can be rewritten as  $\rho > \max\left\{\frac{(\phi-\phi^*)L}{(1-\phi^*)(L+L^*)}, \frac{(\phi^*-\phi)L^*}{(1-\phi)(L+L^*)}\right\}$ . Given the parameters  $(L, L^*, \phi, \phi^*)$ , Assumption 2 holds when the share of sector M,  $\rho$ , is sufficiently large. In particular, when  $L = L^*$ ,  $\rho > 1/2$  is sufficient for Assumption 2. Assumption 2, together with Assumption 1, guarantees that both countries produce the manufacturing good, implying  $w = w^*$  (i.e., FPE) and  $p_m = p_m^* = \gamma w$ . Also, we have  $c_m = c_m^* = \rho / \gamma$  for both types of consumers. Firms in sector C choose  $p = p^* = \beta w / \theta$  and  $x = x^* = \alpha \theta / \beta(1-\theta)$ . A global consumer's consumption of a cultural good produced in either country is given by  $c_g = c_g^* = (1-\rho)w / (n+n^*)p$ . A local consumer in the home country consumes  $c_l = (1-\rho)w / np$  units of each domestic cultural good, while one in the foreign country consumes  $c_l^* = (1-\rho)w / n^*p$  units of each domestic cultural good. Using market clearing conditions, we obtain  $x = \phi L c_g + (1-\phi)L c_l + \phi^* L^* c_g^* = \phi^* L^* c_g^* + (1-\phi^*)L^* c_l^* + \phi L c_g$ . Combining this with another condition  $n + n^* = (1-\theta)(1-\rho)(L+L^*) / \alpha$  yields

$$n = \frac{(1-\theta)(1-\rho)(L+L^*)}{\alpha} \frac{(1-\phi)L}{(1-\phi)L + (1-\phi^*)L^*}$$

and

$$n^* = \frac{(1-\theta)(1-\rho)(L+L^*)}{\alpha} \frac{(1-\phi^*)L^*}{(1-\phi)L + (1-\phi^*)L^*}.$$

The number of cultural goods produced in each country is pinned down uniquely in equilibrium, and it is proportional to each country's share of local consumers in the two countries. That is, a country with many local consumers produces a large variety of cultural goods. A global consumer benefits from trade of cultural goods as it allows him to enjoy imported cultural goods. A local consumer gets better off after trade if the proportion of local consumers in his country is larger than that in the other country. Although a local consumer consumes no imported cultural goods, he may enjoy increased variety resulting from exports of cultural goods. This is in contrast with Krugman's (1980) model, in which all increase in variety comes from imports. By the full employment condition, we have

$$x_m = \left[ 1 - (1-\rho)(L+L^*) \frac{(1-\phi)}{(1-\phi)L + (1-\phi^*)L^*} \right] \frac{L}{\gamma}$$

and

$$x_m^* = \left[ 1 - (1 - \rho)(L + L^*) \frac{(1 - \phi^*)}{(1 - \phi)L + (1 - \phi^*)L^*} \right] \frac{L^*}{\gamma}.$$

Note that both  $x_m$  and  $x_m^*$  are positive by Assumption 2.

## 2.4. Welfare Analysis

I study the effect of cultural barriers on the welfare of consumers. Let  $U_g(\phi, \phi^*)$  and  $U_l(\phi, \phi^*)$  be the utilities of a global consumer and a local consumer, respectively, in the home country in the trade equilibrium given the proportions of global consumers,  $(\phi, \phi^*)$ . Similarly, let  $U_g^*(\phi, \phi^*)$  and  $U_l^*(\phi, \phi^*)$  be the utilities of a global consumer and a local consumer, respectively, in the foreign country. The functions  $U_g$ ,  $U_l$ ,  $U_g^*$ , and  $U_l^*$  are continuous although they may not be differentiable at points where there is a switch from an interior equilibrium to a corner equilibrium.

In the following proposition, I analyze the impacts of changes in  $(\phi, \phi^*)$  on the utilities  $U_g$ ,  $U_l$ ,  $U_g^*$ , and  $U_l^*$ , focusing on the region of  $(\phi, \phi^*)$  satisfying Assumptions 1 and 2 while studying the other region in Appendix A.

**Proposition 1.** *Suppose that Assumptions 1 and 2 are satisfied. Then the following statements hold:*

- (i)  $U_g(\phi, \phi^*) = U_g^*(\phi, \phi^*)$ , and their values are independent of  $(\phi, \phi^*)$ .
- (ii)  $U_l(\phi, \phi^*)$  is decreasing in  $\phi$  and increasing in  $\phi^*$ . Also,  $U_l^*(\phi, \phi^*)$  is decreasing in  $\phi^*$  and increasing in  $\phi$ .

*Proof.* See Appendix B.

Proposition 1(i) shows that a global consumer's utility in equilibrium is the same across the two countries and that it is independent of the proportions of global consumers in the two countries. Under Assumptions 1 and 2, the total number of cultural goods is determined by the total population through the relationship  $n + n^* = (1 - \theta)(1 - \rho)(L + L^*) / \alpha$ , the relative wage is fixed at unity, and the consumption of the manufacturing good is  $\rho / \gamma$ . Hence, global consumers in the two countries choose the same consumption bundle independent of the proportions of global consumers. On the other hand, Proposition 1(ii) shows that a local consumer's utility in equilibrium decreases as there are more global consumers in his country and it increases as there are more global consumers in the other country. This is because a local consumer gets better off as there are more cultural goods

produced in his country while the number of cultural goods produced in a country is proportional to its share of local consumers in the world. In other words, as the proportion of global consumers in a country increases (i.e., as cultural barriers in a country get lower), the number of cultural goods produced in the country decreases while that in the other country increases, which makes a local consumer in the country worse off while making a local consumer in the other country better off. Hence, if local consumers are politically influential, a country may engage in cultural protectionism in order to increase local variety.<sup>9</sup> There is a similarity between cultural barriers and tariffs in the sense that they both may improve the welfare of (local) consumers by increasing the variety of differentiated goods produced in the country that engages in protection.<sup>10</sup>

The overall utility of the home country can be defined as  $W(\phi, \phi^*) = [\phi U_g(\phi, \phi^*) + (1-\phi)U_l(\phi, \phi^*)]L$ , and that of the foreign country as  $W^*(\phi, \phi^*) = [\phi^* U_g^*(\phi, \phi^*) + (1-\phi^*)U_l^*(\phi, \phi^*)]L^*$ . In the following proposition, I study the properties of  $W(\phi, \phi^*)$ , while symmetric results can be established for  $W^*(\phi, \phi^*)$ .

