EXPORTING TO BYPASS WEAK INSTITUTIONS

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Abstract

Institutions have been shown to be important for growth and trade. For example, weak institutions may reduce the returns to quality products in some markets, thereby reducing welfare in those markets. We model this and explore whether exporting to countries with strong institutions where quality is properly rewarded increases welfare. We find that because home prices do not reflect the marginal value of quality, access to developed markets can be welfare reducing. That is, there always are export prices such that welfare increases if exporting were prevented. Exporting can even reduce producer surplus, leading to a contraction of the export industry; although, welfare can decrease even if production of the exported good increases.

Keywords: institutions, trade, development, adverse selection, moral hazard, asymmetric information, quality

JEL classification: D82, F12, L15, O24

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1 Introduction

There has been a resurgence interest as to the extent to which weak institutions hamper economic growth (\textit{e.g.}, Acemoglu \textit{et al.}, 2001, Rodrik \textit{et al.}, 2004, Acemoglu \textit{et al.}, 2005). Among other problems, weak regulatory and judicial institutions hinder markets that are characterized by asymmetric information as sellers cannot capture their product’s true value when regulatory scrutiny is scant or unreliable, or it is too costly to enforce contractual promises and warranties. Indeed, “regulatory quality” and “rule of law” are two of the six indicators used by the World Bank to appraise governance and economic development (Kaufmann \textit{et al.}, 2009).

The problem with weak regulatory and judicial institutions in the enforcement of contracts has motivated research focusing on how the hold-up problem in particular can lead to the under provision of input quality (\textit{e.g.}, Antras 2005, Acemoglu, \textit{et al.}, 2007, Levchenko 2007, Vogel 2007, Costinot 2009). These studies show that hold-up leads to a comparative disadvantage in producing goods in the “institutionally dependent” sector, \textit{i.e.}, with “greater contractual incompleteness” than developed countries. Presumably such institutional deficiencies can also affect output markets and other aspects of transactional efficiency, such as claims to product quality—the focus of our paper—leading to again producers not capturing their product’s entire value as well as introducing another inefficiency: misallocations with heterogeneous firms and consumers. That is, the well-known problems of adverse selection and moral hazard in quality should also be more prevalent.

While not considered in the aforementioned models, exporting the imperfectly valued good offers a way to alleviate part of this inefficiency by bypassing the home market and selling the good to markets with strong institutions that allow them to credibly communicate their product’s value.\footnote{There is also a partly analogous story of financial capital outflows to bypass weak domestic institutions. Ju and Wei (2010) find that this has an ambiguous effect for the home country.} \footnote{Antras (2005) specifically assumes that trade cannot bypass this problem. Likewise, these models do not consider importing even though intermediate goods account for almost two-thirds of international trade (Johnson and Noguera, 2012). However as the imported good is under the jurisdiction of the local institution, it faces the same problem as domestic inputs and so importing does not offer a solution in these models.} Indeed, Young (1999) and Feenstra and Hanson (2004) have
studied how Hong Kong and other re-exporters serve as quality verifiers. More generally, the exporting of high quality products is often viewed as important for economic growth, and, e.g., Hausmann, et al. (2007) find empirical support for this. However, a country may see their high quality products exported and only low quality remaining—shipping the good apples out—even when seemingly there is home demand for high quality. Thus, there are anecdotal stories of being able to buy high quality home products only while abroad: the best Indian tea is only available through Great Britain, high quality Turkish garments are not available in Turkey, the best Kenyan produce is shipped to Europe, and superior quality coffees are not available in the markets where the beans are grown. While part of these trade patterns can be traced to the relation between income and the proportion of consumers who demand high quality (Fajgelbaum, Grossman, Helpman, 2011), given the complete absence of high quality on the home market, the suspicion is that weak institutions are hampering the sale of high quality on some home markets.

There has been recent empirical interest in the role of quality in international trade. In particular, Hummels and Skiba (2004) in examining the relationship between export quality across different destinations as a function of shipping costs find support for the Alchain and Allen (1964) conjecture that high quality products are exported, while low quality ones remain at home. However, these studies do not examine the role of information asymmetry in trade and in fact quality generally is not directly observed, but rather inferred from prices or a combination of prices and other variables.4,5

To explore how weak institutions concerning quality verification influence trade, we consider a model with a competitive home market with asymmetric information regarding qual-

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3For a brief review see Khandelwal (2010) or Hallak and Schott (2011).
5There is also an extensive literature examining trade with asymmetric information including the seminal papers of Grossman and Horn (1988) and Bagwell (1991). The focus there, however, has been on home producers communicating their quality to the export market and welfare improving export subsidies, rather than producers using the export market to bypass home market inefficiencies. A partial exception is Grossman and Horn (1988) who examine the infant industry argument in a reputation model with home producers facing foreign importers of known quality. Export to a market where their quality is verifiable is not an option for the home producers.
ity, and a developed foreign market in which quality is observable. Upon entering the market, a fraction of a firm’s resulting production is of low quality. Home consumers and government are unable to observe quality, but a firm (and the foreign market) can observe quality and sort it.

We begin with autarky as the benchmark. Firms choose not to sort their unobservable quality, putting both high and low quality together on the home market, resulting in a misallocation of quality and therefore welfare below the first-best. We then consider the effect of there being an export market where quality is verifiable, considering both short run (i.e., fixed supply) and long run effects. Not surprisingly, high quality products are exported. However, even when some home consumers are willing to pay more than the export price for high quality products, all high quality may be exported in equilibrium. This occurs when the export of high quality drives down the home price as average quality at home is decreasing in exports. One implication of this is that exporting can endogenize the cost differences in quality. Another is that lower home prices can also lead to home firms’ profits decreasing.

Turning to welfare analysis, we find that access to developed markets can harm home welfare. As a result of weak home institutions the home market price does not reflect the value of high quality to the home market. Specifically, the home market price is determined by the marginal consumer’s valuation of average quality, but the loss to home welfare from exporting a good is the average valuation of all consumers for high quality (since which home consumer had received that high quality good is random, due to weak institutions). Due to this discrepancy, there always exist export prices such that each and every unit exported causes a loss in welfare to the home country that exceeds the amount that is made in profit.

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6Etro (2011) examines the importance of entry in trade models with complete information.

7An alternative, behavioral interpretation is that a fraction of firms have less innate ability and so must incur a small effort cost to provide high quality, or have no personal integrity and are willing to cheat on quality. This is closer in nature to the assumption in Costinot (2009), where a fraction of the contracts are enforced and non-enforcement results in zero value. This fractional assumption also appears in Acemoglu et al., (2007), where a fraction of the contracts are nonverifiable and noncontractible; and Levchenko (2007), where a fraction of the investment is relationship specific and unenforceable.

8Levchenko (2007) finds a similarly flavored result; namely that the country with weak institutions can lose from “institutional comparative advantage driven trade.” The source of the result differs, as in Levchenko it comes from the loss of “good” jobs in the institutionally dependent sector (as wages differ across sectors), which contracts with trade.
through exporting. Second, the marginal harm from exporting is increasing in the amount of high quality exported. Third, home welfare can *always* be increased by restricting exports if in equilibrium some high quality remains on the home market; and when all high quality is exported, it is still possible that welfare can be increased by restricting exports even if home country welfare is greater with exporting. Fourth, the harm to home welfare may be non-monotonic in export prices, *e.g.*, for low export prices exporting harms home welfare, for higher prices exporting increases home welfare, but for even higher prices exporting harms home welfare.

Comparing the long and short run outcomes, since producer surplus can decrease with exporting, a country with a new export market can find this export sector *shrinking* over time. In terms of welfare, while one might expect that entry decisions should mitigate any harm found in the short run, we find that welfare can be lower in the long run as entry and exporting can lead to a collapse of the home market.

We extend the model to allow for investment to increase the fraction of output that is of high quality (*i.e.*, a greater fraction of good apples). We find first that the possibility of export may have *no* effect on the decision to invest in quality and so the previous results still hold. This occurs when trade equilibrates the home price to the export price. As a result, all quality is sold at the same price and so firms have no reason to invest. The other possibility is that all high quality is exported. While this resolves the moral hazard issue (all firms will make the Pareto improving investment which they did not in autarky), home welfare, and even home producer surplus, can still decrease as there is less high quality on the home market.

## 2 The Model and the Autarkic Benchmark

Consider a country with weak institutions that faces a developed foreign market. In the home country neither consumers nor the government can observe product quality. The developed foreign market has the institutions to verify a product’s quality allowing home
firms to receive a higher price for their high quality products through exports.

