Export Quality in Developing Countries

Christian Henn, Chris Papageorgiou, and Nikola Spatafora

May 2014

Abstract

This paper develops new estimates of export quality, far more extensive than previous efforts, covering 178 countries and hundreds of products over 1962–2010. We find that quality upgrading is particularly rapid during the early stages of development, with quality convergence largely completed as a country reaches upper middle-income status. There is significant cross-country heterogeneity in the growth rate of quality. Within any given product line, quality converges both conditionally and unconditionally to the world frontier; increases in institutional quality and human capital are associated with faster quality upgrading. In turn, faster growth in quality is associated with more rapid output growth. These results suggest that governments should pursue horizontal, rather than sector-specific, policies to encourage quality upgrading, as well as create new upgrading opportunities through diversification.

JEL Classification Numbers: F14, L15.

Keywords: Exports; Product Quality; Upgrading; Developing Countries.

Authors’ E-Mail Addresses: christian.henn@wto.org, cpapageorgiou@imf.org, nspatafora@worldbank.org.
Contents

I. Introduction .............................................................................................................................................3

II. Estimating Product Quality: Methodology and Data .............................................................................4

III. Export Quality: Stylized Facts ............................................................................................................8
    A. Comparison of Quality Estimates with Unit Values .................................................................8
    B. Export Quality over Time: Examples from Specific Sectors ....................................................9
    C. Quality Ladders: Potential for Quality Upgrading ...............................................................10
    D. Export Quality Along the Development Path .........................................................................11
    E. Quality Upgrading by Income Group and Region ............................................................12

IV. Determinants of Quality Upgrading ..................................................................................................14

V. Conclusion and Policy Implications ....................................................................................................15

References ..................................................................................................................................................17

Table 1. Imports: Quality-Augmented Gravity Equations ........................................................................19
Table 2. Quality Upgrading: Summary Statistics for Data .......................................................................20
Table 3. Quality Upgrading: Panel Regressions, for All Products ..........................................................21
Table 4. Quality Upgrading: Panel Regressions, for Manufacturing Alone ............................................22

Figure 1. Quality and Unit Values ...........................................................................................................23
Figure 2. Changes in Quality and Changes in Unit Values .................................................................24
Figure 3. Quality and Unit Values for Passenger Motor Cars Exports (SITC 7321) .........................25
Figure 4. Quality and Unit Values for Apparel Exports (SITC 84) ....................................................26
Figure 5. Quality Ladders .......................................................................................................................27
Figure 6. Quality, Unit Values, and GDP per capita ............................................................................28
Figure 7. Quality in Agriculture and Manufacturing ..........................................................................29
Figure 8. Quality, Unit Values, and GDP per capita: Within-Country Variation .................................30
Figure 9. Export Quality by Income Group over Time .......................................................................31
Figure 10. Quality Upgrading by Region ............................................................................................32
Figure 11. Country-level Heterogeneity in Quality Upgrading in Asia and Africa .............................33
Figure 12. Quality Upgrading and Destination Markets ....................................................................34
I. INTRODUCTION

Economic development requires the transformation of a country’s economic structure. This involves diversifying into new sectors; it implies reallocating resources towards more productive firms; and, critically, it relies on improvements in the quality of goods produced. Producing higher-quality varieties of existing products helps build on existing comparative advantages to boost export revenues and productivity. Yet the potential for quality upgrading varies by product (Khandelwal, 2010), and has been found to be higher in manufactures than in agriculture and natural resources. For countries at an early stage of development, diversification into new products may therefore be a precondition to reaping large gains from quality improvement.

This paper makes three contributions to the debate on quality upgrading. First, we develop new estimates of export quality. This dataset is far more extensive than previous efforts, covering 178 countries and hundreds of products over 1962–2010. Second, we present a series of stylized facts relating to export quality. In particular, we illustrate changes over time in quality, both for the entire sample and for selected countries of interest, and we discuss the relationship between quality and income. Throughout, we examine separately the quality of primary goods versus manufactures, and disaggregate manufacturing into different sectors. Finally, we begin the task of harvesting this dataset to analyze the determinants of quality upgrading.

The literature on quality upgrading is growing rapidly. Sutton and Trefler (2011), elaborating on Hausmann et al. (2007), find that between 1980 and 2005 low-income countries (LICs) have moved into more “sophisticated” products, defined as those products predominantly produced by rich countries. However, LICs are producing low-quality or low-end products within these industries; as a result, this diversification has not led to a big boost in GDP per capita. Put differently, diversification and quality upgrading should be viewed as complementary. In a related vein, Hwang (2007) argues that, to achieve rapid income convergence, countries need to enter sectors with long “quality ladders” that they can climb.

---

1 Schott (2004) finds dramatic within-product quality differences, based on shipment-level U.S. customs data. For instance, unit values for cotton shirts imported from Japan are 30 times higher than those from the Philippines. He also finds that unit values within products vary systematically with exporter relative factor endowments and exporter production techniques and argues that intra-industry trade is indeed trade in goods of different quality.

2 While rich countries also tend to produce higher-quality varieties, the concepts of quality and sophistication are quite different. Quality refers to the relative price of a country’s varieties within their respective product lines. Product sophistication, as in Hausmann et al. (2007), assesses the composition of the aggregate export basket.

