Quality and price competition between high- and low-wage countries

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The short-term quality of exporting countries within a product is estimated as a time-invariant variable in a demand equation, conditional on price and after controlling for the number of horizontal varieties. It is argued that estimating quality of imported varieties requires that characteristics of a product category observed by consumers be described in detail. This does not occur for several product categories at the ten-digit level imported by the US. When product categories are not described in sufficient details, quantities and unit values of exporting countries will partly reflect the possible different compositions of hidden products within each country's variety and may result in biased and inefficient estimators. The empirical model and methodology of this paper identify these aggregate products, applying an endogenous data trimming mechanism and exploiting information on monthly unit values and quantities for a selected set of US imported machines. Quality of varieties is reasonably estimated for short-ladder products but quality for long-ladder products is most likely to be wrongly estimated.

Keywords: differentiated products; quality ladder; elasticity of substitution; trade specialization

Introduction

The international trade literature on quality has had significant contributions since Linder (1961). Some of them estimate quality using products defined at aggregate levels to apply to multiple importing countries, as for instance, Hallak and Schott (2011), Feenstra and Romalis (2014), and Yue (2018). This paper focusses on three relatively recent and relevant contributions: Schott (2004), Hummels and Klenow (2005), and Khandelwal (2010). They all estimate countries' quality using varieties[1] within product categories at the most disaggregated data level available. This investigation builds on their work.

Schott (2004) estimates quality based on unit values of varieties within product categories of US imports. His analysis rejects factor-proportions specialization across industries and products but is consistent with such specialization within products. Based on a demand equation for imported quantities, conditional on unit values and controlling for the number of non-observed horizontal varieties of each exporting country, this paper shows that high-wage countries are at the top of the quality ladder within most products.

Hummels and Klenow (2005) integrate horizontally and vertically differentiated products in a single framework. The utility function has, for simplicity, a single constant elasticity of substitution (CES) for all products. It uses a consumer's love-of-variety-Dixit-Stiglitz formulation that also depends on the quality of each imported variety. The representative consumer maximizes utility subject to the income constraint of the importing country. The model applied here in this paper slightly modifies the utility function of the above authors to allow different elasticities of substitution for each product and each product segment.

Khandelwal's (2010) relaxes the quality-equals-price assumption and estimate quality using both quantity and unit values.[2] One of Khandelwal's (2010) novelty and substantial contribution is the empirical implementation of a nested logit demand system to estimate the quality of varieties of US import products. The nested logit model is a discrete-choice model of product differentiation. Consumers are heterogeneous in discrete-choice models of product differentiation, and the nested logit model requires that each consumer's preferences be more correlated for varieties within nests than across nests. Hence, perceptions about quality and preferences for other product characteristics may differ among consumers. Generally, the number of product characteristics observed by consumers is larger than by the econometrician.[3]

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[1] A variety is an import from a country within a product.

[2] "Quality is a demand shifter..., raising the quantity a country can export to a market at a given price." Hummels and Klenow (2005), footnote on p.707.

[3] Berry (1994), p.242. When one tries to map products available at online retailers, considering all their characteristics, onto each product description of US imported products at the lowest level of aggregation, one often observes dozens of products supplied by retailers for each HS(10) product description, sometimes more than a hundred.

Another important insight of Khandelwal (2010) is the relevance of the range of quality estimates within products for the role of exports of low-wage countries in raising import penetration and reducing domestic output and employment in a high-wage-importing country. The range of quality estimates within products is the quality ladder, which is interpreted as a measure of the scope for quality differentiation of each product market.[4] This paper will show that long-ladder products are most likely to be too aggregated for quality estimation (TAFQE).