**Proposition 2.** *Suppose that Assumptions 1 and 2 are satisfied. Then the following statements hold:*

- (i)  $\frac{\partial W(\phi, \phi^*)}{\partial \phi} > 0$  and  $\frac{\partial W(\phi, \phi^*)}{\partial \phi^*} > 0$ .
- (ii) *If the home country has sufficiently many local consumers relative to the foreign country, then  $\frac{\partial W(\phi, \phi^*)}{\partial \phi} < \frac{\partial W(\phi, \phi^*)}{\partial \phi^*}$ . Also, if the foreign country has sufficiently many local consumers relative to the home country, then  $\frac{\partial W(\phi, \phi^*)}{\partial \phi} > \frac{\partial W(\phi, \phi^*)}{\partial \phi^*}$ .*

*Proof.* See Appendix B.

Proposition 2(i) shows that the overall utility of each country increases as there are more global consumers in the world. The partial derivatives of  $W$  are given by  $\partial W / \partial \phi = [(1-\phi)(\partial U_l / \partial \phi) + (U_g - U_l)]L$  and  $\partial W / \partial \phi^* = (1-\phi)(\partial U_l / \partial \phi^*)L$ . Since  $U_l$  is increasing in  $\phi^*$ , it is clear that  $\partial W / \partial \phi^* > 0$ . In the expression of  $\partial W / \partial \phi$ ,  $\partial U_l / \partial \phi$  is negative while  $U_g - U_l$  is positive. As a local consumer turns into a global consumer, his utility gain  $U_g - U_l$  outweighs the utility loss of other local consumers in his country  $(1-\phi)(\partial U_l / \partial \phi)$ , leading to  $\partial W / \partial \phi > 0$ .

Proposition 2(ii) compares the marginal effects of increasing  $\phi$  and  $\phi^*$  on the overall utility  $W$ . This comparison is relevant in a scenario where a country can increase the proportions of global consumers in the two countries (for example, by

<sup>9</sup> In the real world, producers of cultural goods can also urge the government to adopt protectionist policies. An example is the screen quota system, which aims to protect domestic film industries. In the model, due to the assumption of free entry and exit, producers of cultural goods gain no profit, and their activities benefit local consumers.

<sup>10</sup> For an analysis of the effects of tariffs in a similar model, see Venables (1987) and Helpman and Krugman (1989, Ch. 7).

educating local consumers) at a cost.  $\partial W / \partial \phi < \partial W / \partial \phi^*$  means that increasing  $\phi^*$  is more effective in improving the overall utility than increasing  $\phi$ , and vice versa. Proposition 2(ii) shows that increasing  $\phi^*$  is more effective when the home country has many local consumers and thus produces a large number of cultural goods, while increasing  $\phi$  is more effective in the opposite case. This result suggests that a country producing relatively many cultural goods tends to promote its own culture abroad, whereas a country producing relatively few cultural goods is inclined to actively embrace foreign cultures and become globalized.

### III. Decisions on Cultural Learning

In the previous section, I have analyzed the effects of cultural barriers on equilibrium production and consumption decisions and trade patterns. However, there is also the other direction of influence. The variety of cultural goods produced in a country certainly affects the decisions on cultural learning in the country as well as in the other country. In this section, I extend the trade model so that the levels of cultural barriers in the two countries are endogenously determined by individuals' decisions on cultural learning. I suppose that each individual is born with local tastes and that he can develop global tastes by learning the culture of the other country. With this assumption, the proportion of global consumers in a country can be interpreted as the learning level in that country. There is a cost associated with cultural learning. I assume that the learning costs incurred by individuals in each country are distributed following a cumulative distribution function  $F(k)$  with support  $[\underline{k}, \bar{k}]$ , where  $0 \leq \underline{k} < \bar{k}$ . I assume that  $F(k)$  is continuously differentiable with positive derivative  $f(k)$  on  $[\underline{k}, \bar{k}]$ . When every individual with a learning cost lower than  $F^{-1}(\phi)$  becomes a global consumer in a country for  $\phi \in [0, 1]$ , the proportion of global consumers is  $\phi$  and their average learning cost is given by  $K(\phi) = \int_{\underline{k}}^{F^{-1}(\phi)} k dF(k)$ . Note that the derivative of  $K$  is  $K'(\phi) = F^{-1}(\phi)$ . For example, if learning costs are uniformly distributed on  $[\underline{k}, \bar{k}]$ , i.e.,  $F(k) = (k - \underline{k}) / (\bar{k} - \underline{k})$ , then  $K(\phi) = (\bar{k} - \underline{k})\phi^2 / 2 + \underline{k}\phi$  and  $K'(\phi) = (\bar{k} - \underline{k})\phi + \underline{k}$ .

Welfare in the home country is defined as total utility minus total learning costs in the home country,

$$V(\phi, \phi^*) = [\phi U_g(\phi, \phi^*) + (1 - \phi)U_l(\phi, \phi^*) - K(\phi)]L. \quad (5)$$

Similarly, welfare in the foreign country is defined as

$$V^*(\phi, \phi^*) = [\phi^* U_g^*(\phi, \phi^*) + (1 - \phi^*)U_l^*(\phi, \phi^*) - K(\phi^*)]L^*. \quad (6)$$



In order to determine  $(\phi, \phi^*)$ , I consider three solutions corresponding to three different scenarios. First,  $(\phi_o, \phi_o^*) \in [0, 1]^2$  is a *world optimum* if

$$V(\phi_o, \phi_o^*) + V^*(\phi_o, \phi_o^*) \geq V(\phi, \phi^*) + V^*(\phi, \phi^*) \quad \text{for all } (\phi, \phi^*) \in [0, 1]^2.$$

That is, at a world optimum, a world social planner chooses the proportions of global consumers in the two countries to maximize total welfare in the world economy. Second,  $(\phi_c, \phi_c^*) \in [0, 1]^2$  is a *country-level equilibrium* if

$$V(\phi_c, \phi_c^*) \geq V(\phi, \phi_c^*) \quad \text{for all } \phi \in [0, 1]$$

and

$$V^*(\phi_c, \phi_c^*) \geq V^*(\phi_c, \phi^*) \quad \text{for all } \phi^* \in [0, 1].$$

In other words, in a country-level equilibrium, each country has its own social planner who chooses the proportion of global consumers in the country optimally given the proportion of global consumers in the other country. An assumption underlying in the two solutions is that a social planner can educate a desired proportion of a country's population in increasing order of learning costs.<sup>11</sup> Lastly,  $(\phi_d, \phi_d^*) \in [0, 1]^2$  is a *consumer-level (decentralized) equilibrium* if

$$U_g(\phi_d, \phi_d^*) - U_l(\phi_d, \phi_d^*) \begin{cases} \leq \underline{k} & \text{if } \phi_d = 0, \\ = F^{-1}(\phi_d) & \text{if } 0 < \phi_d < 1, \\ \geq \bar{k} & \text{if } \phi_d = 1, \end{cases}$$

and

$$U_g^*(\phi_d, \phi_d^*) - U_l^*(\phi_d, \phi_d^*) \begin{cases} \leq \underline{k} & \text{if } \phi_d^* = 0, \\ = F^{-1}(\phi_d^*) & \text{if } 0 < \phi_d^* < 1, \\ \geq \bar{k} & \text{if } \phi_d^* = 1. \end{cases}$$

In a consumer-level equilibrium, each individual makes an optimal decision on cultural learning given the proportions of global consumers in the two countries. In the scenario where consumers make decisions on cultural learning individually,

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<sup>11</sup> The figurative interpretation discussed in footnote 3 may help to understand this assumption. In this interpretation, the cost distribution function  $F(k)$  can be considered as capturing the representative agent's overall ability to learn the culture of the other country.