3 Starting production of higher-quality varieties need not imply abandoning production of lower-quality varieties, particularly if there are destination markets suited for the latter. Mukerji and Panagariya (2009) note that the U.S. produces goods at a huge variety of quality levels suggesting that exporting low-quality goods to certain markets is profitable as well.
Export quality cannot be directly observed and needs to be estimated. Only unit values (that is, average trade prices for each product category) are observable. Schott (2004) and Hummels and Klenow (2005) showed that these unit values increase with GDP per capita. This sparked an interest in estimating export quality, for which unit values are at best a noisy proxy, being driven also by a series of other factors, including production cost differences. The strategies recently developed for quality estimation (including Khandelwal, 2010, Hallak and Schott, 2011, and Feenstra and Romalis, 2012) typically model demand, and in some cases also supply, using explicit microeconomic foundations. However, these methodologies do not allow calculation of a set of quality estimates with large country and time coverage, owing to their significant data requirements.

Moreover, much work remains to be done in establishing stylized facts about quality and in linking growth in quality to development. Existing work computed estimates of quality mainly to answer other questions. Khandelwal’s (2010) primary aim in calculating quality ladders is to show that U.S. sectors with short quality ladders are exposed to larger employment and output declines resulting from low-wage competition. Hallak (2006), from whom we adapt our estimation strategy, focuses on showing that rich countries import more from countries producing high-quality goods. Hallak and Schott (2011) and Feenstra and Romalis (2012) are mainly concerned with decomposing changes in unit values into changes in quality and pure trade-price changes. Consequently, they devote little space to discussing stylized facts about export quality.

This paper yields a series of interesting results, many of them worthy of further research. Quality upgrading is particularly rapid during the early stages of development, with quality convergence largely completed as a country reaches upper middle-income status. There is significant cross-country heterogeneity in the growth rate of quality. Finally, determinants of export quality are investigated. Within any given product line, quality converges both conditionally and unconditionally to the world frontier; increases in institutional quality and human capital are associated with faster quality upgrading. In turn, faster growth in quality is associated with more rapid output growth.

II. Estimating Product Quality: Methodology and Data

Much of the existing literature measures export quality using unit values. Unit values are the trade prices, defined as the ratio of export value over quantity for any given product category. Unit values are readily observable, but suffer from three serious shortcomings. First, if the composition of goods within a given product category varies across exporters, then cross-country differences in unit values may reflect these differences in composition, rather than
quality differences. Second, unit values may reflect production costs, or pricing strategies (i.e., firms’ choice of mark-up). Third, changes over time in unit values may reflect changes in quality-adjusted prices (owing to supply or demand shocks), rather than changes in quality. The quality estimates presented in this section address the last two shortcomings; the first cannot be addressed if one is to maintain broad country and time coverage.

The remaining literature does not provide a set of quality estimates well suited to analyzing developments in developing countries. Khandelwal (2010) requires data on market shares of imports relative to corresponding domestic varieties are needed. These are only available for few countries and for limited time periods. Hallak and Schott (2011) require extensive data on tariffs, which is unavailable even for many relatively large countries before 1989. Feenstra and Romalis (2012) require for each product two different unit-value observations, one derived from importer-reported (CIF) and one from exporter-reported (FOB) data. However, exporter-reported data are not available for many LIC exports, especially for early years, limiting their analysis to the 1984–2008 period. Consequently, a reduced-form approach, which circumvents data constraints, is more suitable for our purposes.

Our methodology estimates quality based on unit values, but with two important adjustments. The methodology is a modified version of Hallak (2006), which sidesteps data limitations to achieve maximum country and time coverage. As a first step, for any given product, the trade price (equivalently, unit value) $p_{mxt}$ is assumed to be determined by the following relationship:

$$\ln p_{mxt} = \zeta_0 + \zeta_1 \ln \theta_{mxt} + \zeta_2 \ln y_{xt} + \zeta_3 \ln Dist_{mx} + \xi_{mxt},$$

where the subscripts $m$, $x$, and $t$ denote, respectively, importer, exporter, and time period. Prices reflect three factors. First, unobservable quality $\theta_{mxt}$. Second, exporter income per capita.
Capture cross-country variation systematically related to income. With high-income countries typically being capital-abundant, we expect $\zeta_2 < 0$ for capital-intensive sectors and $\zeta_2 > 0$ for labor-intensive sectors.\(^9\) Third, the (great circle) distance between importer and exporter, $Dist_{mx}$. This accounts for selection bias: typically, the composition of exports to more distant destinations is tilted towards higher-priced goods, because of higher shipping costs.\(^10\)

Next, we specify a quality-augmented gravity equation. This equation is specified separately for each product, because preference for quality and trade costs may vary across products:

$$\ln(Imports)_{mxt} = ImFE + ExFE + \alpha \ln Dist_{mx} + \beta I_{mxt} + \delta \ln \theta_{mxt} y_{mt} + \epsilon_{mxt} \quad (2)$$

$ImFE$ and $ExFE$ denote, respectively, importer and exporter fixed effects. Distance is as defined above. The matrix $I_{mxt}$ is a set of standard trade determinants from the gravity literature.\(^11\) The exporter-specific quality parameter is $\theta_{mxt}$, which enters interacted with the importer’s income per capita $y_{mt}$. If $\delta > 0$, then greater income increases the “demand for quality”.