The present paper also uses US import data at the most disaggregated level available. To estimate quality reasonably well, econometricians need to make sure that there is not measurement error in prices, characteristics, and quantities. When a product is an aggregate of two or more products observed by consumers but not by the econometrician, both prices and quantities will be weighted averages of the non-observed products. Therefore, it is essential to describe a product in exceptionally fine details for prices and quantities to be as close as possible to those observed by consumers, since measurement error on both sides of a regression may lead to wrong estimates.[5]

The lowest level of product aggregation of US imports is the ten-digit level of the Harmonized System (HS), or US Harmonized Tariff Schedule-HTS(10). These HS(10) product categories are specific to the US economy.[6] Khandelwal's (2010) empirical model assumes nests are any HS(10) product and industries are defined at the more aggregated SITC-5 level.[7] All HS(10) products are implicitly assumed to be described in such a homogeneously detailed way that the effects of non-observed characteristics on prices and quantities necessarily reflect horizontal and quality differences among the varieties of each product.

There is no a priori reason to assume that the described characteristics of HS(10) products are equally good proxies relatively to those directly observed by consumers.[8] Quite the contrary, the main criteria used by importing countries to define their lowest level of product aggregation are related to their policy of import tariffs and other restrictions to imports, as well as to the sizes of their product import values.

A cursory examination at HS(10) product categories of US imports reveals that some have quite general descriptions while others are more specific. This raises a question as to what extent quality ladders, or the scopes for quality differentiation, are so heterogeneous, as Khandelwal (2010) argues, or it is the level of detail of the descriptions of HS(10) product categories that is heterogenous.

One example of a quite general description is the ten-digit product described as "other machines and mechanical appliances having individual functions, not specified or included elsewhere (NESOI) in chapter 84; parts thereof". This is one out of thirteen HS(10) products that make the HS(6) subheading (HS847989): "machines and mechanical appliances having individual functions, NESOI". The US FOB import value of this miscellaneous HS(10) product was 72 per cent of its six-digit subheading, which totalled $3.5 billion

[4] Quality ladder as well as the scope for quality differentiation are defined as an ex-post concept in Khandelwal (2010) as well as in this paper. Antoniades (2015) develops a theoretical dynamic model in which the scope for quality differentiation changes endogenously over time.

[5] "Measurement error in observed prices, characteristics…may create difficulties…measurement error in output quantities presents a more serious problem", Berry (1994), p.259.

[6] Up to the six-digit level, HS codes and product descriptions are equally applied by all 180 country and territory members of the World Customs Organization (WCO) as of 2015. Codes and product descriptions of HS products more disaggregated than HS(6) are specific to countries and some custom unions. HS(2) is called chapter, HS(4) headings, and HS(6) subheadings.

[7] SITC-5 is the Standard International Trade Classification at the 5-digit level. The way products and industries are defined have effects on how consumers' preferences for varieties are correlated within the nests and thus on quality estimates. Hence, if an industry were split into a few sub industries, or two or more industries were aggregated into one broader industry, quality estimates would change. Quality estimates also change through a second channel, because Khandelwal's data trimming depends on how both product and industry are delineated: "I trim the data along two dimensions. The first excludes all varieties that report a quantity of one unit or a total value of less than $7500 in 1989 dollars. The second removes varieties with extreme unit values that fall below the 5th percentile or above the 95th percentile within the industry", ibid., p.1460.

[8] "Of course, the more disaggregated the trade data the more cross-category variety is captured by the observable categories", Hummels and Klenow (2005), p.707. It is also important to recall that "the econometrician is assumed to observe the market outcomes of price and quantities sold by each firm", Berry (1994), p.245. Here, we are talking about annual unit values of HS(10) product categories by country, while Berry had firm's price and quantity in mind.

dollars in 2014. As a not-elsewhere-included product, it appears to be TAFQE, since its varieties look likely to be too weak substitutes or not substitutes at all. This HS(10) product is examined in the empirics of this paper and found most likely to be TAFQE. There are several NESOI-HS(10) products in US import product descriptions.

It makes sense to estimate the quality of varieties within a finely described product. But the quality of varieties within an HS(10) product category made of a basket of non-observed products that should have been classified in more detailed product categories is likely to be badly estimated. A case in point is the product category HS8413810040 described as pumps for liquids NESOI. Pumps have different uses and technical specifications such as the amount of horsepower (HP). A consumer is not free to choose between a one HP or a two HP pump but must purchase the right pump for the specific job it is supposed to do, independently of preferences for other non-observed characteristics of each pump. This HS(10) product category is examined in the empirics of this paper and found most likely to be TAFQE.