$(\phi_d, \phi_d^*)$  is stable if exactly  $\phi_d$  and  $\phi_d^*$  proportions of consumers obtain a positive net gain from learning in the home and foreign countries, respectively, when the benefit of learning is given by  $U_g(\phi_d, \phi_d^*) - U_l(\phi_d, \phi_d^*)$  in the home country and by  $U_g^*(\phi_d, \phi_d^*) - U_l^*(\phi_d, \phi_d^*)$  in the foreign country. Decisions on cultural learning are typically made at an individual level although government policy may influence those decisions. Thus, the first two solutions can be considered as benchmark outcomes arising in hypothetical scenarios.

For simplicity, I assume that there are sufficiently many consumers with low and high learning costs so that all the three solutions occur in the interior, i.e., in  $(0,1)^2$ . This will make Assumption 1 valid.<sup>12</sup> In addition, for convenience of discussion I assume that the three solutions occur in the region of Assumption 2. A sufficient condition for this to occur is  $\rho > \max\{L, L^*\} / (L + L^*)$ . That is, when the demand for the manufacturing good is sufficiently high, both countries produce it in the trade equilibrium regardless of  $(\phi, \phi^*) \in (0,1)^2$ . I assume that the functions  $V(\phi, \phi^*)$  and  $V^*(\phi, \phi^*)$ , defined in (5) and (6), respectively, are strictly concave. The first-order conditions for the world optimum  $(\phi_o, \phi_o^*)$  are given by

$$\frac{\partial V(\phi_o, \phi_o^*)}{\partial \phi} + \frac{\partial V^*(\phi_o, \phi_o^*)}{\partial \phi} = 0 \quad (7)$$

and

$$\frac{\partial V(\phi_o, \phi_o^*)}{\partial \phi^*} + \frac{\partial V^*(\phi_o, \phi_o^*)}{\partial \phi^*} = 0. \quad (8)$$

Noting that  $U_g$  and  $U_g^*$  are independent of  $(\phi, \phi^*)$  under Assumptions 1 and 2, (7) and (8) can be rewritten as

$$\left[ U_g - U_l(\phi_o, \phi_o^*) + (1 - \phi_o) \frac{\partial U_l(\phi_o, \phi_o^*)}{\partial \phi} - F^{-1}(\phi_o) \right] L + (1 - \phi_o^*) \frac{\partial U_l^*(\phi_o, \phi_o^*)}{\partial \phi} L^* = 0$$

and

$$(1 - \phi_o) \frac{\partial U_l(\phi_o, \phi_o^*)}{\partial \phi^*} L + \left[ U_g^* - U_l^*(\phi_o, \phi_o^*) + (1 - \phi_o^*) \frac{\partial U_l^*(\phi_o, \phi_o^*)}{\partial \phi^*} - F^{-1}(\phi_o^*) \right] L^* = 0,$$

respectively. The first-order conditions for the country-level equilibrium  $(\phi_c, \phi_c^*)$  are

<sup>12</sup> In Appendix A, I study the possibility of cultural dependence, i.e., a situation where all consumers in one country develop global tastes and the country does not produce cultural goods at all.

given by

$$\frac{\partial V(\phi_c, \phi_c^*)}{\partial \phi} = 0$$

and

$$\frac{\partial V^*(\phi_c, \phi_c^*)}{\partial \phi^*} = 0,$$

which can be rewritten as

$$U_g - U_l(\phi_c, \phi_c^*) + (1 - \phi_c) \frac{\partial U_l(\phi_c, \phi_c^*)}{\partial \phi} - F^{-1}(\phi_c) = 0$$

and

$$U_g^* - U_l^*(\phi_c, \phi_c^*) + (1 - \phi_c^*) \frac{\partial U_l^*(\phi_c, \phi_c^*)}{\partial \phi^*} - F^{-1}(\phi_c^*) = 0,$$

respectively. In a country-level equilibrium, the social planner for each country does not take into account the positive effect of cultural learning on the utility of local consumers in the other country. Thus, the learning levels in the country-level equilibrium are lower than those at the world optimum, i.e.,  $\phi_c < \phi_o$  and  $\phi_c^* < \phi_o^*$ . Lastly, the conditions for an interior consumer-level equilibrium  $(\phi_d, \phi_d^*)$  are given by

$$U_g - U_l(\phi_d, \phi_d^*) = F^{-1}(\phi_d)$$

and

$$U_g^* - U_l^*(\phi_d, \phi_d^*) = F^{-1}(\phi_d^*).$$

In a consumer-level equilibrium, individuals ignore the negative effect of their cultural learning on the utility of local consumers in the same country. As a result, the learning levels in the consumer-level equilibrium are higher than those in the country-level equilibrium, i.e.,  $\phi_d > \phi_c$  and  $\phi_d^* > \phi_c^*$ . The result that the learning levels in the country-level equilibrium are lower than those at the world optimum and in the consumer-level equilibrium can explain the nationalist viewpoint, which

encourages consumers to favor domestic cultural goods over foreign ones.