2.1 Demand and Supply in the Home Market

We use a standard specification for demand in the home market, as was first introduced by Bagwell and Riordan (1991), although we generalize this and allow for non-linear demand. Specifically, there is a mass of consumers normalized to one, with each consumer demanding exactly one unit of the good. The quality is either high or low, denoted by $H$ and $L$. Consumers have heterogeneous reservation prices, denoted $v$, for a high-quality product, distributed with a strictly positive density everywhere on a support normalized to $[0,1]$. The inverse demand for high quality generated by this distribution is denoted by $h(q)$, which gives the value $v$ for the consumer with the $q^{th}$ highest value, so $-\infty < h'(q) < 0$; with $h(1) \equiv 0$.

There is a common reservation price for a low-quality product, for ease normalized to zero. As will be clear from the derivations this normalization has no qualitative effect on the results so long as consumers value high quality more. Given a consumer with valuation $v$ for the high quality product and a belief of $\rho$ that a given good is of high quality, the consumer’s valuation for that good is $\rho v + (1 - \rho)0 = \rho v$.

Given these specifications, market demand on the home market, where quality is not observed, is given by $\rho h(q) + (1 - \rho)0 = \rho h(q)$ when $\rho$ is the commonly held belief of the probability of obtaining high quality. We consider only equilibrium beliefs that are consistent, so in equilibrium $\rho$ not only reflects consumers’ beliefs, but is also the actual proportion of high quality on the market.

Consider now supply. There is a continuum of firms, $q \in [0, 1]$, each having a capacity of one unit of output that can be produced at zero cost. It is common knowledge that for each firm, a fraction $\bar{\rho} \in (0, 1)$ of its output is of high quality.\footnote{This assumption can alternatively (and commonly) be interpreted as with probability $\bar{\rho} \in (0, 1)$ a given firm has high quality. As it is more natural in the context of our story, we use the first interpretation. The fraction of high quality could also be interpreted as being a group with a lower percentage of low quality.} We take $\bar{\rho}$ initially as exogenously given (e.g., the proportion of grains or produce that is naturally free of blemishes in any given...}
bushel, or the percentage of units off the production line that pass a testing standard). In Section 5 we allow firms to invest in quality in order to increase the percentage of their output that is of high quality. A firm can incur a small, but positive sorting costs of $s$ to separate the high from the low quality output, but even then quality remains both unobservable and unverifiable on the home market. So there is moral hazard in sorting and later (in Section 5) quality-investments, as well as the potential for adverse selection for given quality on the home market.

In addition to potential sorting costs $s$ and quality-investment costs (Section 5), firms incur a fixed cost. Firms are heterogenous with respect to fixed costs, distributed with a strictly positive density everywhere on $[0, 1]$. From this distribution $c(q)$ denotes the fixed cost for the firm with the $q^{th}$ lowest fixed cost (so $0 < c'(q) < \infty$), with the most efficient firm’s fixed cost normalized to zero ($c(0) = 0$). An implication of having heterogenous fixed costs is that the equilibrium size of the market is endogenously determined, which allows us to study short run and long run effects of trade as there is endogenous entry (expansion) and exit (contraction) in light of changes in trading opportunities.

### 2.2 The Foreign Market

The foreign price for high quality goods is $P^F$; and for low quality the price is zero. In order to access the foreign market firms must first sort their output, incurring the cost $s$. In addition, firms incur transactions costs of $t > 0$, which may include transportation costs, home inefficiency costs (e.g., bribes), or packaging and standardization costs to meet foreign standards (see, e.g., Iacovone and Javorcik, 2012). Lastly, products to be sold abroad could be subject to verification costs of $v \geq 0$. The foreign market is large compared to home market, so exporting does not affect the foreign price and therefore a firm that exports receives a price of $p^X := P^F - s - t - v$.\(^{10}\)

We assume that foreign firms do not import high quality into the home market and do-

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\(^{10}\)To rule out trivial no-trade configurations assume values of $P^F, s, t, v$ and $\rho$ so $p^X > 0$. Also, since $P^F$ is fixed, the country does not experience adverse terms-of-trade effects when it exports.
mestic firms do not re-import high quality that has initially been exported. This assumption is trivially satisfied if the value of high quality on the home market is below the import price once all (re-)import costs are accounted for. This assumption is also consistent with the starting assumption that the home country is unable to verify any claim of quality such as being imported from abroad. While (re-)importation introduces additional possibilities, some of which may be worth studying in their own right, the potential for trade to lower welfare occurs also in these cases and follows the same principles as are derived here without (re-)importation.

2.3 The Autarkic Equilibrium

Before analyzing short run and long run effects of opening to trade, we first derive the benchmark of autarky. Throughout we consider Walrasian equilibrium configurations, so firms and consumers are price-takers.

Because production costs are zero, all firms in the market will produce and sell all their output. And because quality on the home market is unobservable and unverifiable, firms do not invest in quality or sorting. Hence, the average quality on the market is $\rho$ and demand is given by $\rho h(q)$. With $q$ being the number of firms and the amount of output on the market, the autarkic price (and therefore a firm’s revenue) is $p_A := \rho h(q)$. It follows that the equilibrium number of firms in the autarkic market $q_A$ is implied by the amount of entry that allows the last firm to just cover its fixed costs: $c(q_A) \equiv \rho h(q_A)$.

Home welfare in autarky is consumer surplus plus industry profit:

$$W^A(q_A) := \left[ \int_0^{q_A} \rho h(x) dx - q_A p_A \right] + \left[ q_A p_A - \int_0^{q_A} c(x) dx \right] = \int_0^{q_A} [\rho h(x) - c(x)] dx. \tag{1}$$

It is straightforward to show this is the second-best welfare optimum, i.e., constrained Pareto optimal where the constraint is that there is incomplete information about product quality resulting in moral hazard and a misallocation of goods among consumers. Not surprisingly, the first best outcome is obtained with complete information which separates
qualities, as this eliminates the allocative inefficiency of high quality not being matched to high-valued consumers.

3 Trade and Welfare in the Short Run

Starting from the autarkic state, we now consider what happens as the economy (unexpectedly) opens and firms are given the opportunity to sort and export their high quality. Firms’ fixed costs $c(\cdot)$ are sunk at this time, so the industry size is as in the autarkic equilibrium $q^A$. In contrast, in the long run, the industry size adjusts as firms can exit or enter in light of the new trading opportunities. Industry adjustment and the long run equilibrium is considered in Section 4.

3.1 The Export Equilibrium

As indicated above, we consider Walrasian equilibrium configurations (i.e., price-taking behavior) and require that consumers’ equilibrium beliefs about the quality composition on the home market are consistent with firms’ exporting decisions. With $q^A$ firms in the domestic industry, $\rho q^A = q^A_H$ units of high quality and $(1 - \rho) q^A = q^A_L$ units of low quality are produced, so $\rho \equiv q^A_H / (q^A_H + q^A_L)$.

Low quality cannot be exported, so letting $q_L$ denote the amount of low-quality products on the home market, $q_L = q^A_L$. However, assuming that the export price exceeds the autarkic price, i.e., $p^X > p^A$, some high quality will be exported (and otherwise now trade takes place). Letting $q_H$ denote the high quality that remains on the home market, and $q^X_H$ the amount that is exported, $q_H = q^A_H - q^X_H$. Given consistent beliefs, $\rho (q_H, q_L) = q_H / (q_H + q^A_L)$; and given Walrasian market clearing, the price on the domestic market is

$$p(q_H, q_L) := \rho(q_H, q_L) h(q_H, q_L) = \frac{q_H}{q_H + q^A_L} h(q_H + q^A_L).$$

(2)

There are two possible export equilibrium constellations: one in which all high quality is exported, and another in which some high quality remains on the home market. The former
constellation may be the unique equilibrium. However, it may also be the result of a self-fulfilling prophecy (or coordination failure), and when it is, we rule it out as the equilibrium, since this is a well understood possibility and only reinforces are findings.

For some high quality to remain on the home market it must be that the home price is equal to the export price. That is, $q_H$ must satisfy

$$p(q_H, q_L^A) = \frac{q_H}{q_H + q_L^A} h(q_H + q_L^A) \equiv p^X. \quad (3)$$

With $p^A < p^X$ the condition implies that the domestic price must rise as high quality is exported. That this can happen is tied to the fact that the domestic price (2) is a function of both the average quality on the market (the first component, $\rho(\cdot)$) and the total quantity on the market (the second component, $h(\cdot)$). Average quality decreases with exports, putting downward pressure on the domestic price; whereas the decreased quantity remaining on the home market tends to increase the price due to downward sloping demand for high quality.

