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# Improving “National Brands”: Reputation for Quality and Export Promotion Strategies

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## Abstract

Why do “made in” labels matter? We study the effect of firm and country reputation on exports when buyers cannot observe quality prior to purchase. Firm-level demand is determined by expected quality, which depends on both past experience with the good and the country of origin’s reputation for quality. Asymmetric information acts as a barrier to entry for high-quality firms but facilitates sales by “fly-by-night” low-quality firms. We derive two types of steady-state equilibria with endogenous reputation. In a high-quality equilibrium, imperfect information does not hinder entry into export markets, but there is a distortion in profits and in the quality composition of exports. In a low-quality equilibrium, we obtain a sorting of firms into exporting that is non-linear in quality. A range of relatively high-quality firms are permanently kept out of the market by the informational friction, so that countries with bad quality reputation can be locked into exporting low-quality, low-cost goods. Export subsidies then have a positive welfare effect on the exporting country, by improving the average quality of its exports and its terms of trade. However, a subsidy has the opposite long-run effects in a country that initially exports relatively high-quality products. The model is consistent with empirical patterns of export prices. Measuring national reputations by analyzing the content of US newspaper articles about foreign countries over 1988-2006, we find that more positive news coverage of foreign countries and companies is associated with higher unit values of their exports to the US, particularly in sectors with a larger scope for vertical differentiation.

*Keywords:* product quality, product differentiation, export promoting, industrial policy

*JEL:* F12, F13, L15, L52, O14, O24

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# 1 Introduction

Why are consumers willing to pay more for indistinguishable “Made in Germany” than “Made in China” products? In which way is building a solid reputation for reliability and quality key to a developing country’s economic success – and how can it be achieved? Conversely, can a history of exporting cheap low-quality goods be an obstacle *per se* to national development strategies aimed at upgrading quality over time? These questions find no clear answers in standard models of international trade, which assume that consumers are perfectly informed about the characteristics of every available product and leave no role for country reputations. However, as an old and large literature on experience goods has shown, starting with Nelson (1970), quality is not fully known to consumers prior to purchase for a wide range of goods. Inferring the quality of a good on offer requires time and is achieved both through search and through experience. For these categories of goods, country-of-origin affects product evaluations and consumers’ decisions. Indeed, many survey-based studies in the marketing literature, summarized by Roth and Diamantopoulos (2009), emphasize the role of country-of-origin labels in setting consumer perceptions of quality.

In this paper, we argue that a “national brand image” matters because it provides an anchor for the expected unobservable quality of imports. Consumption decisions, in practice, are based on a limited information set about the characteristics of goods or varieties. To understand the determinants of demand faced by entrants as well as incumbents in an industry, we need to consider the information available to consumers at the time of purchase: information gathered as a result of past consumption experience and word-of-mouth diffusion, but also the producer’s brand name and the country where the good was manufactured. Together, these elements determine perceived quality, which affects consumption more than true quality when the latter is not observable. Specifically, for new and unknown foreign brands, the main piece of information available to consumers is the “made in” label, which indicates the country of manufacturing and creates a key role for national reputations. We call “national reputation” the common component of consumers’ perceptions of the quality of goods produced within a given country. Usual examples of such priors are the widespread perceptions that “German goods last a lifetime” or “Chinese goods break down quickly”. Country reputations determine the quality that buyers expect from a product before they learn any information specific to this variety. In the long-run, reputations should adjust to the actual average quality of exported goods.

Using newspaper content analysis to proxy for national reputations, we provide evidence that a better reputation is associated with higher unit prices on exports to the US, after controlling for other determinants of within-sector vertical specialization across countries. Moreover, this relationship is stronger for sectors with more quality differentiation, which lends support to the asymmetric information foundation of our model.

We proceed to analyze the impact of asymmetric information on the demand for imported goods and on the long-run quality composition of a foreign country's exports. Quality uncertainty leads to consumption patterns where both brand reputation and country-of-origin matter, and where incumbents are able to charge higher prices than unknown brands. As long as quality is gradually observed through consumption, asymmetric information about quality distorts demand relatively more for new entering firms without established brand names, compared to the perfect information case. It raises profits of low-quality firms benefiting from good country-of-origin labels, but is an obstacle to exporting for high-quality firms unable to signal their type in low-reputation countries.

Broadly speaking, we are addressing three main questions. First, how does a poor "national brand" act as a barrier to entry into foreign markets? Second, under which conditions do quality expectations have self-fulfilling effects, keeping some exporting countries into low-quality traps? Finally, which policy instruments can help countries overcome the adverse impact of such information asymmetries?

More specifically, we consider a two-country model with a continuum of potential foreign exporters heterogeneous in quality and a constant flow of new entrants per period. Quality is exogenous and known to firms but not observed by consumers before purchase. Hence, import demand depends on perceived quality, which has two components. Goods imported from a given country are first evaluated according to a country-wide prior, which is determined by the average quality of the country's exports in a long-run industry equilibrium. Importers then learn about the true quality of firms that have exported in the past. The fraction of informed consumers increases with the time a firm has been active on the market. The effect of the country prior will thus prevail for new exporters and fade over time as buyers gain familiarity with individual foreign brands. On the supply side, potential foreign exporters decide whether to enter the market and when to exit, taking into account the impact of their decisions on expected future sales. If active, they sell at a price determined by the buyer's quality expectation. We assume that the cost of producing one physical unit of the good is monotonically increasing in quality, but the cost per quality-adjusted unit is decreasing in quality. Thus, although our focus is on vertical differentiation, quality and productivity are positively related in our model.

Our main channel is a distortion in entry and sales due to unobservable quality. Asymmetric information fosters entry by low-quality firms, which earn higher profits than under perfect information by free-riding on high quality expectations. It depresses profits of the highest-quality firms, forced to incur initial losses in order to reveal information about their type. At the industry level, there are two types of steady-state equilibria with endogenous country reputations. In a high-quality, high-reputation equilibrium, imperfect information does not hinder entry of high-quality firms into export markets but generates excess entry by

low-quality firms. In a low-quality, low-reputation equilibrium, a range of firms with above-average quality are permanently kept out of the market by the informational friction. With costs too high to allow for positive profits in the first periods, and quality too low for initial losses to be recouped with future profits, this set of firms choose never to be active. The sorting of firms into export status is therefore non-linear: only the lowest-quality and the highest-quality firms are active. Furthermore, there can be multiple low-quality equilibria, such that countries with bad quality reputation can be locked into exporting low-quality, low-cost goods.

The model yields interesting policy implications. In particular, imperfect information about the quality of imported goods provides a justification for export promotion policies in economies specialized in low-quality products. Some export-led growth strategies for developing countries, pursued in the past by East Asian economies, rely on exporting low-quality, low-cost goods and gradually moving up to higher quality, higher unit value goods.<sup>1</sup> China is attempting to follow the same path. Without policy intervention, though, we show that it may not be feasible if the economy is trapped in a self-fulfilling low equilibrium, in which the country's reputation for low quality prevents high-quality firms from entering export markets. A successful export promotion policy then involves either subsidizing exporters' initial losses, or investing public resources into raising the country's perception abroad. Indeed, we find that export subsidies improve the average quality of exports, raise unit prices received by exporting firms and have a positive welfare effect in countries that are initially in a low-quality equilibrium.<sup>2</sup> However, subsidies have the opposite long-run effects in countries exporting high-quality goods. In the latter case, the induced entry by low-quality firms creates a negative externality on all exporters, lowering average quality, reputation and aggregate profits.

Moreover, we show that large reputation shocks, for instance triggered by heavily mediated events or by a government-sponsored national promotion campaign, can have self-fulfilling features. Small reputation shocks only have short-lived effects. But when there are multiple steady-states, a large positive reputation shock in a low-quality equilibrium raises prices received by all firms and allows more firms with above-average quality to enter, thereby driving up the true average quality of exported goods. Reputation and quality increase jointly until the economy settles in a higher steady-state.

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<sup>1</sup>We dwell in more details on the Japanese and South Korean examples in Section 2.

<sup>2</sup>The case for export subsidies is mixed in the existing literature. Brander and Spencer (1985) first introduced the idea of welfare-enhancing subsidies in a Cournot strategic rivalry, and Greenwald and Stiglitz (2006) developed an infant-industry argument for protective trade policy. Flam and Helpman (1987) find that the desirability of export subsidies is ambiguous, depending on the production structure. Demidova and Rodríguez-Clare (2009) show that subsidies improve productivity in a model with heterogeneous firms, but are nonetheless detrimental to welfare due to losses in terms of trade and variety. Recently, Aghion et al. (2012) make a more specific case for targeted industrial policy towards more competitive sectors. The main arguments for active trade policy relying on coordination failures and externalities are reviewed and assessed in Harrison and Rodríguez-Clare (2009).

This paper relates to two main strands of literature. In a closed economy framework, several early papers (Shapiro, 1983; Riordan, 1986; Farrell, 1986; Liebeskind and Rumelt, 1989) have studied entry and pricing strategies for experience goods, for which quality is unobservable a priori and is only revealed through repeated consumption. Bergemann and Välimäki (1996, 2006) incorporate the experimentation and learning processes by consumers. Furthermore, there is evidence of the benefits of a reputation for quality in terms of brand premia (Imbs et al., 2010) and image spillovers across products of the same brand (Sullivan, 1990). We develop these insights further by considering the demand for imports, where initial priors depend on country-of-origin and reputations are built not only for specific firms but also for exporting countries as a whole.

In the international trade literature, vertical quality differentiation has recently been studied by Baldwin and Harrigan (2011); Johnson (2012); Verhoogen (2008); Hallak and Sivadasan (2009); Kugler and Verhoogen (2012); Manova and Zhang (2012) and Fajgelbaum et al. (2011). However, these papers assume perfectly observable quality and deal with the choice of quality by exporters. Instead, we abstract from the endogenous quality choice by firms and study the implications of asymmetric information on the equilibrium quality range of exports.

The literature most closely related to this paper deals with the policy implications of asymmetric information about the quality of foreign goods. Grossman and Horn (1988) examine the infant-industry argument in a two-period model with moral hazard in the choice of quality, and find no case for temporary or permanent protection. However, the extensive margin of trade in their model concerns only low-quality firms, while we show that a subsidization policy can also encourage entry by high-quality firms in an infinite-period setting with overlapping generations of firms. Although Bagwell and Staiger (1989) point out that asymmetric information may lead to insufficient entry by high-quality firms, they focus on a single-firm, single-consumer interaction with two quality levels and do not allow for reputation externalities between firms. We show that these externalities, from the entry decisions of heterogeneous firms to buyers' beliefs, lie at the core of the effects and of the policy implications of unobservable quality. Chisik (2003) develops the idea of a "reputational comparative advantage" whereby country labels act as a coordinating device for exporters, but also assumes away within-country reputation externalities by building a single-firm model. Lastly, Dasgupta and Mondria (2012) develop a two-period model with similar features to ours, where the quality of new exporters is unobservable and that of continuing exporters is known by a fraction of consumers. However, their paper deals with firm reputations and the role of intermediaries in providing quality assurance, taking as given the first-period price. We take the analysis further by endogenizing country reputations in an infinite-horizon setting and characterizing steady-state equilibria.

Other papers introducing imperfect information in trade have addressed different issues

such as uncertainty about demand conditions for firms entering a foreign market (Hoff, 1997; Segura-Cayuela and Vilarrubia, 2008), reputation-building for distributors in the importing country (Araujo and Ornelas, 2007), or marketing costs incurred to make consumers aware of the existence of foreign goods (Arkolakis, 2010). Rauch and Watson (2003) focus on the tendency of buyers in developed countries to start small in building partnerships with suppliers in less developed countries, in order to learn about their ability to fill large orders. Finally, there are some empirical studies of the effect of perceptions of foreign countries on trade flows. Guiso et al. (2009) and Disdier and Mayer (2007) find a relationship between bilateral trust or bilateral opinions and imports, but do not consider the quality aspect of countries' reputations. Specific reputation shocks have only been analyzed through event studies, such as the negative perception of France in the US at the onset of the Iraq war (Michaels and Zhi, 2010) and recalls of Chinese toys (Freedman et al., 2009).

The remainder of this paper proceeds as follows. Section 2 presents motivating historical evidence and stylized facts on the importance of national quality reputation for exporters. Section 3 lays out our modelling framework and Section 4 analyzes high-quality and low-quality steady-state equilibria with endogenous reputation. Section 5 explores the effects of export promotion policies on quality, reputation and profits. Finally, Section 6 concludes.

## 2 Empirical motivation

### 2.1 Historical motivation: Creating “National Brands”

Since their creation, country-of-origin labels have been related to protectionist concerns. When the “Made in Germany” label – now an internationally recognized signal of quality – was introduced, it was as a policy instrument against German exports. The label was originally created in the United Kingdom by the Merchandise Marks Act of 1887 to signal foreign products, then considered by the British society as inferior to domestic ones. Ironically, a few years later, in 1894, a commission of the German Reichstag reported that German manufacturers found the label to be of good use: having achieved superior quality, they were better able to distinguish themselves from British manufacturers. Even more surprisingly, as reported by Umbach (2003), *“English manufacturers even began to forge the label, printing it on their English-made products”*. The “Made in Germany” label had turned from a signal of poor quality into a signal of the best quality.

Similarly, at the end of World War II, “Made in Japan” goods had a reputation for being cheap low-quality goods. Japanese companies were suffering from an inferior “national brand”. On the contrary, currently, Japanese cars and electronics are ranked among the most reliable in all consumer surveys. More generally, Japan’s pattern of specialization in manufactures has evolved dramatically, shifting from unskilled labor-intensive goods to human capital and

R&D-intensive products (Balassa and Noland, 1989). Japanese companies achieved such a dramatic change by privately imposing strict quality norms. They formed export cartels which provided product quality guarantees, by setting product design and quality standards, establishing industry brand names, guaranteeing delivery schedules and mediating disputes between individual exporters and foreign buyers (Dyck, 1992). Providing product quality assurances to importers stimulated growth in exports and improved terms of trade. Hence, as argued by Lynn and McKeown (1988), the ability to establish collectively a reputation for product quality was key to Japan’s export success. This ability was the outcome of both private companies and government initiatives: in the public policy realm, not only did antitrust laws permit the formation of export cartels, but export restrictions were exercised under the Control Law<sup>3</sup>.

Government initiatives also played a key role in the shift in South Korea’s pattern of trade specialization since the 1970s. Public investment subsidies were tied to exporting activity, as Korean governments were determined to favor the emergence of the country on the international trade scene.<sup>4</sup> These policies resulted in the channeling of credit at negative interest rates to South Korean conglomerates and provided them with insurance against business risk, particularly in the export market (Aw et al., 1998). This export-led development strategy is often pointed as having been the hallmark of the East Asian miracle growth (e.g. World Bank, 1993). Incidentally, Korea’s determination to play a growing international role was showcased by hosting the Olympic Games in Seoul in 1988.<sup>5</sup> From a historical point of view, the 1988 Olympics symbolized the success of over three decades of active government intervention in the economy.<sup>6</sup>

In a similar way, the 2008 Beijing Olympics reaped a huge prestige bonanza for China, being (again) the most-viewed televised event ever – in the United States, the cumulative audience amounted to over two-thirds of the population – and representing China’s grand entrance onto the world stage. However, an interesting takeout of this example is also its limitations. China is struggling to move up the value chain in its exports.<sup>7</sup> Although a

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<sup>3</sup>The first paragraph of Article 48 of this law sets that “*any person desiring to export goods of any designated type, or goods destined for any special areas, or to export goods by means of any designated form of transaction or payment, may be required to obtain the approval of the Ministry of International Trade and Industry*” (Matsushita, 1979).

<sup>4</sup>Pack and Westphal (1986), Westphal (1990), Levy (1991), and Rodrik (1995) have documented the importance of government investment subsidies in Korea.

<sup>5</sup>On a related note, Rose and mark M. Spiegel (2011) show that hosting the Olympics boosts a country’s subsequent exports and find support for the hypothesis that hosting mega-events (or applying to do so) serves as a policy signal.

<sup>6</sup>On September 17, 1988, over a billion people worldwide watched the Olympics opening ceremony, telecast from Seoul, the then largest television audience in history (Larson and Park, 1993) and a global advertisement for the country’s image. South Korea “*emerged from the Games in triumph both as host and competitor. (...) [It] has been bent on showing the world that it is no longer a place to overlook. The Games are only part of that*” (New York Times, 10/08/1988).

<sup>7</sup>Schott (2008) documents that the prices that US consumers are willing to pay for Chinese exports are substantially lower than the prices they are willing to pay for OECD exports in the same product category.

large-scale national promotion event can help improve a country’s image abroad, it is far from sufficient to overcome a bad reputation when the economy seems stuck in a low-quality trap, whereby high-quality firms suffer from the country’s reputation in their attempts to export. The strategy of Lenovo, the only Chinese company to get a worldwide sponsorship for the 2008 Beijing Olympics, is revealing in this respect. With a Western-sounding name, the legacy of the I.B.M. brand name and technology, and a chief executive who hails from Dell and NCR, the Lenovo Group is not a company that most Americans would assume is Chinese. This is exactly what the company aims for (although Lenovo’s largest shareholder is the Chinese government), aware of the fact that the typical American consumer associates Chinese products with cheap and unreliable: “*They want to be viewed as a global company, not a Chinese company, in the West or they’ll never be able to beat the cheap rap*” (*New York Times*, 06/20/08). In some sectors, Chinese firms are even relocating factories or assembly lines in Europe to obtain the “made in Europe” label, as in the plan for a “Châteauroux Business District” in France.<sup>8</sup> Hence, whether China can, in the coming years or decades, successfully follow the same path as Japan and South Korea in the past, remains an open question.

## 2.2 Stylized facts: National reputations and unit prices

Moving beyond anecdotal motivations, we provide some additional evidence of the importance of country-of-origin reputations in current trade patterns. This section shows that the quality of a country’s exports, as measured by unit prices, is not only determined by observable fundamentals such as the country’s income level and factor endowments. Perceptions, mediated by news sources, also seem to play a role – either because the media are a supplier of information beyond observable country characteristics or because of a pure reputation effect. Both of these interpretations are associated with asymmetric information in the demand for imports, which is the foundation of our model.

More specifically, news coverage of a country provides a proxy for national reputations. For consumers, the media are providers of information about safety scandals or successful businesses in foreign countries, work practices and the general reliability of foreign goods. For firms sourcing inputs from foreign suppliers, news also reflect information relevant to risks of delays, disruption of supply chains or corruption practices, which affect their expected value from the importer-exporter relationship. Our working hypothesis is that media coverage is a channel through which country perceptions are formed, confirmed or changed, affecting the demand for goods produced in countries that receive massive positive or negative news coverage.<sup>9</sup> We establish that controlling for the determinants of unit values and specialization

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Furthermore, the gap or “OECD brand premium” has been increasing over time.

<sup>8</sup> “Un ‘made in France’ très convoité”, *L’Express*, 01/11/2012.

<sup>9</sup> This empirical approach is inspired by the literature on media bias. The broad insight from this growing

into higher-quality goods that have already been identified in the literature, better reputation is associated with higher unit prices on exports. This relationship does not need to be interpreted causally but rather as an equilibrium outcome under asymmetric information: in our model, the relationship between the national reputations of exporting countries and the quality of their exports runs both ways to generate a price-reputation dependence.

### 2.2.1 Data

We collect news coverage data from the Factiva website, which aggregates content from over 31,000 news sources. We developed a script that searches all US news and business publications for articles covering a given foreign country, in a given year, and including a keyword from a list of relevant terms.<sup>10</sup> We gather data on 146 countries over 1988-2006, excluding countries of less than 1 million inhabitants, which receive almost no coverage in US media. The list of 116 keywords was identified through a systematic listing of recurring terms and phrases in the coverage of foreign countries and companies in the *New York Times*, the *Wall Street Journal*, *Business Week* and the *Boston Globe*. We sort them into four categories. The “political” category relates to the foreign country’s general political context and is split between positive terms (e.g. “democratic transition”) and negative terms (e.g. “corruption”). The “quality” category deals specifically with quality issues, improvements or scandals. We distinguish between positive (e.g. “quality control”) and negative (e.g. “class-action suit”) terms.<sup>11</sup> To avoid misclassifying negative articles as positive and vice versa, we exclude articles where a negating word appears around the keyword. For quality-related keywords, we conduct the searches both at the aggregate country level and in articles dealing with specific industries for 11 sectors<sup>12</sup>.

