Country-of-Origin Labelling Under Asymmetric Information

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Abstract

Firms in countries North and South choose between producing high or low quality. Those that choose low quality take advantage of adverse selection problems, while those that choose high quality do so to establish reputations and earn positive profits in subsequent periods when information is perfect. Cross-country differences in the relative costs of producing high quality result in different average qualities and prices in autarky. Trade is welfare deteriorating (improving) for the North (South). Allowing the Northern government the option of origin-labelling eliminates the international externalities associated with trade, when adverse selection is an international problem, and is clearly welfare improving for the North.

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1. Introduction

Nations often claim the need to protect consumers from low quality imports, particularly in the face of information asymmetries where the quality of goods may not be observable at the time of purchase. Examples of such products may include fresh produce, apparel or spare parts for cars. Relatedly, because consumers often believe that the quality of a good is dependent on its origin, consumer demand for country-of-origin labels, based on the "right-to-know" mantra, is often heard and many governments have responded. The United States Farm Security and Rural Investment Act of 2002, requires that beef, pork, lamb, fish, peanuts, fruits, and vegetables, be labelled as to their country of origin by September 30, 2004. Japan and the European Union require mandatory country-of-origin labelling for fresh produce.

Moreover, many producers voluntarily undertake schemes to ensure consumers of their product's quality. Amongst such schemes are geographical indications, which identify a good as originating in a region where a given quality or reputation of the good is essentially attributable to its geographical origin. Examples include Czech crystal, Swiss watches and Indian carpets.

Many developing countries generally regard mandatory mark-of-origin requirements as protectionist on the basis that consumer perceptions of quality are based less on fact than on stereotype. Moreover, its direct costs, which include *inter alia* the costs of segregating and tracking product origins by retailers and compliance costs by suppliers, can lead to some foreign products being taken off the retail shelves (Carter and Zwane, 2003).

Despite the claim that mandatory country-of-origin labelling is protectionist, it is allowed under Art. IX GATT 1947, which permits Members to enforce such labelling subject to the requirements that the disruptions to commerce are kept to a minimum and that due regard

to the necessity of protecting consumers against fraudulent or misleading indications be taken into consideration. Art. XX of the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), places a general obligation on WTO Members to protect legitimate geographical indications and to prevent the designation or presentation of a good that would mislead the public as to its geographical origin or constitute an act of unfair competition. Geographical indications are also not free from the claims of protectionism as witnessed by the dispute between South Africa and the EU. Article XXIII of TRIPS provides a higher or enhanced level of protection for geographical indications for wines and spirits, even if misuse would not cause the public to be misled, and thus the EU requires South African wine producers to phase out the use of the terms "port" and "sherry", which are generally associated with wines originating in Portugal and Spain.

While we do not debate that mandatory country-of-origin labelling and geographical indications can be exploited as protectionist devices, this paper provides a mechanism where such labelling schemes are not protectionist and play a useful role in eliminating negative international externalities when adverse selection is an international problem.

In order to capture a situation where the need for regulation stems from an asymmetric information problem between producers and consumers, we develop the model in Grossman-Horn (1988). In the model domestic firms can choose between high or low quality. Those that choose low quality take advantage of adverse selection problems, while those that choose high quality do so to establish reputations and earn positive profits in subsequent periods when information is perfect. Grossman-Horn show that with imperfect consumer information, the lack of reputation puts domestic latecomers at a disadvantage to the foreign firm, whose quality and reputation are already established in the domestic market, but that infant-industry protection

may exacerbate the welfare losses associated with information asymmetries.

We extend the Grossman-Horn model by allowing markets in both the domestic and foreign countries (which we rename North and South) and evaluate the welfare effects of trade when countries differ in the relative cost of producing high quality. We show that when countries trade, welfare in the North, which has a lower relative cost of producing high quality, decreases. Northern consumers' willingness-to-pay diminishes as imports from the South lower the average quality of the good available on the Northern market. The opposite is true in the South where the possibility of imports of higher average quality from the North increase price and welfare. We introduce welfare-maximizing governments and analyze their incentive to adopt mandatory country-of-origin labelling, or to protect a geographical indication within their domestic market. Art. IX GATT 1947 and Art. XX of TRIPS allow North the opportunity to protect itself from "beggar-thy-neighbour" trade with the South, but global welfare effects are ambiguous.

Other literature related to the discussion of information asymmetries as a possible rationale for trade policy include Bagwell and Staiger (1989), Falvey (1989), Jansen and Lince de Faria (2002) and Kirchhoff (2002). In Bagwell and Staiger, information asymmetry acts as a barrier to trade and a two-period export tax/subsidy program can enable high quality producers to export profitably to markets where information asymmetries prevent them from selling at prices that reflect their true quality.

In a model where the incentive to produce higher quality arises out of a *reputation premium* built into prices and the costs of reputation building depend on production costs, Falvey (1989) concludes that origin-labelling has an important role to play in providing information that is useful to consumers because without it, the price incentive to high quality producers increases as low quality firms milk their reputations by importing cheaper imports. The model in our

paper differs from the model in Falvey (1989) in several important ways. Cost functions in this paper are not identical for firms within a country but depend on a firm's type. We make no assumptions about absolute cost advantages and instead focus on the cross-country difference in the relative costs of producing high quality and, unlike in Falvey (1989), there is no gain to consumers from importing lower cost goods because all consumer surplus is extracted by firms.

Falvey (1989) considers the effects of trade where reputations have already been established independently in each country. We focus on the effects of trade when firms are *reputationless* and a unified world market results. Consequently, we consider the problem of unobservable quality in the international market. Consequently, our paper has the interesting result that Southern firms, who produce a lower average quality, receive a higher price after trade because they exploit the less severe adverse selection problem of the North. Trade does not necessarily minimize production costs because Southern output increases which may be more expensive to produce. Origin-labelling has clear welfare improving implications for the North and unlike in Falvey (1989), both high and low quality firms in the North favour origin-labelling.