For common specifications of $h(q)$, e.g., linear or constant elasticity of demand, the home price is strictly unimodal (single peaked) in $q_H$: thus $p(q_H, q_L)$ is first strictly increasing and then decreasing in $q_H$ and high quality demand need not be concave.\footnote{A function is strictly unimodal if for some $m$, it is strictly increasing for $x \leq m$ and strictly decreasing for $x \geq m$. Though similar, this concept is distinct to the strict definition of unimodality for distributions, which admits multiple local maxima although those are usually referred to as being multimodal. Strict unimodality is a weaker condition than the standard assumption of strategic substitutability as the latter implies that, with constant elasticity demand for high quality, high quality demand $h(q)$ must be inelastic while with unimodality it can be elastic. With unimodality there can be strictly convex segments. Actually, for unimodality not to hold would require near horizontal or vertical segments in high quality demand.}

For ease of exposition we will assume unimodality for the remainder—although extending the analysis without unimodality leaves most of the discussion unchanged and is otherwise straightforward albeit somewhat tedious.

With unimodality there are potentially two levels of exports that equilibrate the home price to the export price (see Panel 1 of Figure 1). When this is the case the equilibrium with less high quality on the home market is an unstable equilibrium: an increase in exports causes the home price to decrease resulting in even more exports (and \textit{vice versa}). The equilibrium with the smaller amount of exports—leaving more high quality on the home
market—yields a stable equilibrium in that if fewer units were exported, the export price would exceed the home price resulting in exporting being profitable (and vice versa).

Ruling out coordination failure-type and unstable configurations, we denote by $\hat{q}_H$ the unique equilibrium amount of high quality that remains in the home market (see Figure 1). Whenever there is an export level that renders (3) true $\hat{q}_H > 0$ (see Panel 1); otherwise all high quality is exported and $\hat{q}_H = 0$ (Panels 2-4). As will become clear, $\hat{q}_H$ is also the welfare maximizing value of high quality remaining on the home market when considering the unrestricted equilibrium set. Thus, we are analyzing (only) the most favorable export

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12 An obviously sufficient (albeit not necessary) condition for $\hat{q}_H = 0$ is that the home price decreases in exports at the autarkic equilibrium (*viz.*, increases when the amount of high quality on the market increases; so, letting the subscript denote the partial derivative: $p_1(q_H^A, q_L^A) > 0$; see Panels 2 and 4); conversely a necessary (but not sufficient) condition for $\hat{q}_H > 0$ is that the home price increases in exports (*i.e.*, decreases as high quality is taken off the home market, $p_1(q_H^A, q_L^A) < 0$; see Panels 1 and 3).
equilibrium in terms of home welfare.

### 3.2 Harm from Exporting

Let $W^{SR}$ denote the total welfare in the short run equilibrium with trade; i.e., the welfare that the home country experiences when the industry has not adjusted through entry or exit and is therefore of size $q^A$. Then, similar to (1), letting $q_H$ denote the amount of high quality remaining on the home market (not necessarily the equilibrium amount so that potentially $q_H \leq \hat{q}_H$),

$$W^{SR}(q_H, q^A) := \int_0^{q_H + q^A} \rho(q_H, q^A) h(x)dx + p^X(q^A - q_H) - \int_0^{q^A} c(x)dx. \quad (4)$$

The first term is the surplus generated on the home market, the second term is the repatriated profit from exporting, and the final term is the (sunk) industry fixed cost.

The first finding is a stark one: there exist export prices for which any and every unit exported lowers total welfare.\(^{13}\)

**Proposition 1 (Welfare Losses in the Short Run)** There always exist export prices such that each and every unit exported decreases total welfare. Specifically, this is the case when the export price is below the average valuation of a high quality good on the home market in autarky. That is,

$$p^X < \bar{\rho} h(q^A) + (1 - \bar{\rho}) \frac{\int_0^{q^A} h(x)dx}{q^A} \iff \frac{\partial}{\partial q_H} W^{SR}(q^A_H - q^X_H, q^A_L) < 0; \ \forall q_H \in [0, q^A_H].$$

Moreover, the greater is the number of units exported, the greater is the harm from additional exports, i.e., $\frac{\partial^2 W^{SR}}{\partial (q_H^X)^2} > 0$.

At first glance the result is surprising: with exporting, high quality is brought to a wealthier market for a higher price. However, welfare has been lowered even though the process reduces asymmetric information, which would normally increase welfare. The formal proof is in the appendix, but the basic argument and the intuition are readily presented here.

\(^{13}\)All proofs are in Appendix A.
For a unit that is exported to harm the home country requires that the revenue obtained abroad is less than the welfare that the unit provided at home. Because the export price is fixed, each unit sold abroad generates the same welfare for the home country, namely $p^x$.

Consider now the loss to home welfare. When a unit of high quality is exported, the marginal consumer no longer buys. The probability the high quality unit that is exported went to the marginal consumer is $\rho$ and so that consumer’s valuation was $\rho h(q^A)$—which is also the market price (the first term on the condition on the export price identified in the proposition). However, with probability $(1 - \rho)$ the marginal consumer had a low quality unit and the exported high quality unit was randomly bought by some other consumer. And so there is a second loss: the average value of high quality to consumers who are purchasing weighted by the probability of one of them receiving it (the second term), all of whom have a higher value than the marginal consumer since demand slopes downward. Taken together this yields the average valuation of the high quality unit on the home market that is identified in the proposition: $\rho h(q^A) + (1 - \rho) \int_0^{q^A} h(x) dx / q^A$.

Thus, the reason that there always exist export prices under which exporting the first unit harms home welfare is tied to the institutional weakness in the home country: because quality cannot be verified, there is a discrepancy between the market price, and the value of a high quality unit to the home market. So even when the export price exceeds the domestic price of $p^A = \rho h(q^A)$, if it fails to compensate the home market for the potential loss of welfare from infra-marginal consumers, $(1 - \rho) \int_0^{q^A} h(x) dx / q^A$, welfare decreases when the first high quality unit is exported.

As for the second part of the proposition, that each and every unit exported harms welfare and does so at an increasing rate, note two points. First, fewer units bought in the home market means that the marginal consumer no longer buys; and because demand slopes down the average value for a given level of quality increases and hence the loss of another unit exported is greater. Second, average quality is decreasing at an increasing rate. Thus, the condition for home welfare to decrease from exports at autarky implies that home welfare decreases from a firm choosing to export independent of the amount of high quality
An implication of increasing losses to the home market is that the condition in Proposition 1 is a sufficient, but not a necessary condition for exporting to harm welfare. This is because if the export price were to rise to a level where the first unit exported just benefits home welfare, all other units exported will offset this benefit.

**Corollary 1** There always exist export prices such that even when the first unit exported raises welfare, welfare decreases with exports. That is,

\[ p^X < \int_{q^A}^{q^X} \rho h(x) dx - \int_{\hat{q}_H}^{\hat{q}_H+q^L} \rho \left( \hat{q}_H, q^A \right) h(x) dx \quad \iff \quad W^{SR}(\hat{q}_H, q^A) < W^A(q^A). \]

With specific demand functions the range of export prices that reduce welfare can be large. As an example, in Appendix B we consider linear demand with \( \rho = 1/2 \), showing that the export price can be three times the export price and welfare still decreases (Example 1).

Because the loss in home welfare is increasing in exports, it is possible that even when the export price is such that repatriated profits more than offset the loss in home welfare from exporting, total welfare can be improved by imposing an export quota and restricting exports on the margin.

The increase in welfare upon restricting some exports is tied to the intuition that the price on the home market only reflects the value of average quality to the marginal consumer, whereas exporting deprives the home market of a unit whose value is greater than the marginal consumer’s value. When in equilibrium some high quality is traded at home, restricting some output is necessarily welfare-improving: When some high quality remains on the home market, the firm obtains the same price for the goods it sells at home and abroad (\( p(\hat{q}_H, q^A_L) = p^X \)), but the value of the good at home exceeds the market price, so keeping the last unit at home increases welfare.

In the case that all high quality is exported in equilibrium a qualification holds: the benefit of the last unit exported is \( p^X \), whereas the value of keeping one unit of high quality on the home market is the average valuation for high quality when only low quality is on the market: \( \int_{0}^{q^A_L} h(x) dx / q^A_L \).
Corollary 2 The last unit exported in equilibrium harms welfare whenever \( \hat{q}_H > 0 \), or \( p^X < \int_0^{q^A} h(x)dx/q^A_L \) when \( \hat{q}_H = 0 \).