We obtain a total of over 2.5 billion relevant articles published in US news sources. We count the number of articles with positive or negative keywords per country-year for political and quality categories, and per country-year-industry for quality categories. We define current news variables with the number of articles in each category in the current year. Article counts

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literature is that media coverage affects real outcomes, such as political participation (Della Vigna and Kaplan, 2007; Cagé, 2012), political accountability (Besley and Burgess, 2002), or stock market reactions to earnings announcements (Dyck and Zingales, 2003).

<sup>10</sup>Or any word sharing the root of the keyword. For instance for the keyword “counterfeit”, the script also searches for “counterfeited”, “counterfeiting”, etc.

<sup>11</sup>Examples of search results on China are: “World briefs - Houston Chronicle, 31 December 1996, 486 words, (English) ... BEIJING - China is preparing this week to carry out a series of legal reforms hailed by some as a step toward greater rule of law and protection of individual rights. ...” (political, positive); “Brilliance China Automotive Holdings Limited Announcement - PR Newswire, 5:16 AM, 31 December 2003, 3733 words, (English) ...relationship with the JinBei group of companies and will be in a better position to monitor and exercise more stringent quality control over the automotive components that it purchases from the JinBei group of companies. Accordingly, the Directors consider...” (quality, positive).

<sup>12</sup>Aerospace/Defense; Automobiles; Chemicals; Clothing/Textiles; Computers/Electro-nics; Consumer Products; Food/Beverages/Tobacco; Machinery/Industrial Goods; Paper/Packaging; Pharmaceuticals; and Telecommunications.

are then normalized by the sum of all articles in the same category and same period across countries. The normalization accounts for the positive trend in the number of articles in the database over time.

Specifically, for country  $c$ , industry  $i$ , year  $t$  and  $k \in \{\text{positive, negative}\}$ , we construct the following variables:

$$\text{industry quality news}_{c,t,i,k} = \frac{\# \text{ quality articles}_{c,t,i,k}}{\sum_{c \in C} \# \text{ quality articles}_{c,t,i,k}} \quad (1)$$

$$\text{political news}_{c,t,k} = \frac{\# \text{ political articles}_{c,t,k}}{\sum_{c \in C} \# \text{ political articles}_{c,t,k}} \quad (2)$$

We match the news data with US import data at the 5-digit SITC level from Robert Feenstra, described in Feenstra et al. (2002). We calculate f.o.b. unit values at the 10-digit HS level where quantity units are homogeneous across observations. We then construct sectoral indices of export unit values for each country  $c$  by calculating the average, across all 10-digit products exported in the 5-digit sector, of  $c$ 's unit prices relative to those of all countries exporting the product to the United States.

Our independent variables include gravity variables from Head et al. (2010)<sup>13</sup> and international and civil conflict variables from the Correlates of War database. The correlation of votes at the United Nations General Assembly controls for the degree of political alliance with the United States. Following Schott (2004) on the determinants of unit prices, we include the capital/labor ratio of the exporting country and the fraction of its population having achieved at least secondary education. These data are constructed respectively from Penn World Tables 7.0 and from Barro and Lee (2010). Finally, the length of quality ladders from Khandelwal (2010) measures the extent of quality variation within 5-digit sectors, and therefore the scope for vertical differentiation.<sup>14</sup> Table 1 provides some descriptive statistics.

### 2.2.2 Unit prices, reputation and quality

Table 2 reports the results of the industry-level specifications. As mentioned above, we include as independent variables GDP per capita, capital/labor endowment and education attainment, which affect the quality range of a country's production. We also include year and sector fixed effects and cluster standard errors by country. We show that export unit values, after controlling for these and gravity variables, are correlated with the type of news that appear in US printed media about the exporting country and its companies.

<sup>13</sup>Distance, GDP, population, common border, common official language, former colonial ties, common legal origin, common currency and GATT/WTO membership. Note that GDP, market size and remoteness are also determinants of firms' choice of export quality across destinations, as shown by Manova and Zhang (2012).

<sup>14</sup>Khandelwal estimates the quality of US imports from price and market share data. Conditional on price, a product with higher market share is assigned higher quality. In our framework, it is more precisely a measure of perceived quality. The scope for vertical differentiation (length of quality ladders) is then calculated from the heterogeneity in estimated product qualities within products.

Table 1: **Summary statistics**

	Mean	St. dev.	Min	Max
Export unit value index	89.287	107.237	0.002	2795.957
Positive industry quality news	1.703	0.986	0	4.021
Negative industry quality news	3.126	3.578	0	40.323
Positive political news	1.554	0.888	0	4.001
Negative political news	0.401	0.680	0	3.097
Quality ladder	2.072	0.8776	0	5.803
Capital/labor ratio	60.952	36.482	0.438	153.856
Skilled fraction of population	50.161	19.156	2.001	92.656
UN vote correlation	0.223	0.347	-0.680	0.882

Positive and negative industry quality news are defined and normalized as in equation (1) and political news as in equation (2). Quality ladder is the length of industry-level quality ladders from Khandelwal (2010).

In column 1, we find that within industries, countries where a sector receives better coverage in US media charge higher unit values on the sector’s exports, relative to countries receiving less favorable coverage. The coefficient is larger for negative quality news, about quality defects or scandals, than for positive news, about successes and quality control. We also find that unit prices are higher on imports from political allies (high correlation of UN votes) and lower on imports from countries with higher capital-labor ratios.<sup>15</sup>

In column 2, we interact the news variables with Khandelwal’s quality ladder measure.<sup>16</sup> A longer quality ladder implies that the sector has more dispersion in quality, hence is more vulnerable to concerns about unobserved quality. Consistent with our interpretation in terms of asymmetric information, we find that the effect of industry-level news is magnified in sectors where there is more scope for vertical differentiation. According to the point estimates, a 10% increase in the quantity of positive (respectively, negative) quality-related news relative to other foreign countries is associated with a 0.3% increase (respectively 0.5% decrease) in the unit value of exports in a sector at the mean of quality ladders. For the sector with the longest quality ladder, i.e. the most vertical differentiation, the corresponding values are respectively a 0.8% increase and a 1.3% decrease in unit value.

It may be that these results are affected by the total volume of news coverage of a country if some countries are more heavily covered by US media because of a cultural or geographical proximity not captured by our controls, and are also more frequent and trusted trading part-

<sup>15</sup>This result on capital-labor ratios seems to contrast with the existing literature. However, we can replicate Schott (2004)’s finding that higher capital-labor ratios are associated with higher unit values when the independent variables only include, beyond the capital/labor ratio, year and sector fixed effects, as in his paper. When we add country fixed effects or control for gravity variables, the positive coefficient on the capital-labor ratio disappears.

<sup>16</sup>Since the quality ladder variable is calculated at the industry level and is time-invariant, its direct effect is captured by industry fixed effects in the regressions.

ners. Controlling for the total amount of news concerning the country-sector pair, however, does not change any of the relevant coefficients (columns 3 and 4). Finally, in columns 5 and 6, we include political news at the country level, and find insignificant coefficients, confirming that the most relevant information is quality-related news rather than general country images. Note that we already proxy for political goodwill towards foreign countries with the correlation of UN votes.

In Table 3, we repeat the exercise with aggregate country news per year (both political and quality-related) instead of news covering specifically the industry. We find again that positive news about quality are associated with higher unit prices on exports and negative quality news with lower unit prices. Political news coverage does not enter significantly after including the UN vote measure of alliances. The coefficients do not vary in a significant manner according to the length of quality ladders. Thus, these results seem to indicate that national reputations are formed at the country-sector level rather than at the overall country level.

To sum up, we have shown that countries with a better quality reputation, mediated by news coverage, have higher unit prices after controlling for known determinants of country-wide quality. The link is stronger in sectors with large scope for vertical differentiation, supporting our interpretation of country reputations as a component of expected quality. Naturally, although reputation shocks may not be directly related to changes in the actual quality distribution of a country's exports, long-run perceived and actual quality go hand-in-hand and the contents of media articles are related to both. What we have shown is that after controlling for observable country characteristics, there is still a role for quality perceptions to influence unit prices. These results support the presence of imperfect information in international trade transactions. We proceed to formalize these insights in a model with asymmetric information.

## 3 Model setup

### 3.1 Firms

We develop a model with two countries, Home and Foreign. We focus on the industry equilibrium in an export-oriented sector in Foreign, for which Home is the importer. The industry is composed of overlapping generations of foreign exporters. We do not model explicitly the domestic market of foreign firms: all firms in the industry produce for export only.<sup>17</sup>

There is a constant number  $E$  of potential exporters being born every period. Each new

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<sup>17</sup>We could easily extend the model to allow firms to serve their domestic market as long as the decisions to enter the domestic and export markets are separable. The key assumption is that there is no information flowing between buyers located in different geographic markets. In particular, a firm having established a reputation in its domestic market would not be able to transfer this reputation to export sales.

Table 2: **Export unit prices and country/industry news coverage**

	Unit value index					
	(1)	(2)	(3)	(4)	(5)	(6)
Positive industry quality news	0.035*	0.006	0.046	0.016	0.030*	0.000
	[0.018]	[0.019]	[0.030]	[0.029]	[0.016]	[0.017]
Negative industry quality news	-0.059***	-0.010	-0.053***	-0.007	-0.056***	-0.008
	[0.021]	[0.022]	[0.019]	[0.021]	[0.019]	[0.021]
Positive industry quality news*ladder		0.015***		0.015***		0.015***
		[0.005]		[0.005]		[0.005]
Negative industry quality news*ladder		-0.024***		-0.023***		-0.024***
		[0.006]		[0.006]		[0.006]
Total industry quality news			-0.008	-0.007		
			[0.025]	[0.025]		
Positive political news					0.099	0.098
					[0.064]	[0.064]
Negative political news					-0.087	-0.086
					[0.060]	[0.060]
Capital/labor ratio	-0.163***	-0.163***	-0.221***	-0.221***	-0.174***	-0.174***
	[0.053]	[0.052]	[0.061]	[0.061]	[0.054]	[0.054]
Skilled fraction of population	0.009	0.009	0.025	0.025	0.010	0.011
	[0.070]	[0.069]	[0.084]	[0.084]	[0.069]	[0.068]
UN vote correlation	0.252***	0.252***	0.282***	0.282***	0.230***	0.230***
	[0.084]	[0.084]	[0.089]	[0.089]	[0.084]	[0.084]
Observations	157 906	157 906	143 024	143 024	157 906	157 906
R-squared	0.261	0.261	0.264	0.264	0.261	0.261

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. All regressions include year and industry fixed effects and gravity variables as described in footnote 13. Standard errors clustered by country are in brackets. All news variables, capital/labor ratio and the skilled fraction of the population are in logs.

Table 3: **Export unit prices and country news coverage**

	Unit value index					
	(1)	(2)	(3)	(4)	(5)	(6)
Positive quality news		0.163*	0.195**	0.222**	0.251***	0.423**
		[0.088]	[0.086]	[0.088]	[0.085]	[0.171]
Negative quality news		-0.120	-0.119*	-0.170**	-0.166**	0.005
		[0.075]	[0.071]	[0.083]	[0.080]	[0.120]
Positive quality news*ladder				-0.030	-0.029	-0.028
				[0.021]	[0.021]	[0.021]
Negative quality news*ladder				0.025	0.024	0.023
				[0.021]	[0.021]	[0.021]
Positive political news	0.110		0.006		0.005	0.004
	[0.069]		[0.062]		[0.062]	[0.056]
Negative political news	-0.089		-0.052		-0.052	0.029
	[0.064]		[0.054]		[0.055]	[0.041]
Total news						-0.421
						[0.301]
Capital/labor ratio	-0.173***	-0.164***	-0.172***	-0.164***	-0.173***	-0.174***
	[0.053]	[0.046]	[0.047]	[0.046]	[0.047]	[0.046]
Skilled fraction of population.	-0.004	0.009	0.021	0.009	0.021	0.023
	[0.066]	[0.060]	[0.057]	[0.060]	[0.057]	[0.054]
UN vote correlation	0.155*	0.170*	0.142*	0.170*	0.142*	0.138*
	[0.084]	[0.087]	[0.080]	[0.086]	[0.080]	[0.077]
Observations	204 237	203 883	203 460	203 883	203 460	203 460
R-squared	0.261	0.262	0.262	0.262	0.263	0.263

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. All regressions include year and industry fixed effects and gravity variables as described in footnote 13. Standard errors clustered by country are in brackets. All news variables, capital/labor ratio and the skilled fraction of the population are in logs.

firm draws a quality parameter  $\theta$  from a distribution  $G(\theta)$  with support on  $[\theta_m, \infty)$  and density  $g(\theta)$ , and has the option to produce a good of quality level  $\theta$ .<sup>18</sup> At the beginning of every period, firms decide whether to stay active and export, or shut down. Each firm has capacity 1, so that it can choose to sell either one unit or nothing.

If it produces and sells, a firm  $j$  of type  $\theta$  incurs a cost  $w\theta + k$ , including both production and transport costs.  $k$  includes all costs that are independent of quality, while  $w\theta$  is the portion of costs that increases with the quality of the product (e.g. quality control processes, better intermediate inputs, more skilled workers). Hence, profits at period  $t + s$  of an active firm  $j$  born at date  $t$  are:

$$\pi_{t+s}(j) = p_{t+s}(j) - w\theta(j) - k \quad (3)$$

where  $p_{t+s}(j)$  is the price at which firm  $j$  sells its output. The price-setting mechanism is described in the next subsection.

A firm can freely exit at any period and realize zero profits from this period onwards. However if it chooses to exit the export market in a given period, it cannot re-enter later.<sup>19</sup> Moreover, each firm has an exogenous probability  $1 - \delta$  of disappearing every period, independent of both quality and the firm's age. The probability that a firm still exists from one period to the next, conditional on not choosing to exit, is  $\delta$ . There is no additional discount rate.

### 3.2 Buyers

In Home, there is a pool of importers each of which demands one unit of the good. We assume that there are no tariffs.<sup>20</sup> Potential demand for imported goods in Home is assumed to be large, in the sense that the market size is sufficient for all foreign exporters to find a buyer at a price that does not exceed the expected value of their goods. The true utility from consuming the product is  $\theta$  but is not observable before purchase. We can think of  $\theta$  as characteristics that are observed only upon consumption, or for durable goods, as the inverse of the probability of breakdown per period.

At the beginning of every period, each active firm is randomly matched to a buyer in Home. The firm cannot sell to another importer in that period, nor can the buyer purchase from another exporter before the next period. The firm then sets the price equal to the expected value of the good for its buyer. The indirect utility buyer  $i$  receives from variety  $j$

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<sup>18</sup>For simplicity we do not model the choice of quality. We can think of the exogenous quality draw as determined on the domestic market before considering the decision to export, or as a technology blueprint which comes from an R&D process with uncertain outcome: all firms invest the same sunk cost in R&D and randomly, some come up with better quality products than others.

<sup>19</sup>This assumption is inconsequential for the steady-state analysis. It rules out coordination problems among high-quality firms along the transition path.

<sup>20</sup>Ad valorem tariffs are introduced in Appendix C.

is:

$$u^i(j) = \theta(j) - p(j) \quad (4)$$

which can be derived from an additively separable utility function where buyer  $i$  consumes a numeraire good and one unit of the imported differentiated good. As  $\theta(j)$  is not observed, the maximum price that an importer  $i$  is willing to pay for the output of firm  $j$  at time  $t + s$  is given by its expected quality from the perspective of the buyer:

$$p_{t+s}(j) = E_{t+s}^i [\theta(j) | I_{t+s}^i] \quad (5)$$

where  $I_{t+s}^i$  is the information set of buyer  $i$  at time  $t + s$ . We assume that firms hold all the bargaining power and receive the full expected surplus of the transaction.<sup>21</sup>

There are two types of buyers, informed and uninformed. Uninformed buyers (noted  $U$ ) have no information specific to firm  $j$ : they do not know its quality or how long it has been an active exporter. The only information at their disposal is the “national reputation”, i.e. a prior  $\mu_{t+s}$  about expected quality among all foreign exporters.  $\mu_{t+s}$  is common across buyers and will be endogenized in Section 4. Informed buyers (noted  $I$ ) know the true quality of firm  $j$ , either because they have past experience from consumption of good  $j$  or because they have received information from another importer who has. Hence, the relevant information sets of both types of buyers are:

$$\begin{aligned} I_{t+s}^U(j) &= \{\mu_{t+s}\} \\ I_{t+s}^I(j) &= \{\theta(j), \mu_{t+s}\} \end{aligned}$$

The price received by firm  $j$  matched with buyer  $i$  in period  $t + s$  is therefore equal to its quality if  $i$  is informed, and to the country’s reputation if  $i$  is uninformed. Equation (5) can thus be rewritten as:

$$p_{t+s}(j) = \begin{cases} \mu_{t+s} & \text{if } i \in U \\ \theta(j) & \text{if } i \in I \end{cases} \quad (6)$$

In the first period when a firm  $j$  enters the market, all importers are uninformed about  $j$ . Then, if firm  $j$  has exported  $s$  times in the past, a fraction  $\rho(s)$  of buyers are informed, where we make the following natural assumption:

*Assumption 1:*  $\rho' \geq 0$ ,  $\rho(0) = 0$ , and  $\lim_{s \rightarrow \infty} \rho(s) = 1$ .

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<sup>21</sup>Long-term contracts between exporters and importers are ruled out in this setting: all contracts are one-period sales contracts and firms are matched to customers for one period only. In particular, there cannot be price schedules resembling an introductory pricing strategy, whereby buyers would pay a low price in the initial period and offer a sequence of prices contingent on their future consumption experience.

The fraction of informed buyers increases as the firm gains export experience.<sup>22</sup> Note that a concave  $\rho(s)$  would capture the idea that a firm having already exported is more likely to be matched again with one of its previous buyers or with someone close to a previous buyer in terms of informational diffusion. Hence the rate at which the scope of informed buyers expands would decrease with the number of periods the firm has been on the market. However, the only conditions needed for our analysis is that  $\rho$  is monotonically increasing and takes values between 0 and 1.

For expositional simplicity we drop the  $j$  notation in the next sections and refer to “firm  $\theta$ ” instead of “firm  $j$  with quality parameter  $\theta$ ” whenever possible.

### 3.3 Timing

For a given cohort of firms born at date  $t$ , the timing of moves proceeds as follows:

- At  $t$ , each new firm  $j$  draws a parameter  $\theta(j)$  and decides whether to export or not.
- For each  $s \geq 1$ , at time  $t + s$ :
  - Each active firm  $j$  is matched with a buyer  $i$  and observes whether  $i$  is informed or uninformed.
  - The price is set at  $E_{t+s}^i [\theta(j) | I_{t+s}^i]$ , and production and sales take place.
  - For each good  $j$  that was sold, the fraction of informed buyers rises from  $\rho(s)$  to  $\rho(s + 1)$ .
  - The exogenous death shock is realized. Firms that survive decide whether to stay active.
  - New firms are born (cohort  $t + s$ ).

### 3.4 Perfect information

Under perfect information, all  $\theta(j)$  are observable by all parties. All firms receive a price  $p_{t+s}^*(j)$  equal to true quality regardless of how long they have been exporting:

$$p_{t+s}^*(j) = \theta(j) \text{ for all } s$$

Therefore, it follows from (3) that firms are active exporters if and only if  $\theta \geq \theta^*$ , where the perfect information threshold is defined as:

$$\theta^* \equiv \frac{k}{1 - w} \tag{7}$$

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<sup>22</sup>A possible microfoundation for the  $\rho(s)$  function is that importers belong to distinct groups within which information diffusion takes place. The fraction of informed buyers rises according to the probability of sampling a buyer from an uninformed versus an informed group. See Appendix B for a formal development.

Under perfect information, the model therefore predicts a sorting of firms into non-exporters and exporters similar to that of Melitz (2003). We can define productivity as the inverse of the cost per unit of quality  $w + \frac{k}{\theta}$ . The firms with the highest quality  $\theta$  are also those with the highest productivity. Firms above the quality threshold  $\theta^*$ , or equivalently below the quality-adjusted cost threshold  $w + \frac{k}{\theta^*}$ , are and remain exporters, while firms below the threshold never export.