Some products in US imports are defined at the six-digit level when there is just one HS(10) for one HS(6) product. Most of these products are primary goods if they belong to chapters 01 to 27 of the Harmonized System. Otherwise, they often are manufactured products, as for instance, HS8542310000, described as "processors and controllers, whether or not coupled with storage elements, converters, logic circuits, timing circuits, and other circuits". In Japan, imports of subheading HS854231 are split into six HS(9) product categories that have different functions and uses and quite different unit values. In US imports, these products are hidden in the HS8542310000 product category, distorting quantities and unit values of countries' varieties. This product is also examined in the empirics of this article.

At least one of these Japanese HS(9) products described as "uncased processors and controllers" is an input to some of the other processors and controllers. When an HS(10) product category contains non-observed products that are at different stages of a production chain, estimated quality is bound to be spurious, because countries whose exports are more concentrated towards the end of the chain will have higher prices that are not related to the quantity and quality of these exports. The same reason applies to products that may have components or accessories added to just some varieties. These products are also likely to be TAFQE.

US imports of chapter 84 reveal that out of 1285 imported products at the ten-digit level in 2014 only eighteen have a single exporting country, of which sixteen are developed countries and two are developing countries.[9] This also appears to suggest that some HS(10) product categories in chapter 84 may indeed be TAFQE, motivating further investigation.

In quality ladder models, quality has just one dimension, which is an intrinsic assumption of the quality ladder concept. In standard CES trade models, the more disaggregated the trade data is, the more plausible the assumption of unidimensional quality of varieties within a product should be. In love-of-variety-CES-trade models, in which varieties are horizontally differentiated, varieties within a product are required to be gross substitutes.

In Khandelwal's (2010) empirical model, quality of varieties within each nest is also assumed to be unidimensional, since it is uniquely estimated for each HS(10) product, even though heterogeneous consumers may have different perceptions of it. Consumers may also see products within categories that are not observed by econometricians. Hence, HS(10) products ought to be equally and finely disaggregated. But, however different the levels of detail of the HS(10) products (nests) are, however weak substitutes the varieties within the nests are, and however large the range of unit values of varieties within each nest is, the model does not have any constraint on these variables and will adjust to deliver the quality estimates based on its underlying mean utility function. If an expensive and low-quality variety is purchased by some

[9] It is assumed throughout this paper that developed and developing countries are high-wage and low-wage countries, respectively.

consumers, it is argued that these consumers must have an idiosyncratic preference for the horizontal attributes of the variety.

When varieties within a product are weak substitutes, one should ask if they belong to the same product. If they do not, then the product should be more disaggregated, if possible, or it needs to be withdrawn from the demand regression. Except for data trimming, Khandelwal's applied empirical model does not have any mechanism to criticise the data. Furthermore, it is not possible to estimate the elasticity of substitution of varieties within each nest from the nested logit model. In contrast, I estimate the elasticity of substitution and the quality of varieties of a group of HS(10) products applying a standard love-of-variety model, in which varieties are horizontally and vertically differentiated. The model assumes a representative consumer for each product, and varieties within a product are required to be gross substitutes.

This paper finds evidence that products at higher aggregate levels than HS(10) products and with larger ranges of countries' quality estimates have larger numbers of varieties, lower elasticities of substitution, and larger range of countries' unit values. These indicators of product aggregation are the fundamental base to consider long-ladder products likely to be TAFQE.

The purpose of this paper, which is also its main contribution, is to develop and apply a new methodology to identify and distinguish import product categories that are too aggregated for quality estimation from products for which quality estimation is plausible. The quality model closely resembles the models in Hummels and Klenow (2005), Broda and Weinstein (2006), and Yue (2018) but its focus on the short-term brings out some novel implications. The method of endogenously trimming monthly US import data and the procedures to segment product categories are also novelties and important tools to estimate quality, when possible, and identify products that are TAFQE.