The estimation equation is obtained by substituting observables for the unobservable quality parameter in the gravity equation. Rearranging (1) for $\ln \theta_{mxt}$, and substituting into (2), yields:

$$\ln(Imports)_{mxt} = ImFE + ExFE + \alpha Dist_{mx} + \beta I_{mxt} + \xi'_{mxt} \ln y_{mt} + \zeta'_{mxt} \ln y_{mt} + \xi'_{mxt} \ln n_{mxt} \ln y_{mt} + \epsilon_{mxt} \quad (3)$$

where $\zeta_1' = \frac{\delta}{\zeta_1}$, $\zeta_2' = -\frac{\delta \zeta_2}{\zeta_1}$, $\zeta_3' = -\frac{\delta \zeta_3}{\zeta_1}$, and $\xi'_{mxt} = -\frac{\delta \zeta_0' + \delta \xi_{mxt}}{\zeta_1} \ln y_{mt} + \epsilon_{mxt}$.

This equation is estimated separately for each of the 851 SITC 4-digit-plus product categories in the dataset, yielding 851 sets of coefficients. We obtain estimates by two stage least squares. $\xi_{mxt}$ is a component of $p_{xmt}$, so that the regressor $\ln p_{xmt} \ln y_{mt}$ is correlated with the disturbance term $\epsilon'_{mxt}$. We therefore use $\ln p_{xmt-1} \ln y_{mt}$ as an instrument for $\ln p_{xmt} \ln y_{mt}$.

---

\(^9\) This approach builds on Schott (2004), who showed that unit values for any given product vary systematically with exporter relative factor endowments, as proxied by GDP per capita.

\(^10\) Hallak (2006) uses distance to the U.S. instead of distance to the importer, because it only focuses on prices of exports to the U.S. Harrigan, Ma, and Shlychkov (2011) find that the correlation between export prices and distance is due to a composition, or “Washington apples”, effect. They also find that U.S. firms charge higher prices to larger and richer markets.

\(^11\) It includes indicator variables for a common border, a common language, the existence of a preferential trade agreement, a colonial relationship, and a common colonizer.
Where a unit value for the preceding year is not available (for instance, because the good was not traded), we use the unit value in the closest available preceding year, going back up to 5 years.\footnote{If unit values are not available in any of the preceding 5 years, the observation is excluded from the estimation.}

**The dataset is a significantly extended version of the UN–NBER dataset.** Starting with the COMTRADE database, we construct a trade dataset for 1962–2010 by supplementing importer-reported data by exporter-reported data where former does not exist.\footnote{The only exceptions to this methodology are export flows as reported by the U.S., which take precedence over importer-reported flows.} We ensure consistency over time and in aggregating to broader categories by using the methodology of Asmundson (forthcoming). This dataset is analogous to the UN-NBER dataset, but provides longer time coverage. The dataset contains 45.3 million observations on bilateral trade values and quantities at the SITC 4-digit (Revision 1) level. Any given importer-exporter-product-year combination will have more than one observation for the same 4-digit category whenever import quantities are reported for more than one set of units. In this case, the two sets of import quantities are considered distinct “SITC 4-digit-plus” products, so that comparable unit values can be obtained within each product category. The total number of products based on this procedure is 851.\footnote{SITC 4-digit-plus products were dropped if they met either of two criteria for smallness. First, the product comprised less than 1 percent of total observations or trade value of the corresponding SITC 4-digit product. Second, the product had less than 1000 observations, and comprised less than 25 percent of total observations or trade value of the corresponding SITC 4-digit product. In addition, outliers were eliminated by excluding any observation with: (i) a quantity of 1; or (ii) a total trade value of less than $7,500 at 1989 prices; or (iii) a unit value above the 95\textsuperscript{th} or below the 5\textsuperscript{th} percentile in 1989 prices within any given product.} Information on preferential trade agreements was taken from the World Trade Organization’s Regional Trade Agreements database, and other gravity variables are taken from CEPII (Head and Mayer, 2013). Data on income per capita was taken from the Penn World Tables, version 7.1.

Reassuringly, estimation results mirror closely those of Hallak (2006). All coefficients have the expected sign, and are statistically significant in the majority of specifications (Table 1). Moreover, the coefficients are closely comparable to those in Hallak (2006), except for those on the price-importer income interaction, which is as expected because our trade price vector is defined differently.\footnote{Hallak (2006), using U.S. data only, computes Fisher price indices for each SITC 2-digit sector starting from 10-digit sectors. In this paper, we use directly unit values of SITC 4-digit-plus products.}

**The regression results are used to calculate a comprehensive set of quality estimates.** Rearranging (1) and using the estimated coefficients, quality is calculated as the unit value
adjusted for differences in production costs and for the selection bias stemming from relative distance:

\[
Quality\ estimate_{mxt} = \delta \ln \theta_{mxt} = \zeta_1' \ln p_{mxt} + \zeta_2' \ln y_{xt} + \zeta_3' \ln Dist_{mx}
\] (4)

As is standard, quality \( \theta_{mxt} \) and importers’ taste for quality \( \delta \) are not separately identified.\(^{16}\)

The quality estimates are then aggregated into a multi-level database. The estimation yields quality estimates for more than 20 million product-exporter-importer-year combinations.\(^{17}\) To enable cross-product comparisons, all quality estimates are first normalized by their 90\(^{th}\) percentile in the relevant product-year combination. The resulting quality values typically range between 0 and 1.2. The quality estimates are then aggregated, using current trade values as weights, to higher-level sectors (SITC 4-, 3-, 2-, and 1-digit, as well as country-level totals).\(^{18}\) At each aggregation step, the normalization to the 90\(^{th}\) percentile is repeated. Aggregations are also produced based on the BEC classification, as well as on 3 broad sectors (agriculture, non-agricultural commodities, and manufactures). To allow for easy comparisons with unit values, the latter are also normalized with the 90\(^{th}\) percentile set equal to unity.