### 3.5 Imperfect information: Price and profits

Under asymmetric information, suppose  $\mu_t$  is the buyers' prior about the expected quality of a good from the foreign country at time  $t$ . This prior is the national reputation or "national brand" and is taken as exogenous by individual firms. We derive its equilibrium value in the next section, as a function of the quality distribution of exports. The price offered to a firm  $j$  born at date  $t$  is either the country-wide prior if the buyer is uninformed, or its true quality if the buyer is informed. The probability of receiving a price which reflects the firms' true quality increases with the firm's export experience. In the first period in which firm  $j$  is active, no buyer has any information specific to the firm, so that the price only depends on the prior:

$$p_{t+1}(j) = \mu_{t+1} \quad (8)$$

Then in the following periods, conditional on firm  $j$  still being active, the pricing equation (6) implies that the price received by firm  $j$  is set according to the following rule:

$$p_{t+s}(j) = \begin{cases} \theta & \text{with probability } \rho(s-1) \\ \mu_{t+s} & \text{with probability } 1 - \rho(s-1) \end{cases} \quad \text{for } s \geq 1 \quad (9)$$

where  $\rho(s-1)$  is the fraction of informed buyers for a firm that has previously exported  $s-1$  times. In particular, a firm that exports for the first time faces only uninformed importers ( $\rho(0) = 0$ ). As  $\lim_{s \rightarrow \infty} \rho(s) = 1$ , the expectation of the price converges to the perfect information price  $\theta(j)$  over time if firm  $j$  stays in the market indefinitely.

Expected profits of firm  $j$  in future periods, conditional on remaining active, are the difference between its expected price and its production cost:

$$E_t^j \pi_{t+s}(j) = (\rho(s-1) - w) \theta(j) + (1 - \rho(s-1)) E_t \mu_{t+s} - k \quad (10)$$

Expected profits place a larger weight on true quality and a smaller weight on national reputation as the firm gains tenure into exporting. It immediately follows that if reputation is time-invariant, a firm with quality above the country prior ( $\theta(j) > \mu$ ) expects to realize an increasing sequence of profits over time, while a firm with quality below the country

prior ( $\theta(j) < \mu$ ) expects decreasing profits. For all active firms, if  $\mu$  is constant, the price is monotonically converging towards  $\theta$  and profits are monotonically converging towards their perfect information value  $(1 - w)\theta - k$ .

We also assume that the updating parameter is large enough relative to the cost of producing quality:

*Assumption 2:*  $\rho(1) > w$

This assumption ensures that expected profits from repeat purchases – as opposed to initial purchases – are increasing in true quality.

## 4 Industry equilibrium

In this section, we define a steady-state industry equilibrium as one in which national reputation is pinned down by the average quality of a country's exports and the quality distribution is stationary. We lay out the existence conditions for high-quality and low-quality steady-state equilibria and characterize the price, entry and exit patterns in each equilibrium type.

### 4.1 Equilibrium definition

Country reputations are taken as exogenous by individual firms. In each period  $t$ , let  $M_t(\theta, s)$  be the number of active firms of quality  $\theta$  having previously exported  $s$  times. Given an underlying quality distribution  $G(\theta)$  and pdf  $g(\theta)$ , we derive  $\bar{\theta}_t$  as the average quality of exports across quality levels and cohorts of firms:

$$\bar{\theta}_t = \frac{\int_{\theta_m}^{\infty} \theta \left[ \sum_{s=0}^{\infty} M_t(\theta, s) \right] d\theta}{\int_{\theta_m}^{\infty} \left[ \sum_{s=0}^{\infty} M_t(\theta, s) \right] d\theta} \quad (11)$$

Country reputations evolve according to the actual quality of exported goods in the previous period<sup>23</sup>:

$$\mu_{t+1} = \mu_t + \eta(\bar{\theta}_t - \mu_t) \quad (12)$$

where  $\eta < 1$  and  $\bar{\theta}_t$  is the average quality of foreign firms' exports at period  $t$ . Reputation rises (respectively, falls) from one period to the next if the average quality of exported goods in the previous period was higher (respectively, lower) than expected. Setting  $\eta < 1$  captures the slow-moving aspect of reputations and only matters for equilibrium stability. Along with  $\bar{\theta}_t$ , this determines  $\mu_{t+1}$  according to (11).

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<sup>23</sup>This equation is a reduced form for consumers' updating process, where the implied simplifying assumption is that  $\eta$  is constant. This hypothesis is not necessary for our main steady-state results and only ensures that equilibrium stability holds under general conditions.

In each period, a firm of quality  $\theta$  having exported  $s$  times in the past stays active if the expected present value of doing so,  $PV_t(\theta, s)$ , is positive. The firm is free to exit at any future date. Let  $T(\theta)$  be the exit date (possibly infinity) that maximizes the firm's intertemporal problem. Then  $PV_t(\theta, s)$  is the discounted sum of current and future profits in (10) up to the optimal exit date:

$$PV_t(\theta, s) = \sum_{u=0}^{T(\theta)} \delta^u [(\rho(s+u) - w)\theta + (1 - \rho(s+u))E_t\mu_{t+u} - k] \quad (13)$$

Since there is no aggregate uncertainty,  $E_t\mu_{t+u} = \mu_{t+u}$  for all  $u$ . There are  $E$  new firms per period, with quality draws distributed according to the pdf  $g(\theta)$ . A new firm of quality  $\theta$  is active at  $t+1$  if  $PV_{t+1}(\theta, 0) > 0$ . Hence the number of active new firms per quality level is:

$$M_{t+1}(\theta, 0) = \begin{cases} Eg(\theta) & \text{if } PV_{t+1}(\theta, 0) > 0 \\ 0 & \text{if } PV_{t+1}(\theta, 0) \leq 0 \end{cases} \quad (14)$$

Among incumbent firms of quality  $\theta$  having exported  $s$  times,  $\delta M_t(\theta, s-1)$  survive from period  $t$  to period  $t+1$ . They remain active if  $PV_{t+1}(\theta, s) > 0$  in equation (13). Thus the number of active old firms is, for  $s \geq 1$ :

$$M_{t+1}(\theta, s) = \begin{cases} \delta M_t(\theta, s-1) & \text{if } PV_{t+1}(\theta, s) > 0 \\ 0 & \text{if } PV_{t+1}(\theta, s) \leq 0 \end{cases} \quad (15)$$

Equations (12), (11), (14) and (15) determine  $\bar{\theta}_{t+1}$  and  $\mu_{t+2}$ . We can then define the industry steady-state as an equilibrium with constant reputation and a constant distribution of quality.

**Definition 1**  $\{\mu, \{M(\theta, s)\}_{s,\theta}\}$  is a steady-state equilibrium if and only if:

- (i) For all  $\theta \in [\theta_m, \infty)$  and all  $s \geq 0$ , if  $M_t(\theta, s) = M(\theta, s)$  and  $E_t\mu_{t+u} = \mu$  for all  $u \geq 0$ , then  $M_{t+1}(\theta, s) = M(\theta, s)$  in (14) and (15);
- (ii) If  $M_t(\theta, s) = M(\theta, s)$  for all  $\theta \in [\theta_m, \infty)$  and all  $s \geq 0$ , then  $\bar{\theta}_t = \mu$  in (11).

Condition (i) ensures that the number of firms in each quality-age segment is constant in the steady state. Condition (ii) states that the average quality resulting from an equilibrium distribution of active firms is equal to the equilibrium country reputation. It guarantees that  $\mu$  is constant in a steady state. In other words, a steady state with national reputation  $\mu$  is a rational expectations equilibrium if the average quality of active exporters is equal to buyers' quality expectation. The endogenous entry and exit decisions induced by  $\mu$  justify the reputation ex post.

From this point on, we assume that the quality draw of entrants has a Pareto distribution

with support on  $[\theta_m, \infty)$  and shape parameter  $\alpha > 1$ :

$$G(\theta) \equiv 1 - \left(\frac{\theta_m}{\theta}\right)^\alpha \quad (16)$$

We note  $\mu_0$  the unconditional expectation of quality draws:  $\mu_0 \equiv \frac{\alpha}{\alpha-1}\theta_m$ .

## 4.2 High-quality equilibrium

We call “high-quality equilibrium” (HQE) a steady-state equilibrium where the country reputation  $\mu$  exceeds the perfect information quality threshold  $\theta^*$ .

**Definition 2**  $\left\{\mu, \{M(\theta, s)\}_{s,\theta}\right\}$  is a high-quality steady-state equilibrium if  $\mu > \theta^*$  and  $\left\{\mu, \{M(\theta, s)\}_{s,\theta}\right\}$  is a steady-state equilibrium according to Definition 1.

We first characterize firms’ entry and exit decisions in a high-quality equilibrium given  $\mu$ . We then proceed to derive the existence conditions for a HQE.

### 4.2.1 Entry and exit

In a HQE, national reputation is high and time-invariant, i.e.  $\mu_t = \mu > \theta^*$  for all  $t$ . Therefore, a firm with quality equal to the country’s reputation would be viable in a perfect information setting. All firms receive high prices as they enter the export market, which encourages entry. Formally, we prove the following.

**Lemma 1** *In a HQE with country reputation  $\mu > \theta^*$ , (i) All entrants are initially active; (ii) Firms with  $\theta < \theta^*$  expect to exit after a number of periods  $T(\theta)$  weakly increasing in quality  $\theta$ ; (iii) Firms with  $\theta > \theta^*$  stay in the market until hit by the exogenous shock.*

Proof: see Appendix A.1.

The sorting of firms according to their quality parameter is represented in Figure 1. Low-quality firms below  $\theta^*$  find it profitable to enter initially as they have low production costs and can therefore reap positive profits as long as buyers do not have information about their type. The higher the country reputation, the higher the price they receive in the first period. As first-period profits are decreasing in quality, low- $\theta$  firms always find it profitable to enter the market as fly-by-nights. However, given the expected profit equation (10) and Assumption 2, profits from repeat purchases are increasing in quality and converging over time towards their perfect information value. Hence, all firms below  $\theta^*$ , which would not survive under perfect information, face a decreasing sequence of profits converging to a negative value. They will eventually see their expected present value of profits turn negative and exit. The number of periods  $T(\theta)$  that a firm with quality  $\theta < \theta^*$  stays active is pinned down by the condition

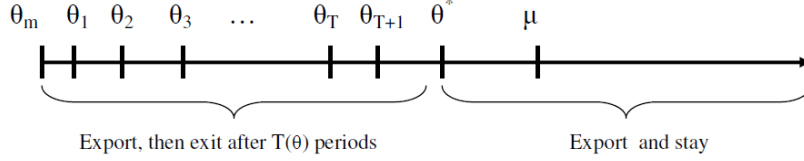


Figure 1: **Sorting of firms by  $\theta$  with high national reputation**

that its expected profit is positive for the first  $T(\theta)$  periods it exports, and negative in all following periods.

Let us define  $\theta_T$  as the highest quality type that exits after selling for  $T$  periods – or the lowest quality type that exits after selling for  $T + 1$  periods:

$$\theta_T = \max \left\{ \frac{k - (1 - \rho(T))\mu}{\rho(T) - w}, \theta_m \right\} \quad \text{for } T \geq 1 \quad (17)$$

and  $\lim_{T \rightarrow \infty} \theta_T = \theta^*$ .

For high-quality firms above  $\theta^*$ , it is always profitable to enter and keep exporting. Firms between  $\theta^*$  and  $\mu$  have expected profits declining over time, but positive in every period. Firms above  $\mu$  have expected profits increasing over time. The highest quality firms incur losses in the initial period but recoup these losses in later periods once enough buyers have received information about their type. Their expected intertemporal profits are always positive. Thus, firms above  $\theta^*$  never exit before they are forced to by the exogenous shock, as their per-period profits are converging towards the strictly positive perfect information level.

#### 4.2.2 Average quality

In a steady state indexed by  $\mu > \theta^*$ , the number  $M(\theta, s)$  of active firms of quality  $\theta$  having already exported  $s$  times is derived from Lemma 1 and equations (14) and (15):

$$M(\theta, s) = \begin{cases} \delta^s E g(\theta) & \text{if } \theta < \theta^* \text{ and } s < T(\theta) \\ 0 & \text{if } \theta < \theta^* \text{ and } s \geq T(\theta) \\ \delta^s E g(\theta) & \text{if } \theta \geq \theta^* \end{cases} \quad (18)$$

so that the total number of active firms of quality  $\theta$  is  $\frac{1 - \delta^{T(\theta)}}{1 - \delta} E g(\theta)$  if  $\theta < \theta^*$ , and  $\frac{1}{1 - \delta} E g(\theta)$  if  $\theta \geq \theta^*$ . Using (11) and (16), we derive the steady-state average quality of exports in a HQE as a function of  $\mu$  and exogenous parameters:

$$\bar{\theta}(\mu) = \mu_0 \left( \frac{1 - \sum_{T=0}^{\infty} \delta^{T+1} \left[ \left( \frac{\theta_m}{\theta_T} \right)^{\alpha-1} - \left( \frac{\theta_m}{\theta_{T+1}} \right)^{\alpha-1} \right]}{1 - \sum_{T=0}^{\infty} \delta^{T+1} \left[ \left( \frac{\theta_m}{\theta_{T+1}} \right)^{\alpha} - \left( \frac{\theta_m}{\theta_{T+1}} \right)^{\alpha} \right]} \right) \quad (19)$$

where  $\theta_0 \equiv \theta_m$  and  $\theta_T, \theta_{T+1}$  are defined by (17). The average quality of active firms is higher than the mean of the unconditional distribution of  $\theta$ , as lower-quality firms exit earlier than high-quality firms. However, it lies below the perfect information average export quality.

#### 4.2.3 Existence conditions

There exists a HQE if there is a fixed point of  $\bar{\theta}(\mu)$  in equation (19) such that  $\mu = \bar{\theta}(\mu) > \theta^*$ . Proposition 1 establishes existence conditions.

**Proposition 1** *There is a unique HQE if and only if  $\bar{\theta}(\theta^*) > \theta^*$ , or equivalently if and only if*

$$\alpha \left( \frac{\theta_m}{\theta^*} \right) + \frac{\delta}{1-\delta} \left( \frac{\theta_m}{\theta^*} \right)^\alpha > \alpha - 1 \quad (20)$$

Proof: see Appendix A.3.

An equilibrium steady-state reputation is a reputation  $\mu$  such that  $\bar{\theta}(\mu) = \mu$ . The intuition of the proof is as follows. Starting from a reputation above  $\theta^*$ , raising  $\mu$  has a negative effect on actual quality. Improving national reputation, for a given distribution of  $\theta$  draws, does not affect the decisions of firms above  $\theta^*$  to stay or exit, as they are already remaining active as long as possible. However, it encourages lower-quality firms to stay longer: for firms below  $\theta^*$ , a higher  $\mu$  raises all  $T(\theta)$ , implying that low-quality firms wait longer before exiting the market. In short, the incentives of high-quality firms are not affected but those of low-quality firms result in a higher export duration of firms producing “bad” varieties. Hence, the average quality of exported goods falls when  $\mu$  increases. It follows that  $\bar{\theta}(\mu)$  is strictly decreasing on  $[\theta^*, \infty)$  and therefore if  $\bar{\theta}(\theta^*) > \theta^*$ , there is a unique fixed point of  $\bar{\theta}(\mu)$  in the high quality region. This fixed point is the unique HQE.

The HQE existence condition (20) holds for  $\delta$  high enough,  $\alpha$  low enough, and/or  $w$  and  $k$  low enough. A high  $\delta$  implies that exogenous exit is relatively less prevalent than endogenous exit, increasing the relative mass of high-quality firms. A low  $\alpha$  means that there is high dispersion in the prior distribution of  $\theta$  and therefore more firms at the right tail of the distribution pushing up the mean. A low  $w$  reduces the relative cost advantage of low-quality firms, as well as the loss incurred in initial periods by high-quality firms. Lower  $w$  and  $k$  also lower the perfect information threshold  $\theta^*$ , making it more likely that the economy ends up in a high-quality equilibrium.

#### 4.3 Low-quality equilibrium

We call “low-quality equilibrium” (LQE) a steady-state equilibrium where the country reputation falls short of the perfect information quality threshold  $\theta^*$ .

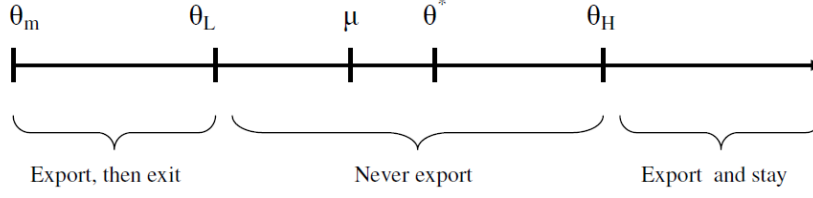


Figure 2: **Sorting of firms by  $\theta$  with low national reputation**

**Definition 3**  $\left\{ \mu, \{M(\theta, s)\}_{s,\theta} \right\}$  is a low-quality steady-state equilibrium if  $\mu < \theta^*$  and  $\left\{ \mu, \{M(\theta, s)\}_{s,\theta} \right\}$  is a steady-state equilibrium according to Definition 1.

As in the high-quality case, we first determine the entry and exit patterns given  $\mu$  and then derive existence conditions.

#### 4.3.1 Entry and exit

In a LQE, national reputation is low and constant, i.e.  $\mu_t = \mu < \theta^*$  for all  $t$ . A firm with quality  $\mu$  would never export in a perfect information setting. Under asymmetric information, we can show the following:

**Lemma 2** In a LQE with country reputation  $k + w\theta_m < \mu < \theta^*$ , (i) Firms with quality  $\theta < \theta_L$  enter the export market and exit after selling for one period, where

$$\theta_L \equiv \frac{\mu - k}{w} < \mu < \theta^* \quad (21)$$

(ii) Firms with quality  $\theta > \theta_H$  enter and stay in the market until hit by the exogenous shock, where

$$\theta_H \equiv \frac{k - \mu(1 - A_\rho)}{A_\rho - w} > \theta^* \quad (22)$$

and  $A_\rho \equiv (1 - \delta) \sum_{s=0}^{\infty} \delta^s \rho(s)$ . (iii) Firms with quality  $\theta_L \leq \theta \leq \theta_H$  never enter the market.

Proof: see Appendix A.2.

Figure 2 shows the sorting of firms by quality into “fly-by-nights”, non-exporters and continuous exporters. Fly-by-night firms exist as long as  $\mu > k + w\theta_m$ , which ensures that some low-quality firms realize positive first-period profits. These firms would not survive under perfect information but gain from the information asymmetry. However, given  $\mu < \theta^*$  and Assumption 2, they would make losses if they were to stay active in the second period, after buyers have received a firm-specific signal. Firms below  $\theta_L$  therefore exit immediately after selling once.

All firms with better quality than the country reputation  $\mu$  are not profitable in the first period when they enter export markets. Above  $\theta_H$ , the present value of expected profits is

positive: expected profits from sales in later periods, when a larger portion of the price reflects true quality, exceed initial losses. The negative profits in their first periods of existence can be interpreted as investments in building a brand name or firm-specific reputation, distinct from the country reputation.

An intermediate range of firms  $[\theta_L, \theta_H]$  around  $\theta^*$  never become active exporters. Those with  $\theta_L < \theta < \theta^*$  have negative expected profits at all periods, while those with  $\theta^* < \theta < \theta_H$  would be profitable in the long run once enough buyers have gathered information about their type. However, for the latter, the present value of their profit stream is negative: losses incurred in the initial periods in order to establish a reputation are not made up for with later profits (due to the exogenous exit shock which acts similarly to a discount rate). Hence this range of firms is kept out of export markets by the information asymmetry and the cost of revealing quality.

Lastly, if  $\mu < k + w\theta_m$ , then there are no active firms below  $\theta^*$ , given that national reputation is too low for any firm to realize positive first-period profits. This results in a high average quality of exported goods. Therefore, there cannot be an equilibrium with endogenous reputation in this region.