Quality estimation exploits quantities and unit values information on monthly[10] US imports over a one-year period for a selected group of HS(10) product categories, largely drawn from chapter 84 of the Harmonized System of classification. This helps to examine to what extent high- and low-wage exporting countries compete within detailed product categories and product segments. The paper finds evidence that the dispersion of quality ladders of HS(10) products within a couple of industries, HS(4) headings, and HS(6) subheadings is large, implying that aggregating quality ladders at the industry level may be misleading.

The paper is organised as follows. Section 1 presents the short-term demand model for vertically and horizontally differentiated traded goods. Section 2 presents the empirical methodology, describing the procedures for estimating CES and quality. Section 3 presents the data and reveals the results obtained for a selected sample of products and product segments. Section 4 analyses competition between high- and low-wage countries. Section 5 does some sensitivity analyses, and Section 6 concludes.

1) Estimating CES and quality of differentiated products

The underlying assumptions of discrete-choice models are much more flexible to deal with oligopolistic markets with differentiated products than standard demand models assumptions. Nevertheless, I opt to base the empirical work on a standard demand model with the specific purpose of estimating the elasticity of substitution among varieties within products and identifying possible data aggregation problems.

The model adopted here assumes that each product is theoretically so finely defined that, consistent with the quality ladder concept and theoretical quality ladder models, non-observed quality has just one dimension. Products with different uses or technical specifications should be classified as different products. Products at different stages of the production chain should also be classified as different products and so are products that have different components and accessories. If a small group of consumers prefer a more expensive and lower quality variety within an existing product category and the variety is found not to be a substitute of the other varieties, then it should be allocated to a new product category even if it contains only

[10] To the best of our knowledge, monthly imports have never been applied to estimate quality of varieties within a product, using trade data.

that single variety. Instead of focussing on consumers' heterogeneity and idiosyncratic preferences of some groups of consumers, the model focusses on the degree of heterogeneity of described characteristics of products and the resulting substitutability of varieties within products.

Therefore, the number of non-observed characteristics of the theoretical product being modelled is expected to be smaller than existing and more aggregated products. This should make more plausible the standard assumptions of constant elasticities of substitution (CES) across exporting countries within products and representative consumers of individual products. Clearly, no existing product classification can rigorously meet the strict conditions of this theoretical product. Nevertheless, the empirical methodology in the next section will introduce some innovative procedures also aiming at making the model more plausible.

The utility function includes quality and love of variety and is like the one used by Hummels and Klenow (2005), except for a subtle but important change: It allows CES to vary across products. Thus, quality is defined and can only be compared among varieties within finely characterized products and not across different products. Representative consumers may represent different groups of consumers across products. Therefore, the model has distinct implications. Some other implications will be mentioned below.

Consumers maximize a utility[11] given by:

(1) $U_i = \left(\sum_{j=1}^{J} Q_{ij} N_{ij} x_{ij}^{(\sigma_i-1)/\sigma_i}\right)^{\sigma_i/(\sigma_i-1)}$; subject to

(2) $\sum_{j=1}^{J} N_{ij} p_{ij} x_{ij} \leq \overline{M_i}$

where Q_{ij} is the quality of the variety exported by each country $j \in J$ to country *m* of a finely described product category *i*; N_{ij} is the number of symmetric horizontal varieties exported from *j* to *m* within the product category *i*; x_{ij} is the number of units (quantity) exported from *j* to *m* per horizontal variety within product *i*; p_{ij} is the price of each of variety of product *i*; and σ_i is the CES among the varieties within product *i*. If the importing country does not buy product category *i* from country *j*, then $x_{ij} = 0$ and $N_{ij} = 0$.