To give a sense of the price and welfare magnitudes that are possible, Example 2 demonstrates that even if \( \rho = .9 \) the export price can be 10 times the autarkic price and limiting exports increases welfare.

3.3 Welfare Implications of Export Prices

So far the discussion concerned overall home welfare, but not how exporting specifically affects consumer surplus and industry profit. It is easy to show that exporting—at any level—always reduces consumer surplus. Intuitively, consumers are worse off because average quality on the home market deteriorates as high quality is exported, even if the home price decreases as a result of lower average quality. Formally, noting that the first term in (4) is consumer surplus in the short run, consumer surplus is increasing in the amount of high quality that remains at home:

\[
\frac{dCS_{SR}(q^A_H)}{dq_H} = \frac{q^A_L}{(q_H + q^A_L)^2} \left[ \int_0^{q_H + q^A_L} h(x)dx - (q_H + q^A_L) h(q_H + q^A_L) \right] - q^A_L h'(q_H + q^A_L) > 0.
\]

Given that firms voluntarily export and only do so when it is individually profit maximizing to do so, it is tempting to surmise that the negative welfare effects identified in Proposition 1 and its two corollaries are the result of losses in consumer surplus being so large that they cannot be offset by increases in profits. But this is not necessarily so. In fact, even producer surplus can shrink in the export equilibrium:

**Proposition 2** When \( \hat{q}_H > 0 \), then producer surplus increases with exporting. However, whenever \( \hat{q}_H = 0 \) producer surplus decreases after allowing for exporting if \( p^X < h(q^A) \).

Linear demand again readily yields examples to illustrate this (Example 3).

The reason that even producer surplus can diminish in the export equilibrium is because the presence of high quality on the home market bestows a positive pricing externality on firms. This positive externality is lost when high quality is exported. To see this, note that
under autarky a firm sells all of its output at a price of $p^A$. However, when all high quality is exported, the home price drops to zero, and revenue is only obtained on the fraction $\bar{\rho}$ of high quality that a firm exports. This leads to smaller revenue than autarky whenever $p^X \times \bar{\rho} q^A < p^A \times q^A = \bar{\rho} h(q^A) \times q^A$. Thus, it is individually rational for firms to export, because they make more on the output they export than they do on output sold at home; but the act of collectively exporting lowers the home price which can result in diminished revenue when all high quality is exported.

We close this section by considering how the level of the export price affects home welfare, and note that welfare under exporting can alternate below and above autarkic welfare as the export price increases.

**Proposition 3** Welfare may not be monotone in the export price. That is, while there always exist sufficiently high export prices that home welfare increases, there may exist even higher export prices that harm home welfare.

To better understand the result, note that holding exports constant, an increase in the export price raises home welfare. Simple comparative statics show that (not surprisingly) an increase in the export price increases the amount exported. However, we have already seen that an increase in the amount exported holding constant the export price increases the marginal harm to home market welfare. As a result, welfare need not be monotone in the export price.

Example 4, with linear demand, gives parameters such that $p^A = .09$. Trade diminishes welfare when $p^X \in (p^A, .22)$, but it increases welfare for $p^X \in (.22, .49)$. When $p^X \geq .49$ all high quality is exported and equilibrium welfare is below autarkic welfare, unless $p^X \geq .55$, at which point exporting again raises welfare. The result is tied to the fact that as the export price exceeds .49 it comes to a tipping in the market such that all high quality is exported and the home price drops discontinuously.
4  Trade and Welfare in the Long Run

We now consider how welfare in the home country evolves as the industry adjusts to the new export opportunity and firms enter or exit the industry given their fixed costs. This establishes a long run equilibrium that we define as being characterized by the condition that the marginal firm just covers its fixed costs and obtains zero profit, when firms properly anticipate the long run equilibrium profit (i.e., they have consistent beliefs concerning the adjustment process).\textsuperscript{14}

4.1 Industry Adjustment

As a matter of notation, variables are superscripted by \( SR \) for the short run and by \( LR \) for the long run. Welfare in the long run is then given by

\[
W^{LR} (q^H, q^L) := \int_0^{q^H + q^L} \rho (q_H, q^L_R) h(x)dx + p^X (q^L_R - q_H) - \int_0^{q^L_R} c(x)dx,
\]

where \( q^L_R \) is the number of firms in the industry after the adjustment process has taken place. The extent of the industry expansion or contraction, and thus \( q^L_R \), depends on the long run equilibrium configuration.

If some high quality remains on the home market in the long run equilibrium so that \( \hat{q}^L_R > 0 \), then the home price equals the export price and all firms sell all their output at that price, i.e., \( p (q^L_R, q^L_R) = p^X \). The industry size is given by \( c (q^L_R) = p^X \). Note that this necessarily implies an industry expansion, \( q^L_R > q^A \); since \( c (\cdot) \) is increasing and \( p^X > p^A \), so \( c (q^L_R) = p^X > p^A = c (q^A) \).

If it is the case that in the long run equilibrium all high quality is exported so that \( \hat{q}^L_R = 0 \), then firms in the industry obtain revenue solely from the units exported (as the domestic price drops to zero—the value of low quality). In this case the industry entry equilibrium is given by \( c (q^L_R) = \overline{p} p^X \), and \( q^A \leq q^L_R \), as is readily seen by the second condition in Proposition 2.

\textsuperscript{14}Analogous to the short-run equilibrium there always exists a long-run equilibrium in which all high quality is exported. We continue to abstract from this when it is the result of a coordination failure.
As noted in the previous section, the opportunity for firms to export a portion of their output that is of high quality lowers consumer surplus in the short run as consumers lose the benefit of potentially consuming high quality. It turns out that this is reinforced in the long run: If in the short run some high quality remained on the home market, but all high quality is exported in the long run, then clearly this strictly reduces consumer surplus. But consumer surplus is also reduced if some high quality remains on the home market in the long run.

As showed at the outset of the section, if in the long run some high quality remains at home then this implies an industry expansion, \( i.e., \) an increase in \( q \). However, the domestic price must still equilibrate with the (fixed) export price, so (3) must hold for the expanded industry size. The implicit function theorem yields that as the industry, \( q \), increases, the amount of high quality on the home market, \( \hat{q}_H(q) \), decreases:

\[
\frac{\partial \hat{q}_H}{\partial q} = \frac{-p_2(\hat{q}_H, (1 - \rho)q)}{p_1(\hat{q}_H, (1 - \rho)q)} (1 - \rho) < 0.
\]

This follows since \( p_1(\hat{q}_H, q_L) < 0 \) and \( p_2 < 0 \) (increasing low quality always reduces the price as it increases aggregate quantity and lowers average quality). In other words, as there is more entry, the amount of high quality on the home market needed to equate the home price to the export price decreases. This is intuitive: more entry means more low quality on the home market and the only way to maintain the home price equal to the export price is by reducing output (\( i.e., \) high quality) on the home market as \( p_1 < 0 \). Note that average quality is lower as a result and therefore consumer surplus is lower.

While it is natural to assume that profits increase compared to the short run, as firms base their entry and exit decisions on the current state, it turns out that this does not necessarily hold. A necessary condition for profits to decrease when moving from the short run to the long run is that in the short run there is some high quality on the home market, whereas all high quality is exported in the long run. While it is obviously the case that the new entrants in the industry generate additional profit, the tipping of the market implies that the incumbent firms henceforth can only sell their high quality output at the export price, whereas beforehand they were selling their entire stock at that price, because the home

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price was equal to the export price.

The two results together—decreasing consumer surplus and decreases in profits—imply that there is a sufficient condition so that total welfare in the long run can be below total welfare in the short run. Example 5 shows that it is possible to have short run welfare even up to seven times greater than long run welfare.

4.2 Long Run Effects of Trade

We now consider how the long run equilibrium with trade compares to the (long run) autarkic equilibrium. The preceding analyses have uncovered some immediate results. Thus, consumer surplus is always lower in the long run, since it first decreases in the short run and then further decreases upon industry adjustment. Another important result follows readily from the previous analysis. Coupling the fact that the industry may contract with the observation that consumers are always worse off in the long run establishes a sufficient condition for welfare in the long run to be lower than under autarky. However, this is not a necessary condition for welfare to decrease in the long run. Even when the industry expands, and therefore profits necessarily increase compared to autarky, total welfare can be smaller in the long run with trade than in autarky.