#### 4.3.2 Average quality

In a steady state indexed by  $\mu < \theta^*$ , the number  $M(\theta, s)$  of active firms of quality  $\theta$  having already exported  $s$  times is derived from Lemma 2 and equations (14) and (15):

$$M(\theta, s) = \begin{cases} Eg(\theta) & \text{if } \theta < \theta_L \text{ and } s = 0 \\ 0 & \text{if } \theta < \theta_L \text{ and } s \geq 1 \\ 0 & \text{if } \theta_L \leq \theta \leq \theta_H \\ \delta^s Eg(\theta) & \text{if } \theta > \theta_H \end{cases} \quad (23)$$

so that the number of active firms of quality  $\theta$  is  $Eg(\theta)$  if  $\theta < \theta_L$  and  $\frac{1}{1-\delta}Eg(\theta)$  if  $\theta > \theta_H$ . Using (11) and (16), we derive the steady-state average quality of exports in a LQE as a function of  $\mu$  and the economy's exogenous parameters:

$$\bar{\theta}(\mu) = \mu_0 \left( \frac{1 - \left(\frac{\theta_m}{\theta_L}\right)^{\alpha-1} + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H}\right)^{\alpha-1}}{1 - \left(\frac{\theta_m}{\theta_L}\right)^{\alpha} + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H}\right)^{\alpha}} \right) \quad (24)$$

where  $\theta_L$ ,  $\theta_H$  are defined respectively by (21) and (22). The volume of sales and average quality are lower than in high-reputation equilibria, due both to the existence of a gap in the distribution of active exporters, and to the fact that low-quality firms exit after selling for one period only.

### 4.3.3 Existence conditions

The industry has at least one LQE if there exists a fixed point of  $\bar{\theta}(\mu)$  in equation (24) such that  $\mu = \bar{\theta}(\mu) < \theta^*$ . Specifically:

**Proposition 2** *If  $\bar{\theta}(\theta^*) < \theta^*$ , there exists at least one LQE.*

Proof: see Appendix A.4.

In other words, if condition (20) does not hold, there is an odd number of LQE and no HQE. The lowest possible level of national reputation ( $\mu = \theta_m$ ) results in the highest average quality, as it drives out all low-quality firms and some high-quality firms. Hence  $\bar{\theta}(\theta_m) > \theta_m$  and if  $\bar{\theta}(\theta^*) < \theta^*$ , there must be at least one fixed point in  $(\theta_m, \theta^*)$ . However, the equilibrium may not be unique, since  $\bar{\theta}(\mu)$  is not monotonic over the interval. In the low reputation region, increasing  $\mu$  has two consequences with opposite effects on average quality. First, it enables more firms to realize positive profits from first-period sales (higher  $\theta_L$ ). This fosters entry by firms with below-average quality, given that  $\theta_L < \mu$  in a LQE, and it lowers the expected quality of active firms. Second, increasing  $\mu$  reduces the loss incurred by high-quality firms before they have been able to signal their quality to buyers, allowing more firms with above-average quality to be active (lower  $\theta_H$ ). The net change in  $\bar{\theta}$  depends on the balance between these two effects. As long as the economy remains in the low reputation region ( $\mu < \theta^*$ ), there is no effect of a better reputation on the exit rates of exporters: all active firms below  $\theta^*$  sell for one period only, while all active firms above  $\theta^*$  stay as long as they are able to.

### 4.4 Summary: Industry steady-states

To sum up, depending on parameters, the rational expectations steady-state falls into one of two categories. The type of equilibrium will depend on whether the (not necessarily unique) fixed point of  $\bar{\theta}(\mu)$  falls left or right of  $\theta^*$ . In a “high-quality equilibrium”, all firms produce and sell for at least one period, firms above  $\theta^*$  remain active until they are exogenously forced to exit, and firms below  $\theta^*$  exit in finite time after a number of periods increasing in  $\theta$ . In a “low-quality equilibrium”, there is a gap around  $\theta^*$  where firms are never active. Below  $\theta_L$ , they exit after exporting for a single period. Above  $\theta_H$ , they only exit exogenously.

In general, we cannot rule out multiple equilibria. If  $\bar{\theta}(\theta^*) < \theta^*$ , there are an odd number of LQEs. If  $\bar{\theta}(\theta^*) > \theta^*$ , there is one HQE and there are either zero or an even number of LQEs.<sup>24</sup> These multiple equilibria give rise to the possibility of self-fulfilling reputation shocks, examined in Section 5.

Figure 3 illustrates the existence condition (20). In the dark region, the condition holds and a unique HQE exists. This is true for low enough  $\alpha$  and high enough  $\delta$ . In the light grey

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<sup>24</sup>A graphical example of multiple equilibria is shown in Figure 7.

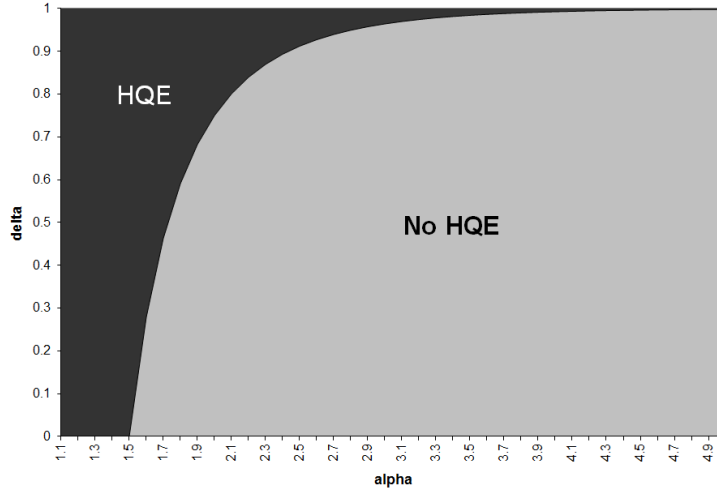


Figure 3: **Parameter values for HQE and LQE** ( $\theta_m = 1, k = 1.5, w = 0.5$ )

region, there is no HQE: the steady-state of the economy is necessarily a LQE. A higher  $k$  or  $w$  shifts the border to the left and expands the no HQE region. Conversely, lowering  $k$  or  $w$  widens the HQE region.

#### 4.5 Additional predictions: Unit prices and hazard rates

The model yields additional predictions on the patterns of price and exit rates. Although these results are not the main focus of our paper, their consistency with existing empirical evidence lends support to our theory. First, we characterize the path of prices for a given cohort of firms.

**Result 1 *Unit prices.*** *In a steady-state low-quality equilibrium, the average unit price charged at  $t + s$  by firms born at date  $t$  is strictly increasing in  $s$ . In a steady-state high-quality equilibrium, the average unit price charged at  $t + s$  by firms born at date  $t$  is strictly increasing in  $s$  for all  $s$  if  $\mu > \frac{\alpha}{\alpha-1}\theta_1$  and for  $s \geq T\left(\frac{\alpha-1}{\alpha}\mu\right)$  otherwise.*

Proof: See Appendix A.5.

At the firm level, there is a brand premium for high-quality firms both in a HQE and in a LQE: the price charged increases over time for a given good provided that its quality is higher than the country average. Result 1 establishes that on average, incumbents receive higher prices than entrants, and the average price among a cohort of firms is higher, the longer the cohort has been active on export markets. This result follows from the fact that over time, an increasing fraction of prices reflect firms' true quality parameters, and the average quality of a cohort of firms weakly increases over time as the lowest quality firms exit.

Interestingly, these predictions are supported by the findings of Foster et al. (2008) on the behavior of US firms in their domestic market. They show that entering businesses have significantly lower prices than incumbents, and that prices rise with plant age.

Second, our model implies that firms' exit rates vary systematically with their quality and across cohorts.

**Result 2 *Hazard rate.*** *In a steady-state equilibrium, the aggregate hazard rate is weakly decreasing in quality and in firms' export experience.*

Proof: See Appendix A.6.

The first part of Result 2 establishes that across cohorts, the fraction of active firms that exit per period is higher for lower-quality firms, both in a LQE and in a HQE. Low-quality firms exit voluntarily in finite time while high-quality firms only exit when hit by the exogenous death shock. The second part states that the probability of exit, across quality levels, decreases with the age of a cohort. It derives from the fact that the distribution of quality among older cohorts has a higher lower bound than among younger cohorts.

This last prediction is consistent with the findings of Besedes and Prusa (2004) on survival rates in US import relationships at the disaggregated product level. They estimate that the probability that the import relationship will end falls with its duration for differentiated products. We confirm these results with our product-level data: within HS-2 manufacturing industries, the average hazard rate of HS-10 products drops from 31% in the first year the country exports the good to 8% after 10 years (see Appendix D for details).

## 5 Policy implications

How can countries improve their “national brand name” – and is it worth it? First-best policies would involve conducting verifiable quality audits or taxing low-quality firms and subsidizing high-quality ones. These policies are not feasible when policy-makers are not better informed than consumers about firms' quality levels. Here, we look at the effects of two main policy instruments on reputation, quality and welfare: export subsidies and export promotion campaigns creating reputation shocks.

### 5.1 Export subsidy

Consider a permanent<sup>25</sup> unanticipated subsidy to fixed export costs, resulting in a lower effective  $k$  for active exporters, financed by non-distortionary lump-sum taxes. Since there

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<sup>25</sup>We are comparing the long-run industry equilibria with and without the policy. With a temporary subsidy, if the equilibrium is unique, the economy would return to the initial steady state in the long-run after the subsidy expires.

are no domestic consumers in our model and foreign consumers are not taken into account in national welfare calculations, welfare considerations abstract from changes in consumer surplus. We will compare the effect of the subsidy on aggregate industry profits and its direct cost in the steady states before and after the subsidy.

### 5.1.1 Starting from a LQE

In a LQE, a decrease in  $k$  induces more high-quality firms to start and continue exporting (lower  $\theta_H$ ) and more low-quality firms to export for one period (higher  $\theta_L$ ). We prove that the overall effect on average quality, and thus steady-state national reputation, is positive with Pareto-distributed quality draws and  $\delta$  not too low: starting from a LQE, an export subsidy increases long-run equilibrium quality.

**Proposition 3** *An export subsidy in a LQE increases the steady-state average quality and welfare of the exporting country.*

Proof: see Appendix A.7.

The welfare result is a consequence of the higher long-run reputation. The entry response to the subsidy creates a positive externality on firms that would be exporting regardless of the policy. They receive higher prices on their exports due to improved reputation. This externality lies at the core of the beneficial effect of an export subsidy for a country that is in a low equilibrium. New exporters also benefit from the better reputation as well as the subsidy, so that the increase in aggregate profits exceeds the tax cost of the subsidy. Hence, our model provides a new justification for export subsidies in countries exporting goods at the low end of the quality ladder.<sup>26</sup>

Figure 4 provides a numerical example of the economy's transition to its new, higher steady state in a case where the LQE is unique. It shows the transition dynamics for average quality, reputation, the thresholds  $\theta_L$  and  $\theta_H$ , as well as the number of active firms and aggregate profits following an unanticipated permanent decline in  $k$  and assuming that all firms correctly anticipate the future path of  $\mu$ . In the first period in which the subsidy is introduced, reputation is unchanged but the lower cost makes entry profitable for a larger range of firms. The gap  $(\theta_L, \theta_H)$  immediately narrows. The immediate net effect is a decline in average quality as the entry of low-quality firms dominates on impact for an unanticipated subsidy. However, over time as new cohorts of high-quality firms enter and decide to stay active, average quality  $\bar{\theta}$  and reputation  $\mu$  start rising, while  $\theta_L$  further increases and  $\theta_H$  keeps falling.  $\mu$  adjusts to  $\bar{\theta}$  with a lag, further encouraging entry and pushing up  $\bar{\theta}$ . This

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<sup>26</sup>In a setting where firms would set prices in a competitive way, we would have to balance this gain against the argument that an export subsidy tends to subsidize foreign consumers.

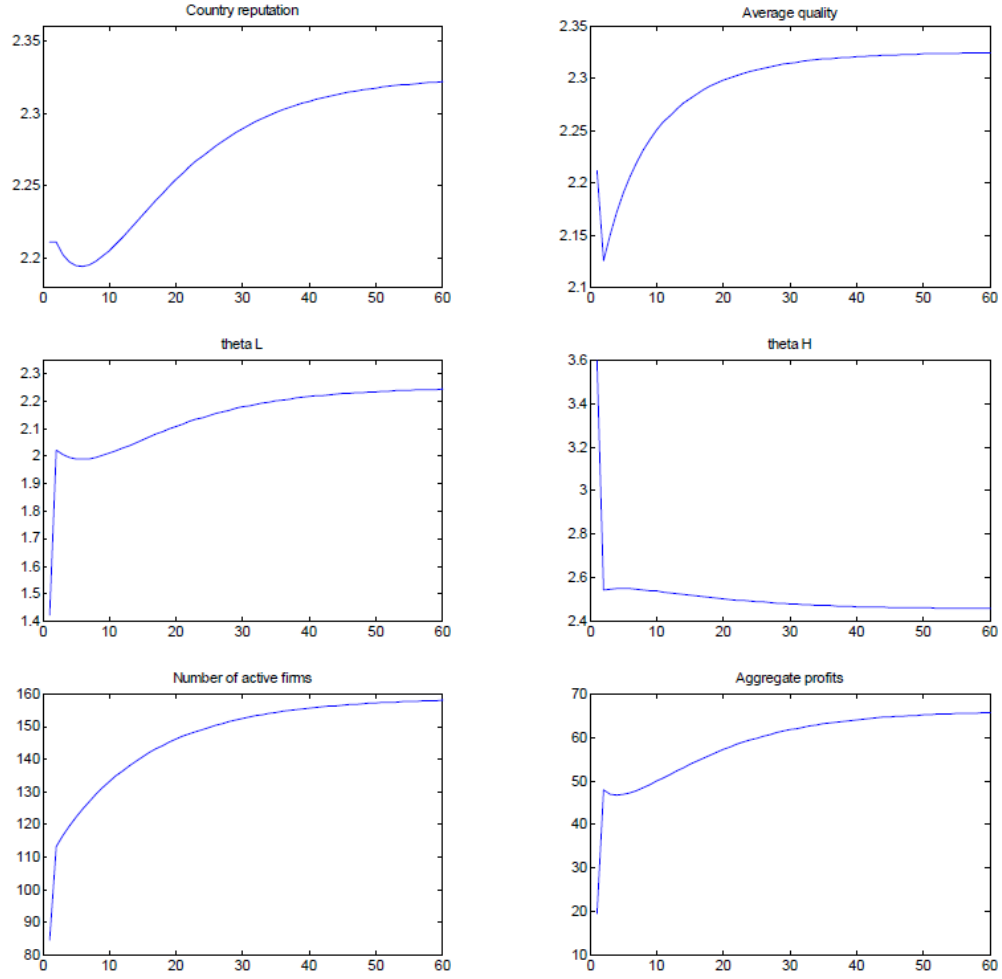


Figure 4: **Export subsidy in a LQE.** Parameter values:  $\theta_m = 1$ ,  $\alpha = 3$ ,  $\delta = 0.9$ ,  $\eta = 0.1$ ,  $E = 100$ ,  $k = 1.5$ ,  $k_{subs} = 1.2$ .  $\theta^* = 3$ . The initial unique steady-state of this economy is a LQE with  $\mu = \bar{\theta} \approx 2.211$ .

continues until reputation has caught up with actual quality and the economy has reached its new steady state.

### 5.1.2 Starting from a HQE

We have shown that an export subsidy enhances welfare in low-reputation exporting countries. Can the same policy be beneficial for a country that already exports high-quality goods? The next proposition states that instead of allowing a high-reputation country to move further up the quality ladder, a subsidy is actually detrimental to average quality and welfare in a high-quality equilibrium.

**Proposition 4** *An export subsidy in a HQE lowers the steady-state average quality of exports and welfare of the exporting country.*

Proof: see Appendix A.8.

This result hinges on the changed exit patterns of high-quality versus low-quality firms. A decrease in  $k$  lowers  $\theta^*$  and induces low-quality firms to stay longer. It does not change the incentives and decisions of high-quality firms. Hence, since average quality is initially above  $\theta^*$ , the subsidy lowers actual mean quality: the number of low-quality firms increases while the number of high-quality firms remains unchanged.

This lower average quality, in turn, damages the country's reputation, which adjusts slowly to observed average quality. It has a negative effect on the profits of all active firms, all the more so as they have been active for a shorter time. Hence, the entry of lower-quality firms induced by the subsidy exerts a negative externality on all other active firms through its effect on national reputation. This externality explains why the overall increase in aggregate profits of all firms receiving the subsidy is not large enough to cover the cost of the policy, despite a higher volume of sales.

Intuitively, we can decompose the welfare effect into two components, respectively the effect on the intensive and extensive margin of profits. For the combination of quality and export experience for which firms are active both with and without the subsidy, the effect is unambiguously negative: they receive lower prices and the additional profits brought about by the subsidy are taken out of taxes. For the additional periods in which firms below  $\theta^*$  stay in the market because of the subsidy, their profits fall short of the cost of the subsidy: otherwise, since the price is lower than in the absence of the policy, they would have been exporting without the subsidy. Therefore, the net effect is unambiguously negative.

Figure 5 shows an illustration of the transition to the new steady state. When the policy is introduced, low-quality firms immediately stay longer, leading to an increase in the number of active firms and a steep decline in average quality. National reputation then starts adjusting downwards until it reaches its new steady-state level. Aggregate profits first rise above their

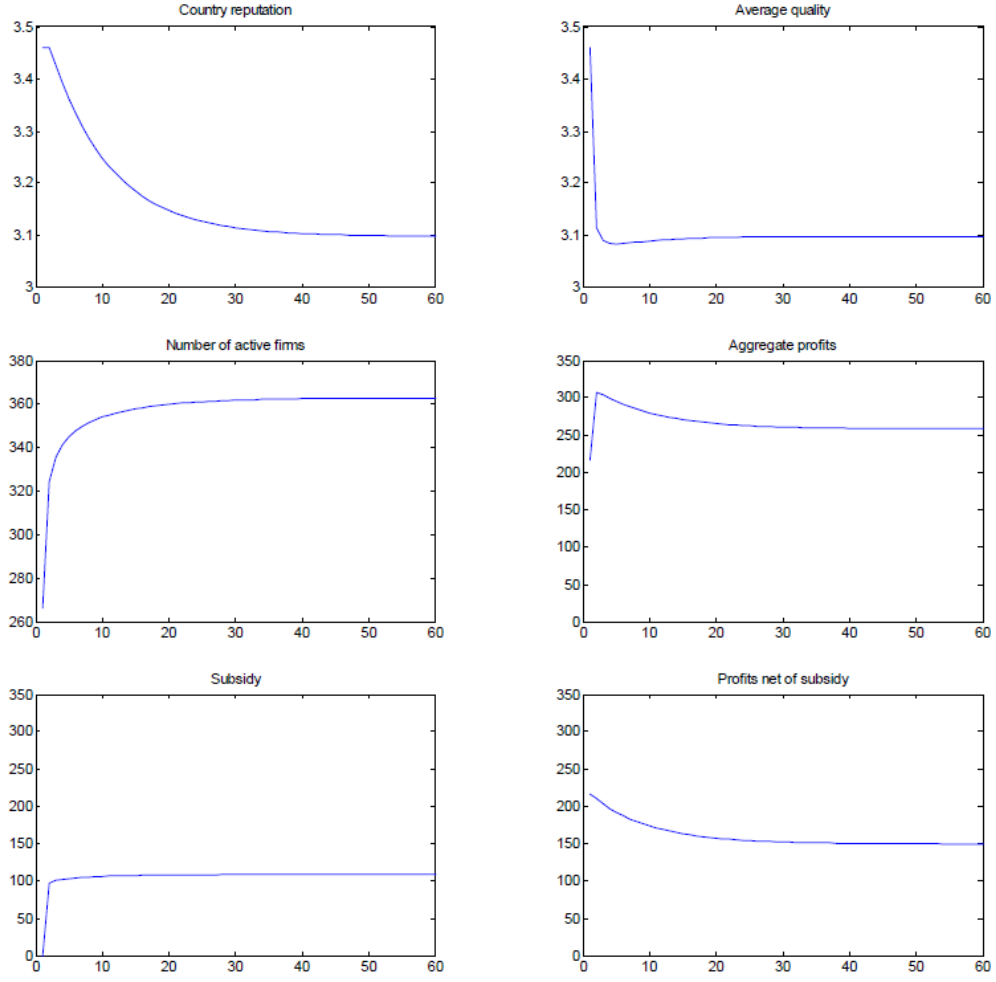


Figure 5: **Export subsidy in a HQE.** Parameter values:  $\theta_m = 1$ ,  $\alpha = 2$ ,  $\delta = 0.9$ ,  $\eta = 0.1$ ,  $E = 100$ ,  $k = 1.5$ ,  $k_{subs} = 1.2$ .  $\theta^* = 3$ . The initial unique steady state of this economy is a HQE with  $\mu = \bar{\theta} \approx 3.461$ .

long-term value, because reputation remains “too high” during the adjustment period. Over time as  $\mu$  falls and new cohorts of firms respond to the lower cost, the economy converges to a steady state with lower reputation and quality. As subsidies reduce firms’ costs, aggregate profits are higher than in the initial equilibrium, but the increase in profits does not match the cost of the subsidy.