The concept of a product should be closely related to the value of the elasticity of substitution among its varieties. σ_i of vertically and horizontally differentiated varieties within a product in equation (1) must be larger than one. If varieties are weak substitutes, they should belong to different products.[12] For simplicity, I take $\overline{M_i}$, country *m*'s spending on imports of all varieties of product *i*, as exogenous.[13]

The maximization with respect to quantity x_{ij} of equation (1) subject to equation (2) yields that the quantity x_{ij} exported by country *j* relative to the quantity exported by a reference country is a function of relative prices and qualities of these varieties:

(3) $\frac{x_{ij}}{\bar{x}_i} = \left(\frac{p_{ij}}{\bar{p}_i}\right)^{-\sigma_i} \cdot \left(\frac{Q_{ij}}{\bar{Q}_i}\right)^{\sigma_i}.$

Normalising $\overline{p_i} = \overline{x_i} = \overline{Q_i} = \overline{N_i} = 1$,[14] and considering that $X_{ij} \equiv x_{ij} . N_{ij}$, the demand equation becomes:

(4) $X_{ij} = p_{ij}^{-\sigma_i} . N_{ij} . Q_{ij}^{\sigma_i}.$

[11] This utility function corresponds essentially to Broda's and Weinstein's (2006) third tier of a three-tier utility function. The first two tiers are not essential for my purpose of estimating the elasticity of substitution and the relative quality among imported varieties within each product over a twelve-month period only. They are essential to Broda's and Weinstein's objective of estimating the gains of varieties over a three-decade period.

[12] The sensitivity of our main conclusions to the condition $\sigma_i > 1$ is left to Section 5.

[13] The demand for domestic varieties must be ignored in this model, since no data is available for detailed domestic products. Implicitly, the model makes the strong assumption that changes in the demand for domestic varieties within the year has no effect on the composition of imported varieties. Khandelwal's model is also forced to ignore the demand for domestic varieties, making the strong assumption that prices and the composition of the domestic varieties within the industry domestic output do not vary within each year. The substitution possibilities take place over the years between each imported variety and the industry domestic output, rather than each domestic variety. During a period of thirteen years, one would expect changes in the relative quality between each domestic and imported varieties, as well as changes in product characteristics, both not captured by the model.

[14] As in Hummels and Klenow (2005). It should be noted that this normalization requires no change in relative prices among the symmetric varieties of each exporting country.

2) The Empirical Methodology

2.1) Dataset

Monthly trade data are drawn from the United States (US) Harmonized System (HS) import data at the six- and ten-digit levels.[15] Unit values are calculated as the ratio of import values of Land-and-Duty Paid (LDP) to import quantities for each HS product category and exporting country (LDP/X). Trade costs (TRC) are the sum of per unit transport costs ((CIF-FOB)/X) and tariffs ((LDP-CIF)/X). Monthly US import data is for 2014, except when indicated otherwise. Population by country data are reported in Table (B.1) and are largely drawn from World Penn Tables (9.0)-see Feenstra et al (2015). Japanese import products categories for 2014 at HS nine-digit level are used to assess the level of disaggregation of one US import product category only available at the six-digit level.

2.2) Quality estimation

Following the model presented in the previous section, the quality of each variety within each product category i is estimated based on a two-step procedure. The first step is a panel data regression for each product category i, applying a two-stage least squares regression to estimate the following demand equation:

(5) $\ln(X_{ijt}) = \alpha_{ij} - \sigma_i \ln(uv_{ijt}) + \delta_{ijt}$, where $\ln(uv_{ijt}) = \ln(p_{ijt})$ and $\alpha_{ij} = \ln(N_{ij}) + \sigma_i \ln(Q_{ij})$.

Trade costs (*TRC*) per unit are used as the instrumental variable for unit values (*uv*), due to the endogenous relation between quantities *X* and unit values *uv*. Cross-country fixed effects (α_{ij}) are calculated using monthly data within a one-year period. As part of the cross-country fixed effects, qualities of varieties are calculated for the whole year. The error term is an error of the regression, not just of quality.[16]

Monthly data increases the number of observations per year and provides some other important advantages. Firstly, it focusses on the short-term, minimizing the hard to control effects of changes in characteristics, quality, and technology of each variety over longer periods of time. Secondly, countries that export in just one month in the year will have just one unit-value observation, carrying a weight equal to one-twelfth of the weight of countries that export every month. In contrast, annual unit values give equal weights to exporters, regardless of whether they are regular or sporadic exporters within the year. Thirdly, although medium-term contracts may sometimes be signed between importers and exporters, decisions to import a certain quantity of a specific variety for a certain price is typically taken at a point in time, considering alternative suppliers. Therefore, monthly data also provides a better identification of exporting countries that are competing with one another at any point in time.