### III. Export Quality: Stylized Facts

This section illustrates some stylized facts about export quality and provides a flavor of the richness of the dataset. First, we compare our quality estimates with standard unit value measures. Second, we focus on a couple of specific sectors to highlight how informative it is to examine jointly developments in quality, unit values, and market share. Third, we turn to quality ladders and show how a country’s position on these ladders may indicate large quality upgrading potential or, contrarily, an increased need for horizontal diversification. Fourth, we discuss how our measure of quality varies along the development path, again establishing a comparison with unit values. Fifth, we analyze developments in product quality at the regional level. Finally, we highlight the large cross-country heterogeneity in quality upgrading.

---

\(^{16}\) The preference for quality parameter \( \delta \) will also vary across sectors. Therefore, when we later aggregate quality estimates across sectors, the procedures necessarily also aggregates across these heterogeneous preferences for quality.

\(^{17}\) This number is smaller than the 45.3 million in the original dataset because of: (i) missing observations for other regressors, primarily per capita income; and (ii) elimination of outliers (see fn. 14).

\(^{18}\) Changes in the higher-level (including country-level) quality estimates will in general reflect both quality changes within disaggregated sectors, and reallocation across sectors with different quality levels. measure. If the composition of exports is shifting toward product lines characterized by low quality levels, it is quite possible for the quality of any given product to be rising sharply, but country-level quality to rise slowly (or indeed decline). We will examine the robustness of the conclusions to using constant weights, or a chain-weighted quality measure.
trajectories and provide some tentative evidence that countries with faster export quality upgrading may also have grown faster.

A. Comparison of Quality Estimates with Unit Values

As expected, we find that unit values are much more dispersed than quality. This is the case even after eliminating extreme values (Figure 1). Quality and unit values are correlated, but only at lower quality levels. Once a country’s quality level reaches about 80-85 percent of the world frontier value, quality and unit values are no longer correlated. Thus, quality increases beyond that level tend to not to drive prices higher, possibly because higher efficiency in production may keep prices stable. Quality increases are particularly strongly correlated with price increases in agricultural goods (up to the 80-85 per cent of world frontier threshold).

The data show that quality evolves gradually. Figure 2 divides the sample into an early (1962–80), middle (1980–95), and most recent (1995–2010) period. In all periods, changes in quality were quite gradual, with changes of more than 20 per cent relative to other countries being rare during any of these periods. Changes in quality also tend to be much lower than changes in volatile unit values. Moreover, for all sectors as well as manufacturing alone, increases in quality are in many cases not accompanied by increases in unit values. Some countries have seen considerable increases in quality accompanied by stable unit values: here, quality increases offset price declines on constant-quality products, as is common in the computer and electronics sectors for instance.

B. Export Quality over Time: Examples from Specific Sectors

We now illustrate our export quality estimates using examples drawn from the car and apparel sectors. We focus on cars because most readers are likely to recognize the brands and have some intuition as to their relative quality. We consider apparel because it is a key export for many LICs, particularly during the early stages of development, and typically constitutes one of the first beachheads in the manufacturing sector.

Results on quality are intuitive and, together with the evolution of prices, help explain developments in market shares.\(^\text{19}\) In the passenger motor cars sector (SITC 7321), the quality of U.S. exports has on average been at the world frontier, but has displayed some slight fluctuations over time (Figure 3). Meanwhile, prices oscillated around 90 per cent of the world frontier and the US's world export market share has been stable since the early 1990s after a long-term decline up to this point. German car exports have featured high quality and high prices throughout since the late 1970s. During the 2000s, German car exports regained much of the market share that they lost during the 1980s.

\(^{19}\) Market share is measured as a percentage of a country's exports in world exports of that product.
Some countries boosted the quality of their car exports as they developed. For instance, Japanese cars experienced strong quality upgrading through 1990, reaching world frontier levels. Meanwhile, prices rose only moderately during this period, allowing for increases in market share. Since then prices have risen a bit further at constant quality, possibly explaining some loss of market share to competitors. Quality of Korean cars was low until the early 1980s. Since then Korean autos have experienced ongoing and substantial quality upgrading. As Korean prices remained relatively low, their market share increased.

Analysis of the apparel sector (SITC 84) provides additional insights. China increased its relative quality of apparel exports substantially, from 70 to 90 per cent of the world frontier since 1980 (Figure 4). This was accompanied by a similarly drastic increase in export market share, and also allowed prices to rise slightly, although they remain low, at 40 per cent of the world frontier. Bangladesh also recorded a strong increase in its market share, but given that quality increases were much less than in China, no price increases could be realized. India mirrors Bangladesh closely. Italy maintained world frontier quality throughout the sample period, but its market share declined as prices rose. Finally, Korea and Thailand are examples of countries which in the past increased their market shares against a backdrop of rising quality and mostly stable prices. Subsequently, however, these countries have been diversifying away from the textile sector. They now seem to retain higher-quality segments of the apparel market, as quality remains stable or continues to increase, but record falling market shares.

C. Quality Ladders: Potential for Quality Upgrading

A country’s position on sectoral quality ladders indicates the potential for further quality upgrading in its existing product basket. Figure 5 illustrates such sectoral quality ladders at the relatively aggregate SITC 1 level for four selected countries, alongside the composition of their export baskets in 2010. It is notable that the length of quality ladders varies considerably by sectors, and likewise a country's relative position may vary considerably across sectors.