In a nutshell, in a HQE, a subsidy to the fixed cost  $k$  actually lowers average quality by promoting entry of low-quality firms. Overall, the desirability of an export subsidy depends on the tradeoff between encouraging entry by high-quality firms which are deterred by the cost of establishing a reputation, and inducing entry by low-quality fly-by-nights.

## 5.2 Export promotion campaign and reputation shocks

An export promotion campaign is an effort to promote the quality of foreign goods in Home, e.g. through advertisements by export promotion agencies or exporters’ associations, or by hosting “mega-events” to showcase the country – as we mentioned, the Olympics in Seoul in 1988 and in Beijing in 2008 were explicitly assigned this goal by government officials. We model it as a one-shot increase in the national image  $\mu_t$  from the initial steady-state, absent any changes in the underlying quality distribution of firms. More generally, the analysis below applies to reputation shocks not driven by changes in the quality distribution. We focus on situations in which the economy is initially in a stable low-quality equilibrium.

### 5.2.1 Unique steady state

If the economy has only one long-run equilibrium, it must return to this steady state in the long run. The export promotion campaign only has short-run effects on the distribution of quality. Figure 6 provides an example of the transition dynamics associated with a positive shock. An export promotion campaign results in a one-shot increase in national reputation  $\mu_t$ , starting from the steady state.

The initial jump in reputation fosters entry by firms in segments of the quality distribution where they were previously inactive:  $\theta_H$  decreases and  $\theta_L$  increases. The net effect of the entry response is a drop in average quality  $\bar{\theta}$  immediately after the shock occurs. Thus, the gap between actual and perceived average quality leads national reputation to adjust downwards in the following periods. As the country’s reputation moves back down, the range of qualities for which entrants choose to stay inactive widens again, driving average quality back up until it has reverted to its original steady-state value, along with reputation. There are no long-run effects.

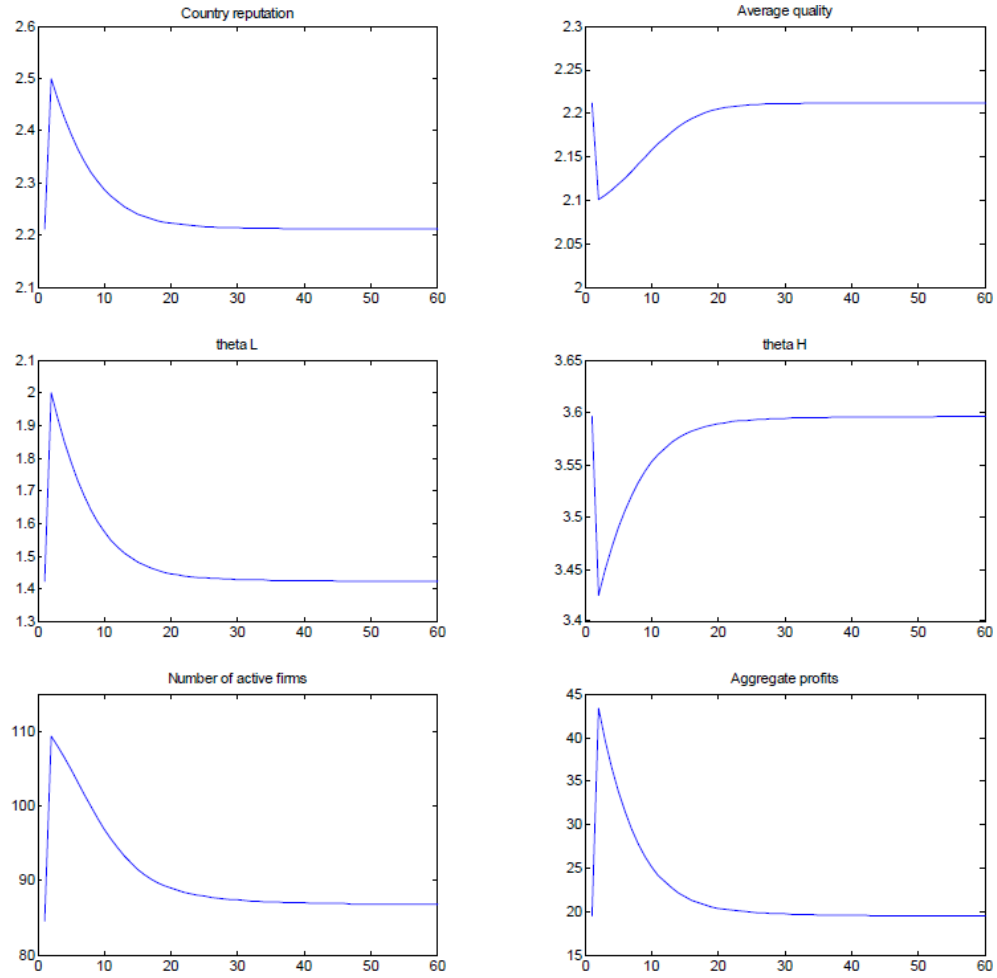


Figure 6: **Positive reputation shock with a unique LQE.** Parameter values identical to Figure 4.  $\mu_t$  rises exogenously to 2.5 at  $t = 1$ .

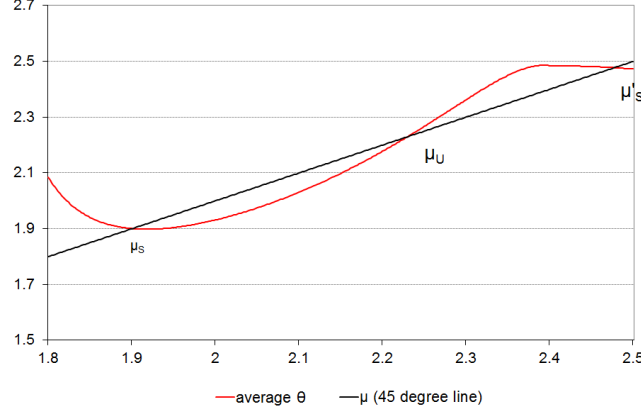


Figure 7: **Multiple equilibria.** Parameter values:  $\theta_m = 1$ ,  $\alpha = 2.2$ ,  $\delta = 0.7$ ,  $\eta = 0.1$ ,  $E = 100$ ,  $k = 1.2$ .  $\theta^* = 2.4$ . The steadystates of this economy are  $\mu_S \approx 1.900$ ,  $\mu_U \approx 2.230$  and  $\mu'_S \approx 2.477$ .

### 5.2.2 Multiple steady states

If the economy has multiple steady states, there are several low-quality equilibria. Figure 7 provides an illustration of this case. Assume the country starts in a stable LQE  $\mu_S$ . If there are no steady states with higher reputation than  $\mu_S$ , an export promotion campaign has the same effects as when the steady state is unique.

If there exists a steady state  $\mu > \mu_S$ , there must be an even number of steady states with  $\mu > \mu_S$ . Let us define  $\mu_U > \mu_S$  such that  $\mu_U$  is a steady state and for all  $\mu_S < \mu < \mu_U$ ,  $\mu$  is not a steady state. Similarly, define  $\mu'_S > \mu_U$  such that  $\mu'_S$  is a steady state and for all  $\mu_U < \mu < \mu'_S$ ,  $\mu$  is not a steady state.  $\mu_U$  is unstable and  $\mu'_S$  is stable.

Starting in  $\mu_S$ , a “small” promotion campaign moves national reputation to a level  $\mu_t$  such that  $\mu_S < \mu_t < \mu_U$ . The impact of a small campaign is similar to the case with a unique equilibrium: in the long run, the economy returns to  $\mu_S$ . A “large” promotion campaign moves national reputation to  $\mu_t > \mu_U$ . Then, the resulting entry by firms below the initial  $\theta_H$  and above the initial  $\theta_L$  leads to an increase in average quality, magnifying the shock. Actual quality follows reputation in a self-fulfilling manner. Quality and reputation keep rising until the economy settles in the more favorable steady-state  $\mu'_S$ . In the example of Figure 7,  $\mu'_S$  is a high-quality equilibrium. These results are summarized in Proposition 5.

#### Proposition 5 Positive reputation shocks

(i) Starting from a unique LQE or from a LQE that has the highest  $\mu$  among steady states, a one-time positive shock to national reputation  $\mu_t$  increases aggregate profits and decreases average quality in the short-run, and has no effect in the long-run.

(ii) Starting from a stable LQE  $\mu_S$  such that there exist other steady states above  $\mu_S$ , a small one-time positive shock ( $\mu_t < \mu_U$  as defined above) to national reputation increases

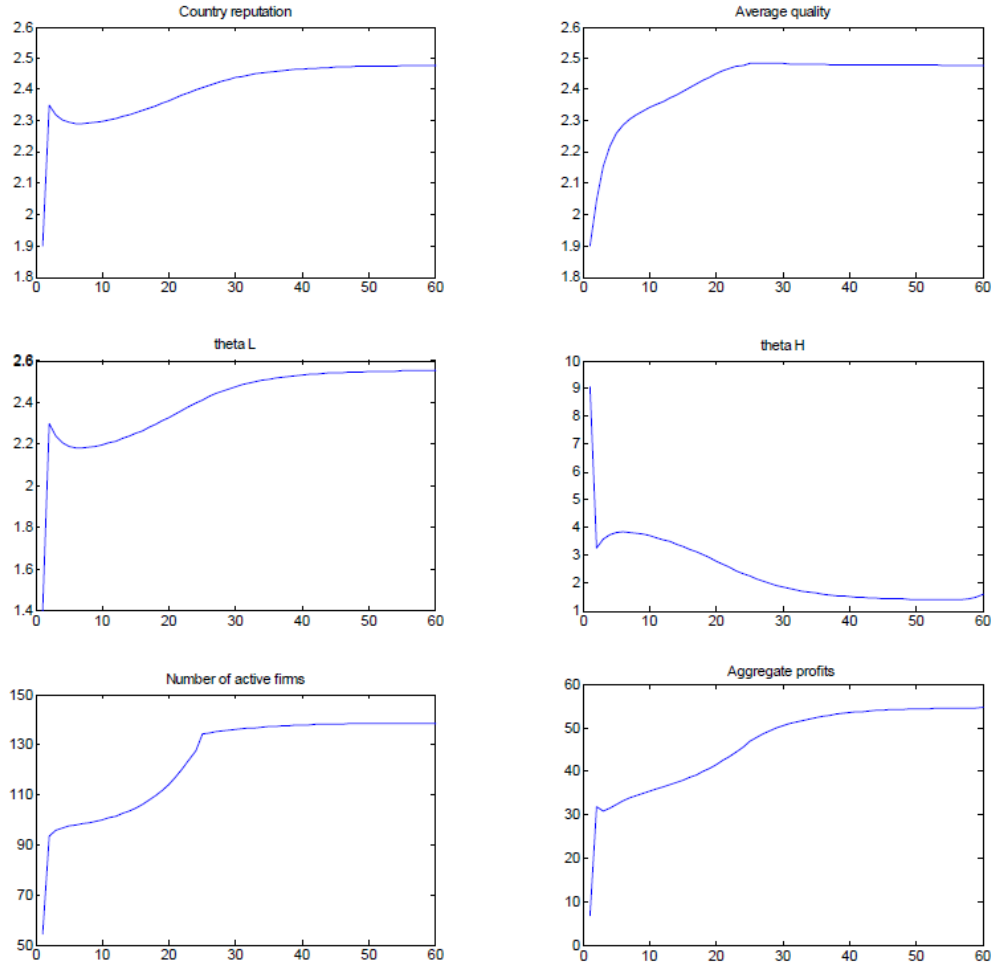


Figure 8: **Large positive reputation shock with multiple equilibria.** Parameter values identical to Figure 7.  $\mu_t$  rises exogenously to 2.35 at  $t = 1$ .

aggregate profits and may increase or decrease average quality in the short-run, and has no effect in the long-run.

(iii) Starting from a stable LQE  $\mu_S$  such that there exist other steady states above  $\mu_S$ , a large one-time positive shock ( $\mu_t > \mu_U$  as defined above) to national reputation increases aggregate profits and average quality both in the short-run and in the long-run.

Proof: see Appendix A.9.

Figure 8 illustrates the transition to the new steady state. With the parameter values of Figure 7, the economy starts in the LQE  $\mu_S$  and the unanticipated one-shot policy at time 1 results in a jump of the country reputation above  $\mu_U$ . Following the large shock, the economy moves to the HQE  $\mu'_S$ . Note that the policy is not anticipated prior to time 1, but once the shock is realized, we assume that all firms have correct expectations of the subsequent path of  $\mu$ . The immediate effect of the shock is to boost expected profits for all firms, fostering

entry by a range of firms that did not export in the initial steady state. For a large shock as defined in Proposition 5, the net effect of additional entry around  $\theta_L$  and  $\theta_H$  is to raise average quality, sufficiently so to ensure that reputation in the next period remains above  $\mu_U$ . As the policy was not anticipated by high-quality firms in the previous periods,  $\mu$  falls in the immediate aftermath of the shock. Reputation rises thereafter as new cohorts of high-quality firms decide to enter and stay active, until the economy settles in the new steady state  $\mu'_S$  with higher quality and higher aggregate profits.

To sum up, a policy which brings about a positive shock to national reputation has only short-lived effects on the quality distribution of exporters and on aggregate profits in a unique steady state or if the shock is small. However, a large shock starting from a low-reputation, low-quality equilibrium is self-fulfilling when the economy has multiple steady states. It encourages entry by high-quality firms. In the segments of the average quality-reputation function where entry by high-quality firms drives up quality more than entry by lower-quality firms drives it down, a one-shot increase in reputation brings about a permanent increase in quality, profits and welfare. To be successful in the long-run, an export promotion campaign based solely on improving the country's brand image must therefore induce a large jump in beliefs. A negative reputation shock has the opposite effects, as stated in Corollary 1.

**Corollary 1** *Negative reputation shocks*

(i) *Starting from a unique LQE or from a LQE that has the lowest  $\mu$  among steady states, a one-time negative shock to national reputation  $\mu_t$  reduces aggregate profits and increases average quality in the short-run, and has no effect in the long-run.*

(ii) *Starting from a stable LQE  $\mu'_S$  such that there exist other steady states below  $\mu'_S$ , a small one-time negative shock ( $\mu_t > \mu_U$  as defined above) to national reputation reduces aggregate profits and may increase or decrease average quality in the short-run, and has no effect in the long-run.*

(iii) *Starting from a stable LQE  $\mu'_S$  such that there exists other steady states below  $\mu'_S$ , a large one-time negative shock ( $\mu_t < \mu_U$  as defined above) to national reputation reduces aggregate profits and average quality both in the short-run and in the long-run.*

This last result implies that there can be long-term consequences of a sudden large drop in reputation, which moves a country to a less desirable steady-state equilibrium. In particular, large product recalls or heavily mediatized consumer safety scandals concerning exports of one country can permanently affect the structure of its industry, lowering both quality and reputation in the long-run.<sup>27</sup>

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<sup>27</sup>Chisik (2003) provides an example of such a negative reputation shock in the Colombian garment industry: "Although expanding at a rapid rate throughout the early 1970s Colombia's deteriorating reputation became a determining factor in the contraction of this industry. Much of this demise can be attributed to a single Colombian garment firm that took a contract (for 50,000 men's suits) that was beyond their capability. The

Lastly, a policy instrument we have not dwelled on is quality standards. It might seem that imposing a quality certification requirement, if the testing process is not too costly, would be a desirable policy as it reduces asymmetric information concerns. This holds true in a purely domestic setting when consumer welfare comes into play. The policy maker would then choose where to set the bar by weighing improved reputation and consumer surplus against the costs of testing and profits forgone by firms that do not meet the standard. However, as regards exports, setting minimum quality standards does not yield a clear-cut welfare improvement and may actually result in welfare losses for the exporting country. The intuition behind this result is simple. On the one hand, a minimum quality standard means that the “made in” label is a better quality signal. It raises the country’s reputation and prices received by all firms that meet the standard. On the other hand, firms below the threshold are forced to shut down. As the foreign consumers’ welfare is not taken into account, this lowers the country’s welfare: the profits received by “fly-by-night” low-quality firms at the expense of foreign consumers are forgone. As a result, such a policy only improves welfare in our model under specific assumptions regarding in particular the shape of the quality distribution. Hence, it is not the case in general that a quality standard (even one that is costless to enforce) benefits the exporter.

## 6 Conclusion

We have shown that when consumers are not fully informed about the quality of what they buy, national reputation matters for exporters. For new firms without established brand names, the inability to reveal quality to consumers before purchase distorts the incentives to enter export markets. Low-quality firms rely on the national brand, while high-quality firms suffer from it. This framework helps explain the high observed turnover rate among new exporters and a “brand premium” whereby incumbents receive higher unit prices than entrants.

More broadly, unobservable quality tilts the long-run quality composition of an export-oriented industry towards its low end, all the more so as the exporting economy has a poor reputation for quality in the importing country. In that respect, reputation has self-perpetuating features since future national reputation adjusts to past exports quality. These issues are particularly relevant for developing countries trying to grow into exporting increasingly sophisticated goods. National reputations create history dependence in the range of goods a country can successfully export. A damaged national reputation is a barrier to entry for companies that develop more expensive high-quality products, threatening the success of such a

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*poor-quality result so tarnished the American importer’s name that other high-quality importers became wary of Colombian-sewn garments. With the payoff to high-quality production reduced, Colombian garment firms then concentrated on low-quality markets, and the newly-found unfavorable reputation was justified.”*

growth strategy. To overcome the adverse aggregate effects of asymmetric information, the optimal policy critically depends on whether the country’s initial equilibrium is a high-quality or a low-quality one. In cases with low initial reputation, we find that policies that lower the cost of exporting can lead to a welfare gain by improving the country’s long-run average quality and reputation. We also show that policies inducing a positive jump in consumer beliefs can have self-fulfilling effects on the quality of exports if the shock is sufficiently large, but have no long-run effects if the shock is small. Export subsidies are, however, detrimental to both reputation and welfare in countries already exporting high-quality products, as they encourage the entry of “fly-by-night” unreliable firms.

This paper opens the way for new research in several directions. We have developed a model with reduced-form import demand, abstracting from the determinants of demand for domestic versus foreign goods. We could explore further the conditions under which developing countries end up specializing in low-quality exports by introducing within-sector competition between domestic and foreign firms and non-homothetic preferences for quality. Both country reputations and the sensitivity of host market consumers to quality will be determinants of within-industry specialization across countries. Specifically, as long as the elasticity of demand to perceived quality rises with income, we expect that asymmetric information concerns will affect exports from developing countries to advanced countries more than to other developing countries. Hence, the relative force of factor-driven comparative advantage and “reputational comparative advantage” will shape export patterns differently both in more versus less differentiated industries and towards high- versus low-income destination markets.

Regarding policy responses, we have focused on country-level economic and trade policies, designed to enhance the position of a country’s exports along the quality ladder. Going further, our analysis provides a framework for a richer understanding of firms’ sourcing decisions through the lens of a strategic use of “made in” rules. Exporters can find it optimal to resort to original equipment manufacturers or depart from the cost-minimizing way of splitting the production process across locations, in order to obtain a favorable country-of-origin denomination. The location of manufacturing and assembly will be decided not only according to cost considerations, but also depending on the regulations surrounding rules of origin, consumer sensitivity to quality, and the degree of asymmetric information in the industry. An extension of our model along these lines would generate testable predictions at the firm level. These topics will be investigated in future research.