The second step is to regress the cross-country fixed effects (α_{ij}) on a proxy for the non-observed number of symmetric horizontally differentiated varieties exported by each country, which is also assumed to be constant within the year. The year-average population (pop_j) of each country is adopted as this proxy, following Krugman (1980) and Khandelwal (2010). In doing so, the model can separate Q_{ij} (short-term quality) from N_{ij} (the number of symmetric varieties), in contrast with the models in Hummels and Klenow (2005) and Yue (2018).

(6) $\alpha_{ij} = c + \beta \ln pop_j + \varepsilon_j$.

β is expected to be positive. Quality qe_{ij} is obtained as the residual of regression (6):

(7) $qe_{ij} = \alpha_{ij} - \widehat{\alpha_{ij}}$.

When the p-value of the population coefficient is larger than 5 per cent, the hypothesis that the population coefficient is zero cannot be rejected and, hence, equation (7) must be slightly modified:

(7′) $qe_{ij} = \alpha_{ij} - \bar{\alpha}$;

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[15] USITC dataweb.

[16] I also test the assumption that $\widehat{\alpha_{ij}} + \widehat{\delta_{ij}} = \ln(N_{ij}) + \hat{\sigma}_i \ln(Q_{ij})$. Section 5 will show that this assumption does not change the main results of the paper.

Where $\bar{\alpha}$ is the mean of α_{ij} for each product across countries, $\bar{\alpha} = \sum_{j=1}^{J} \alpha_{ij}/J$. It should be noted that the cross-country fixed effects in (5) are measured in natural log of quantity units and so is qe_{ij}.
Quality in natural log of price units qep_{ij} is given by:
(8) $qep_{ij} = \; qe_{ij}/\widehat{\sigma_i}$; and the mean is always $\overline{qep} = \sum_{j=1}^{J}\left(qep_{ij}/J\right)$ = 0.

It should be noted that quality levels of varieties within products are not measured in the same way as in the literature cited in the introduction. This is because short-term quality is calculated for a period of just one year. If the same calculation were done separately for two or more years, the quality ranking of varieties within the same product and the quality ladder could be compared but not the quality levels. In contrast, when quality and quality ladder are measured typically over a period of around one decade or more, it is not possible to control for all the changes that take place in each country in such a long period, which may affect relative quantities and prices independently of quality changes. Hummels and Klenow (2005) calculate quality based on a one-year period, but quality is estimated as an aggregate price index.

In addition to running the demand regression (5) for each product category *i*, other ten regressions are run with the inclusion of a *k*-order autoregressive, AR(*k*) variable, with *k* varying from *k*=1 to *k*=10. The objective of including the AR process is to avoid autocorrelation and misspecification[17] as indicated by DW statistics.
(9) $\epsilon_{ijt} = \sum_{k=1}^{p} \rho_k \, \epsilon_{ijt-k} + \mu_{ijt}$; where μ_{ijt} are independent and identically distributed.
(10) $\ln\left(X_{ijt}\right) = \sum_{k=1}^{p} \rho_k \ln\left(X_{ijt-k}\right) + \alpha_{ij}\left(1 - \sum_{k=1}^{p} \rho_k\right) - \sigma_i\left[\ln\left(uv_{ijt}\right) - \sum_{k=1}^{p} \rho_k \ln\left(uv_{ijt-k}\right)\right] + \mu_{ijt}$
The inclusion of AR variables automatically excludes exporting countries that do not export for (*k*+1) consecutive months and month observations of non-excluded countries that do not have observations in *k* preceding months. This procedure makes data trimming endogenous and helps the model to search for reasonable values for the DW statistics as the *k* lag increases and the number of exporting countries falls.[18] CES and quality estimates will also change as *k* increases, making the model more flexible.