**Proposition 4 (Welfare Losses in the Long Run)** *Even when accounting for firms’ long run adjustment processes there exists \( p^X > p^A \) such that long run welfare with trade is below autarkic welfare.*

Algebraic examples show that these possibilities are not restricted to knife-edge constellations but are easily found, even with linear demand. In other words, \( \hat{p}^X \) need not be close to \( p^A \), and the difference in welfare need not be trivial. Some examples in which all high quality is exported in the long are given in Example 6, and cases with high quality remaining are in Example 7.

What is not readily apparent from the proposition, but may play a critical role in recognizing instances of welfare reducing trade in some markets in countries with weak institutions
is that long run welfare can be lower than autarkic welfare, even if short run welfare was higher than autarkic welfare. That is, as Example 8 illustrates, it is possible that short run trade welfare is greater than autarkic welfare \( W^{SR} > W^A \), but autarkic welfare is still greater than long run trade welfare \( W^A > W^{LR} \).

Another important possibility is that even if the conditions of Proposition 4 are not met and so welfare in the long run increases upon opening to exporting, the marginal firm in the industry can cause welfare losses. That is, there is also a long run version of Corollary 2. However, this can only occur when some high quality remains on the home market: even though welfare can be lower when all is exported, the marginal entrant does not reduce welfare as its cost just equals the benefit \( p^X \). Formally:

**Proposition 5** In the long run, home welfare is harmed by the marginal firm if in equilibrium there is high quality on the home market, i.e.,

\[
q_H^{LR} > 0 \implies \left. \frac{dW^{LR}}{dq^{LR}} \right|_{q_H^{LR}} < 0.
\]

Lastly, there is a long run analogue to Proposition 3: an increase in the export price can reduce home welfare. This can occur when some high quality remains on the home market at the lower price. Denote the maximum export price such that there is high quality on the home market as \( \tilde{p}^X \), so \( \tilde{p}^X = p(\tilde{q}_H, q_L^{LR}) \), where \( \tilde{q}_H := \arg \max_p (q_H, q_L^{LR}) \). A slightly higher export price results in a discrete decrease in high quality at home and in producer surplus, reducing welfare:

**Proposition 6** When in equilibrium there is high quality on the home market, home welfare decreases in the export price at \( \tilde{p}^X \), i.e.,

\[
\exists \epsilon > 0 \text{ such that } \tilde{q}_H^{LR} > 0 \implies W^{LR}(\tilde{p}^X) - W^{LR}(\tilde{p}^X + \epsilon) > 0.
\]

Since we know that when in equilibrium there is high quality on the home market there always exist export prices sufficiently close to the autarkic price that harm welfare (Proposition 4), then Proposition 6 implies that, as in the short run (Proposition 3), it is possible that the effect of exporting on home welfare is non-monotonic in export prices.
5 Investments in Quality Improvement

We now consider the case of firms having the ability to make a Pareto efficient investment in quality. The model is as before except that a firm now chooses whether to invest to increase the fraction of high quality output from $\bar{\rho}$ to $\rho_I$, $\bar{\rho} < \rho_I$. The investment increases a firm's fixed cost: $c_I(q) > c(q)$.

It is useful to begin by considering what occurs if in the home market quality was observable. In this case, the $q^{th}$ firm would choose to invest so long as

$$\rho_I p - c_I(q) > \bar{\rho} p - c(q),$$

where $p$ is the domestic price. Since investment is efficient, i.e., $\rho_I / c_I(q) \geq \bar{\rho} / c(q)$, all firms that are in the industry would invest under complete information.

With autarky the equilibrium does not change: all firms choose not to sort and all quality receives the same price. Thus, it is more profitable to not invest:

$$p^A - c_I(q) < p^A - c(q).$$  \hfill (6)

The autarkic equilibrium, then, is unchanged: $\bar{p}_h (q^A) = c(q^A)$ and welfare is the same.

Consider now the long run trade equilibrium and suppose first that in the long run equilibrium some high quality remains on the home market. In this case, all firms—whether they export or not—receive the same price for their high and low quality product. By (6), then, no firm would choose to invest. Thus, the key results (and examples) from the previous section for when there is high quality on the home market also hold with moral hazard in investment, yielding the following corollary:

**Corollary 3** If firms can make a costly, but efficient investment to increase the fraction of high quality and in equilibrium there is high quality on the home market, i.e., $\hat{q}_{LR}^{H} > 0$, then

1. no firms make the efficient investment,
2. there exist export prices such that welfare decreases from exporting,
3. home welfare is harmed by the marginal entrant, and
4. welfare can be greater in the short run than the long run trade equilibrium.

Turning to when in the long run equilibrium all high quality is exported, the efficiency assumption \( (\rho_I/c_I(q) \geq \bar{p}/c(q)) \) implies that investing is more profitable for any firm that enters the industry: \( \rho_I p^X - c_I(q) > \bar{p} p^X - c(q) \). As a result, the new entry level, denoted \( q^I \) is now defined by \( p^X \rho_I = c_I(q^I) \).

As all high quality is exported, welfare, \( W^I \), is simply profit:

\[
W^I = p^X \rho_I q^I - \int_0^{q^I} c(x)dx.
\]

Despite firms making efficient investments, previous results indicate that there still exist export prices that reduce welfare. For example, as \( c(q) \rightarrow c_I(q) \) and \( \bar{p} \rightarrow \rho_I \), there can exist export prices such that welfare and even producer surplus can decrease.

**Proposition 7 (Welfare Losses With Investment in Quality)** With linear demand and costs, when firms can make a costly, but efficient investment to increase the fraction of high quality and all high quality is exported, then all firms invest in quality improvement and yet there always exist export prices such that home producer surplus and welfare decrease with exporting.

The potential for this to occur in a non-trivial way is shown in Example 9.

6 Conclusion

International trade is generally welfare improving and it is an important means by which lesser developed economies can grow. For countries with weak institutions, trading partners with strong institutions can also offer a path that circumvents the barriers to growth associated with weak institutions.

We examine a model in which, because of weak institutions, a home market is characterized by asymmetric information about product quality. Trade allows the home firms in the affected industry to bypass this and earn a higher return on their high quality products.
Despite this, we find that such trade may harm the home country. This was found both in the short run when the opening of export markets is unexpected, and in the long run when home exporters can respond through entry and investment in quality.

The reason for this is that in markets with asymmetric information regarding product quality the price is determined by the marginal consumer’s expected value of the product. However, when a unit of high quality is exported, the loss in home welfare is the average consumer’s value of the high quality product. Thus, since weak institutions result in the high quality good being allocated at random, the home price does not accurately reflect the marginal value of a high quality good to the home country.

We find that trade can lead to a shrinking of the industry—leading to decreased welfare; yet trade can also lead to an expansion of the export sector and welfare can still decrease: a case of immiserizing growth from asymmetric information. Finally, whenever autarky generates greater welfare than trade in the long run, the home government can face a time inconsistency problem: after firms make their entry decisions expecting autarky the home country may prefer to unexpectedly allow trade.\(^\text{15}\)

Three types of policies come to mind that might ameliorate the problems associated with the exportation of high quality in light of the home country’s weak institutions. First, taxing exports would reduce exporting and thus assure that not all high quality leaves the home country. Second, the quantity exported could be directly curtailed be requiring firms to acquire export licenses that are limited (\emph{i.e.}, an export quota). And third, the amount exported could also be limited by restricting the amount of entry into the industry—a policy that helps when it is the industry adjustment that is the cause for the deterioration in welfare.

Of course with all of these policies there is a question of whether they can effectively be implemented in a country with weak institutions. But another issue is that welfare effects may not be readily apparent. Thus, it is not uncommon to use industry expansion as a

\(^{15}\)This is the reverse of the usual time consistency problem where governments profess free trade policy, but then protect an industry (\emph{e.g.}, Miyagiwa and Ohno 1995).
positive sign of improved welfare. However, we show that home welfare can decrease even as the exporting industry expands in the long run. And even when welfare can be measured more directly, long run adjustment patterns may obscure welfare implications. For instance, as we saw, it is possible that a country that opens up to trade sees its welfare increase initially; yet welfare may be lower than in autarky once the domestic industry has adjusted to the long run equilibrium. At that point—with subsequent unrelated events having possibly intervened—observers might find it difficult to trace the reduced welfare to the policy of opening up to trade; especially, as the immediate results of the policy seemingly confirmed the conventional wisdom that exporting increases welfare.