Cultural learning in a country makes a local consumer in the country worse off while making a local consumer in the other country better off. Due to these counteracting effects, it is possible that the consumer-level equilibrium achieves higher total welfare than the country-level equilibrium, i.e.,  $V(\phi_d, \phi_d^*) + V^*(\phi_d, \phi_d^*) > V(\phi_c, \phi_c^*) + V^*(\phi_c, \phi_c^*)$ . In particular, when the two countries are of the same size (i.e., when  $L = L^*$ ), we have  $\phi_o = \phi_o^*$  and the two counteracting effects offset each other exactly, i.e.,

$$(1 - \phi_o) \frac{\partial U_l(\phi_o, \phi_o^*)}{\partial \phi} L + (1 - \phi_o^*) \frac{\partial U_l^*(\phi_o, \phi_o^*)}{\partial \phi} L^* = 0$$

and

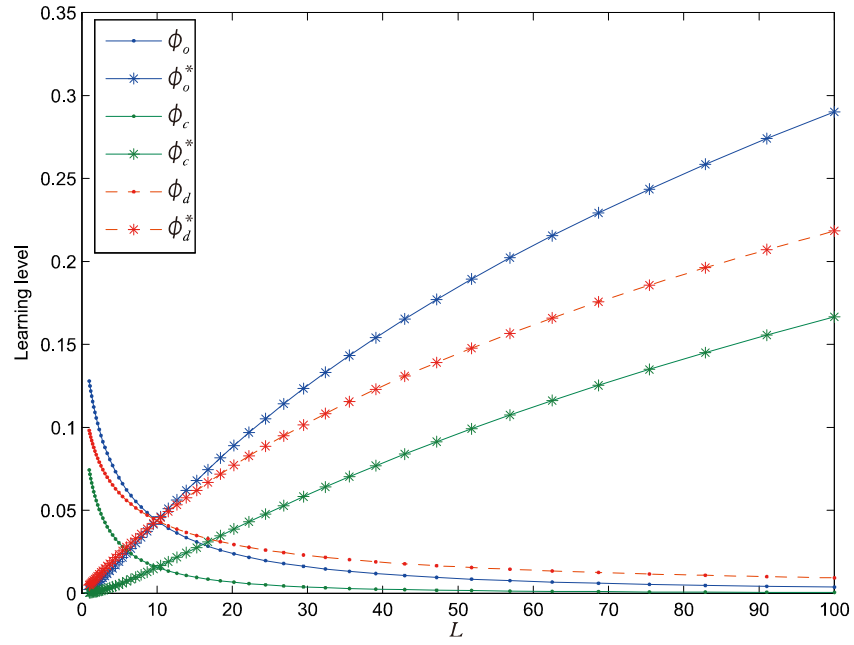
$$(1 - \phi_o) \frac{\partial U_l(\phi_o, \phi_o^*)}{\partial \phi^*} L + (1 - \phi_o^*) \frac{\partial U_l^*(\phi_o, \phi_o^*)}{\partial \phi^*} L^* = 0.$$

Thus, when  $L = L^*$ , the consumer-level equilibrium achieves world optimum, i.e.,  $\phi_d = \phi_o$  and  $\phi_d^* = \phi_o^*$ . This result suggests the following general idea. Suppose that there are two groups and that individuals' actions have opposing effects on the two groups. Then it may be socially desirable to let individuals make decisions independently (as in the consumer-level equilibrium) rather than collectively as a group (as in the country-level equilibrium).

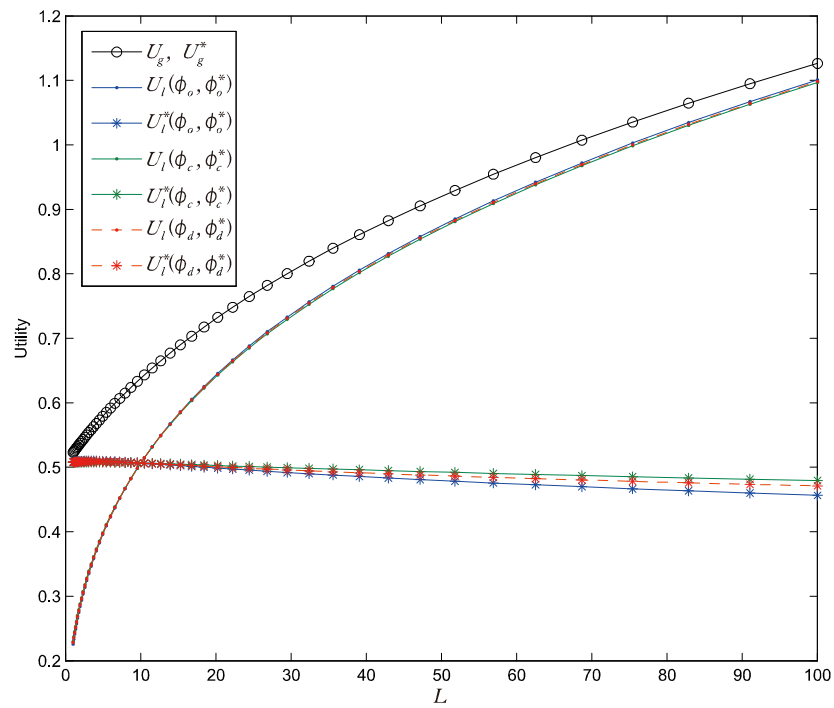
In Fig. 1, I plot the three solutions  $(\phi_o, \phi_o^*)$ ,  $(\phi_c, \phi_c^*)$ , and  $(\phi_d, \phi_d^*)$  and the utilities of global and local consumers in the two countries at those solutions when  $L^*$  is fixed at 10 and  $L$  is varied from 1 to 100. The setup I consider has  $\rho = 0.5$ ,  $\gamma = 1$ ,  $\alpha = 10$ ,  $\beta = 0.2$ ,  $\theta = 0.6$ , and  $F(\cdot)$  as the uniform distribution on  $[0, 3]$ . The qualitative features of the three solutions and the utilities remain the same when the parameters are varied. I mention three important features observed in Fig. 1(a). First, at all the three solutions, the larger country has a lower learning level than the smaller country.<sup>13</sup> This result is intuitive and conforms to reality. Since a country with a large market can offer a wide variety of cultural goods, consumers in that country receive little benefit of cultural learning while consumers in the other country gain a lot by learning the culture of that country. Second, the learning level of a country in the country-level equilibrium is the lowest among those at the three

<sup>13</sup> Using this result, I can argue that as long as  $\rho$  is not too small, the solutions are likely to fall in the region of Assumption 2. When  $\rho$  is not small, not to have Assumption 2 requires that the learning level in the larger (or not so smaller) country be high and that in the smaller (or not so larger) country be low, which is inconsistent with the result that the larger country tends to have a lower learning level.

[Figure 1] Plot of learning levels and utilities at the three solution concepts ( $L^* = 10$ )



(a) Learning levels



(b) Utilities

solutions, as discussed above.<sup>14</sup> Lastly, the world optimum and the consumer-level equilibrium coincide when  $L = L^*$ , as argued above, and in the consumer-level equilibrium more consumers in the larger country learn than at the world optimum whereas less consumers in the smaller country learn than at the world optimum. In other words, the gap between the learning levels in the two countries is smaller in the consumer-level equilibrium than at the world optimum. This is because in the larger country the negative aggregate effect of cultural learning on domestic local consumers is larger than the positive aggregate effect on foreign local consumers while the opposite is true in the smaller country. Now I mention the features of utilities observed in Fig. 1(b). The utility of global consumers is increasing in  $L$ , because more cultural goods are produced in the world as the world population grows. As  $L$  gets larger, local consumers in the home country get better off while those in the foreign country get worse off (possibly except for at small  $L$ ). The utility of local consumers in the larger country is the highest at the world optimum and the lowest in the country-level equilibrium, whereas that in the smaller country exhibits the opposite pattern. That is, the world optimum is favorable to local consumers in the larger country, and the country-level equilibrium to those in the smaller country.