Haucap *et al* (1997) and (2000), Chiang and Masson (1998) and Chisik (2003) discuss the relationship between country characteristics and country-of-origin quality reputation. Haucap *et al* (1997) and (2000) argue that location choice can act as a signaling device for product quality. High country-specific costs signal high product quality and so a "Made in X" label allows high quality firms to receive the price that reflects their true quality. Our paper is similar in that consumers know individual country cost structures and rationalize country average quality based on those cost structures. In, Haucap *et al* (1997) and (2000), a"Made in X" label allows high quality firms to separate from low quality firms if the former locate in a high cost country. High-cost countries export high-quality goods and import low-quality goods. In our paper, firms can

not choose production location and high quality types can not rely on country characteristics to separate from low quality types. Countries do not specialize in quality but trade in average qualities.

Chiang and Masson (1998) and Chisik (2003) show that low quality provision in developing countries can be the result of a self-fulfilling prophecy based on consumer expectations in developed countries. Chisik shows that identical countries can be correctly perceived as differing in their measure of high quality producers. Unlike Chisik (2003), our paper, by considering rational expectations, abstracts away from consumer stereotypes.

Jansen and Lince de Faria (2002) show that because of differences in tastes for quality, different governments have different incentives to label quality in autarky and this transmits negative international externalities when countries trade as the lower label crowds out the higher label. The mechanism that generates negative international externalities in Jansen and Lince de Faria (2002) is different tastes across countries, whereas in our model the mechanism is the difference in the severity of the adverse selection problem across countries and its extension to international markets. Bose and Kemme (2002) model the effect of liberalization on product quality and industrial activity in transition economies.

Section 2 introduces the basic model under perfect information. In Section 3 we introduce information asymmetries and show that equilibrium prices and average quality are higher in the North in autarky than in the South. In Section 4 we let countries trade. We show that trade is welfare deteriorating (improving) for the North (South). In Section 5 we show that the option of mandatory origin-labelling or the protection of a domestic geographical indication is always preferred by the North. Section 6 discusses the possibility of other measures to regulate quality and discusses how the constraints that international law places on such measures reinforces the

useful role that marks-of-origin have to play. Section 8 concludes.

2. The Model

Assume a two-period, two-country model where the two countries are indexed by $j = N, S$ for North and South respectively. Assume initially that countries do not trade and that all agents have perfect information.

In each country in period 1, firms of type t enter the market and can produce a homogeneous good of quality θ_n with $n = h, l$ and $\theta_h > \theta_l$. Define X^j as the total number of firms that enter. Firms choose quality once-and-for-all at the beginning of period 1.[1] A firm of type t, choosing quality θ_n, has a per-period constant marginal cost function $tc^j(\theta_n)$ with $c^j(\theta_h) > c^j(\theta_l)$. A firm's type can be interpreted as an efficiency parameter and is identical across countries. We assume t to be uniformly distributed (IID) with cumulative distribution function $F(t)$ on support $[0, T]$ where

$$F(t) = \begin{cases} 0 & \text{for } t < 0 \\ \frac{t}{T} & \text{for } 0 \leq t < T \\ 1 & \text{for } T \leq t \end{cases}$$

and marginal density function $f(t) = \frac{1}{T}$. We assume that for a given t, North has comparative advantage in the production of high quality:

$$\frac{c^N(\theta_h)}{c^N(\theta_l)} < \frac{c^S(\theta_h)}{c^S(\theta_l)}$$

Either country can have an absolute cost disadvantage in either or both qualities. We assume

[1] This assumption eliminates the incentive to cheat in period 2 under information asymmetries.

that each firm can produce up to one unit of the good. A firm of type t that chooses quality θ_n can enjoy profits over both periods of

$$\pi_n^j(t) = (p_{1n}^j - tc^j(\theta_n)) + \delta(p_{2n}^j - tc^j(\theta_n))$$

where $\delta > 0$ is the discount rate and p_{in}^j the price of a unit of the good of quality θ_n in period i.

In each country there is a continuum of consumers on support $\left[0, M^j\right]$. Consumers are homogeneous in tastes within and across countries. A representative consumer in country j demands a unit of the good and has the following per-period utility function

$$U^j = \begin{cases} \theta_n - p_{in}^j & \text{if buys one unit of quality } \theta_n \\ S & \text{otherwise} \end{cases}$$

where S is the consumer's reservation utility and is identical for all consumers within and across countries. With perfect information, the maximum price that the consumer is willing to pay for a unit of each quality, leaves the consumer indifferent between consuming high quality, consuming low quality and not consuming at all. Consequently, the per-period equilibrium prices for a unit of high and low quality are $p_{ih}^j = \theta_h - S$ and $p_{il}^j = \theta_l - S$ respectively. Since $\underline{t} = 0$, $\pi_h^j(\underline{t}) > \pi_l^j(\underline{t})$ at the equilibrium prices. In equilibrium, the measure of consumers in country j buying a unit of quality θ_h is $F(t_h)X^j$ where t_h is the solution to $\pi_h^j(t_h) = \pi_l^j(t_h)$. The measure of consumers in country j buying a unit of quality θ_l is $[F(t_l) - F(t_h)]X^j$ where t_l is the solution to $\pi_l^j(t_l) = 0$. The measure of consumers that do not buy a unit of the good is $M^j - F(t_l)X^j$. We assume M^j sufficiently large such that there are always consumers who do not buy. All firms produce up to capacity and firms are always able to extract all consumer surplus. Under perfect

information, a firm's output and pricing decisions are independent of the actions of other firms and the equilibrium is identical across both periods.

Proposition 1 *Under perfect information, and assuming small trade costs τ, countries do not trade.*

Under perfect information and if $\tau = 0$, $p_{ih}^S = p_{ih}^N = \theta_h - S$ and $p_{il}^S = p_{il}^N = \theta_l - S$. Firms receive the same price in both markets. Since this model does not assume any trade dynamics there is no reason to assume that countries do not trade, *unless* $\tau > 0$, which lowers the price that firms would receive in the foreign market relative to their domestic market. In the next section we assume that consumers can not observe quality at the time of purchase and show that trade occurs, even for a small τ. It can be said that information asymmetries drive trade in the sense that higher prices may justify incurring a small τ.