Tanzania and Vietnam are examples of countries with considerable quality upgrading potential within existing export sectors. Tanzania has experienced strong growth during the last decade. Yet, Tanzania’s exports are concentrated in primary and agricultural exports, and within those sectors the country is near the bottom of the quality ladder, suggesting large potential for quality upgrading. Horizontal diversification, for instance towards manufactures, may create additional opportunities for quality upgrading. Vietnam's exports, on the other hand, are already heavily tilted towards manufactures, particularly the important miscellaneous manufactures sector, which includes apparel and footwear. However, as in Tanzania, there is still much potential for further quality upgrading in these sectors.

Some of the more mature Asian countries may require horizontal diversification to enable more quality upgrading. Malaysia is heavily specialized in electronics exports, a subcategory of the
machinery and transport equipment sector, but is already coming close to the the world frontier in this sector. To enable further quality upgrading, it may first need to diversify. This diversification could occur across SITC1 sectors, as well as within the machinery and transport equipment sector. China’s position across most sectors is between Vietnam and Malaysia. Some quality upgrading potential has already been realized, but also some remains. These countries may also be able to increase the value added in their existing exports by engaging in more sophisticated tasks than, say, assembly, as highlighted by a growing literature on offshoring (see, for instance, Baldwin and Robert-Nicoud, 2010).20

D. Export Quality Along the Development Path

Overall, income per capita is correlated with export quality. This holds both at the aggregate level, and for manufacturing, agriculture, and non-agricultural commodities separately (Figure 6).21 These finding are consistent with Hummels and Klenow (2005) and Sutton and Trefler (2011).

Quality increases with income particularly sharply during the early stages of development. Quality upgrading is particularly rapid until GDP per capita reaches $10,000. Quality convergence then continues at a diminishing rate, and is largely complete by the time GDP per capita reaches $20,000. Among high income countries, average export quality levels only vary within a narrow band.

The results indicate that there is scope for quality upgrading in not just manufacturing, but also agriculture. As countries develop, the quality of both agricultural products and commodities increases substantially. The latter likely reflects countries shifting toward more processed products within each commodity category. And lengths of quality ladders vary substantially across subsectors in both agriculture and manufacturing (Figure 7). All this suggests that early development need not be driven by the establishment of a manufacturing base. Although soil and climate may impose some limitations, the finding that sharp increases in quality can be registered in agricultural and commodity exports is particularly important since in many LICs a large share of the labor force remains concentrated in agriculture.

Figure 6 also highlights wide variations in average quality among developing countries, even when controlling for income. This suggest that some economies could reap particularly large gains from quality upgrading, while for others diversification may be a priority. Quality estimates show wide variation among middle- and particularly low-income exporters. Those

---

20 Our quality measure can only evaluate the quality of a good exported by a country, not how much domestic input it includes. It may thus prove misleading for cases where a country combines low-value assembly services and high-quality imported intermediates to generate (high-quality) exports.

21 The correlation between income and unit values for non-agricultural commodities is relatively weak.
countries with low average quality have considerable scope to upgrade quality even within existing export sectors. Other developing countries may already enjoy relatively high export quality, but given their low incomes this is likely in sectors with short quality ladders or low productivity. These economies could benefit from diversification into sectors with new opportunities for quality upgrading.

These stylized facts hold also when focusing on within-country changes over time, or on small states and commodity exporters (Figure 8). Even controlling for country fixed-effects, so as to focus purely on within-country changes, export quality still increases as countries grow richer. We also examine robustness of our baseline results by considering two alternative subsamples: small states and commodity exporters. Small states follow similar patterns to other countries: quality rises with income particularly sharply for income levels below $10,000.22 In commodity exporters, there still appears to be potential for quality upgrading, although it may be more limited by exogenous factors (such as the grade of available minerals) than in manufacturing.23

Unit values increase with income at a relatively constant rate. The slope of the non-parametric best-fit curve linking income and unit values is quite constant across different income levels, particularly for manufacturing (Figure 6 and Figure 8).

E. Quality Upgrading by Income Group and Region

MICs have been experiencing increases in manufacturing export quality for many decades, whereas agriculture has lagged behind. In manufacturing, MICs have been gradually converging toward the world quality frontier since the 1980s (Figure 9). Quality convergence in agriculture only commenced later, in the 2000s after a prolonged period of divergence previously.

No pronounced quality upgrading pattern can yet be identified for LICs. Manufacturing export quality has been stable during the last three decades. In agriculture, there are some signs of quality upgrading during the last decade, after a prolonged gradual decline in relative quality during the earlier sample period. Similarly, in non-agricultural commodities, LICs’ average quality has deteriorated substantially relative to the world frontier since the 1980s. This suggests that LICs have increasingly focused on raw material exports, as opposed to developing processing activities in the context of vertically integrated industries. In contrast, in

---

22 Countries are classified as small states if their population is smaller than 1.5 million in either 2010 or 2011, using Penn World Tables (2010) and World Development Indicators (2011) data. This classification does not include fuel exporters that are high income (as per World Bank definition), including in particular Bahrain, Brunei, and Equatorial Guinea.

23 Countries are classified as commodity exporters, following the IMF World Economic Outlook classification, if commodities on average exceed 50 percent of total exports.
high-income countries, export quality both overall and for commodities increased further from already high levels.

At the regional level, East Asia has exhibited particularly fast quality upgrading (Figure 10). The quality convergence was particularly impressive in manufactures. Quality of commodities also increased, particularly in the 1970s and 1980s, as a result of the development of vertically-integrated industries engaged in elementary processing. Again, agriculture only seems to follow with a substantial lag, with quality starting to increase only since 2000.