#### IV. Conclusion

In this paper, I incorporated cultural barriers and cultural learning in a model of international trade. I imposed a particular type of cultural barriers which result from difficulty consumers have in appreciating foreign cultural goods, and assumed that such difficulty can be overcome by cultural learning. First, I considered a scenario where two countries trade given their cultural barriers. In this scenario, a local consumer gets better off as cultural barriers of his country are raised and as cultural barriers of the other country are lowered, while a global consumer's utility is not affected by cultural barriers. This observation can provide an economic rationale for policies to protect and promote a country's own culture at home and abroad. Then I considered another scenario where cultural barriers are chosen endogenously, analyzing three solutions for determining learning levels. Among the three solutions, the country-level equilibrium yields the lowest levels of cultural learning, which can explain the nationalist viewpoint. Due to the opposing effects of cultural learning on local consumers in the two countries, the consumer-level equilibrium may

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<sup>14</sup> An assumption maintained in the discussion is that the solutions fall in the region of Assumptions 1 and 2. If the world optimum occurs at a corner, it is possible to have  $\phi_o = 0 < \phi_c$  when the home country is larger. For more details about this possibility, see the discussion in Section A.4 of Appendix A.

achieve higher total welfare than the country-level equilibrium, especially when the two countries are of similar sizes.

I mention some important aspects that are not addressed in my model, which will provide directions for future research. First, I considered consumers' cultural learning as a means of overcoming cultural barriers, but producers can also put various efforts to make their products more accessible to foreign consumers (as mentioned in footnote 5). Second, I used the idea of countries affecting cultural barriers and their desired levels of cultural learning but did not discuss specific policy measures to achieve their objectives. For example, a government may impose required quantities of local content, as in the screen quota system, in order to influence the equilibrium outcome in its favor. Lastly, I did not model cultural identity explicitly. If individuals derive an intrinsic value from their cultural identity, losing their cultural goods may hurt them severely. In such a scenario, a government may want to protect its cultural sector by using policy measures such as subsidy on cultural production, tariff on imported cultural goods, and a quota system.

## A. Analysis of Specialization Cases

In this appendix, I examine the cases not covered in the analysis in Sections II and III. In Section A.1, I continue the discussion in Section 2.3.2 and study the possibility of specialization. In Section A.2, I consider the remaining case not studied in Section 2.3, namely the case where one country has only global consumers while the other country has some local consumers. In Section A.3, I analyze the welfare impact of  $(\phi, \phi^*)$  in the region covered in Sections A.1 and A.2. Finally, in Section A.4, I augment the discussion in Section III by studying the possibility that one country depends entirely on the other country for supply of cultural goods.

### A.1. Some Local in Both Countries

Suppose that there are some local consumers in both countries (i.e., Assumption 1 holds). As mentioned in Section 2.3.2, it is possible that a country specializes in sector C when it has a relatively large demand base for its cultural goods. The following assumption induces the home country to specialize in sector C.

**Assumption 3.**  $(1-\phi)[\rho L - (1-\rho)L^*] + (1-\phi^*)L^* \leq 0$  and  $(1-\phi)L + (1-\phi^*)[\rho L^* - (1-\rho)L^*] > 0$ .

Note that a necessary condition for Assumption 3 to hold is  $\rho L < (1-\rho)L^*$ . Provided that  $\rho L < (1-\rho)L^*$  is satisfied, Assumption 3 is likely to hold when  $\phi$  is small and  $\phi^*$  is large. Roughly speaking, in this case, cultural barriers are low in the foreign country, and cultural goods produced in the home country have a large demand base in the world economy. As a result, the nonnegativity constraint for  $x_m$  is binding, and the home country specializes in sector C. Without the nonnegativity constraint, there will be more firms willing to operate in sector C of the home country. In order to limit their number and to make the nonnegativity constraint satisfied, the home country should have a higher wage rate, which makes entry to sector C in the home country less attractive. Thus, it can be expected that  $w \geq w^*$  in equilibrium, which will be verified later. The decisions of firms in sector C are not affected by the wage difference. Firms still face a constant elasticity of demand,  $1/(1-\theta)$ , and thus they choose  $p = \beta w / \theta$ ,  $p^* = \beta w^* / \theta$ , and  $x = x^* = \alpha \theta / \beta(1-\theta)$ . It can be shown that  $x_m = 0$ , which implies  $n = (1-\theta)L / \alpha$  by the full employment condition of the home country. The price of the manufacturing good in the foreign country is thus given by  $p_m^* = \gamma w^*$ , while that in the home country satisfies  $p_m^* \leq p_m \leq \gamma w$ . Consumption of the manufacturing good in the two countries is given by



$$c_m = \frac{\rho}{\gamma} \frac{w}{w^*} \quad \text{and} \quad c_m^* = \frac{\rho}{\gamma}.$$

Hence, the market clearing condition for the manufacturing good can be written as

$$x_m^* = Lc_m + L^*c_m^* = \frac{\rho}{\gamma} \left( L \frac{w}{w^*} + L^* \right).$$

The full employment condition of the foreign country yields

$$n^* = \frac{1-\theta}{\alpha} \left[ (1-\rho)L^* - \rho L \frac{w}{w^*} \right].$$

Since there are local consumers in the foreign country,  $n^*$  must be positive in equilibrium.