## A Proofs

### A.1 Proof of Lemma 1

Assume  $\mu > \frac{k}{1-w}$ . First, we have  $\frac{\mu-k}{w} > \mu > \theta^*$  which ensures  $\pi_{t+1}(\theta) = \mu - w\theta - k > 0$  for all firms born at  $t$  which have quality  $\theta < \theta^*$ . Hence all such firms enter initially. Also,  $\theta < \frac{k}{1-w}$  and  $\rho' > 0$  imply that

$$E_t \pi_{t+s}(\theta) = (\rho(s-1) - w)\theta + (1 - \rho(s-1))\mu - k$$

is decreasing in  $s$  and  $\lim_{s \rightarrow \infty} E_t \pi_{t+s} = (1-w)\theta - k < 0$  so all firms below  $\theta^*$  expect to exit in finite time when their profits turn negative. The expected number of periods a firm  $\theta$  born at  $t$  is active is  $T(\theta)$  given by

$$\begin{aligned} [1 - \rho(T(\theta - 1))]\mu &> [w - \rho(T(\theta) - 1)]\theta + k \\ \text{and} \quad [1 - \rho(T(\theta))]\mu &< [w - \rho(T(\theta))]\theta + k \end{aligned}$$

The highest quality type  $\theta_T$  that exits after selling for  $T$  periods (or the lowest quality type that exits after selling for  $T+1$  periods) is defined by  $E_t \pi_{t+T+1}(\theta_T) = 0$ , hence

$$\theta_T = \max \left\{ \frac{k - [1 - \rho(T)]\mu}{\rho(T) - w}, \theta_m \right\}$$

and  $\theta_T$  is increasing with  $T$ :

$$\frac{\partial \theta_T}{\partial T} \propto \rho'(T)(\mu(1-w) - k) > 0 \quad \text{as } \rho' > 0 \quad \text{and } \mu > \theta^*$$

Second, firms with  $\theta^* < \theta < \mu$  expect positive profits at all periods: they have  $E_t \pi_{t+s}(\theta)$  monotonically decreasing from

$$\pi_{t+1}(\theta) = \mu - w\theta - k > \mu(1-w) - k > 0 \quad \text{since } \theta < \mu$$

to

$$\lim_{s \rightarrow \infty} E_t \pi_{t+s}(\theta) = \theta(1-w) - k > 0 \quad \text{since } \theta > \theta^*$$

Hence firms with  $\theta^* < \theta < \mu$  always enter the market and stay until they are exogenously forced to exit.

Finally, firms with  $\theta > \mu$  have increasing expected profits over time. They enter the market if and only if their expected intertemporal profits are positive, which requires:

$$E_t \left( \sum_{s=1}^{\infty} \delta^{s-1} \pi_{t+s}(\theta) \right) = \sum_{s=0}^{\infty} \delta^s [(\rho(s) - w)\theta + (1 - \rho(s))\mu] - \frac{k}{1-\delta} > 0$$

or equivalently:

$$\theta > \frac{k - \mu(1 - \delta) \sum_{s=0}^{\infty} \delta^s (1 - \rho(s))}{(1 - \delta) \sum_{s=0}^{\infty} \delta^s \rho(s) - w} \equiv \theta_H$$

Let us show that  $\theta_H < \mu$ . Rearranging:

$$\theta_H < \mu \text{ iff } \mu \left[ (1 - \delta) \sum_{s=0}^{\infty} \delta^s (1 - \rho(s)) + (1 - \delta) \sum_{s=0}^{\infty} \delta^s \rho(s) \right] > w\mu + k$$

or equivalently iff  $\mu > \frac{k}{1-w}$  which holds by assumption in the high reputation case. Hence all firms with  $\theta > \mu$  always export until they are hit by the exogenous shock.

## A.2 Proof of Lemma 2

Assume  $\mu < \frac{k}{1-w}$  and  $\mu > k + w\theta_m$ . First, consider firms with  $\theta < \mu$  born at date  $t$ . Since their expected profits are decreasing with time, they are active in the first period if and only if  $E_t \pi_{t+1}(\theta) = \mu - w\theta - k > 0$ , which requires  $\theta \leq \frac{\mu - k}{w} \equiv \theta_L$ . We can immediately check that  $\mu < \frac{k}{1-w} \Leftrightarrow \theta_L < \mu$ . Expected second-period profits are

$$E_t \pi_{t+2}(\theta) = (\rho(1) - w)\theta + (1 - \rho(1))\mu - k < (1 - w)\mu - k < 0$$

since  $\theta < \mu$  and  $\rho(1) > w$ . Hence among firms with  $\theta < \mu$ , those with  $\theta < \theta_L$  are active in the first period and exit afterwards, and those with  $\theta_L \leq \theta < \mu$  are never active.

Second, consider firms with  $\mu \leq \theta < \theta^*$ . These firms have  $E_t \pi_{t+1}(\theta) < 0$  since  $\theta > \theta_L$ ,  $E_t \pi_{t+s}(\theta)$  monotonically increasing in  $s$  since  $\theta \geq \mu$ , and  $\lim_{s \rightarrow \infty} E_t \pi_{t+s}(\theta) < 0$  since  $\theta < \theta^*$ . Thus their expected profits are negative in all periods and they optimally exit after drawing their quality parameter.

Third, consider firms with  $\theta > \theta^*$ . These firms have  $E_t \pi_{t+s}(\theta)$  monotonically increasing in  $s$  since  $\theta > \mu$ , and  $\lim_{s \rightarrow \infty} E_t \pi_{t+s}(\theta) > 0$  since  $\theta > \theta^*$ . If they decide to be active in the first period, they expect to remain in the market as long as they survive the exogenous shock. However given  $\theta > \theta_L$  they incur a loss in the initial periods. The condition for a firm of type  $\theta > \theta^*$  to be active is for intertemporal expected profits to be positive, which requires  $\theta > \frac{k - (1 - A_\rho)\mu}{A_\rho - w} \equiv \theta_H$  as derived in the proof of Lemma 1, where we define  $A_\rho \equiv (1 - \delta) \sum_{s=0}^{\infty} \delta^s \rho(s)$ . Finally,

$$\theta_H > \theta^* \Leftrightarrow \frac{k - (1 - A_\rho)\mu}{A_\rho - w} > \frac{k}{1 - w} \Leftrightarrow k(1 - A_\rho) > (1 - A_\rho)\mu(1 - w)$$

which is equivalent to  $\frac{k}{1-w} > \mu$  and holds by assumption in the low reputation case. Hence firms with  $\theta^* \leq \theta \leq \theta_H$  are never active and firms with  $\theta > \theta_H$  enter the export market and stay active.

### A.3 Proof of Proposition 1

A HQE is a fixed point of  $\bar{\theta}(\cdot)$  where

$$\begin{aligned}\bar{\theta}(\mu) &= \mu_0 \left( \frac{1 - \sum_{T=0}^{\infty} \delta^{T+1} \left( \left( \frac{\theta_m}{\theta_T} \right)^{\alpha-1} - \left( \frac{\theta_m}{\theta_{T+1}} \right)^{\alpha-1} \right)}{1 - \sum_{T=0}^{\infty} \delta^{T+1} \left( \left( \frac{\theta_m}{\theta_T} \right)^{\alpha} - \left( \frac{\theta_m}{\theta_{T+1}} \right)^{\alpha} \right)} \right) \\ &= \mu_0 \left( \frac{1 + \sum_{T=\tilde{T}}^{\infty} \delta^T \left( \frac{\theta_m}{\theta_T} \right)^{\alpha-1}}{1 + \sum_{T=\tilde{T}}^{\infty} \delta^T \left( \frac{\theta_m}{\theta_T} \right)^{\alpha}} \right)\end{aligned}$$

and  $\tilde{T}$  is the lowest value of  $T$  such that  $\theta_T > \theta_m$ .

Step 1: Let us show that  $\bar{\theta}(\mu)$  is strictly decreasing in  $\mu$  on  $[\theta^*, \infty)$ . We have

$$\begin{aligned}\bar{\theta} &= \mu_0 \left( \frac{1 + K(\alpha - 1)}{1 + K(\alpha)} \right) \quad \text{where } K(\alpha) \equiv \sum_{T=\tilde{T}}^{\infty} \delta^T \left( \frac{\theta_m}{\theta_T} \right)^{\alpha} \\ \frac{\partial K(\alpha)}{\partial \alpha} &= \sum_{T=\tilde{T}}^{\infty} \delta^T \ln(\theta_m/\theta_T) \left( \frac{\theta_m}{\theta_T} \right)^{\alpha} < 0\end{aligned}$$

Consider a change in one of the thresholds,  $\theta_S$ , leaving unchanged all other thresholds. Then all else equal, average quality rises:

$$\begin{aligned}\frac{\partial \bar{\theta}}{\partial \theta_S} &= \frac{\delta^S}{\theta_S} \left( \frac{\theta_m}{\theta_S} \right)^{\alpha-1} \left[ \alpha \left( \frac{\theta_m}{\theta_S} \right) (1 + K(\alpha - 1)) - (\alpha - 1) (1 + K(\alpha)) \right] \\ &= \frac{\delta^S}{\theta_S} \left( \frac{\theta_m}{\theta_S} \right)^{\alpha-1} (1 + K(\alpha)) \left[ \alpha \left( \frac{\theta_m}{\theta_S} \right) \frac{\bar{\theta}}{\mu_0} - (\alpha - 1) \right] \\ &= \frac{\delta^S}{\theta_S} \left( \frac{\theta_m}{\theta_S} \right)^{\alpha-1} (1 + K(\alpha)) (\alpha - 1) \left[ \left( \frac{\bar{\theta}}{\theta_S} \right) - 1 \right] > 0\end{aligned}$$

which derives from  $\bar{\theta} > \theta^* > \theta_S$  for all  $S$  in a HQE. An increase in  $\mu$  lowers all  $\theta_T$  given Assumption 1 and differentiating:

$$\frac{\partial \theta_T}{\partial \mu} = -\frac{1 - \rho(T)}{\rho(T) - w}$$

Thus, in a HQE,  $\bar{\theta}(\mu)$  is a decreasing function:

$$\frac{\partial \bar{\theta}}{\partial \mu} = \sum_{T=\tilde{T}}^{\infty} \frac{\partial \bar{\theta}}{\partial \theta_T} \frac{\partial \theta_T}{\partial \mu} < 0$$

We have proved that  $\bar{\theta}$  is strictly and continuously decreasing in  $\mu$  on  $[\theta^*, \infty)$ .

Step 2: Let us show that  $\lim_{\mu \rightarrow \infty} \frac{\bar{\theta}(\mu)}{\mu} < 1$ . As  $\mu \rightarrow \infty$ , it remains profitable for all firms to stay active, so firms of all qualities continue exporting until hit by the exogenous shock:  $T(\theta) \rightarrow \infty$  for all  $\theta$ . Therefore,  $\lim_{\mu \rightarrow \infty} \mu_0$  which is finite, so  $\lim_{\mu \rightarrow \infty} \frac{\bar{\theta}(\mu)}{\mu} < 1$ .

By the fixed point theorem, we have established that if  $\bar{\theta}(\theta^*) > \theta^*$ ,  $\bar{\theta}(\cdot)$  has a unique fixed point on  $(\theta^*, \infty)$ , which proves Proposition 1.

Step 3: Derive the condition for  $\bar{\theta}(\theta^*) > \theta^*$ . At  $\mu = \theta^*$ ,  $\pi_t(\theta) < 0$  for all  $t > 1$  and  $\theta < \theta^*$ . Then

$$\bar{\theta}(\theta^*) = \frac{\int_{\theta_m}^{\theta^*} \theta dG(\theta) + \frac{1}{1-\delta} \int_{\theta^*}^{\infty} \theta dG(\theta)}{\int_{\theta_m}^{\theta^*} dG(\theta) + \frac{1}{1-\delta} \int_{\theta^*}^{\infty} dG(\theta)} = \mu_0 \left( \frac{1 - \delta + \delta \left( \frac{\theta_m}{\theta^*} \right)^{\alpha-1}}{1 - \delta + \delta \left( \frac{\theta_m}{\theta^*} \right)^{\alpha}} \right)$$

So  $\bar{\theta}(\theta^*) > \theta^*$  is equivalent to  $\mu_0 \left( \frac{1 - \delta + \delta \left( \frac{\theta_m(1-w)}{k} \right)^{\alpha-1}}{1 - \delta + \delta \left( \frac{\theta_m(1-w)}{k} \right)^{\alpha}} \right) > \frac{k}{1-w}$ , which after substituting for the value of  $\mu_0$  and rearranging yields the following condition:

$$\alpha \left( \frac{\theta_m(1-w)}{k} \right) + \frac{\delta}{1-\delta} \left( \frac{\theta_m(1-w)}{k} \right)^{\alpha} > \alpha - 1$$

#### A.4 Proof of Proposition 2

A LQE is a fixed point of  $\bar{\theta}(\mu)$  where:

$$\bar{\theta}(\mu) = \mu_0 \left( \frac{(1-\delta) \left( 1 - \left( \frac{\theta_m}{\theta_L} \right)^{\alpha-1} \right) + \left( \frac{\theta_m}{\theta_H} \right)^{\alpha-1}}{(1-\delta) \left( 1 - \left( \frac{\theta_m}{\theta_L} \right)^{\alpha} \right) + \left( \frac{\theta_m}{\theta_H} \right)^{\alpha}} \right)$$

Step 1: The sign of  $\frac{\partial \bar{\theta}(\mu)}{\partial \mu}$  is indeterminate. Differentiate with respect to each threshold:

$$\begin{aligned} \frac{\partial \bar{\theta}}{\partial \theta_L} &= \frac{\mu_o(\alpha-1)}{1 - \left( \frac{\theta_m}{\theta_L} \right)^{\alpha} + \frac{1}{1-\delta} \left( \frac{\theta_m}{\theta_H} \right)^{\alpha}} \left( \frac{1}{\theta_L} \right) \left( \frac{\theta_m}{\theta_L} \right)^{\alpha-1} \left[ 1 - \frac{\bar{\theta}}{\theta_L} \right] < 0 \\ \frac{\partial \bar{\theta}}{\partial \theta_H} &= \frac{\frac{1}{1-\delta} \mu_o(\alpha-1)}{1 - \left( \frac{\theta_m}{\theta_L} \right)^{\alpha} + \frac{1}{1-\delta} \left( \frac{\theta_m}{\theta_H} \right)^{\alpha}} \left( \frac{1}{\theta_H} \right) \left( \frac{\theta_m}{\theta_H} \right)^{\alpha-1} \left[ \frac{\bar{\theta}}{\theta_H} - 1 \right] < 0 \end{aligned}$$

$$\begin{aligned} \frac{\partial \bar{\theta}}{\partial \mu} &= \frac{\partial \bar{\theta}}{\partial \theta_L} \frac{\partial \theta_L}{\partial \mu} + \frac{\partial \bar{\theta}}{\partial \theta_H} \frac{\partial \theta_H}{\partial \mu} = \frac{\mu_o(\alpha-1)}{1 - \left( \frac{\theta_m}{\theta_L} \right)^{\alpha} + \frac{1}{1-\delta} \left( \frac{\theta_m}{\theta_H} \right)^{\alpha}} \times \dots \\ \dots &\times \left[ \left( \frac{\theta_m^{\alpha-1}}{\theta_L^{\alpha}} \right) \left[ \frac{\bar{\theta}}{\theta_L} - 1 \right] \left( \frac{1}{w} \right) - \frac{1}{1-\delta} \left( \frac{\theta_m^{\alpha-1}}{\theta_H^{\alpha}} \right) \left[ 1 - \frac{\bar{\theta}}{\theta_H} \right] \left( \frac{1-A_{\rho}}{A_{\rho}-w} \right) \right] \\ \frac{\partial \bar{\theta}}{\partial \mu} &< 0 \text{ iff } \frac{1}{1-\delta} \left( \frac{1}{\theta_H} \right)^{\alpha} \left[ 1 - \frac{\bar{\theta}}{\theta_H} \right] \left( \frac{1-A_{\rho}}{A_{\rho}-w} \right) > \left( \frac{1}{\theta_L} \right)^{\alpha} \left[ \frac{\bar{\theta}}{\theta_L} - 1 \right] \left( \frac{1}{w} \right) \end{aligned}$$

This condition can be rewritten as

$$\delta > 1 - \left( \frac{\theta_L}{\theta_H} \right)^{\alpha+1} \left( \frac{\theta_H - \bar{\theta}}{\bar{\theta} - \theta_L} \right) \left( \frac{(1 - A_\rho) w}{A_\rho - w} \right)$$

Then note that the bracketed terms are  $\frac{\theta_L}{\theta_H} = \frac{(\mu-k)(A_\rho-w)}{w(k-(1-A_\rho)\mu)}$  and  $\frac{\theta_H - \bar{\theta}}{\bar{\theta} - \theta_L} = \frac{\frac{k-(1-A_\rho)\mu}{A_\rho-w} - \bar{\theta}}{\bar{\theta} - \frac{\mu-k}{w}} = \frac{w}{A_\rho-w} \left( 1 - \frac{A_\rho(\bar{\theta}-\mu)}{k-\mu+w\bar{\theta}} \right)$ . Therefore  $\bar{\theta}(\mu)$  decreases in  $\mu$  when

$$\delta > 1 - \left( \frac{\mu - k}{k - (1 - A_\rho)\mu} \right)^{\alpha+1} \left( \frac{A_\rho - w}{w} \right)^{\alpha-1} \left( 1 - \frac{A_\rho(\bar{\theta} - \mu)}{k - \mu + w\bar{\theta}} \right)$$

and decreases in  $\mu$  otherwise. The reason why  $\bar{\theta}(\mu)$  needs not be monotonic over  $[\theta_m, \theta^*]$  is that  $\mu$  has opposite effects on  $\bar{\theta}$  coming from  $\theta_L$  and  $\theta_H$ . Which effect dominates depends on the position of  $\mu$  as well as the shape parameter  $\alpha$  and the survival parameter  $\delta$ . This non-monotonicity is what gives rise to the possibility of multiple equilibria.

Step 2: If  $\mu = \theta_m$ , no firm below  $\theta^*$  finds it profitable to export, as national reputation imposes a first-period loss on all firms. Some firms with high enough  $\theta$  have a positive NPV of future profits and enter. So since  $\theta_m$  is the lower bound of the prior quality distribution,  $\bar{\theta}(\theta_m) > \theta^* > \theta_m$ .

Step 3: From the derivation of Proposition 1 we know that

$$\bar{\theta}(\theta^*) < \theta^* \Leftrightarrow \alpha \left( \frac{\theta_m(1-w)}{k} \right) + \frac{\delta}{1-\delta} \left( \frac{\theta_m(1-w)}{k} \right)^\alpha < \alpha - 1$$

So we have proved that if this condition holds, there is no HQE and there must be at least one LQE.

## A.5 Proof of Result 1

In a LQE, the set of continuing firms is  $[\theta_H, \infty)$  from the second period onwards, so the average price  $\bar{p}_{t,t+s}^{lqe}$  of cohort  $t$  at time  $t+s$  is given by:

$$\bar{p}_{t,t+s}^{lqe}(\bar{\theta}) = \begin{cases} \bar{\theta} & \text{if } s = 1 \\ \bar{\theta} + \rho(s) \left( \frac{\alpha}{\alpha-1} \theta_H - \bar{\theta} \right) & \text{if } s > 1 \end{cases}$$

As  $\bar{\theta} < \theta_H$  in a LQE and  $\rho(s)$  increases in  $s$ , it immediately follows that  $\bar{p}_{t,t+s}^{lqe}$  increases with  $s$ .