3. Introducing Information Asymmetries

Assume that quality is not observable when consumers buy a unit of the good in period 1 but that in period 2 all is revealed and consumers know which firms are selling what quality.[2] If in period 1, consumers are willing to pay $\theta_l - S < p < \theta_h - S$, for a unit of expected quality, despite the risk that the unit they buy is low quality, some types that would choose to produce a unit of θ_h under perfect information, have an incentive to choose θ_l (once-and-for-all) instead. But the consumers' willingness to pay a higher price for high quality in period 2, when all is revealed, means that some types continue to produce a unit of θ_h. "Reputable types" and "θ_h types" are used interchangeably in the following sections.

[2]Goods are assumed non-storable, that is firms can not save products and sell them in the second period.

The period 2 equilibrium when all is revealed is identical to the per-period perfect information equilibrium. Unless specifically stated otherwise, the analysis that follows is of period 1 and time subscripts are dropped. Assume initially that countries do not trade.

The equilibrium concept is Perfect Bayesian equilibrium (PBE). We restrict our attention to pure-strategy equilibria. There are two possible types of equilibrium in prices. In pooling equilibria, both reputable and θ_l types charge the same price. In separating equilibria, reputable firms set a different price to θ_l firms and signal quality.

We start by evaluating the pooling equilibria where both reputable and θ_l types in country j charge the same price denoted p^j. A reputable firm's profit over both periods is

$$\pi_R^j(t) = p^j + \delta(\theta_h - S) - (1+\delta)tc^j(\theta_h)$$

A θ_l type earns profits:

$$\pi_F^j(t) = p^j + \delta(\theta_l - S) - (1+\delta)tc^j(\theta_l)$$

We know that $\pi_R^j(\underline{t}) > \pi_F^j(\underline{t})$. The type, t^{jR}, that is indifferent between being reputable and being low-quality for a given p^j, solves $\pi_R^j(t^{jR}) = \pi_F^j(t^{jR})$. Firms in the interval $[0, t^{jR}]$ are reputable. In country j,

$$t^{jR} = \frac{\delta(\theta_h - \theta_l)}{(1+\delta)[c^j(\theta_h) - c^j(\theta_l)]} < t_h \tag{3.1}$$

The type (t^{jF}) that is indifferent between producing a unit of quality θ_l and not producing at all is the solution to $\pi_F^j(t^{jF}) = 0$. In country j,

$$t_l \leq t^{jF} = \frac{p^j + \delta(\theta_l - S)}{(1+\delta)c^j(\theta_l)} \tag{3.2}$$

and firms in the interval $(t^{jR}, t^{jF}]$ are θ_l types. The proportion of reputable firms to θ_l types in country j is

$$\frac{\int_0^{t^{jR}} f(t)dt}{\int_{t^{jR}}^{t^{jF}} f(t)dt} = \frac{F(t^{jR})}{F(t^{jF}) - F(t^{jR})} \tag{3.3}$$

which is non-increasing in p^j because t^{jR} is independent of price. Also, the proportion of reputables to θ_l types is inefficiently low compared with perfect information even at $p^j = \theta_h - S$, because some types prefer to switch to θ_l under imperfect information.

The equilibrium pooling price in each country in autarky depends on how consumers form their beliefs about the average quality available on the market, given that they observe costs and the distribution of types, but not each firm's type. We assume rational expectations. Let $\bar{\theta}^j$ be the actual average quality available in market j and $\bar{\theta}^{ej}$ be consumers expected quality. Under rational expectations $\bar{\theta}^{ej} = \bar{\theta}^j$ and

$$\begin{aligned} \bar{\theta}^j &= \frac{1}{F(t^{jF})}\left\{\theta_h\left[F(t^{jR}) - F(0)\right] + \theta_l\left[F(t^{jF}) - F(t^{jR})\right]\right\} \\ &= \frac{F(t^{jR})}{F(t^{jF})}(\theta_h - \theta_l) + \theta_l \end{aligned} \tag{3.4}$$

$\bar{\theta}^j$ is non-increasing in p^j (refer Proof A:1).

A consumer buys a unit of the good of unknown quality if $p^j \leq \bar{\theta}^j - S$. Equilibria where the inequality is strict exist, because rational expectations governs equilibrium prices (determines beliefs in equilibrium) but says nothing about consumer beliefs off the equilibrium path. Assume an equilibrium $\tilde{p}^j < \bar{\theta}^j - S$. This can be supported as an equilibrium if firms have no incentive to deviate to a price $\tilde{p}^j < p^d$ because consumer beliefs at p^d are such that they will not buy because they are overly pessimistic about the average quality of the type of firm that deviates.

Any beliefs, including overly pessimistic one's can be supported at $\tilde{p}^j \neq p^j$ because $\tilde{p}^j$ are off the equilibrium path.

Using the Intuitive Criterion in Cho and Kreps (1987), it can be argued that these types of overly pessimistic beliefs are "unreasonable" and that all equilibria except $p^j = \bar{\theta}^j - S$ can be ignored. First, consumers should rule out the possibility that the firm offering p^d is a firm with type $\frac{p^d+\delta(\theta_l-S)}{(1+\delta)c^j(\theta_l)} < t^{jF}$ because that firm is making losses and would rather exit at that price. Second, a firm has an incentive to deviate *if and only if* the consumer will buy at that price. But if the consumer buys at that price, then *all* firms have an incentive to deviate, not just low-quality producers. Because both reputable and θ_l firms have the possibility of increasing their profits if they deviate, a consumer must have the beliefs that assign positive probability to all firms deviating. Consumers can evaluate average quality offered on the market at p^d and as long as $p^d \leq \bar{\theta}^j - S$ there is no reason for the consumer not to accept the price and buy the unit. When a consumer's beliefs are restricted to "reasonable" beliefs, $p^j < \bar{\theta}^j - S$ can be ignored.