Let  $c_g$  be the consumption of a cultural good produced in the home country by a global consumer in the home country. Due to the price difference, a global consumer in the home country consumes  $\tilde{c}_g = \sigma c_g$  units of a cultural good produced in the foreign country, where

$$\sigma = \left( \frac{w}{w^*} \right)^{\frac{1}{1-\theta}}.$$

Note that  $\sigma \geq 1$  and thus  $\tilde{c}_g \geq c_g$ . From the budget constraint of a global consumer in the home country, we obtain  $c_g = (1-\rho)w / (np + n^*p^*\sigma)$ . A local consumer in the home country consumes  $c_l = (1-\rho)w / np$  units of each cultural good produced in the home country. Let  $c_g^*$  be the consumption of a cultural good produced in the home country by a global consumer in the foreign country. A global consumer in the foreign country consumes  $\tilde{c}_g^* = \sigma c_g^*$  units of a cultural good produced in the foreign country, and from his budget constraint we obtain  $c_g^* = (1-\rho)w^* / (np + n^*p^*\sigma)$ . A local consumer in the foreign country consumes  $\tilde{c}_l^* = (1-\rho)w^* / n^*p^*$  units of each cultural good produced in the foreign country. The market clearing conditions for cultural goods in the two countries are given by  $x = \phi Lc_g + (1-\phi)Lc_l + \phi^*L^*c_g^*$  and  $x^* = \phi^*L^*\sigma c_g^* + (1-\phi^*)L^*\tilde{c}_l^* + \phi L\sigma c_g$ . The relative wage rate, denoted by  $\omega = w / w^*$ , can be obtained from either condition. Here I use the first condition, which gives after manipulation

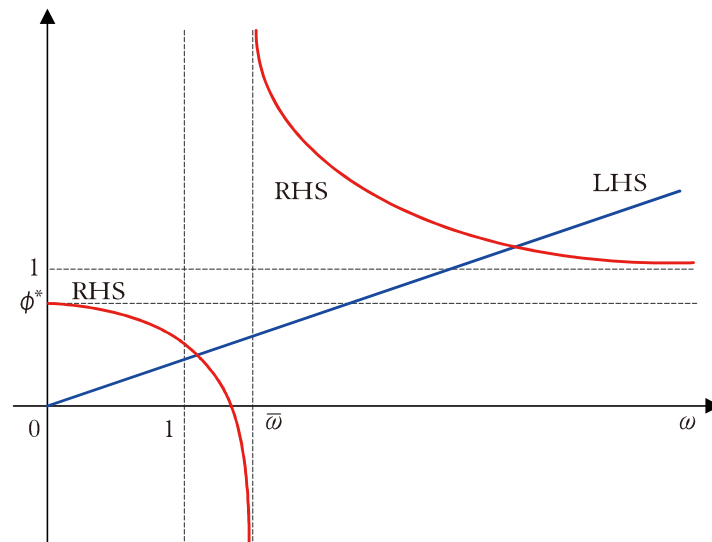
$$\frac{\rho L}{(1-\rho)L^*} \omega = \frac{\phi^* - [1 - (1-\rho)(1-\phi)]\omega^{1/(1-\theta)}}{1 - [1 - (1-\rho)(1-\phi)]\omega^{1/(1-\theta)}}. \quad (9)$$

Let

$$\bar{\omega} = \left[ \frac{1}{1 - (1 - \rho)(1 - \phi)} \right]^{1-\theta}.$$

The right-hand side of (9) is not defined at  $\omega = \bar{\omega}$ . The graph of the two sides of (9) is depicted in Fig. 2. Let  $h(\omega)$  be the left-hand side minus the right-hand side of (9). It can be shown that  $h(\omega)$  is continuous and increasing on each of the two intervals,  $[0, \bar{\omega})$  and  $(\bar{\omega}, +\infty)$ . We have  $h(1) \leq 0$ ,  $\lim_{\omega \rightarrow \bar{\omega}^-} h(\omega) = +\infty$ ,  $\lim_{\omega \rightarrow \bar{\omega}^+} h(\omega) = -\infty$ , and  $\lim_{\omega \rightarrow +\infty} h(\omega) = +\infty$ . Therefore, there are two roots of  $h(\omega)$ , one in the interval  $[1, \bar{\omega})$  and the other in the interval  $(\bar{\omega}, +\infty)$ , as shown in Fig. 2. Since  $n^* > 0$ , the left-hand side of (9) is less than 1, and thus the root in the interval  $[1, \bar{\omega})$  is the equilibrium relative wage rate. The equilibrium relative wage rate  $\omega$  increases as  $\phi^*$  increases and as  $\phi$  decreases. This result can be explained by noting that as  $(1 - \phi)[\rho L - (1 - \rho)L^*] + (1 - \phi^*)L^*$  becomes more negative we need to make entry to sector C in the home country less attractive to have the nonnegativity constraint satisfied, which leads to a higher relative wage rate. Once  $\omega$  is determined, all the remaining variables can be determined.

[Figure 2] Graph of the left-hand side (LHS) and the right-hand side (RHS) of (9)



When  $(1 - \phi)[\rho L - (1 - \rho)L^*] + (1 - \phi^*)L^* > 0$  and  $(1 - \phi)L + (1 - \phi^*)[\rho L^* - (1 - \rho)L] \leq 0$ , we have the opposite pattern of specialization: The home country produces goods in both sectors while the foreign country specializes in sector C,

yielding  $\omega \leq 1$ . Thus, this case can be analyzed analogously to the previous case changing the roles of the two countries, and I omit the details. Finally, note that the remaining case of  $(1-\phi)[\rho L - (1-\rho)L^*] + (1-\phi^*)L^* \leq 0$  and  $(1-\phi)L + (1-\phi^*)[\rho L^* - (1-\rho)L] \leq 0$  cannot hold because the two inequalities yield  $x_m + x_m^* \leq 0$ , a contradiction.

## A.2. All Global in One Country and Some Local in the Other Country

I examine the remaining case where one country has only global consumers while the other country has some local consumers.

**Assumption 4.**  $\phi < 1$  and  $\phi^* = 1$ .

Under Assumption 4, there are some local consumers in the home country while every consumer is global in the foreign country. Since there are local consumers in the home country, the home country produces cultural goods in equilibrium. On the contrary, the foreign country may not produce cultural goods at all while it always produces the manufacturing good. With Assumption 4 maintained, three subcases are considered below.

**Assumption 5.**  $(1-\rho)L^* > \bar{\omega}\rho L$ .

Under Assumption 5, the home country specializes in the production of cultural goods while the foreign country produces both the manufacturing good and cultural goods. Hence, the equilibrium variables are the same as with Assumptions 1 and 3, except that the condition  $x = \phi L c_g + (1-\phi)L c_l + \phi^* L^* c_g^*$  now yields  $\omega = \bar{\omega} > 1$ . Note that we have  $n^* > 0$  since  $(1-\rho)L^* > \bar{\omega}\rho L$ .

**Assumption 6.**  $\rho L \leq (1-\rho)L^* \leq \bar{\omega}\rho L$ .

Under Assumption 6, the home country specializes in sector C while the foreign country specializes in sector M. That is, we obtain  $x_m = 0$  and  $n^* = 0$ . By the full employment conditions, we have  $n = (1-\theta)L / \alpha$  and  $x_m^* = L^* / \gamma$ . The market clearing condition for the manufacturing good is given by  $L^* / \gamma = \rho(\omega L + L^*) / \gamma$ , which yields

$$\omega = \frac{(1-\rho)L^*}{\rho L}.$$

Note that  $1 \leq \omega \leq \bar{\omega}$ . Also,  $\omega$  decreases from  $\bar{\omega}$  to 1 as  $\rho$  increases in the

range of Assumption 6.