In a HQE, the set of active firms of cohort  $t$  at time  $t+s$  is  $[\theta_{s-1}, \infty)$ , and their average

price is:

$$\bar{p}_{t,t+s}^{hqe}(\bar{\theta}) = \begin{cases} \bar{\theta} & \text{if } s = 1 \\ \bar{\theta} + \rho(s) \left( \frac{\alpha}{\alpha-1} \theta_{s-1} - \bar{\theta} \right) & \text{if } s > 1 \end{cases}$$

$\rho(s)$  and  $\theta_{s-1}$  increase with  $s$ . Immediately following the entry of cohort  $t$ ,  $\bar{p}_{t,t+s}^{hqe}$  may fall with  $s$  if the distribution of  $\theta$  has low variance ( $\alpha$  high), such that  $\frac{\alpha}{\alpha-1} \theta_1 > \mu$ . In this case, there is initially a large mass of firms at the bottom of the distribution of continuing firms and their prices are falling. However, since  $\mu < \frac{\alpha}{\alpha-1} \theta^*$ , there is some finite  $s'$  such that for all  $s \geq s'$ ,  $\bar{p}_{t,t+s+1}^{hqe}(\bar{\theta}) > \bar{p}_{t,t+s}^{hqe}(\bar{\theta})$  and thus at each given point in time, the average unit price is higher for older cohorts of firms.

## A.6 Proof of Result 2

The first part establishes that across cohorts, the fraction of active firms that exit per period is higher for lower quality firms. In a LQE, the hazard rate is 1 for firms below  $\theta_L$  and  $1 - \delta$  for firms above  $\theta_H$ . In a HQE, the hazard rate is  $\frac{1-\delta}{1-\delta^T}$  for firms between  $\theta_{T-1}$  and  $\theta_T$  for all  $T$ , which is decreasing in  $T$ , and  $1 - \delta$  for firms above  $\theta^*$ .

The second part states that the probability of exit, across quality levels, decreases with the age of a cohort. In a LQE, the hazard rate of cohort  $t$  at time  $t + s$  is

$$h_{t,t+s}^{lqe} = \begin{cases} 1 - \delta + \delta \frac{G(\theta_L)}{G(\theta_L)+1-G(\theta_H)} & \text{if } s = 1 \\ 1 - \delta & \text{if } s > 1 \end{cases}$$

It falls from  $t + 1$  to  $t + 2$  and remains constant thereafter. In a HQE, the hazard rate of cohort  $t$  at  $t + s$  is

$$h_{t,t+s}^{hqe} = 1 - \delta + \delta \frac{G(\theta_s) - G(\theta_{s-1})}{1 - G(\theta_{s-1})} = 1 - \delta + \delta \left( 1 - \left( \frac{\theta_{s-1}}{\theta_s} \right)^\alpha \right)$$

Since  $\frac{\theta_{s-1}}{\theta_s}$  is decreasing in  $s$ ,  $h_{t,t+s}^{hqe}$  falls over time.

## A.7 Proof of Proposition 3

In a LQE, average quality is given by:

$$\bar{\theta} = \mu_0 \left( \frac{(1 - \delta) \left( 1 - \left( \frac{\theta_m}{\theta_L} \right)^{\alpha-1} \right) + \left( \frac{\theta_m}{\theta_H} \right)^{\alpha-1}}{(1 - \delta) \left( 1 - \left( \frac{\theta_m}{\theta_L} \right)^\alpha \right) + \left( \frac{\theta_m}{\theta_H} \right)^\alpha} \right)$$

Differentiate with respect to each threshold:

$$\begin{aligned}\frac{\partial \bar{\theta}}{\partial \theta_L} &= \frac{\mu_o(\alpha-1)}{1 - \left(\frac{\theta_m}{\theta_L}\right)^\alpha + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H}\right)^\alpha} \left(\frac{1}{\theta_L}\right) \left(\frac{\theta_m}{\theta_L}\right)^{\alpha-1} \left(1 - \frac{\bar{\theta}}{\theta_L}\right) < 0 \\ \frac{\partial \bar{\theta}}{\partial \theta_H} &= \frac{\frac{1}{1-\delta} \mu_o(\alpha-1)}{1 - \left(\frac{\theta_m}{\theta_L}\right)^\alpha + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H}\right)^\alpha} \left(\frac{1}{\theta_H}\right) \left(\frac{\theta_m}{\theta_H}\right)^{\alpha-1} \left(\frac{\bar{\theta}}{\theta_H} - 1\right) < 0\end{aligned}$$

$$\begin{aligned}\frac{\partial \bar{\theta}}{\partial k} &= \frac{\partial \bar{\theta}}{\partial \theta_L} \frac{\partial \theta_L}{\partial k} + \frac{\partial \bar{\theta}}{\partial \theta_H} \frac{\partial \theta_H}{\partial k} = \frac{\mu_o(\alpha-1)}{1 - \left(\frac{\theta_m}{\theta_L}\right)^\alpha + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H}\right)^\alpha} \times \dots \\ &\times \left[ \frac{1}{1-\delta} \left(\frac{1}{\theta_H}\right) \left(\frac{\theta_m}{\theta_H}\right)^{\alpha-1} \left(1 - \frac{\bar{\theta}}{\theta_H}\right) \left(\frac{1}{A_\rho - w}\right) - \left(\frac{1}{\theta_L}\right) \left(\frac{\theta_m}{\theta_L}\right)^{\alpha-1} \left(\frac{\bar{\theta}}{\theta_L} - 1\right) \left(\frac{1}{w}\right) \right] \\ \frac{\partial \bar{\theta}}{\partial k} &> 0 \text{ iff } \frac{1}{1-\delta} \left(\frac{1}{\theta_H}\right)^\alpha \left(1 - \frac{\bar{\theta}}{\theta_H}\right) \left(\frac{1}{A_\rho - w}\right) > \left(\frac{1}{\theta_L}\right)^\alpha \left(\frac{\bar{\theta}}{\theta_L} - 1\right) \left(\frac{1}{w}\right)\end{aligned}$$

This condition can be rewritten as

$$\delta > 1 - \left(\frac{\theta_L}{\theta_H}\right)^{\alpha+1} \left(\frac{\theta_H - \bar{\theta}}{\bar{\theta} - \theta_L}\right) \left(\frac{w}{A_\rho - w}\right)$$

Then note that, starting from a steady-state ( $\bar{\theta} = \mu$ ), the bracketed terms are  $\frac{\theta_L}{\theta_H} = \frac{(\mu-k)(A_\rho-w)}{w(k-(1-A_\rho)\mu)}$  and  $\frac{\theta_H - \bar{\theta}}{\bar{\theta} - \theta_L} = \frac{\frac{1}{A_\rho-w}(k-(1-w)\mu)}{\frac{1}{w}(k-(1-w)\mu)} = \frac{w}{A_\rho-w}$ . Therefore  $\bar{\theta}$  decreases in  $k$  if and only if

$$\delta > 1 - \left(\frac{\mu-k}{k-(1-A_\rho)\mu}\right)^{\alpha+1} \left(\frac{A_\rho-w}{w}\right)^{\alpha-1}$$

The RHS is decreasing in  $\mu$  and  $\alpha$ , so this holds for  $\delta$  not too low,  $\alpha$  not too high and an initial  $\mu$  not too low. Then starting from a LQE, a decrease in  $k$  moves up the  $\bar{\theta}(\mu)$  function left of the initial  $\mu$ . The new steady-state equilibrium quality and reputation are necessarily higher. If the steady-state is unique, the new steady-state has higher  $\mu$ . If there are multiple steady-states, ranked by increasing  $\mu$ , either the new steady-state has the same rank and higher  $\mu$ , or the new steady-state has higher rank and higher  $\mu$ .

The welfare effect of a subsidy  $\sigma$  ( $\sigma = -dk$ ) has three components. First, for firms with  $\theta$  parameters such that they sell both without and with the subsidy, the policy adds to their profits the amount it costs to the government, plus the extra profits brought by a higher reputation  $\mu' > \mu$ . The total effect is unambiguously positive.

Second, for new exporters that enter around  $\theta_L$  because of the policy ( $\theta_L < \theta < \theta_{L'}$ ), the

net benefit  $NB_L$  of the subsidy is positive:

$$\begin{aligned}
NB_L &= \int_{\theta_L}^{\theta_{L'}} (\mu' - w\theta - k + \sigma) dG(\theta) - \int_{\theta_L}^{\theta_{L'}} \sigma g(\theta) d\theta \\
NB_L &= (\mu' - k) \int_{\theta_L}^{\theta_{L'}} g(\theta) d\theta - w \int_{\theta_L}^{\theta_{L'}} \theta dG(\theta) \\
&= \left[ (\mu' - k) \left( \left( \frac{\theta_m}{\theta_L} \right)^\alpha - \left( \frac{\theta_m}{\theta_{L'}} \right)^\alpha \right) - w \frac{\alpha}{\alpha-1} \theta_m \left( \left( \frac{\theta_m}{\theta_L} \right)^{\alpha-1} - \left( \frac{\theta_m}{\theta_{L'}} \right)^{\alpha-1} \right) \right] \\
&= w \theta_m \left[ \left( \frac{\theta_{L'}}{\theta_L} \left( \frac{\theta_m}{\theta_L} \right)^{\alpha-1} - \left( \frac{\theta_m}{\theta_{L'}} \right)^{\alpha-1} \right) - \frac{\alpha}{\alpha-1} \left( \left( \frac{\theta_m}{\theta_L} \right)^{\alpha-1} - \left( \frac{\theta_m}{\theta_{L'}} \right)^{\alpha-1} \right) \right] \\
&> \frac{w \theta_m}{\alpha-1} \left( \left( \frac{\theta_m}{\theta_L} \right)^{\alpha-1} - \left( \frac{\theta_m}{\theta_{L'}} \right)^{\alpha-1} \right) > 0
\end{aligned}$$

where we go from the second to the third line using  $w\theta_{L'} = \mu' - k$ .

Third, for new exporters that enter around  $\theta_H$  because of the policy ( $\theta_{H'} < \theta < \theta_H$ ), the net benefit  $NB_H$  of the subsidy is also positive:

$$\begin{aligned}
NB_H &= \int_{\theta_{H'}}^{\theta_H} \left( \sum_{t=0}^{\infty} \delta^t (\rho(t)\theta + (1-\rho(t))\mu' - w\theta - k + \sigma) \right) g(\theta) d\theta - \dots \\
&\quad \dots \frac{1}{1-\delta} \int_{\theta_{H'}}^{\theta_H} \sigma g(\theta) d\theta \\
&= \frac{1}{1-\delta} \int_{\theta_{H'}}^{\theta_H} ((A_\rho - w)\theta + (1 - A_\rho)\mu' - k) g(\theta) d\theta \\
&= \frac{1}{1-\delta} \left[ - (k - (1 - A_\rho)\mu') \left( \left( \frac{\theta_m}{\theta_{H'}} \right)^\alpha - \left( \frac{\theta_m}{\theta_H} \right)^\alpha \right) + \frac{\alpha(A_\rho - w)}{\alpha-1} \theta_m \left( \left( \frac{\theta_m}{\theta_{H'}} \right)^{\alpha-1} - \left( \frac{\theta_m}{\theta_H} \right)^{\alpha-1} \right) \right] \\
&= \frac{1}{1-\delta} (A_\rho - w) \theta_m \left[ \left( \left( \frac{\theta_m}{\theta_{H'}} \right)^{\alpha-1} - \frac{\theta_{H'}}{\theta_H} \left( \frac{\theta_m}{\theta_H} \right)^{\alpha-1} \right) - \frac{\alpha}{\alpha-1} \left( \left( \frac{\theta_m}{\theta_{H'}} \right)^{\alpha-1} - \left( \frac{\theta_m}{\theta_H} \right)^{\alpha-1} \right) \right] \\
&> \frac{1}{1-\delta} (A_\rho - w) \frac{\theta_m}{\alpha-1} \left( \left( \frac{\theta_m}{\theta_{H'}} \right)^{\alpha-1} - \left( \frac{\theta_m}{\theta_H} \right)^{\alpha-1} \right) > 0
\end{aligned}$$

So the overall welfare gain is positive.

## A.8 Proof of Proposition 4

In a HQE, average quality is given by  $\bar{\theta} = \mu_0 \left( \frac{1+K(\alpha-1)}{1+K(\alpha)} \right)$  where  $K(\alpha) \equiv \sum_{T=\tilde{T}}^{\infty} \delta^T \left( \frac{\theta_m}{\theta_T} \right)^\alpha$  and  $\theta_T = \frac{k-(1-\rho(T))\mu}{\rho(T)-w}$ . Using the derivations in the proof of Proposition 1, we have

$$\begin{aligned} \frac{\partial \theta_T}{\partial k} &= \frac{1}{\rho(T)-w} > 0 \quad \text{for all } T > \tilde{T} \\ \frac{\partial \bar{\theta}}{\partial k} &= \sum_{T=\tilde{T}}^{\infty} \frac{\partial \bar{\theta}}{\partial \theta_T} \frac{\partial \theta_T}{\partial k} > 0 \end{aligned}$$

Hence a subsidy that lowers  $k$  shifts down the  $\bar{\theta}(\mu)$  function. As  $\bar{\theta}$  is decreasing in  $\mu$  in the HQE region, the new steady-state equilibrium defined by  $\bar{\theta}(\mu) = \mu$  necessarily has lower  $\mu$ . So average quality and national reputation are higher in the HQE steady-state without subsidies than with subsidies.

## A.9 Proof of Proposition 5

This appendix section provides a sketch of the proof of Proposition 5. It essentially relies on the stability of  $\mu_S$  and  $\mu'_S$  and the instability of  $\mu_U$ . For (i) and (ii), let us show that if  $\mu_S$  is a steady-state LQE and  $\frac{\partial \bar{\theta}(\mu)}{\partial \mu} < 0$  at  $\mu_S$ , then  $\mu_S$  is a stable equilibrium for  $\eta < 1$ . Define  $\theta_{L,S} \equiv \frac{\mu_S - k}{w}$  and  $\theta_{H,S} \equiv \frac{k-(1-A_\rho)\mu_S}{A_\rho - w}$ . At time  $t-1$  the economy is in an initial steady-state where

$$\mu_S = \bar{\theta}(\mu_S) = \mu_0 \left( \frac{1 - \left( \frac{\theta_m}{\theta_{L,S}} \right)^{\alpha-1} + \left( \frac{\theta_m}{\theta_{H,S}} \right)^{\alpha-1}}{1 - \left( \frac{\theta_m}{\theta_{L,S}} \right)^\alpha + \left( \frac{\theta_m}{\theta_{H,S}} \right)^\alpha} \right)$$

Suppose  $\bar{\theta}$  is locally decreasing in  $\mu$ . Then for all  $\mu_S < \mu < \mu_U$ ,  $\bar{\theta}(\mu) < \mu$ . Now suppose there is a perturbation at time  $t$  such that  $\mu_t = \mu_S + \varepsilon$ ,  $\varepsilon > 0$  and  $\varepsilon < \mu_U - \mu_S$ . The entry thresholds at  $t$  are:

$$\begin{aligned} \theta_{L,t} &= \frac{\mu_t - k}{w} = \frac{\mu_S + \varepsilon - k}{w} \\ \theta_{H,t} &= \frac{k - (1-\delta) \sum_{u=0}^{\infty} (1-\rho(u)) \mu_{t+u}}{A_\rho - w} \end{aligned}$$

where  $\theta_{H,t}$  is determined by the zero intertemporal profits condition

$$\sum_{u=0}^{\infty} \delta^u [(\rho(u) - w) \theta_{H,t} + (1 - \rho(u)) E_t \mu_{t+u} - k]$$

and the absence of aggregate uncertainty allows us to remove the expectations operator.

Let us conjecture, to be verified, that  $\mu_S \leq \mu_{t+u+1} \leq \mu_{t+u} \leq \mu_S + \varepsilon$  for all  $u \geq 1$ . Then:

$$\begin{aligned} \theta_{L,S} &< \theta_{L,t+u+1} < \theta_{L,t+u} < \theta_{L,t} \\ \theta_{H,S} &> \theta_{H,t+u+1} > \theta_{H,t+u} > \theta_{H,t} \end{aligned} \quad \text{for all } u \geq 1$$

The average quality of exports is determined by the  $\theta_L$  and  $\theta_H$  thresholds in the periods after the shock in the following manner: for  $u \geq 0$ ,

$$\begin{aligned} \bar{\theta}_{t+u} &= \mu_0 \left( \frac{1 - \left(\frac{\theta_m}{\theta_{L,t+u}}\right)^{\alpha-1} + \sum_{l=0}^u \delta^{u-l} \left(\frac{\theta_m}{\theta_{H,t+l}}\right)^{\alpha-1} + \sum_{l=u+1}^{\infty} \delta^l \left(\frac{\theta_m}{\theta_{H,S}}\right)^{\alpha-1}}{1 - \left(\frac{\theta_m}{\theta_{L,t+u}}\right)^{\alpha} + \sum_{l=0}^u \delta^{u-l} \left(\frac{\theta_m}{\theta_{H,t+l}}\right)^{\alpha} + \sum_{l=u+1}^{\infty} \delta^l \left(\frac{\theta_m}{\theta_{H,S}}\right)^{\alpha}} \right) \\ \theta_{L,t+u} &= \frac{\mu_{t+u} - k}{w} \\ \theta_{H,t+u} &= \frac{k - (1 - \delta) \sum_{l=0}^{\infty} (1 - \rho(l)) \mu_{t+u+l}}{A_{\rho} - w} \end{aligned}$$

At time  $t$ , let us define  $\bar{\theta}_t^{perm}$  as the average quality that would prevail if firms expected the shock to be permanent, i.e. if  $E_t \mu_{t+u} = \mu_t$  for all  $u \geq 0$ . We calculate:

$$\begin{aligned} \bar{\theta}_t &= \mu_0 \left( \frac{1 - \left(\frac{\theta_m}{\theta_{L,t}}\right)^{\alpha-1} + \left(\frac{\theta_m}{\theta_{H,t}}\right)^{\alpha-1} + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\theta_{H,S}}\right)^{\alpha-1}}{1 - \left(\frac{\theta_m}{\theta_{L,t}}\right)^{\alpha} + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\theta_{H,t}}\right)^{\alpha} + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\theta_{H,S}}\right)^{\alpha}} \right) \\ \bar{\theta}_t < \bar{\theta}_t^{perm} &= \mu_0 \left( \frac{1 - \left(\frac{\theta_m}{\theta_{L,t}}\right)^{\alpha-1} + \left(\frac{\theta_m}{\bar{\theta}_t^{perm}}\right)^{\alpha-1} + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\theta_{H,S}}\right)^{\alpha-1}}{1 - \left(\frac{\theta_m}{\theta_{L,t}}\right)^{\alpha} + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\bar{\theta}_t^{perm}}\right)^{\alpha} + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\theta_{H,S}}\right)^{\alpha}} \right) \end{aligned}$$

as  $\theta_{H,t}^{perm} = \frac{k - (1 - A_{\rho})(\mu_S + \varepsilon)}{A_{\rho} - w} < \theta_{H,t}$  from the conjecture  $\mu_S \leq \mu_{t+u+1} \leq \mu_{t+u} \leq \mu_S + \varepsilon$  for all  $u \geq 1$ . Also

$$\bar{\theta}_t^{perm} < \bar{\theta}(\mu_S + \varepsilon) < \mu_t$$

The first inequality results from  $\theta_{H,S} > \theta_{H,t}^{perm}$ . The second inequality comes from  $\bar{\theta}(\mu) < \mu$  for  $\mu \in (\mu_S, \mu_U)$ . Hence  $\bar{\theta}_t < \mu_t$  and therefore:

$$\bar{\theta}_t < \mu_{t+1} = \mu_t + \eta(\bar{\theta}_t - \mu_t) < \mu_t$$

Additionally as long as  $\eta$  is not too close to 1,  $\mu_{t+1} > \mu_S$ .

We can show, similarly, that in all subsequent periods,  $\bar{\theta}_{t+u} < \mu_{t+u}$  as long as  $\mu_{t+u} > \mu_S$ . Thus  $\mu_{t+u+1} < \mu_{t+u}$  for all  $u$  and the conjecture that  $\mu_{t+u}$  follows a decreasing path from  $\mu_S + \varepsilon$  to  $\mu_S$  is verified. In case of a negative shock to  $\mu$  at time  $t$  starting from a steady-state where  $\bar{\theta}$  is locally decreasing in  $\mu$ , the proof is identical with opposite signs. It follows that if

$\mu_S$  is a steady-state reputation and  $\bar{\theta}(\mu)$  is locally decreasing in  $\mu$  at  $\mu_S$ , then  $\mu_S$  is stable. Any positive shock, starting from  $\mu_S$ , that brings  $\mu_t$  to a value in  $(\mu_S, \mu_U)$  has no long-run effects as the economy moves back to  $\mu_S$ .