Sub-Saharan Africa is still lagging behind, but there are now tentative signs of quality convergence. Manufacturing export quality has increased sharply in sub-Saharan Africa since the late 1990s, and prolonged quality divergence in agriculture has seemingly been halted. In contrast, there are no strong signs of quality convergence in any large sector for South Asia. In the Middle East and North Africa (MENA), manufacturing quality increased from the 1960s through the 1980s, but stagnated thereafter; in agriculture, no sustained quality increases have occurred, although there is a trend toward quality upgrading is notable since 2000. In Latin America, export quality has stagnated for several decades, which may be related to its lack of income convergence. However, during the last decade there are some signs of convergence have appeared in both the manufacturing and agricultural sectors.

**Even within regions, there is considerable cross-country heterogeneity in the pace of quality upgrading.** Within Asia, we can identify several countries, such as Japan, Korea, China, and Vietnam, which have converged or are converging fast towards the world quality frontier (Figure 11). India, Indonesia, and Bangladesh seem to be converging at a slower pace, although some acceleration is notable during the last decade. Meanwhile, in countries including Malaysia and Thailand quality convergence has slowed since the mid–1990s. In Africa, the patterns of convergence seem more heterogeneous than in Asia, with larger fluctuations in quality indices particularly in countries whose exports are strongly driven by a few products. Upward trends in quality can be noted in a series of countries since the early 2000s including Senegal, Ghana, Uganda, Nigeria, and South Africa. Egypt constitutes an interestingly different case, in which quality upgrading has a long history, but recently stagnated. Finally, there are countries in which export quality has remained largely stagnant throughout the sample period. These include in Morocco, Cote d'Ivoire, and Cameroon.

---

24 In a similar vein, Lederman and Maloney (2012) argue that both Latin America and MENA are already near the quality frontier for many of their exports, consisting largely of natural-resource based goods, and thus benefit little from quality upgrading in existing exports.
IV. DETERMINANTS OF QUALITY UPGRADING

This section begins the task of harvesting the quality dataset to analyze the determinants of quality upgrading. Specifically, we estimate a series of cross-country, product-level panel regressions to examine the relationship between the growth rate of product quality and a set of potential determinants:

\[ \text{Growth}_i{}^{\text{Quality}}_{jlt} = \alpha_i + \beta_j + \gamma_t + \delta_1 \ln \text{Initial}_i{}^{\text{Quality}}_{jlt} + \delta_2 \text{Other}_{i} + \epsilon_{i}{}^{t.l}, \]  

where \(i,j,\) and \(t\) index, respectively, the country, product, and time period; \(\text{Initial}_i{}^{\text{Quality}}\) denotes the initial product quality level; and \(\text{Other}\) denotes a vector of other controls, including initial income per capita, initial institutional quality, and initial human capital. Institutional quality is measured here using the “constraints on the executive variable” from the Polity IV dataset, but similar results obtain using the Kaufmann-Kraay-Mastruzzi indicators. Human capital is measured using the secondary-school completion rate, from the World Development Indicators. All variables are expressed as averages over 10-year non-overlapping periods (see Table 2 for summary statistics).

The quality of individual products tends to converge across countries over time. Specifically, the growth rate of product quality depends negatively on its initial level (Table 3). This convergence can be observed unconditionally, and is robust to the inclusion of other controls. The speed of convergence, at about 5 percent per annum, is stable across specifications. Quality convergence for individual products need not imply quality convergence for countries’ overall export baskets, owing for instance to the presence of country-level fixed effects. The result does imply, however, that new entrants into a sector on average see their quality rise over time towards the world frontier.

Quality tends to converge even more rapidly within manufacturing. The speed of convergence within manufacturing is about 7 percent per annum, and is again stable across specifications (Table 4). This increased rate of convergence may reflect greater scope for flows of quality-enhancing knowledge within this sector.

Both institutional quality and human capital are positively associated with the growth rate of product quality. The relationships are significant both statistically and economically (Table 3 and Table 4). A one standard deviation increase in institutional quality or in human capital is associated with, respectively, a 0.3 and a 0.2 standard deviations increase in the pace of quality upgrading.

Developing countries’ potential for quality upgrading does not appear to be limited by low demand for quality in their destination markets. Lower-income countries do tend to serve markets that import lower-quality products (Figure 12). However, the differences are not substantial enough to act as a constraint on quality upgrading. On average, the poorer the
exporter, the greater the gap between its export quality and the average quality demanded by its trade partners in those products that the exporter sells to them). Likewise, in countries with slower convergence, export quality is substantially lower than the average quality of their trade partners’ imports. All this suggests that policy should focus on creating a domestic environment broadly conducive to quality upgrading; lowering barriers to entry into high-quality export markets constitutes a less urgent priority.

V. CONCLUSION AND POLICY IMPLICATIONS

We develop a new dataset on export quality. This dataset is far more extensive than previous efforts, covering 178 countries over 1962–2010, and providing breakdowns up to the SITC 4-digit and BEC 3-digit levels, for a total of more than 20 million quality estimates. Our estimates, based on sector-specific quality-augmented gravity equations, explicitly recognize that high product prices are not necessarily an indicator of high quality, but may rather reflect supply-side considerations such as high production costs. The estimates also control for selection bias, such that only higher-priced items are shipped to far-away destinations.