**Assumption 7.**  $(1-\rho)L^* < \rho L$ .

Under Assumption 7, the home country produces both the manufacturing good and cultural goods while the foreign country specializes in the production of the manufacturing good. Since both countries produce the manufacturing good, we have  $\omega = \omega^*$ , i.e.,  $\omega = 1$ . Since  $n^* = 0$ , we have  $x_m^* = L^* / \gamma$ . Since the total demand for the manufacturing good is  $\rho(L + L^*) / \gamma$ , we have  $x_m + x_m^* = \rho(L + L^*) / \gamma$ , which yields  $x_m = [\rho L - (1-\rho)L^*] / \gamma$ . Note that  $x_m > 0$  because  $(1-\rho)L^* < \rho L$ . Finally, the full employment condition for the home country gives  $n = (1-\theta)(1-\rho)(L + L^*) / \alpha$ .

[Table 1] Summary of the results when  $\phi < 1$  and  $\phi^* = 1$

	Home		Foreign		$\omega$
	$x_m$	$n$	$x_m^*$	$n^*$	
Assumption 5 (small $\rho$ )	0	+	+	+	$\bar{\omega}$
Assumption 6 (medium $\rho$ )	0	+	+	0	between 1 and $\bar{\omega}$
Assumption 7 (large $\rho$ )	+	+	+	0	1

The results under Assumption 4 are summarized in Table 1. Note that when  $(1-\rho)L^* \leq \bar{\omega}\rho L$ , i.e., when sector M has a large market share, the country that has only global consumers produces no cultural goods. That is, when all consumers in a country can enjoy cultural goods produced in the other country and sector C has a small market share, consumers in the country will rely on imported cultural goods, with no domestic cultural goods available.

The opposite case where  $\phi = 1$  and  $\phi^* < 1$  can be analyzed analogously by switching the roles of the two countries, and thus I omit the details.

### A.3. Welfare Analysis

I study the impacts of changes in  $(\phi, \phi^*)$  on the utilities  $U_g$ ,  $U_l$ ,  $U_g^*$ , and  $U_l^*$  in the region covered in Sections A.1 and A.2. First, I consider a change in  $(\phi, \phi^*)$  within the region of Assumptions 1 and 3. In this region, the relative wage  $\omega$  is in  $[1, \bar{\omega})$ , and it is decreasing in  $\phi$  and increasing in  $\phi^*$ . Also, we have  $c_m = \rho\omega / \gamma$ ,  $c_m^* = \rho / \gamma$ ,  $n = (1-\theta)L / \alpha$ , and  $n^* = (1-\theta)[(1-\rho)L^* - \omega\rho L] / \alpha$ . Thus,  $\phi$  and  $\phi^*$  affect the utilities through the relative wage  $\omega$ . As  $\phi$  increases,  $\omega$  decreases, which reduces  $c_m$  and increases  $n^*$ . On the other hand, as  $\phi^*$  increases,  $\omega$  increases, which increases  $c_m$  and reduces  $n^*$ . Thus, the impacts of  $\phi$  and  $\phi^*$  on  $U_g$  are ambiguous, since the induced changes in  $c_m$  and  $n^*$  have offsetting

effects. Noting that  $U_g$  depends on  $\phi$  and  $\phi^*$  only through  $\omega$ , we can express  $U_g$  as a function of  $\omega$ :

$$\log U_g = \rho \log \omega + (1-\rho) \frac{1-\theta}{\theta} \log \left\{ 1 + \left[ (1-\rho) \frac{L^*}{L} - \rho \omega \right] \omega^{\frac{\theta}{1-\theta}} \right\} + C,$$

where  $C$  represents terms independent of  $\omega$ .  $U_g$  is decreasing in  $\phi$  and increasing in  $\phi^*$  if  $U_g$  is increasing in  $\omega$ . A sufficient condition to have  $U_g$  increasing in  $\omega$  is  $\theta(1-\rho)L^* > \rho^\theta L$ . Given the necessary condition for Assumption 3,  $\rho L < (1-\rho)L^*$ , this sufficient condition holds when  $\theta$  is close to 1. As  $\omega$  increases, the terms of trade for a consumer in the home country improve, and the only negative impact on a global consumer in the home country comes from the reduced number of foreign cultural goods. When cultural goods are highly substitutable, this negative impact will be small compared to the gain from the improvement in the terms of trade, and thus an increase in  $\omega$  will make a global consumer in the home country better off. It can be verified that  $U_l$  is decreasing in  $\phi$  and increasing in  $\phi^*$ , while  $U_g^*$  and  $U_l^*$  are increasing in  $\phi$  and decreasing in  $\phi^*$ . In this case, raising cultural barriers in the home country makes its local consumers better off through a different channel, a higher relative wage rate (i.e., an improvement in the terms of trade). At the same time, raising cultural barriers in the home country makes consumers in the foreign country worse off by reducing their relative wage rate as well as the number of cultural goods produced in the foreign country. As an example, consider the following scenario. Suppose that the US specializes in the film industry while Mexico produces both the manufacturing good and movies. Suppose that American consumers become more global in that they are more able to enjoy Mexican movies. Then the terms of trade for Americans become worse, and there are more Mexican movies produced. Local consumers in the US become worse off due to the reduced consumption of the manufacturing good. (Note that the number of movies produced in the US is fixed in this model.) Global consumers in the US may get worse off as well if their love for variety is not so strong. In contrast, both local and global consumers in Mexico get better off because they face the better terms of trade and they can enjoy more Mexican movies.

Next I turn to the impact of  $(\phi, \phi^*)$  in the region of Assumption 4. Since  $\phi^* = 1$  is fixed in this region, I consider a change in  $\phi$  only. As  $\phi$  increases within the region of Assumption 5, the relative wage rate  $\omega = \bar{\omega}$  goes down, and its impacts on  $U_g$ ,  $U_l$ ,  $U_g^*$ , and  $U_l^*$  are as with Assumptions 1 and 3. Under Assumption 6 or 7, equilibrium variables are independent of  $\phi$ , and thus a change in  $\phi$  does not affect the utilities.