To conclude, the pooling equilibrium price and average quality in autarky are given as the solution to $p^j_A = \bar{\theta}^j_A(p^j_A) - S$ where $\bar{\theta}^j_A(p^j_A)$ is average quality at price p^j_A. Define $\hat{p}^j$ as the price where $F(t^{jF}) = 1$. I assume that:

$$\bar{\theta}^j(\hat{p}^j) - S < \hat{p}^j$$

and it is never the case that all types are active in the market.[3] Consequently, it must be the case that $\theta_l - S < p^j_A < \hat{p}^j$. A measure $F(t^{jF})X^j$ of consumers buy a unit of quality $\bar{\theta}^j_A(p^j_A)$. Because we assume M^j sufficiently large, all active firms produce up to capacity and there are

[3]Dropping this assumption will not alter the results but will require a restriction on costs such that $c^N(\theta_h) - c^N(\theta_l) < c^S(\theta_h) - c^S(\theta_l)$ to ensure that $\bar{\theta}^S(p^S_A) < \bar{\theta}^N(p^N_A)$. Both countries might still have an absolute cost disadvantage in both qualities relative to the other country.

no strategic interactions between firms. Each type makes its quality decision independently of other types.

It remains to compare the pooling equilibria across countries. For all $\theta_l - S < p < \hat{p}^j$, where $\hat{p}^j = \min[\hat{p}^N, \hat{p}^S]$ it is true that $\frac{t^{SR}}{t^{SF}} < \frac{t^{NR}}{t^{NF}}$ and $\bar{\theta}^S(p_A^S) < \bar{\theta}^N(p_A^S)$. By strict monotonicity of $\bar{\theta}^N$ in the relevant range, $p_A^S < p_A^N$. Also,

$$\bar{\theta}^N(p_A^N) - p_A^N = S = \bar{\theta}^S(p_A^S) - p_A^S$$

and $\bar{\theta}^S(p_A^S) < \bar{\theta}^N(p_A^N)$.

Lemma 1 *The equilibrium price and average quality are higher in the North in autarky than in the South.*

In period 2, $p_{2h}^S = p_{2h}^N = \theta_h - S$ and $p_{2l}^S = p_{2l}^N = \theta_l - S$. Finally, there are no separating equilibria with $p_h \neq p_l$ (refer Proof A:2).[4]

In the next section, we let countries trade and show that South can increase its welfare at North's expense. Assuming that consumers can not distinguish a good's country of origin, Southern firms can exploit Northern adverse selection, which is less severe than in the South. That is, Southern low-quality types can not only pretend to be reputable in period 1 but can also pretend to be Northern. Although consumers predict this, Southern types still receive a higher price relative to autarky, while the opposite is true for Northern types.

[4]There are still no separating equilibria if the assumption of fixed unit output is dropped as long as the firm's variable output is not observable by consumers. In Grossman-Horn (1988), investment in capacity, which is observable by consumers, can signal quality. Also, pooling equilbria under capacity investment are possible, but the results are qualitatively the same as pooling equilibria with no capacity investment.

4. The Trading Equilibrium

Let countries trade and define average quality sold in market j as $\bar{\theta}_T^j$ which is sold at a price p_T^j. Average quality sold in market j is now a function of the average quality being sold by North *and* South firms which are (possibly) active in that market. Firms can sell their unit output anywhere but they can not choose their production location. Consumers observe the distribution of types and the costs of producing θ_h and θ_l in both countries, but they can not determine a product's country-of-origin. Consumers are rational.[5] As in autarky, a consumer in market j is willing to buy a unit of the good if $p_T^j \leq \bar{\theta}_T^j(p_T^j) - S$. In any trade equilibrium, arbitrage requires that a consumer's expected utility be equal across markets:[6]

$$S \leq \bar{\theta}_T^N(p_T^N) - p_T^N = \bar{\theta}_T^S(p_T^S) - p_T^S$$

but to ensure that firms have no incentive to deviate it must be that $p_T^N = p_T^S = p_T$, which in turn requires $\bar{\theta}_T^N(p_T) = \bar{\theta}_T^S(p_T) = \bar{\theta}_T(p_T)$. We eliminate $p_T^j < \bar{\theta}_T^j(p_T^j) - S$ using the Intuitive Criterion as before. Firms can sell anywhere they want to but in equilibrium average qualities and prices are identical in both countries. Global average quality as a function of price can be written as:

$$\bar{\theta}_T^N = \bar{\theta}_T^S = \bar{\theta}_T = \frac{F(t^{NR})X^N + F(t^{SR})X^S}{F(t^{NF})X^N + F(t^{SF})X^S}(\theta_h - \theta_l) + \theta_l$$

[5] Rational expectations, while restrictive, is necessary to avoid results that hinge on stereotypes. Dropping the assumption of rational expectations would open a Pandora's Box with regard to the determination of equilibrium average quality and prices and any results regarding the uselfulness of origin-labelling would hinge crucially on consumer perceptions of a country's general quality level. Origin-labelling in that context might be deemed protectionist. Rather, in this paper rational expectations captures (although in a stark manner) the idea that consumers do have some idea about costs and quality across countries and can make partially informed decisions based on those ideas.

[6] One can assume that the consumer's themselves undertake arbitrage but it is more realistic to assume the existence of middlemen which can acquire information on prices and average quality in both markets.

$\bar{\theta}_T$ is non-increasing in p_T (see Proof B:1).

Reputable firms still have no way of separating from low quality firms in period 1.[7] Southern firms can pretend to be Northern firms because consumers do not observe country-of-origin. But consumers rationally expect this and are only willing to pay a price that equals expected average quality given the distribution of types and costs across both countries. The period 2 equilibrium is identical to the per-period perfect information equilibrium.

Global average quality can equivalently be written as $\bar{\theta}_T(p) = \beta\bar{\theta}^N(p) + (1-\beta)\bar{\theta}^S(p)$ where

$$\beta = \frac{F(t^{NF})X^N}{F(t^{NF})X^N + F(t^{SF})X^S}$$

β is independent of price (see Proof B:2).