By the same reasoning,  $\mu_U$  is unstable. Suppose there is a negative shock to  $\mu$  starting from

$$\mu_U = \bar{\theta}(\mu_U) = \mu_0 \left( \frac{1 - \left(\frac{\theta_m}{\theta_{L,U}}\right)^{\alpha-1} + \left(\frac{\theta_m}{\theta_{H,U}}\right)^{\alpha-1}}{1 - \left(\frac{\theta_m}{\theta_{L,U}}\right)^{\alpha} + \left(\frac{\theta_m}{\theta_{H,U}}\right)^{\alpha}} \right)$$

where  $\theta_{L,U} \equiv \frac{\mu_U - k}{w}$ ,  $\theta_{H,U} \equiv \frac{k - (1 - A_\rho)\mu_U}{A_\rho - w}$  and  $\bar{\theta}(\mu)$  is increasing in  $\mu$  at  $\mu_U$ . At time  $t$ ,  $\mu_t = \mu_U - \varepsilon$ , where  $\varepsilon > 0$  and  $\varepsilon < \mu_U - \mu_S$ . We conjecture  $\mu_S \leq \mu_{t+u+1} \leq \mu_{t+u} \leq \mu_U - \varepsilon$ , which implies  $\theta_{L,S} < \theta_{L,t+u+1} < \theta_{L,t+u} < \theta_{L,U}$  and  $\theta_{H,S} > \theta_{H,t+u+1} > \theta_{H,t+u} > \theta_{H,U}$  for all  $u \geq 0$ . Then  $\bar{\theta}_{t+u} < \mu_{t+u}$  and thus  $\mu_{t+u+1} < \mu_{t+u}$  for all  $u \geq 0$ .

For part (iii), consider a “large shock”, starting from  $\mu_S$ , as a shock  $\varepsilon > \mu_U - \mu_S$  such that if  $\mu_t = \mu_S + \varepsilon$ , then  $\underline{\mu} > \mu_U$ , where  $\bar{\theta}_t$  is defined as in (ii) and  $\underline{\mu}$  is defined below.  $\bar{\theta}_{t+u}$ ,  $\theta_{L,t+u}$  and  $\theta_{H,t+u}$  are defined as in part (ii). Also, for  $\mu_U < \mu < \mu'_S$ , we know that  $\bar{\theta}(\mu) > \mu$ . We can then show that  $\bar{\theta}_{t+u}$  is increasing in  $u$  as long as  $\bar{\theta}_{t+u} < \mu'_S$ , and  $\mu_{t+u}$  is increasing in  $u$  for  $u \geq \underline{u}$  if  $\mu_{t+u} > \mu_U$  for all  $u \geq 0$ .  $\underline{u}$  is the inflexion point of the path of  $\mu_{t+u}$ , which can initially decrease but is eventually increasing as long as  $\mu < \mu'_S$ . Define  $\underline{\mu} = \mu_{t+\underline{u}}$ , a large reputation shock is a shock such that  $\underline{\mu} > \mu_U$ . It ensures that reputation and average quality both grow along the transition path until the economy reaches the steady-state  $\mu'_S$ .

Finally, note that more entry and higher reputation in the long-run imply higher aggregate profits and higher average quality. The latter follows from  $\bar{\theta} = \mu$  in the long run. The former results from a higher number of active firms and the fact that the range of firms which are active both with the initial  $\mu$  and with the higher final  $\mu$  receive a higher sequence of prices.

## A.10 Proof of Appendix C results

Proposition 6: Part (i) follows immediately from  $\theta_L = \frac{\mu - k}{w}$  and  $\theta_H = \frac{k - \frac{1}{\tau}(1 - A_\rho)\mu}{\frac{1}{\tau}A_\rho - w}$ . The proof of part (ii) uses the derivations of Proposition 2. We know

$$\begin{aligned} \bar{\theta} &= \mu_0 \left( \frac{(1 - \delta) \left( 1 - \left(\frac{\theta_m}{\theta_L}\right)^{\alpha-1} \right) + \left(\frac{\theta_m}{\theta_H}\right)^{\alpha-1}}{(1 - \delta) \left( 1 - \left(\frac{\theta_m}{\theta_L}\right)^{\alpha} \right) + \left(\frac{\theta_m}{\theta_H}\right)^{\alpha}} \right) \\ \frac{\partial \bar{\theta}}{\partial \tau} &= \frac{\partial \bar{\theta}}{\partial \theta_L} \frac{\partial \theta_L}{\partial \tau} + \frac{\partial \bar{\theta}}{\partial \theta_H} \frac{\partial \theta_H}{\partial \tau} = \frac{\frac{1}{\tau^2} \frac{\mu_o}{\theta_m} (\alpha-1)}{1 - \left(\frac{\theta_m}{\theta_L}\right)^{\alpha} + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H}\right)^{\alpha}} \times \dots \\ &\dots \times \left[ \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H}\right)^{\alpha} \left( 1 - \frac{\bar{\theta}}{\theta_H} \right) \left( \frac{(1 - A_\rho)\mu + A_\rho \theta_H}{\frac{1}{\tau}A_\rho - w} \right) - \left(\frac{\theta_m}{\theta_L}\right)^{\alpha} \left( \frac{\bar{\theta}}{\theta_L} - 1 \right) \left( \frac{\mu}{w} \right) \right] \end{aligned}$$

$\frac{\partial \bar{\theta}}{\partial \tau} > 0$  iff  $\frac{1}{1-\delta} \left(\frac{1}{\theta_H}\right)^\alpha \left(1 - \frac{\bar{\theta}}{\theta_H}\right) \left(\frac{(1-A_\rho)\mu + A_\rho\theta_H}{\frac{1}{\tau}A_\rho - w}\right) > \left(\frac{1}{\theta_L}\right)^\alpha \left(\frac{\bar{\theta}}{\theta_L} - 1\right) \left(\frac{\mu}{w}\right)$ . This condition can be rewritten as

$$\delta > 1 - \left(\frac{\theta_L}{\theta_H}\right)^{\alpha+1} \left(\frac{\theta_H - \bar{\theta}}{\bar{\theta} - \theta_L}\right) \left(\frac{w}{\frac{1}{\tau}A_\rho - w} \frac{(1-A_\rho)\mu + A_\rho\theta_H}{\mu}\right)$$

Then note that, starting from a steady-state ( $\bar{\theta} = \mu$ ), the bracketed terms are:  $\frac{\theta_L}{\theta_H} = \frac{(\frac{1}{\tau}\mu - k)(\frac{1}{\tau}A_\rho - w)}{w(k - \frac{1}{\tau}(1-A_\rho)\mu)}$  and  $\frac{\theta_H - \bar{\theta}}{\bar{\theta} - \theta_L} = \frac{w}{\frac{1}{\tau}A_\rho - w}$ . Therefore  $\bar{\theta}$  decreases in  $\tau$  if and only if

$$\delta > 1 - \left(\frac{\frac{1}{\tau}\mu - k}{k - \frac{1}{\tau}(1-A_\rho)\mu}\right)^{\alpha+1} \left(\frac{\frac{1}{\tau}A_\rho - w}{w}\right)^{\alpha-1} \left(1 - A_\rho + \frac{A_\rho\theta_H}{\mu}\right)$$

Under this condition, starting from a LQE, an increase in  $\tau$  moves down the  $\bar{\theta}(\mu)$  function. The new steady-state equilibrium quality and reputation are lower.

Proposition 7: In a HQE with trade costs,

$$\begin{aligned} \theta^* &= \frac{k}{\frac{1}{\tau} - w} \\ \theta_T &= \frac{k - \frac{1}{\tau}(1 - \rho(T))\mu}{\frac{1}{\tau}\rho(T) - w} \end{aligned}$$

Part (i) follows from (26) and modified Assumption 1 that  $\theta_T$  increases with  $\tau$ .

Part (ii) is similar to the proof of Proposition 4. In a HQE, average quality is  $\bar{\theta} = \mu_0 \left(\frac{1+K_\tau(\alpha-1)}{1+K_\tau(\alpha)}\right)$  where  $K_\tau(\alpha) \equiv \sum_{T=\tilde{T}}^{\infty} \delta^T \left(\frac{\theta_m}{\theta_T}\right)^\alpha$  and  $\theta_T = \frac{k - \frac{1}{\tau}(1-\rho(T))\mu}{\frac{1}{\tau}\rho(T) - w}$ . Then

$$\begin{aligned} \frac{\partial \theta_T}{\partial \tau} &= \left(\frac{1}{\tau^2}\right) \frac{(1 - \rho(T))\mu + \rho(T)\theta_T}{\frac{1}{\tau}\rho(T) - w} > 0 \quad \text{for all } T > \tilde{T} \\ \frac{\partial \bar{\theta}}{\partial \tau} &= \sum_{T=\tilde{T}}^{\infty} \frac{\partial \bar{\theta}}{\partial \theta_T} \frac{\partial \theta_T}{\partial \tau} > 0 \end{aligned}$$

using the derivations in the proof of Proposition 1. Hence an rise in the ad valorem tariff  $\tau$  shifts up the  $\bar{\theta}(\mu)$  function. As  $\bar{\theta}$  is decreasing in  $\mu$  in the HQE region, the new steady-state equilibrium defined by  $\bar{\theta}(\mu) = \mu$  necessarily has higher  $\mu$ . So average quality and national reputation are higher, and the volume of trade is lower, in the new steady state.

## B Informed and uninformed buyers

Suppose the population of importers is divided into  $N$  equal-sized groups. There is perfect information diffusion within groups but no information diffusion across groups. Thus, if any individual in group  $n$  has previously consumed the output of firm  $j$ , then all buyers in group

$n$  are informed about good  $j$ . When firm  $j$  is matched with buyer  $i$ ,  $i \in I$  if there exists  $i' \in n$  such that  $i'$  has been matched with  $j$  in the past, and  $i \in U$  if there is no  $i' \in n$  such that  $i'$  has been matched with  $j$  in the past. Further assume that the firm observes in any period whether its buyer is informed or not, but not which group the buyer belongs to; hence it does not know the exact proportion of informed buyers in any period but only its expectation.

It follows immediately from this setup that  $\rho(0) = 0$ . After the firm has exported for one period, one group is informed, so  $\rho(1) = \frac{1}{N}$ . For each subsequent period, if the fraction of informed buyers after  $s$  export periods is  $\rho(s)$ , then with probability  $\rho(s)$ , the firm is matched with a buyer in an informed group, and the proportion of informed importers stays at  $\rho(s)$  for the next period. With probability  $1 - \rho(s)$ , the firm is matched with a buyer in an uninformed group; then the fraction of informed importers next period is  $\rho(s) + \frac{1}{N}$ .

Therefore, the expected fraction of informed buyers is given by the following path: for  $s \geq 0$ ,

$$\begin{aligned}\rho(0) &= 0 \\ \rho(s+1) &= \rho(s)^2 + (1 - \rho(s)) \left( \rho(s) + \frac{1}{N} \right) = \rho(s) \left( \frac{N-1}{N} \right) + \frac{1}{N}\end{aligned}$$

We can check that this function satisfies Assumption 1.

$$\begin{aligned}\rho(s+1) - \rho(s) &= \frac{1}{N} (1 - \rho(s)) > 0 \\ \frac{\rho(s+1) - \rho(s)}{\rho(s)} &= \frac{1}{N} \left( \frac{1}{\rho(s)} - 1 \right) \text{ is decreasing in } s \\ \lim_{s \rightarrow \infty} \rho(s) &= \frac{1}{N} \left( 1 - \frac{N-1}{N} \right)^{-1} = 1\end{aligned}$$

So  $\rho(s)$  is increasing in  $s$ , rises with  $s$  at a falling rate, and converges to 1.

## C Ad valorem tariffs

A straightforward extension of the model allows for ad valorem trade costs. Suppose that when a buyer pays  $p_{t+s}(j)$  defined by (6) for the output of firm  $j$ , the firm receives  $\frac{1}{\tau} p_{t+s}(j)$ , where  $\tau > 1$ . The price being set by the importer's maximum willingness to pay, trade costs are borne by exporters.

We modify Assumption 2 accordingly: let us assume  $\frac{1}{\tau} \rho(1) > w$ . With positive trade

costs, the values of the relevant thresholds are modified as follows:

$$\theta^* = \frac{k}{\frac{1}{\tau} - w} \quad (25)$$

$$\theta_L = \frac{\frac{\mu}{\tau} - k}{w} \quad (26)$$

$$\theta_H = \frac{k - \frac{1}{\tau}(1 - A_\rho)\mu}{\frac{1}{\tau}A_\rho - w} \quad (27)$$

$$\theta_T = \frac{k - \frac{1}{\tau}(1 - \rho(T))\mu}{\frac{1}{\tau}\rho(T) - w} \quad (28)$$

An increase in  $\tau$  lowers export profits for all firms. In a LQE, it widens the range of non-exporters. In a HQE, it leads low-quality firms below  $\theta^*$  to exit sooner. Also, holding constant the economy's exogenous parameters ( $\alpha$ ,  $\delta$ ,  $\theta_m$ ,  $k$ , and  $w$ ), a higher  $\tau$  makes it more likely that the steady-state equilibrium is a LQE. The existence condition for a HQE with tariffs is

$$\alpha \left( \frac{\theta_m \left( \frac{1}{\tau} - w \right)}{k} \right) + \frac{\delta}{1 - \delta} \left( \frac{\theta_m \left( \frac{1}{\tau} - w \right)}{k} \right)^\alpha > \alpha - 1 \quad (29)$$

**Proposition 6** *An increase in the ad-valorem tariff  $\tau$  in a low-quality steady-state equilibrium:*

- (i) *Lowers  $\theta_L$  and raises  $\theta_H$ ;*
- (ii) *Lowers the average quality of exports and equilibrium country reputation*  
*if  $\left( \frac{\frac{1}{\tau}\mu - k}{k - \frac{1}{\tau}(1 - A_\rho)\mu} \right)^{\alpha+1} \left( \frac{\frac{1}{\tau}A_\rho - w}{w} \right)^{\alpha-1} \left( 1 - A_\rho + \frac{A_\rho\theta_H}{\mu} \right) > 1 - \delta$ .*

See Appendix A.10 for proofs. In a LQE, an increase in  $\tau$  discourages entry by some relatively low-quality firms (as  $\theta_L$  falls) as well as some relatively high-quality firms (as  $\theta_H$  rises). Under the stated condition, the latter dominates in the net effect of  $\tau$  on  $\bar{\theta}$ . Thus, a higher tariff, similarly to a higher  $k$ , results in lower steady-state quality in a LQE.

**Proposition 7** *An increase in the ad-valorem tariff  $\tau$  in a high-quality steady-state equilibrium:*

- (i) *Increases  $\theta_T$  for all  $T$  and lowers the survival rate of exporters below  $\theta^*$ ;*
- (ii) *Increases the average quality of exports and equilibrium country reputation.*

See Appendix A.10 for proofs. In a HQE, from an initial steady-state where  $\bar{\theta} = \mu > \theta^*$ , an increase in tariffs induces firms with below-average quality in  $(\theta_m, \theta^*)$  to exit sooner, and has no impact on the exit rate of firms with above-average quality ( $\theta > \bar{\theta}$ ). Hence higher trade costs lead to a smaller mass of active exporters and a higher average quality of their products. Conversely, trade liberalization raises the volume of exports and lowers their average quality in high-quality countries, but brings about better average quality and unit prices, as well as higher trade volume, in low-quality countries.

## D Hazard rates

We calculate hazard rates at the 10-digit product level in US manufacturing imports (SITC codes 5-8) over 1989-2006, using data from Robert Feenstra. HS-10 products in the data are the equivalent of firms in our model. The exit rate is calculated for each country, HS-2 industry and export duration. Specifically, the survival rate of products from country  $c$ , industry  $i$  and export experience  $s$  at time  $t$  is the number of 10-digit products that are exported to the US for the  $(s + 1)$ -th time from country  $c$  in industry  $i$ , divided by the number of 10-digit products from the same country and industry that were exported at time  $t - 1$  for the  $s$ -th time. The hazard rate is one minus the survival rate.

We find that across countries and industries, the average hazard rate falls with export experience. Furthermore, hazard rates for products from non-OECD members are higher than those of OECD members for all export durations, consistent with higher exit rates in countries exporting lower-quality goods.

Table 4: **Hazard rates in US manufacturing imports.** HS-10 level, 1989-2006.

$s$	Hazard rate		
	All	OECD	Non-OECD
1	31.2%	23.2%	38.5%
2	20.2%	16.6%	24.2%
3	15.8%	13.5%	18.4%
4	13.6%	11.9%	15.7%
5	13.8%	13.0%	15.0%
6	10.9%	9.6%	12.4%
7	9.0%	7.7%	10.8%
8	7.5%	6.2%	9.2%
9	7.4%	6.3%	8.8%
10	8.5%	7.8%	9.2%

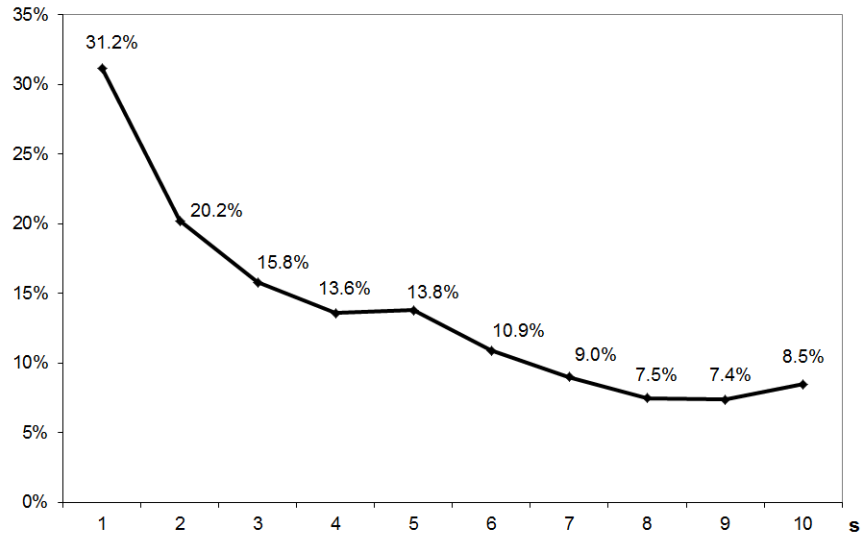


Figure 9: Hazard rates of products from all countries with  $s$  years of export experience in US imports, 1989-2006

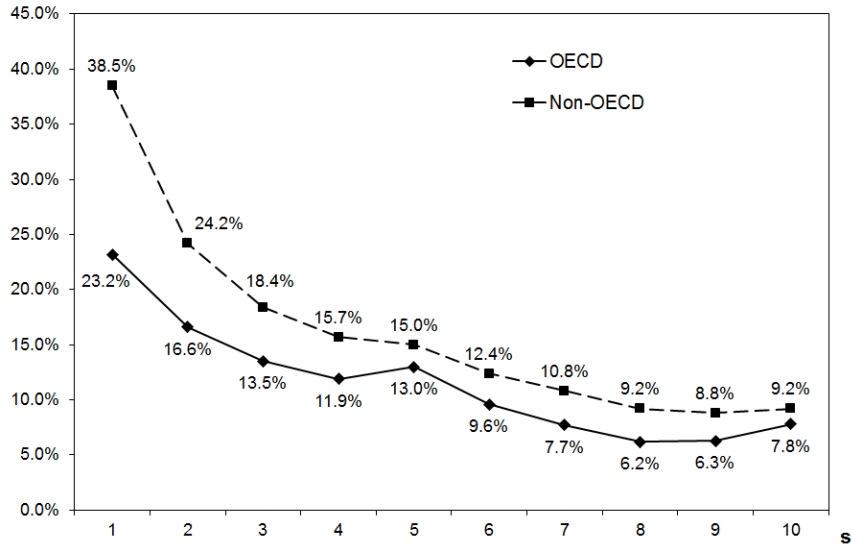


Figure 10: Hazard rates of products from OECD and non-OECD countries with  $s$  years of export experience in US imports, 1989-2006

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