#### A.4. Decisions on Cultural Learning and Possibility of Cultural Dependence

I continue the discussions in Section III. I explore the possibility of corner solutions, without imposing the assumption that the solutions occur in the interior. In particular, I examine whether cultural dependence can arise at a solution. In my model, cultural dependence occurs when a country produces no cultural goods and all consumers in the country learn the culture of the other country. I look for a solution in which the foreign country is dependent on cultural goods produced in the home country, i.e.,  $\phi^* = 1$  and  $n^* = 0$ . Note that  $\phi^* = 1$  and  $n^* = 0$  corresponds to cases where Assumption 6 or 7 holds together with Assumption 4. In these cases, utilities are independent of  $\phi$ . Since the foreign country produces no cultural goods, a consumer in the home country gains nothing by becoming a global consumer, i.e.,  $U_g = U_l$ . Thus, given the assumption that  $\bar{k} \geq 0$  and that  $F(k)$  is increasing on its support,  $\phi = 0$  is a unique value that satisfies the condition for  $\phi$  at each of the three solutions. That is, at all the three solutions, there is no learning by consumers in the home country. Next, I turn to the condition for  $\phi^*$ . If  $\phi^*$  takes a value less than 1, we move to the region of Assumption 1, in which  $U_l$  is increasing in  $\phi^*$ . Thus, the condition to have  $\phi^* = 1$  at the world optimum is given by

$$\bar{k} \leq U_g^*(0,1) + \frac{\partial U_l(0,1)}{\partial \phi^*} \frac{L}{L^*},$$

whereas that in the country-level and consumer-level equilibria is  $\bar{k} \leq U_g^*(0,1)$ . When  $U_g^*(0,1) < \bar{k} \leq U_g^*(0,1) + (\partial U_l(0,1) / \partial \phi^*)(L / L^*)$ , we may have a corner world optimum,  $(\phi_o, \phi_o^*) = (0,1)$ , while having interior equilibria. Lastly, in order to have Assumption 6 or 7 satisfied, the condition  $(1-\rho)L^* \leq \bar{\omega}\rho L$  needs to hold. Since  $\bar{\omega} = 1 / \rho^{1-\theta}$  when  $\phi = 0$ , this condition can be rewritten as  $(1-\rho)L^* \leq \rho^\theta L$ . In summary, when a country is sufficiently small relative to the other country and learning costs are sufficiently small, cultural dependence arises at the solutions. Moreover, it is more likely to obtain cultural dependence at the world optimum than in the country-level and consumer-level equilibria. As mentioned in the Introduction, this result can be used to support or oppose globalization depending on whether one values cultural identity or not.

### B. Proofs of Propositions

**Proof of Proposition 1:** Using the expressions for the equilibrium variables obtained in Section 2.3.2, the utilities  $U_g$ ,  $U_l$ ,  $U_g^*$ , and  $U_l^*$  can be expressed as follows:

$$U_g(\phi, \phi^*) = U_g^*(\phi, \phi^*) = \left( \frac{\rho}{\gamma} \right) \left[ \frac{(1-\rho)\theta}{\beta} \right]^{1-\rho} \left[ \frac{(1-\theta)(1-\rho)(L+L^*)}{\alpha} \right]^{\frac{1-\theta}{\theta}(1-\rho)},$$

$$U_i(\phi, \phi^*) = \left( \frac{\rho}{\gamma} \right) \left[ \frac{(1-\rho)\theta}{\beta} \right]^{1-\rho} \left[ \frac{(1-\theta)(1-\rho)(L+L^*)}{\alpha} \frac{(1-\phi)L}{(1-\phi)L + (1-\phi^*)L^*} \right]^{\frac{1-\theta}{\theta}(1-\rho)},$$

and

$$U_i^*(\phi, \phi^*) = \left( \frac{\rho}{\gamma} \right) \left[ \frac{(1-\rho)\theta}{\beta} \right]^{1-\rho} \left[ \frac{(1-\theta)(1-\rho)(L+L^*)}{\alpha} \frac{(1-\phi^*)L^*}{(1-\phi)L + (1-\phi^*)L^*} \right]^{\frac{1-\theta}{\theta}(1-\rho)}.$$

The results follow immediately from the above expressions.  $\square$

**Proof of Proposition 2:** Let  $u_g$  be the common value of  $U_g(\phi, \phi^*)$  and  $U_g^*(\phi, \phi^*)$ . Then we obtain

$$\begin{aligned} \frac{1}{u_g L} \frac{\partial W(\phi, \phi^*)}{\partial \phi} &= 1 - \left[ \frac{(1-\phi)L}{(1-\phi)L + (1-\phi^*)L^*} \right]^{\frac{1-\theta}{\theta}(1-\rho)} \\ &\quad - \frac{1-\theta}{\theta} (1-\rho) \left[ \frac{(1-\phi)L}{(1-\phi)L + (1-\phi^*)L^*} \right]^{\frac{1-\theta}{\theta}(1-\rho)} \frac{(1-\phi^*)L^*}{(1-\phi)L + (1-\phi^*)L^*} \end{aligned} \quad (10)$$

and

$$\begin{aligned} \frac{1}{u_g L} \frac{\partial W(\phi, \phi^*)}{\partial \phi^*} &= \\ &\quad \frac{1-\theta}{\theta} (1-\rho) \left[ \frac{(1-\phi)L}{(1-\phi)L + (1-\phi^*)L^*} \right]^{\frac{1-\theta}{\theta}(1-\rho)} \frac{(1-\phi)L^*}{(1-\phi)L + (1-\phi^*)L^*}. \end{aligned} \quad (11)$$

Clearly  $\partial W / \partial \phi^* > 0$ . Let  $y = (1-\phi)L / [(1-\phi)L + (1-\phi^*)L^*]$  and  $r = (1-\theta)(1-\rho) / \theta$ . Note that  $0 < y < 1$  and  $r > 0$ . The right-hand side of (10) can be written as  $\lambda(y) = 1 - y^r - ry^r(1-y) = 1 - (r+1)y^r + ry^{r+1}$ . Since  $\lambda'(y) = -r(r+1)y^{r-1}(1-y) < 0$  for all  $y \in (0, 1)$  and  $\lambda(1) = 0$ , we have  $\lambda(y) > 0$  for all  $y \in (0, 1)$ . Thus,  $\partial W / \partial \phi > 0$ .

Now note that the right-hand side of (11) can be written as  $\mu(y) = ry^{r+1}L^* / L$ . We have  $\lambda(1) = 0 < rL^* / L = \mu(1)$ . Since  $\lambda(y)$  and  $\mu(y)$  are continuous, we

have  $\lambda(y) < \mu(y)$  for  $y$  sufficiently close to 1. Also, since  $\lambda(0) = 1 > 0 = \mu(0)$ , we have  $\lambda(y) > \mu(y)$  for  $y$  sufficiently close to 0. Noting that  $y \approx 1$  means  $(1-\phi)L \gg (1-\phi^*)L^*$  while  $y \approx 0$  means  $(1-\phi^*)L^* \gg (1-\phi)L$ , we obtain the results in statement (ii).  $\square$



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