2.3) Product categories that are too aggregated for quality estimation (TAFQE)

The model given by expressions (5) to (10) is initially applied to HS product categories at the six-digit level. Some of these HS(6) product categories contain just one HS(10) product category and are often commodities. Although some commodities may be differentiated, they typically show a relatively low dispersion of unit values, and, in a few of them, the dispersion of unit values is so low that it is not possible to reject the law of one price hypothesis. In the next section, the model will be applied to two HS(6) product categories that contain only one HS(10) product. One is a non-differentiated commodity, and the other is a differentiated product category, to illustrate the two cases.

However, when an HS(6) product category is known to contain two or more HS(10) product categories, the number of exporting countries will be at least equal but most likely larger for the HS(6) product than for any of the individual HS(10) products that make them up.[19] Therefore, other things being equal, a product with many exporting countries has a higher probability of being TAFQE than products with a smaller number of exporting countries.

Furthermore, the quantities and unit values of each exporting country of such an HS(6) product are weighted averages of the varieties of the products they contain. This measurement error, which is one type

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[17] See Praetz (2018) on the use of the DW statistics to detect misspecification.

[18] Excluded countries tend to account for a quite small share of the total quantity imported by product. This helps to reduce measurement error, "since there is good reason to believe that unit values calculated based on large volumes are much better measured than those based on small volumes of imports", Broda and Weinstein (2006, p.566).

[19] It will be equal if and only if at least one of the HS(10) products contains all the exporting countries of the other HS(10) products within the HS(6) product.

of misspecification, may be revealed by small elasticities of substitution, $\sigma_i \leq 1$,[20] or be picked up by the DW statistics of regression (5), showing a large d=|DW-2|.[21] HS(6) product categories may also show large ranges of unit values and quality levels of varieties within products. The ranges of countries' quality levels and annual unit values are measured by the difference between their maximum and minimum values within each product.

Our goal in applying the quality model to aggregate products known to contain two or more detailed products is to examine the results of the regressions in search for indicators and thresholds capable of signalling that the products are TAFQE. These indicators can then be used to identify if HS(10) products are likely to be TAFQE.

3) Empirical Results

There were approximately 17.2 thousand product categories of US imports at the ten-digit level in 2014. To put this figure in perspective, there were approximately 8.0 thousand product categories in Japan's imports at the nine-digit level in the same year. Therefore, US products are often much more disaggregated than Japan's, although there are some exceptions.[22]

Our empirical strategy will mainly focus on US imported products of chapter 84. The chapter includes mainly machinery and mechanical appliances, electronic machines, and parts. Any other chapter could have been chosen, but the choice for machinery and appliances was due to the perception that the decision to purchase these types of products are perhaps based on more objective criteria, such as efficiency, rather than more subjective criteria such as fashion, colour, product image, and others, narrowing down non-observed characteristics of products and consumers.[23]

3.1) US imports of unwrought not alloyed tin (HS 8001100000)[24]

Unwrought not alloyed tin is an international traded commodity whose price is known to behave close to what is expected from a homogeneous product.[25] Table (1) reports the results of applying regression (5) to

Table (1): Tin demand regressions without an AR variable and with AR(k) variables

HS 8001100000	AR(0)	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)	AR(6)	AR(7)	AR(8)	AR(9)	AR(10)
CES p-value	0.993	0.700	0.351	0.445	0.962	0.708	0.572	0.976	0.860	0.146	0.225
d=|DW-2|	0.746	0.076	0.194	0.070	0.015	0.279	1.275	0.349	0.290	0.952	1.667
cross-sections	16	9	8	8	7	7	7	7	7	6	6
observations	107	82	70	60	52	45	38	31	24	17	11
UVR	4.58	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

US monthly imports of tin in 2014 and with AR(k) variables, k varying from zero to ten (zero means without an AR variable). The CES p-values are extremely large in all regressions and the DW statistic suggests autocorrelation and/or misspecification in most of them. The inclusion of AR($k \geq 1$) excludes some exporting countries without valid observations, and the range of unit values (UVR) in natural log falls to just 0.08. As expected for a non-differentiated product, unit values have approximately the same value across the

[20] Rigorously, monthly quantities and unit values, even at the most disaggregated level, are averages of quantities and prices within the month and at different delivery points in the US. See Chami Batista and Silveira Filho (2010) for unit values differences in US imports by main ports. For simplicity, this is ignored in this paper.