Proposition 2 *Average quality and price in the trading equilibrium are such that*:

$$\begin{aligned} p_A^S &< p_T < p_A^N \\ \bar{\theta}^S(p_A^S) &< \bar{\theta}_T(p_T) < \bar{\theta}^N(p_A^N) \end{aligned}$$

Proof See Proof B:3

Average quality consumed in the North decreases even though the average quality of Northern firms increases, because exiting Northern θ_l types are replaced by Southern θ_l types. The opposite is true for Southern consumption because the higher proportion of Southern θ_l types are offset by the relatively larger proportion of Northern reputables. Furthermore, global average

[7] If firms had to sell in the same market in period 2 as that in period 1, then the result that reputable firms can not separate from low-quality firms in period 1 would not necessarily be robust to heterogenous preferences across countries.

quality is lower after trade compared with autarky if,

$$\left[F(t_A^{NF}) - F(t_T^{NF})\right] X^N < \left[F(t_T^{SF}) - F(t_A^{SF})\right] X^S$$

which can be rewritten as

$$\left[\frac{p_A^N - p_T}{c^N(\theta_l)}\right] X^N < \left[\frac{p_T - p_A^S}{c^S(\theta_l)}\right] X^S$$

The larger the relative country size of the North and the higher the costs of producing low quality in the South, the less likely that global average quality will decline relative to autarky. First, β increases in $c^S(\theta_l)$. For a given p, higher costs of producing low quality in the South place a greater weight on $\bar{\theta}^N(p)$ in global average quality because the price response of Southern θ_l types is diminished. Second, Southern $\bar{\theta}^S(p)$ increases in $c^S(\theta_l)$ and the the difference in autarky average costs and prices diminishes in $c^S(\theta_l)$. The net effect of $c^N(\theta_l)$ on global average quality is ambiguous. A higher $c^N(\theta_l)$ increases $\bar{\theta}^N(p)$ for every p, which also increases the gap between autarky average qualities and prices, encouraging more Southern θ_l types to enter in a trading equilibrium. That is, β declines in $c^N(\theta_l)$.

β and $\bar{\theta}_T(p)$ increase (decrease) in X^S (X^N) because the larger the country the stronger its affect on global average qualities after trade. Finally, $\bar{\theta}_T(p)$ decreases in both $c^S(\theta_h)$ and $c^N(\theta_h)$ because $\bar{\theta}^S(p)$ and $\bar{\theta}^N(p)$ are lower respectively. Because firms can not choose production location and because reputable types can not separate from low quality types, increasing the costs of high quality production serves only to lower the price that reputable firms receive, further reducing profits. All these proofs can be found in Appendix B:2.

Some important characteristics of the trading equilibrium must be noted. First, as in autarky, both countries produce both qualities when they trade. This result differs from Falvey (1989)

where the home country specializes in the production of high qualities and the foreign country in the production of low qualities. Specialization is prevented because consumers can not observe a firm's type or country-of-origin and firms extract all consumer surplus. Also, unlike Haucap *et al*, firms can not locate production anywhere and can not rely on country characteristics to signal quality.

Second, trade does not necessarily minimize production costs. In the trading equilibrium, the proportion of Southern θ_l types is larger relative to autarky, while Northern θ_l types have exited. It is possible that $c^N(\theta_l) < c^S(\theta_l)$ in which case trade shifts production to the more expensive country. Southern θ_l types can not only pretend to be θ_h firms but can also pretend to be Northern firms, and it is these information asymmetries that lead to the result that Southern output increases in trade despite it (possibly) being the higher cost producer. This result also differs from Falvey (1989) where the range of revealed comparative advantage corresponds to that predicted on the basis of production costs alone. The difference lies in the fact that Falvey considers an equilibrium where firms have already established a reputation.

Finally, it is conceivable that all active firms sell in one market only. That is, global average quality and prices are independent of trade flows.

Proposition 3 *While $\tau > 0$ eliminates trade in period 2, in period 1, all Southern types export to the North.*[8]

Proof See Proof B:4.

[8] A trade cost in the context of this model must be interpreted as any cost that firms must bear when selling their goods abroad. Consumers can observe the magnitude of τ but can not observe which firms have borne it, otherwise it might help consumers in determining country-of-origin.

5. Welfare Effects of Trade

Welfare in country j after trade can be defined as the sum of consumer and producer surplus, $W^j = CS^j + PS^j$, where $CS^j = (1+\delta)M^j S$ and

$$PS^j = \frac{X^j}{T}\int_{\underline{t}}^{t^{jR}} [p_T + \delta(\theta_h - S) - (1+\delta)tc^j(\theta_h)]dF(t) \quad (5.1)$$

$$+\frac{X^j}{T}\int_{t^{jR}}^{t^{jF}} [p_T + \delta(\theta_l - S) - (1+\delta)tc^j(\theta_l)]dF(t) \quad (5.2)$$

Proposition 4 *South is better off under trade as it exploits the adverse selection of the North, at North's expense. The overall effect of trade on global welfare is ambiguous.*

Relative to autarky, consumer surplus and $F(t^{jR})$ are unchanged in both countries after trade. Northern producer surplus is lower because $F(t^{NF})$ is lower and $p_T < p_A^N$. Southern producer surplus is higher because $F(t^{SF})$ is higher and $p_A^S < p_T$. The loss (gain) in producer surplus to the North (South) is given by the expressions:

$$PS^N(p_A^N) - PS^N(p_T) = \frac{X^N}{T}\int_{p_T}^{p^N} [F(t^{NF})]dp$$

$$PS^S(p_T) - PS^S(p_A^S) = \frac{X^S}{T}\int_{p^S}^{p_T} [F(t^{SF}]dp$$

Global welfare is maximized under perfect information. Defining W_{PI}^j, W_A^j and W_T^j as welfare in country j when information is perfect, autarky welfare and trade welfare, respectively, then:

$$W_{PI}^N > W_A^N > W_T^N$$

$$W_A^S < W_T^S, W_A^S < W_{PI}^S$$

The relationship between W_{PI}^S and W_T^S is unclear, but $\frac{\partial(W_{PI}^S - W_T^S)}{\partial p_T} < 0$ (Appendix B:5).