The potential for welfare-diminishing trade is not only a question of how weak home institutions are, but also depends on home wealth. To the extent that country income determines consumers’ reservation prices, a sufficiently low income country relative to the export market would not face this potential harm from export, however, a slightly higher income country could. So, if the opening of the export market for this sufficiently low-income country increases its income, over time it could then move into the region where the high quality export harms the home country as its consumers become wealthy enough to demand the high quality product. Here, the loss in welfare compared to limiting exports may not be apparent, simply because it is revealed only in the counterfactual of having fewer exports.

References


Appendix A: Proofs

Proof of Proposition 1: Recalling that $q^X_H = q^A_H - q_H$, using (4) the derivative of welfare in the short run with respect to exports evaluated at the autarkic equilibrium is

$$
\frac{\partial W^{SR}}{\partial q^X_H} \bigg|_{q_H = q^A_H} = -\left[ \frac{q_H}{q_H + q_L} h(q_H + q_A^L) + \int_{0}^{q_H + q_L^A} \frac{q_L^A}{(q_H + q_L^A)^2} h(x)dx \right] + p^X
$$

$$
= -\bar{p} h(q) - \frac{q_L^A}{(q_H^A + q_L^A)^2} \int_{0}^{q^A} h(x)dx + p^X.
$$

Thus, at autarky, a high quality unit exported reduces home welfare if and only if

$$
p^X < \bar{p} h(q^A) + \frac{q_L^A}{(q_H^A + q_L^A)^2} \int_{0}^{q^A} h(x)dx = \bar{p} h(q^A) + (1 - \bar{p}) \int_{0}^{q^A} h(x)dx/q^A.
$$

(7)
Consider next the effect of additional units being exported. Welfare is concave in $q_H$:

$$
\frac{\partial^2 W_{SR}}{\partial (q_H^X)^2} = \frac{q_H}{q_H + q_L^A} h'(q_H + q_L^A) - \frac{2q_L^A}{(q_H + q_L^A)^3} \int_0^{q_H+q_L^A} h(x)dx + \frac{2q_L^A}{(q_H + q_L^A)^2} h(q_H + q_L^A)
$$

$$
= \frac{q_H}{q_H + q_L^A} h'(q_H + q_L^A) - \frac{2q_L^A}{(q_H + q_L^A)^2} \left[ \int_0^{q_H+q_L^A} \frac{h(x)}{q_H + q_L^A} dx - h(q_H + q_L^A) \right] < 0.
$$

The inequality is an implication of downward sloping demand, $h'(\cdot) < 0$: the first term is negative and the bracketed term is positive because the average value of high quality, $\int_0^q h(x)dx/q$, is greater than the marginal consumer’s value, $h(q)$. Thus, when (7) is true the harm to the home market from a unit exported is increasing in the amount of exports. □

The proof of Corollary 1 follows readily from comparing and re-arranging the expressions for autarkic welfare (1) and short run welfare (4). The proof to Corollary 2 follows from the discussion in the main body of the paper.

**Proof of Proposition 2:** The case of $\hat{q}_H > 0$ is trivial, since in autarky all is sold at $p^A$, whereas with exporting all is sold at $p^X (> p^A)$. If $\hat{q}_H = 0$, then revenue when all high quality is exported is $p^X q_H^A = p^X \rho q^A$; whereas revenue under autarky is $\rho h(q^A) q^A$. It follows that the former is smaller whenever $p^X < h(q^A)$. □

**Proof of Proposition 3:** Implicitly differentiating (3) shows that the amount of high quality on the home market $\hat{q}_H$ is decreasing in the export price when still some output remains on the home market, i.e.,

$$
\frac{\partial \hat{q}_H^X}{\partial p^X} = -\frac{\partial \hat{q}_H}{\partial p^X} = \frac{1}{-p_1 (\hat{q}_H, (1 - \bar{p})q^A)} > 0,
$$

as $p_1(\hat{q}_H, q_L^A) < 0$. That is, since the home price is increasing in exports, when the export price increases the only way to maintain (3) is to have more high quality exported.

Moreover, note that $p_1 (q_H^A, q_L^A) < 0$ is a necessary condition for there to exist an equilibrium with some high quality on the home market and it is then also a sufficient condition for $p^X$ sufficiently close to $p^A$. By Corollary 1, short run welfare exceeds autarkic welfare when the export price has reached the maximum possible home price if

$$
p^X = \bar{p}^A := p (\hat{q}_H, q_L^A) > \frac{\int_0^{q_H^A} \bar{p} h(x)dx - \int_0^{\hat{q}_H+q_L^A} \rho (\hat{q}_H, q_L^A) h(x)dx}{q_H^A - \hat{q}_H}.
$$
A necessary and sufficient condition for short run welfare to drop below autarkic welfare at \( \hat{p}^A + \epsilon \) for some \( \epsilon > 0 \) is that
\[
\hat{p}^A + \epsilon < \frac{\int_0^{q^A} \bar{p} h(x) dx}{q^A_H}.
\]
Hence a necessary and sufficient condition for there to exists a price range in which short run welfare is above autarkic welfare, yet below it for some prices both below and above that range is
\[
\int_0^{q^A} \bar{p} h(x) dx > \int_0^{\tilde{q}_H^A + q^A_L} \rho \left( \bar{q}_H, q^A_L \right) h(x) dx.
\]

\[
\Longleftrightarrow \frac{\int_0^{\tilde{q}_H^A + q^A_L} \rho \left( \bar{q}_H, q^A_L \right) h(x) dx}{\tilde{q}_H^A} > \frac{\int_0^{q^A} \bar{p} h(x) dx}{q^A_H}.
\]

\[
\square
\]

**Proof of Proposition 4:** Beginning with when all high quality is exported, \( \hat{q}^L_R = 0 \), welfare in the long run (5), is given by
\[
W^{LR} (\hat{q}^L_R = 0, q^L_R) = p_X \bar{p} q^{LR} - \int_0^{q^{LR}} c(x) dx,
\]
Welfare with autarky, (1), less long run welfare with all high quality exported, (9), is
\[
W^A (q^A) - W^{LR} (\hat{q}^L_R = 0, q^L_R) = \int_0^{q^A} (\bar{p} h(x) - c(x)) dx - p_X \bar{p} q^{LR} + \int_0^{q^{LR}} c(x) dx
\]
\[
= \int_0^{q^A} \bar{p} h(x) dx - p^A \bar{p} q^{LR} + \int_0^{q^{LR}} c(x) dx.
\]

Note that if \( p_X = p^A / \bar{p} > p^A \) (so that \( q^{LR} = q^A \)), then
\[
W^A (q^A) - W^{LR} (\hat{q}^L_R = 0, q^L_R) = \int_0^{q^A} \bar{p} h(x) dx - p^A q^A = \int_0^{q^A} \bar{p} h(x) dx - \bar{p} h (q^A) q^A > 0.
\]

Since long run welfare with trade when all high quality is exported is trivially increasing in \( p_X \), it follows that for any \( p^X \in (p^A, p^A / \bar{p}] \) welfare is greater with autarky; and hence there exists \( p^{X^*} > p^A \).

Consider now the case when not all high quality is exported in the long run, \( \hat{q}^L_R > 0 \).
Welfare in the long run (5) expressed as a function of $p^X$ is

$$W^{LR}(p^X) := W^{LR}(p^X, q^{LR}(p^X), \hat{q}_H^{LR}(p^X)) = \int_0^{\hat{q}_H^{LR}(p^X) + (1 - \overline{p})q^{LR}(p^X)} \rho(\hat{q}_H^{LR}(p^X), (1 - \overline{p}) q^{LR}(p^X)) h(x) dx$$

$$+ p^X [\overline{p} q^{LR}(p^X) - \hat{q}_H^{LR}(p^X)] - \int_0^{q^{LR}(p^X)} c(x) dx,$$

(10)

where $\hat{q}_H^{LR}(p^X) \equiv \hat{q}_H(q^{LR}(p^X))$.