Average country-level quality is strongly correlated with income per capita. Further, quality upgrading is particularly rapid during the early stages of development, until a country reaches a GDP per capita of about $10,000. Convergence in export quality continues at a slower pace until GDP per capita reaches $20,000, and levels off thereafter. Overall, those countries and time periods that have witnessed faster growth in quality have also experienced faster growth in GDP per capita.

Substantial cross-country and regional differences in the pace of quality upgrading suggest that policies may have a significant impact. At the regional level, product quality in sub-Saharan Africa and South Asia is lower, and has been growing more slowly, than in East Asia. But there is considerable heterogeneity within regions, with quality rising far more rapidly in Ghana or Uganda than in Cote d’Ivoire or Cameroon. Analysis of countries’ position on sectoral quality ladders shows that some middle-income countries that have increased quality sharply in the past, such as Malaysia and to a lesser extent China, may now have less scope left to upgrade quality within existing export sectors. These countries may profit from horizontal diversification, which would also enable future upgrading. Other countries, such as Tanzania or Vietnam, still have considerable quality-upgrading potential within existing sectors.

Sectors with long “quality ladders” may hold particular potential given our finding that, within any given product line, quality converges to the “frontier” over time. In this sense, diversification and quality upgrading can be thought of as complementary. Importantly for LICs, there is also substantial potential for quality upgrading in agriculture, where large parts of their labor force are concentrated. This suggests that removing barriers to entry into new sectors could boost growth in developing countries by increasing the potential for future quality upgrading.
We find evidence that both institutional quality and human capital are significantly associated with the pace of quality upgrading. In contrast, there is no evidence that lack of demand for quality in a country’s existing destination markets on average constrains quality upgrading. This suggests that, to encourage quality upgrading, governments should pursue horizontal rather than sector-specific policies to shape a domestic environment broadly conducive to quality upgrading, as well as create new upgrading opportunities through diversification. Horizontal policies may also be more suitable in light of the unpredictability of export successes: for instance, Easterly et al. (2009) document that relatively few ‘big hit’ products account for a large share of many developing countries’ exports.
REFERENCES


World Development Indicators (Washington: World Bank).

World Trade Organization, Regional Trade Agreements Database (Geneva, Switzerland: WTO).
Table 1. Imports: Quality-Augmented Gravity Equations

<table>
<thead>
<tr>
<th></th>
<th>In percent of SITC 4-digit-plus sectors</th>
<th>Median coefficient value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive Coefficients</td>
<td>Negative Coefficients</td>
</tr>
<tr>
<td></td>
<td>Significant t</td>
<td>Insignificant t</td>
</tr>
<tr>
<td>Common preferential trade agreement</td>
<td>82 9</td>
<td>6 3</td>
</tr>
<tr>
<td>Colonial relationship</td>
<td>80 11</td>
<td>6 3</td>
</tr>
<tr>
<td>Common colonizer</td>
<td>50 20</td>
<td>16 14</td>
</tr>
<tr>
<td>Common language</td>
<td>71 14</td>
<td>9 5</td>
</tr>
<tr>
<td>Common border</td>
<td>82 9</td>
<td>6 3</td>
</tr>
<tr>
<td>Ln (distance)</td>
<td>6 8</td>
<td>10 76</td>
</tr>
<tr>
<td>Ln (distance) *</td>
<td>61 14</td>
<td>10 16</td>
</tr>
<tr>
<td>Ln (importer GDP per capita)</td>
<td>90 5</td>
<td>4 2</td>
</tr>
<tr>
<td>Ln (exporter GDP per capita)*</td>
<td>238 82</td>
<td>438 93</td>
</tr>
</tbody>
</table>

Notes: All equations estimated using two stage least squares.
Table 2. Quality Upgrading: Summary Statistics for Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth Rate of Quality</td>
<td>0.00121</td>
<td>0.03703</td>
<td>1.95781</td>
<td>-3.60544</td>
</tr>
<tr>
<td>Ln Initial Quality</td>
<td>-0.22553</td>
<td>0.12213</td>
<td>0.00097</td>
<td>-0.63778</td>
</tr>
<tr>
<td>Ln Initial GDP per capita</td>
<td>6.86541</td>
<td>1.17895</td>
<td>10.79187</td>
<td>4.64996</td>
</tr>
<tr>
<td>Institutional Quality</td>
<td>2.03812</td>
<td>6.83642</td>
<td>7.00000</td>
<td>-45.08594</td>
</tr>
<tr>
<td>Human Capital</td>
<td>18.45108</td>
<td>12.91274</td>
<td>64.15278</td>
<td>0.53906</td>
</tr>
</tbody>
</table>

Notes: The annualized growth rate of (product) quality is expressed in annualized natural units. Institutional quality is proxied by the “constraints on the executive” variable, from the Polity IV dataset. Human capital is proxied by the secondary-school completion rate.
Table 3. Quality Upgrading: Panel Regressions, for All Products

<table>
<thead>
<tr>
<th>Growth in Product Quality</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln Initial Quality</td>
<td>-0.049 ***</td>
<td>-0.049 ***</td>
<td>-0.046 ***</td>
<td>-0.046 ***</td>
</tr>
<tr>
<td></td>
<td>(4.2e-4)</td>
<td>(4.4e-4)</td>
<td>(5.0e-4)</td>
<td>(5.1e-4)</td>
</tr>
<tr>
<td>Ln Initial GDP per capita</td>
<td>1.5e-4</td>
<td>1.1e-4</td>
<td>-1.5e-4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.9e-4)</td>
<td>(2.3e-4)</td>
<td>(2.3e-4)</td>
<td></td>
</tr>
<tr>
<td>Initial Institutional Quality</td>
<td>3.8e-5 **</td>
<td>5.2e-5 ***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.6e-5)</td>
<td>(1.7e-5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Human Capital</td>
<td>2.9e-5 ***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(7.2e-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Memo Items