A clear role for policy intervention in the North has been identified. In the next section we consider the role that country-of-origin labelling might play. We show that North can use origin-labelling or geographical indications to eliminate "beggar-thy-neighbour" trade with the South.

6. Country-of-Origin Labelling

In this section we introduce country-of-origin labelling (COOL), which is taken to refer to a government mandated mark-of-origin or to a geographical indication that is voluntarily adopted by Northern firms to distinguish their products from Southern output. We show that the Northern government always mandates mark-of-origin labelling, or guarantees to protect the Northern geographical indication from Southern firms who might use it fraudulently.

Assume that under Art. IX GATT 1947 North adopts a policy that all goods of origin x carry a label stating "Made in x". Since there are only two countries, it suffices that only one of the country's goods be required to carry the label, since by implication the good without the label must come from the other country. We assume that Northern consumers fully trust the enforcement of the law. Consumers observe the distribution of types and the costs of producing θ_h and θ_l in both countries, but now Northern consumers can also distinguish a good's country of origin. Northern consumers form their expectations such that for every p, $\bar{\theta}^{eN} = \bar{\theta}^N(p)$ and $\bar{\theta}^{eS} = \bar{\theta}^S(p)$. Since $\bar{\theta}^N(p) > \bar{\theta}^S(p)$ for all p, all consumers (or more realistically the middlemen undertaking arbitrage) understand that no Northern types have an incentive to sell in the South.

Consequently, the equilibrium price and average quality in the South are given by

$$p_A^S = \bar{\theta}_A^S(p_A^S) - S$$

Define p^{NN} and p^{NS} as the prices paid for Northern and Southern goods sold in the North. In equilibrium

$$\bar{\theta}_A^N(p^{NN}) - p^{NN} = S = \bar{\theta}^S(p^{NS}) - p^{NS}$$

and $p^{NS} = p_A^S$. The origin-labelling equilibrium is identical to autarky except that Southern goods may now be sold in both markets.

Now assume no origin-labelling, but let Northern firms voluntarily label their goods with a geographical indication such that consumers expect that good to be of Northern average quality. Without government protection of the geographical indication, consumers have no reason to trust the label because adverse selection is not eliminated, that is consumers would rationally expect Southern firms to label their goods with the geographical indication too. There is no change from the trading equilibrium of the previous section.

However, if consumers expect both government to prevent Southern firms from abusing the geographical indication, the equilibrium is identical to the origin-labelling/autarky equilibrium except that now Northern firms may sell in the South. The Southern government has no incentive to protect the geographical indication other than it being required to do so if it is a signatory to TRIPS. Of course, whether South is complies with its obligations under TRIPS or not is irrelevant in this paper because global welfare is unchanged if Northern types sell in the North only or also sell to the South under a geographical indication. The Northern government always has an incentive to protect the geographical indication regardless of its obligations under

international law.

Proposition 5 *If country j enforces COOL, Northern types sell average quality $\bar{\theta}_A^N(p_A^N)$ at* price p_A^N *and Southern firms sell quality of $\bar{\theta}_A^S(p_A^S)$* at price p_A^S.

If there is a small trade cost trade is eliminated. To conclude, while high quality firms can not separate from low quality firms in the trading equilibrium, origin-labelling allows Northern firms the opportunity to signal average quality and thus to receive a price that exceeds the trading equilibrium price.

7. Introducing Other Quality Measures

Up to now I have assumed that the only policy tool available to governments is COOL, yet in reality governments have a cornucopia of measures that might regulate the adverse selection problem within their domestic market *inter alia* import bans, minimum standards, technical regulations and quality-labelling. Such measures guarantee consumers a particular quality level at the time of purchase. Thus, while origin-labelling allows Northern firms to signal average quality, other government instruments may allow firms the possibility of receiving a price that reflects their true quality. Article III.4 GATT and the WTO Agreements on Technical Barriers to Trade (TBT Agreement) and on Sanitary and Phytosanitary Measures (SPS Agreement) discipline these measures.

Art. III.4 (National Treatment) requires that all foreign products be accorded treatment as least as favorable as that accorded to domestic "like" goods, that is, domestic regulation must be non-discriminatory. Art. XX of the GATT provides an exception to Article III.4. It reads:

> Subject to the requirement that such measures are not applied in a manner which

> would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade, nothing in this Agreement shall be construed to prevent the adoption or enforcement by any contracting party of measures:... (b) necessary to protect human, animal or plant life or health;

If a Member can justify discriminatory regulation on the basis that it protects human, animal or plant life or health and is not a disguised restriction on trade, the Member's regulation will not be found to be in violation of Art. III.4.

The TBT and SPS Agreements recognize that even non-discriminatory regulation can disguise restrictions on trade and so they go one step further than Art. III.4 and impose additional restrictions such as *inter alia* requiring that it be based on scientific principles, that it not be maintained without sufficient scientific evidence as to the risks or that it be the least-trade restrictive measure available.

The constraints that international law places on quality regulation, reinforces the importance of COOL when adverse selection is an international problem. Clearly, a quality label that informs consumers of the quality of the product at the time of purchase maximizes individual country welfare in both autarky and trade. If a government can monitor quality perfectly and costlessly, it always has an incentive to adopt a quality label in autarky. But there are several reasons why governments may not adopt a quality label when countries trade. First, it may not be legal under international law. Even if the label is non-discriminatory it must be justified under the TBT or SPS Agreement which apply rigorous disciplines which the government may not be able to meet. Second, it may be more difficult for governments to observe the quality of foreign

products making labelling difficult.