Recalling that $\rho(\hat{q}_H^{LR}, (1 - \overline{p}) q^{LR}) = \hat{q}_H^{LR} / (\hat{q}_H^{LR} + (1 - \overline{p}) q^{LR})$, differentiating $W^{LR}$ (with arguments suppressed for ease of reading) yields

$$\frac{d}{dp^X} W^{LR} = (W^{LR})' = \frac{\hat{q}_H^{LR} + (1 - \overline{p})q^{LR}}{(\hat{q}_H^{LR} + (1 - \overline{p}) q^{LR})^2} h(x) dx$$

$$+ [((\hat{q}_H')' + 1 - \overline{p}) q^{LR}]' \frac{\hat{q}_H^{LR}}{\hat{q}_H^{LR} + (1 - \overline{p}) q^{LR}} h(\hat{q}_H^{LR} + (1 - \overline{p}) q^{LR})$$

$$+ [\overline{p} q^{LR} - \hat{q}_H^{LR}] + p^X \left[ \overline{p} (q^{LR})' - (\hat{q}_H') (q^{LR})' \right] - (q^{LR})' c(q^{LR}).$$

Evaluating this at $p^X = p^A$ yields

$$\frac{d}{dp^X} W^{LR}(p^A) = \int_0^{p^A} (1 - \overline{p}) (\hat{q}_H') (q^{LR})' h(x) dx + [(\hat{q}_H') + 1 - \overline{p}] (q^{LR})' \overline{p} h(q^A)$$

$$+ [\overline{p} q^A - \overline{p} q^A] + p^A [\overline{p} (q^{LR})' - (\hat{q}_H') (q^{LR})'] - (q^{LR})' c(q^A).$$

And since $\overline{p} h(q^A) = p^A = c(q^A)$, this simplifies to

$$\frac{d}{dp^X} W^{LR}(p^A) = \int_0^{p^A} (1 - \overline{p}) (\hat{q}_H') (q^{LR})' h(x) dx < 0,$$

where the inequality is due to $(\hat{q}_H')' < 0$ (i.e., exporting increases in the export price) and $(q^{LR})' > 0$ (i.e., increasing the export price while not all is exported increases entry). This proves existence of $p^{X''} > p^A$. Letting $p^X := \min \{p^{X'}, p^{X''}\}$ completes the proof. \qed

**Proof of Proposition 5:** Welfare in the long run (5) expressed as a function of $q^{LR}$ is

$$W^{LR}(q^{LR}) = \int_0^{\hat{q}_H(q^{LR}) + (1 - \overline{p})q^{LR}} \rho(\hat{q}_H(q^{LR}), (1 - \overline{p}) q^{LR}) h(x) dx$$

$$+ p^X [\overline{p} q^{LR} - \hat{q}_H(q^{LR})] - \int_0^{q^{LR}} c(x) dx,$$
Differentiating one obtains
\[
(W^{LR})' = \int_0^{\hat{q}_H(q^{LR})} \frac{(\hat{q}_H)' q^{LR} - \hat{q}_H^{LR}}{(\hat{q}_H(q^{LR}) + (1 - \overline{p}) q^{LR})^2} h(x) dx + [(\hat{q}_H)' + 1 - \overline{p}] p^X 
+ p^X [\overline{p} - (\hat{q}_H)'] - p^X.
\]
where the \( p^X \) in the second term comes from the home price equaling the export price when some high quality is on the home market, and the final \( p^X \) come from the entry condition \( p^X = c(q^{LR}) \). The remaining integral term then renders the derivative negative since
\[
(\hat{q}_H)' = \frac{-p_2(\hat{q}_H, (1 - \overline{p}) q) (1 - \overline{p})}{p_1(\hat{q}_H, (1 - \overline{p}) q)} < 0. \tag{11}
\]

**Proof of Proposition 6:** Notice that when \( p^X = \tilde{p}^X \), \( \hat{q}_H^{LR} > 0 \), so there is strictly positive consumer and each firm earns \( \tilde{p}^X \) on all its output. However, when \( p^X = \tilde{p}^X + \epsilon \), \( \hat{q}_H^{LR} = 0 \), so consumer surplus is zero and firms earn \( \tilde{p}^X + \epsilon \) on only a fraction \( \overline{p} \) of their output implying a smaller industry. Together this implies that for small enough \( \epsilon > 0 \), welfare is strictly lower at \( p^X = \tilde{p}^X + \epsilon \) than at \( p^X = \tilde{p}^X \). □

**Proposition 7** Let \( h(q) = 1 - q \), \( c(q) = \overline{c}q \), and \( c_I(q) = c_Iq \), \( \overline{c} < c_I \). When all high quality is exported in the long run, firms enter until \( \rho_I p^X - c_I q = 0 \) and welfare is simply producer surplus:
\[
W_{LR}^I(\rho_I) = PS(\rho_I) = p^X \rho_I \frac{\rho_I p^X}{c_I} - \int_0^{\rho_I p^X} c_I x dx = (p^X)^2 \rho_I^2 / 2c_I.
\]
Algebraic manipulation yields that producer surplus is greater with autarky \( (PS(\overline{p}) > PS(\rho_I)) \) if \( p^X < (p^X)^{PS} \equiv \overline{p}(\overline{c}_I)^{1/2}/\rho_I(\overline{c} + \overline{p}) \). For welfare it is \( p^X < (p^X)^W \equiv \overline{p}(c_I)^{1/2}/\rho_I(\overline{c} + \overline{p})^{1/2} \). Additional algebraic manipulations show that such prices always exist: \( (p^X)^{PS} > p^A(\overline{p}) \equiv \overline{p} \overline{c}/(\overline{p} + \overline{c}) \). □

**Appendix B: Examples**

**Example 1** Even with \( p^X \) close to \( 3p^A \) and the first unit exported increases welfare, exporting can diminish welfare (Proposition 1 and Corollary 1)
With linear demand, \( h(q) = 1 - q \), one has \( p^A = \overline{p} \left( 1 - q^A \right) \), \( W^A (q^A) = \overline{p} q^A \left( 1 - q^A / 2 \right) \) (we suppress fixed costs as these are sunk), and the condition for the first unit exported to harm home welfare (7) is

\[
p^X < \overline{p} \left( 1 - q^A \right) + (1 - \overline{p}) \left( 1 - q^A / 2 \right) = p^A + (1 - \overline{p}) \left( 1 - q^A / 2 \right).
\]

If \( \overline{p} = 1/2 = q^A \) then \( p^A = 4/16 \) and for any \( p^X < 10/16 \) exporting reduces welfare:

\[
W^{SR} = p^X (q^A_H - q_H) + \frac{q_H}{q_H + q^A_L} \left( q_H + q^A_L - \frac{(q_H + q^A_L)^2}{2} \right).
\] (12)

The condition for home welfare to be harmed (Corollary 1) at \( \hat{q}_H \) is

\[
p^X < 1 - \frac{q^A_H + \hat{q}_H + q^A_L}{2}.
\]

If all high quality is exported \( (q_H = 0) \), any \( p^X < 12/16 = 3p^A \) reduces welfare. Note that the home market choke price is \( \overline{p} = 8/16 < 12/16 \). If \( p^X = 11/16 \) the first unit exported increased welfare (Proposition 1).

**Example 2** Even with \( p^X \) close to \( 10p^A \) there can be short run benefits of export quotas (Corollary 2):

With linear demand, \( h(q) = 1 - q \), if there is high quality on the home market \( \hat{q}_H \) must satisfy (3), and

\[
\hat{q}_H = \frac{1}{2} \left( 1 - q^A_L - p^X + \sqrt{1 - 2q^A_L - 2p^X + (q^A_L - p^X)^2} \right).
\] (13)

Let \( \overline{p} = .9 \) and \( q^A = .9 \) so \( p^A = .09 \). From (12), if \( p^X \in (.22, .49) \), then exporting increases home welfare: \( W^{SR}(\hat{q}_H, q^A_L) > W^A(q^A) \). Though exporting welfare reaches a maximum at \( p^X \approx .47 \), the marginal export harms home welfare: \(- \left( 1 - q_H - q^A_L \right) + p^X \approx - .66 + .47 < 0 \). For when all high quality is exported let \( \overline{p} = .95 \) \( (p^A = .095) \). From (13), if \( p^X > .62 \), all high quality is exported. The cost of the marginal export is \( 1 - q^A_L = .9975 \). Thus, for \( p^X < 10p^A \) the marginal export harms home welfare.

**Example 3** Decrease in profits in the short run due to exporting (Proposition 2).
Assuming \( h(q) = 1 - q \), the relevant condition is \( p^X \bar{p} q^A \leq \bar{p} (1 - q^A) q^A \): \( p^X < 1 - q^A \).

For example, if \( \bar{p} = 3/5 \) and \( q^A = 3/8 \), then \( p^A = 3/8 \) and for \( p^X < 5/8 \) producer surplus decreases.

\[ \square \]

Example 4 Welfare implications need not be monotone in the export price (Proposition 3).

Given \( h(q) = 1 - q \), using \( \hat{q}_H \) given in (13), so that the home price equals the export price, short run welfare without sunk fixed costs (12) is:

\[
W^{SR} = p^X \left( \frac{q^A_H - \frac{1 - q^A_L - a}{2}}{\rho} + \frac{3 - q^A_L + a}{8} (1 - q^A_L - a) \right),
\]

where \( a := p^X - \sqrt{1 - 2q^A_L - 2p^X + (q^A_L - p^X)^2} \).