<table>
<thead>
<tr>
<th></th>
<th>Observations</th>
<th>Countries</th>
<th>Products</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>R²</td>
<td>0.070</td>
<td>0.068</td>
<td>0.062</td>
<td>0.063</td>
</tr>
</tbody>
</table>

Notes: All equations estimated using observations averaged over 10-year non-overlapping periods. The dependent variable is the annualized growth rate of product quality. Institutional quality is proxied by the “constraints on the executive” variable, from the Polity IV dataset. Human capital is proxied by the secondary-school completion rate. Other controls include a full set of country, product, and time-period fixed effects. *, **, and *** denote statistical significance at the, respectively, 10 percent, 5 percent, and 1 percent level.
Table 4. Quality Upgrading: Panel Regressions, for Manufacturing Alone

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln Initial Quality</td>
<td>-0.071 ***</td>
<td>-0.072 ***</td>
<td>-0.066 ***</td>
<td>-0.065 ***</td>
</tr>
<tr>
<td></td>
<td>(5.9e-4)</td>
<td>(6.2e-4)</td>
<td>(6.8e-4)</td>
<td>(7.0e-4)</td>
</tr>
<tr>
<td>Ln Initial GDP per capita</td>
<td>8.9e-4***</td>
<td>8.9e-4 ***</td>
<td>7.6e-4 ***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.1e-4)</td>
<td>(2.4e-4)</td>
<td>(2.5e-4)</td>
<td></td>
</tr>
<tr>
<td>Institutional Quality</td>
<td></td>
<td></td>
<td>3.3e-5 *</td>
<td>4.2e-5 **</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.7e-5)</td>
<td>(1.7e-5)</td>
</tr>
<tr>
<td>Human Capital</td>
<td></td>
<td></td>
<td></td>
<td>1.7e-5 **</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(7.7e-6)</td>
</tr>
</tbody>
</table>

**Memo Items**

<table>
<thead>
<tr>
<th></th>
<th>Observations</th>
<th>Countries</th>
<th>Products</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>156,260</td>
<td>174</td>
<td>568</td>
<td>19623–2008</td>
</tr>
<tr>
<td></td>
<td>147,907</td>
<td>173</td>
<td>568</td>
<td>19623–2008</td>
</tr>
<tr>
<td></td>
<td>127,561</td>
<td>137</td>
<td>568</td>
<td>1965–2008</td>
</tr>
<tr>
<td></td>
<td>121,029</td>
<td></td>
<td>568</td>
<td>1965–2008</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.103</td>
</tr>
<tr>
<td></td>
<td>0.104</td>
</tr>
<tr>
<td></td>
<td>0.089</td>
</tr>
<tr>
<td></td>
<td>0.089</td>
</tr>
</tbody>
</table>

**Notes:** All equations estimated using observations averaged over 10-year non-overlapping periods. The dependent variable is the annualized growth rate of product quality. Institutional quality is proxied by the “constraints on the executive” variable, from the Polity IV dataset. Human capital is proxied by the secondary-school completion rate. Other controls include a full set of country, product, and time-period fixed effects. *, **, and *** denote statistical significance at the, respectively, 10 percent, 5 percent, and 1 percent level.
Figure 1. Quality and Unit Values

Notes: Each dot depicts an exporter-year combination. The 90th percentile is set to unity for both unit values and quality observations.
Figure 2. Changes in Quality and Changes in Unit Values

Notes: Each dot depicts one exporter.
Figure 3. Quality and Unit Values for Passenger Motor Cars Exports (SITC 7321)
Figure 4. Quality and Unit Values for Apparel Exports (SITC 84)
Figure 5. Quality Ladders
Figure 6. Quality, Unit Values, and GDP per capita
Figure 7. Quality in Agriculture and Manufacturing

Quality in Agriculture and Manufacturing Sectors

- Cheese
- Chocolate
- Meat of Bovine (chilled)
- Vegetables preserved
- Footwear
- Office machines
- Passenger motor cars
- Televisions

Quality (90th percentile=1)
Lower Bound (5th percentile)
Upper Bound (95th percentile)

pwt 7.1; Categories at the 4-digit level of disaggregation
Figure 8. Quality, Unit Values, and GDP per capita: Within-Country Variation

Notes: Figures for small states and commodity exporters use both within- and cross-country variation.
Figure 9. Export Quality by Income Group over Time
Figure 10. Quality Upgrading by Region

All Sectors

Manufacturing

Commodities

Agriculture

[Graphs showing quality upgrading by region for All Sectors, Manufacturing, Commodities, and Agriculture, with data points for East Asia & Pacific, Latin America & Caribbean, Middle East & North Africa, South Asia, and Sub-Saharan Africa from 1960 to 2010.]
Figure 11. Country-level Heterogeneity in Quality Upgrading in Asia and Africa
Figure 12. Quality Upgrading and Destination Markets

Export quality relative to destination markets in 2010
(World Frontier=1)

- High income exporters
- Upper middle income...
- Lower middle income...
- Low income exporters

Slower convergers:
- in Asia
- in Africa

- Average quality demanded in destination markets
- Quality exported

Export quality relative to destination markets in 2010
(World Frontier=1)