In either scenario, a government may choose to leave imports unregulated, but then its incentive to regulate its domestic low quality production changes as given by the following first-order conditions:

$$\begin{aligned} \frac{dW^S}{dt^{SF}} &= \frac{d\bar{\theta}_T}{dt^{SF}}(t^{SF}) + \bar{\theta}_T - S - t^{SF}c^S(\theta_l) \\ &= \beta\bar{\theta}_T + (1-\beta)\theta_l - S - t^{SF}c^S(\theta_l) = 0 \end{aligned} \tag{7.1}$$

$$\begin{aligned} \frac{dW^N}{dt^{NF}} &= \frac{d\bar{\theta}_T}{dt^{NF}}(t^{NF}) + \bar{\theta}_T - S - t^{NF}c^N(\theta_l) \\ &= (1-\beta)\bar{\theta}_T + \beta\theta_l - S - -t^{NF}c^N(\theta_l) = 0 \end{aligned} \tag{7.2}$$

When countries trade, the effect of an increasing proportion of domestic θ_l types on global average quality and prices is not fully internalized. Governments may end up in an inefficient Nash Equilibrium. To conclude, while quality labelling maximizes individual country welfare, it may not be available as a policy tool, which reinforces the importance of COOL as an instrument to eliminate cross-border adverse selection problems.

8. Conclusions

In this paper we have shown that origin-labelling and geographical indications are important measures to mitigate adverse selection that transcends national borders. Government mandated origin-labelling in the North is clearly welfare improving for the North, but global welfare im-

plications are ambiguous. Moroeover, geographical indications are useless without guaranteed government protection of the indication.

Although origin-labelling and geographical indications are considered by developing countries to generally be protectionist, particularly when consumer perceptions are based on stereotypes and when quality differences are not obvious (such as in the case of wines and spirits), this paper provides a mechanism where such measures are *not* protectionist and play a useful role in guaranteeing firms a price that reflects their country's average quality.

Our paper does not challenge the belief that origin-labelling can be protectionist. Rather, our paper argues that when there are quality differences reflecting the underlying cost structure, and if consumers have a general idea of this underlying cost structure, then origin-labelling is an important tool at dealing with cross-border adverse selection problems, particularly when other policy measures, such as quality labelling, may not be available to governments.

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10. Appendix A - Autarky

10.1. Proof A:1

$F(t^{jR})$ is independent of price. $F(t^{jF})$ lies in the interval $(F(t^{jR}), 1]$ and is non-decreasing in price. Let $F(t^{jF}) < 1$:

$$\frac{\partial \bar{\theta}^j}{\partial p^j} = \frac{-F(t^{jR})f(t)}{[F(t^{jF})]^2(1+\delta)c^j(\theta_l)}(\theta_h - \theta_l) < 0 \text{ and } \frac{\partial^2 \bar{\theta}^j}{\partial (p^j)^2} = \frac{2F(t^{jR})}{[F(t^{jF})]^3}\left[\frac{f(t)}{(1+\delta)c^j(\theta_l)}\right]^2(\theta_h - \theta_l) > 0$$

If $F(t^{jF}) = 1$, $\frac{\partial \bar{\theta}^j}{\partial p^j} = 0$ and $\bar{\theta}^j$ is non-increasing in p^j.

10.2. Proof A:2

Assume a separating equilibrium with $p_h^j \neq p_l^j$ does exist. It must be the case that

$$p_h + \delta(\theta_h - S) - (1+\delta)tc^j(\theta_h) \geq p_l + \delta(\theta_h - S) - (1+\delta)tc^j(\theta_h)$$

or $p_h^j \geq p_l^j$ and

$$p_l + \delta(\theta_l - S) - (1+\delta)tc^j(\theta_l) \geq p_h + \delta(\theta_l - S) - (1+\delta)tc^j(\theta_l)$$

or $p_l^j \geq p_h^j$. These two conditions can not be met for $p_h^j \neq p_l^j$. Separating equilibria with $p_h^j = p_l^j = \theta_l - S$ and voluntary disclosure of quality is possible. Firms would have no incentive to lie about quality and all active firms at that price could sell their output. But as in the case of pooling equilibria, this equilibrium is not robust to the belief refinements based on the Intuitive Criterion.

11. Appendix B - Trade

11.1. Proof B:1

In a trading pooling equilibrium it must be that:

$$[F(t^{NR})X^N + F(t^{SR})X^S] < [F(t^{NF})X^N + F(t^{SF})X^S] \leq X^N + X^S$$

otherwise all firms are reputable and $p_T = \theta_h - S$ which is not possible as some types have an incentive to choose to produce θ_l at that price. Let $[F(t^{NF})X^N + F(t^{SF})X^S] < X^N + X^S$

$$\frac{\partial \bar{\theta}_T}{\partial p} = \frac{-[F(t^{NR})X^N + F(t^{SR})X^S]}{[F(t^{NF})X^N + F(t^{SF})X^S]^2} \left[\frac{f(t)X^N}{(1+\delta)c^N(\theta_l)} + \frac{f(t)X^S}{(1+\delta)c^S(\theta_l)}\right](\theta_h - \theta_l) < 0$$

$$\frac{\partial (\bar{\theta}_T)^2}{\partial p^2} = \frac{2[F(t^{NR})X^N + F(t^{SR})X^S]}{[F(t^{NF})X^N + F(t^{SF})X^S]^3} \left[\frac{f(t)X^N}{(1+\delta)c^N(\theta_l)} + \frac{f(t)X^S}{(1+\delta)c^S(\theta_l)}\right]^2 (\theta_h - \theta_l) > 0$$

If $[F(t^{NF})X^N + F(t^{SF})X^S] = X^N + X^S$, $\frac{\partial \bar{\theta}_T}{\partial p} = 0$. $\bar{\theta}_T$ is non-increasing in p_T.