Let \( \bar{p} = .9 \) and \( q^A = .9 \) (so \( p^A = .09 \)). For \( p^X \in (.09, .22) \), \( W^{SR}(p^X) < W^A \): exporting harms welfare. For \( p^X \in (.22, .49) \), exporting increases welfare. But, for \( p^X \in (.49, .55) \), all high quality is exported and exporting harms welfare. For higher export prices, exporting again increases welfare.

\[ \square \]

Example 5 Welfare with trade can be greater in the short run than in the long run.

In these examples, there is an equilibrium with some high quality in the home market in the short run \( (q^A) \). Assuming linear demand, \( h(q) = 1 - q \), and linear fixed costs, \( c(q) = \bar{c}q \), in this case short run welfare is \( W^{SR} \) defined by (4). As \( q^A = \bar{p}/(\bar{p} + \bar{c}) \),

\[
W^{SR} \left( \frac{\bar{p}}{\bar{p} + \bar{c}} \right) = p^X \left( \frac{\bar{p}}{\bar{p} + \bar{c}} - \hat{q}_H \right) + \int_0^{\hat{q}_H + (1 - \bar{p})/\bar{c}} \hat{q}_H \left( \frac{\bar{p}}{\bar{p} + \bar{c}} + \hat{q}_H \right) (1 - x)dx - \int_0^{\bar{p} + \bar{c}} \bar{c}xdx.
\]

The long-run equilibrium has all high quality exported, so \( q^X = \bar{p}p^X/\bar{c} \) and \( W^{LR}(\bar{p}p^X/\bar{c}) = (p^X)^2 \bar{p}^2/2\bar{c} \). With this we have:

Example 5

<table>
<thead>
<tr>
<th>( \bar{p} )</th>
<th>( \bar{c} )</th>
<th>( p^X )</th>
<th>( q^X )</th>
<th>( p^A )</th>
<th>( q^A )</th>
<th>( \hat{p}^X )</th>
<th>( W^{SR} )</th>
<th>( W^{LR} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>1</td>
<td>0.6</td>
<td>.54</td>
<td>.47</td>
<td>.47</td>
<td>.58</td>
<td>.20</td>
<td>.15</td>
</tr>
<tr>
<td>0.8</td>
<td>.4</td>
<td>0.4</td>
<td>.8</td>
<td>.267</td>
<td>.6</td>
<td>.34</td>
<td>.23</td>
<td>.13</td>
</tr>
<tr>
<td>0.7</td>
<td>.1</td>
<td>0.2</td>
<td>1.4</td>
<td>.09</td>
<td>.875</td>
<td>.13</td>
<td>.27</td>
<td>.09</td>
</tr>
<tr>
<td>0.6</td>
<td>.5</td>
<td>0.28</td>
<td>.34</td>
<td>.2²</td>
<td>.55</td>
<td>.28</td>
<td>.15</td>
<td>.03</td>
</tr>
<tr>
<td>0.5</td>
<td>.4</td>
<td>0.223</td>
<td>.28</td>
<td>.2²</td>
<td>.55</td>
<td>.22</td>
<td>.14</td>
<td>.02</td>
</tr>
</tbody>
</table>

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Note that when $\bar{\rho} = 0.7, .8, .9, \bar{p}^X > p^A/\bar{p}$, output increases and welfare still decreases.

□

**Example 6** The following example shows that trade can harm welfare in the long run when all high quality is exported (Proposition 4).

Let $h(q) = 1 - q$ and $c(q) = \bar{\epsilon}q = 2q$. As $q^X = p^X\bar{p}/\bar{\epsilon} = p^X\bar{p}/2$, it is straightforward to derive welfare with trade $W^{LR} = (p^X)^2\bar{p} = (p^X)^2\bar{p}/4$; and $W^{LR} < W^A$ where $q^A = \bar{p}/(\bar{p} + \bar{\epsilon}) = \bar{p}/(\bar{p} + 2)$.

<table>
<thead>
<tr>
<th>$\bar{\rho}$</th>
<th>$p^X$</th>
<th>$q^X$</th>
<th>$p^A$</th>
<th>$q^A$</th>
<th>$W^{LR}$</th>
<th>$W^A$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>0.82</td>
<td>0.369</td>
<td>0.621</td>
<td>0.31</td>
<td>0.136</td>
<td>0.139</td>
</tr>
<tr>
<td>0.8</td>
<td>0.84</td>
<td>0.336</td>
<td>0.571</td>
<td>0.286</td>
<td>0.113</td>
<td>0.114</td>
</tr>
<tr>
<td>0.7</td>
<td>0.86</td>
<td>0.301</td>
<td>0.519</td>
<td>0.259</td>
<td>0.090</td>
<td>0.091</td>
</tr>
<tr>
<td>0.6</td>
<td>0.87</td>
<td>0.261</td>
<td>0.462</td>
<td>0.231</td>
<td>0.0681</td>
<td>0.0692</td>
</tr>
<tr>
<td>0.5</td>
<td>0.89</td>
<td>0.223</td>
<td>0.4</td>
<td>0.2</td>
<td>0.0495</td>
<td>0.05</td>
</tr>
</tbody>
</table>

**Example 7** Trade can harm welfare in the long run even when not all high quality is exported (Proposition 4).

As before, $h(q) = 1 - q$ and $c(q) = \bar{\epsilon}q$ and the entry level is $q^X = p^X/\bar{\epsilon}$. Welfare in the long run is:

$$W^{LR} = p^X(\bar{p}p^X/\bar{\epsilon} - \hat{q}_H) + \int_0^{(1-\bar{\rho})p^X/\bar{\epsilon} + \hat{q}_H} \hat{q}_H(1-x)dx - \int_0^{p^X/\bar{\epsilon}} \bar{\epsilon} x dx.$$  

To have high quality on the home market in equilibrium requires an export price lower than in Example 6—we also fix $\bar{\epsilon} = .2$.

<table>
<thead>
<tr>
<th>$\bar{\rho}$</th>
<th>$p^X$</th>
<th>$q^X$</th>
<th>$p^A$</th>
<th>$q^A$</th>
<th>$W^{LR}$</th>
<th>$W^A$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>0.2</td>
<td>1</td>
<td>1.64</td>
<td>0.818</td>
<td>0.356</td>
<td>0.368</td>
</tr>
<tr>
<td>0.8</td>
<td>0.23</td>
<td>1.15</td>
<td>0.16</td>
<td>0.8</td>
<td>0.264</td>
<td>0.32</td>
</tr>
</tbody>
</table>

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Example 8  Welfare can improve in the short run, but be below autarkic welfare in the long run.

Consider Example 4 and suppose that fixed costs are \( c(q) = q^2/9 \) so that \( W^A = .42 \). As was shown there, welfare increases in the short run if \( p^X = .36 \). However, at this price in the long run all high quality is exported with \( q^{LR} = 1.7 \), yielding welfare of \( W^{LR} = .36 < .42 = W^A \). □

Example 9  Trade can reduce welfare in the long run, even if firms can and do invest in quality (Proposition 7)

Let \( h(q) = 1 - q \) and \( c(q) = \overline{c}q = .5q \), but now let \( c_I(q) = c_Iq, c_I > \overline{c} = .5 \). The examples in the table indicate how much greater \( p^X \) can be than \( p^A \) and producer surplus or welfare still decreases with trade even though investment significantly increases high quality.

```
<table>
<thead>
<tr>
<th>( \bar{p} )</th>
<th>( \rho_I )</th>
<th>( c_I )</th>
<th>( \rho_I/c_I )</th>
<th>( (p^X)^{PS}/p^A )</th>
<th>( (p^X)^W/p^A )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.9</td>
<td>1.0</td>
<td>0.9</td>
<td>1.57</td>
<td>1.72</td>
</tr>
<tr>
<td>0.1</td>
<td>0.9</td>
<td>2.0</td>
<td>0.45</td>
<td>2.22</td>
<td>2.43</td>
</tr>
<tr>
<td>0.1</td>
<td>0.9</td>
<td>3.0</td>
<td>0.3</td>
<td>2.72</td>
<td>2.98</td>
</tr>
<tr>
<td>0.1</td>
<td>0.9</td>
<td>4.0</td>
<td>0.225</td>
<td>3.14</td>
<td>3.44</td>
</tr>
</tbody>
</table>
```

Intuitively the price ratios increase as the return to investment decreases as then it takes a higher export price to make trade welfare improving.