11.2. Proof B:2

For a given p_T, β is increasing in X^N and $c^S(\theta_l)$ and decreasing in X^S and $c^N(\theta_l)$:

$$\frac{\partial \beta}{\partial X^N} = \frac{F(t^{NF})F(t^{SF})X^S}{[F(t^{NF})X^N + F(t^{SF})X^S]^2} > 0$$

$$\frac{\partial \beta}{\partial c^N(\theta_l)} = \frac{-f(t)X^N\left[\frac{(p_T+\delta(\theta_l-S)}{(1+\delta)[c^N(\theta_l)]^2}\right]F(t^{SF})X^S}{[F(t^{NF})X^N + F(t^{SF})X^S]^2} < 0$$

$$\frac{\partial \beta}{\partial X^S} = \frac{-F(t^{SF})F(t^{NF})X^N}{[F(t^{NF})X^N + F(t^{SF})X^S]^2} < 0$$

$$\frac{\partial \beta}{\partial c^S(\theta_l)} = \frac{f(t)X^S\left[\frac{(p_T+\delta(\theta_l-S)}{(1+\delta)[c^S(\theta_l)]^2}\right]F(t^{NF})X^N}{[F(t^{NF})X^N + F(t^{SF})X^S]^2} > 0$$

$$\frac{\partial \beta}{\partial p} = \frac{f(t)X^N X^S}{(1+\delta)}\left[\frac{F(t^{SF})}{c^N(\theta_l)} - \frac{F(t^{NF})}{c^S(\theta_l)}\right] = 0$$

For a given p_T, $\bar{\theta}_T$ increases (decreases) in $c^S(\theta_l)$ ($c^N(\theta_h)$ and $c^S(\theta_h)$):

$$\frac{\partial \bar{\theta}_T}{\partial c^S(\theta_l)} = \frac{\partial \beta}{\partial c^S(\theta_l)}(\bar{\theta}^N - \bar{\theta}^S) + (1-\beta)\frac{\partial \bar{\theta}^S}{c^S(\theta_l)} > 0$$

$$\frac{\partial \bar{\theta}_T}{\partial c^N(\theta_h)} = \beta\frac{\partial \bar{\theta}^N}{c^N(\theta_h)} < 0 \text{ and } \frac{\partial \bar{\theta}_T}{c^S(\theta_h)} = (1-\beta)\frac{\partial \bar{\theta}^S}{c^S(\theta_h)} < 0$$

The net effect on average quality with respect to $c^N(\theta_l)$ is ambiguous because $\frac{\partial \bar{\theta}^N}{c^N(\theta_l)} > 0$ but $\frac{\partial \beta}{\partial c^N(\theta_l)} < 0$. Finally,

$$\frac{\partial \bar{\theta}_T}{\partial p} = \beta\frac{\partial \bar{\theta}^N}{\partial p} + (1-\beta)\frac{\partial \bar{\theta}^S}{\partial p} < 0$$

11.3. Proof B:3

We know that $\bar{\theta}_T(p) = \beta\bar{\theta}^N(p) + (1-\beta)\bar{\theta}^S(p)$ and that β is independent of price. Therefore,

$$\bar{\theta}_T(p_A^S) - p_A^S > \bar{\theta}^S(p_A^S) - p_A^S = S$$

and

$$\bar{\theta}_T(p_A^N) - p_A^N < \bar{\theta}^N(p_A^N) - p_A^N = S$$

which both imply the existence of $p_T \in (p_A^S, p_A^N)$ such that $\bar{\theta}_T(p_T) - p_T = S$ and p_T is uniquely defined by strict monotonicity of $\bar{\theta}_T(p)$ in the relevant range. Moreover,

$$\bar{\theta}_T(p_T) - p_T = \bar{\theta}^S(p_A^S) - p_A^S = S$$

and

$$\bar{\theta}_T(p_T) - p_T = \bar{\theta}^N(p_A^N) - p_A^N = S$$

which implies that

$$\bar{\theta}_T(p_T) - \bar{\theta}^S(p_A^S) = p_T - p_A^S > 0$$

and

$$\bar{\theta}_T(p_T) - \bar{\theta}^N(p_A^N) = p_T - p_A^N < 0$$

11.4. Proof B:4

Consumers might be completely unaware of τ, or they might know the magnitude of τ but can not observe which firms bear it (as this might help them to observe country of origin). The

arbitrage condition that consumers expected utility be equal across countries is unchanged at

$$\bar{\theta}_T^N(p_T^N) - p_T^N = \bar{\theta}_T^S(p_T^S) - p_T^S = S$$

where consumers take into account that any importing firms must bear τ, but don't observe who those firms are. The equilibrium pricing conditions for Northern and Southern firms respectively are $p_T^N = p_T^S - \tau$ and $p_T^S = p_T^N - \tau$. Firms will bear τ if the price premium in their export market makes it worthwhile. These two pricing conditions and the arbitrage condition can not be met simultaneously if both Northern and Southern firms are active in both markets. Northern firms require a higher p_T^S to compensate for the trade cost while Southern firms require a higher p_T^N. The only way that both Northern and Southern firms have no incentive to deviate across markets is if $p_T^N - \tau \geq p_T^S$, in which case all firms sell in the North, or $p_T^S - \tau \geq p_T^N$, in which case all firms sell in the Southern market. But if all firms are selling in the Southern market, Northern firms have an incentive to deviate if they can get a price $p_T^N(\tau)$ such that $\bar{\theta}_T^S - S - \tau < \bar{\theta}_T^S - S < p_T^N(\tau) \leq \bar{\theta}^N - S$. Relying on the Intuitive Criterion, Northern consumers know that *both* North reputable and low-quality types have an incentive to deviate. In period 1, Southern firms sell to Northern consumers if $\tau \leq \bar{\theta}_T^N - \bar{\theta}^S$ where $\bar{\theta}^S$ is Southern autarky average quality for a given price.

This result is independent of whether consumers are aware of τ or not. If they are, this provides an additional incentive for Northern types to sell in the North only because τ reduces the proportion of Southern θ_l types in the North and Northern consumers are willing to pay a higher price.

11.5. Proof B:5

The difference in welfare in the South from perfect information to free trade is given by the difference in producer surplus because consumer surplus is unchanged at $(1+\delta)M^S S$:

$$W_{PI}^S - W_T^S = \left[\frac{(\theta_h - \theta_l)^2}{2[c^S(\theta_h) - c^S(\theta_l)]} + \frac{(\theta_l - S)^2}{2c^S(\theta_l)}\right](\frac{1+2\delta}{1+\delta}) - \left[\frac{(p_T)^2 + 2p_T\delta(\theta_l - S)}{2(1+\delta)c^S(\theta_l)}\right]$$

and

$$\frac{\partial(W_{PI}^S - W_T^S)}{\partial p_T} = -t^{SF} < 0$$