[21] DW statistics may be indicating something else is wrong in the regression besides a measurement error due to aggregation problems. However, given the amount of evidence of aggregation problems in HS(10) products found in this paper, I consider aggregation the most likely reason for misspecification.

[22] These exceptions occur when an HS(6) product is subdivided into more HS(9) products in Japan than in US HS(10) products.

[23] Is it possible to specify a general demand function that fits all products and consumers' characteristics, from companies buying machines to individuals purchasing food?

[24] US imports of unwrought and not alloyed tin pay no import tariff and the US does not export it. Quantities are in kilograms.

[25] See Chami Batista and Silveira Filho (2010) for a study on imports of unwrought and not alloyed tin in the US and Japan.

remaining varieties, CES goes to infinity, quantities become independent of unit values, and there is no difference in quality among varieties.[26]

3.2) US imports of processors and controllers (HS 8542310000)
Processors and controllers (ps&cs) are one of the relatively few HS(10) products imported by the US that is defined at a more aggregated level than in Japan. The product category ps&cs is defined at the six-digit level in the US,[27] while Japan disaggregates it into six nine-digit products. Table (2) reports the Japanese HS codes and descriptions of each product up to the nine-digit level. Hence, this US imported product is known to consist of a basket of different product categories observed in Japan but not in the US.

US imports of ps&cs illustrates the case of a product that is likely to be TAFQE, because it consists of non-observed products with distinct functions and uses whose demand curves are likely to have distinct elasticities of substitution across their varieties.

Uncased ps&cs are integrated circuits prior to having terminal connections added and prior to being encased for physical protection. They are inputs for other integrated circuits. Hybrid ps&cs are miniaturized electronic circuits constructed of individual devices, such as semiconductor devices and passive components, bonded to a substrate or printed circuit board.

Table (2): Japan's annual unit values of processors and controllers by product

Import code	Product description	Annual Unit Value in USD of Japan 2014 imports		
85.42	Electronic integrated circuit	total	high-wage countries	low-wage countries
8542.31	Processors and controllers*	1.72	1.83	1.29
8542.31.010	Uncased	0.69	0.71	0.41
8542.31.020	Hybrid integrated circuit	54.66	79.00	18.59
8542.31.031	MPU (microprocessor)	11.45	14.17	4.86
8542.31.032	MCU (microcontroller)	1.20	1.43	0.97
8542.31.033	DSP (digital signal processor)	3.86	5.98	3.09
8542.31.039	Other ones	0.89	0.93	0.76

*Whether or not coupled with storage elements, converters, logic circuits, amplifiers, clock circuits, timing circuits and other circuits.
Source: Trade Statistics of Japan Ministry of Finance

MPUs are designed for general purpose computing, processing inputs into outputs, according to an undefined number of possible instructions. They are used in personal computers, laptops, mobile devices, and central servers. MCUs, on the other hand, are designed to perform specific tasks. They are used in keyboards, printers, washing machines, microwave ovens, cars, mobiles, car braking systems, cruise missiles etc. Each microcontroller receives a specific input and delivers one and only one output. If it is inside a printer, it gets the data and prints it. Some products have more than one MCU inside them.

DSP is a specialised processor with its architecture optimized for the operational needs of digital signal processing. The goal of DSPs is usually to measure, filter or compress continuous real-world analog signals. They are especially important for communications satellites, due to low power consumption.
Microcontrollers have better power efficiency than general-purpose microprocessors and are thus more suitable to portable devices with power consumption constraints. But a general-purpose microprocessor can perform several tasks. The implication is that a microcontroller cannot be used in place of a microprocessor

[26] Rearranging equation (4) in natural logs: $\ln(Q_{ij})=(1/\sigma_i).\ln(X_{ij})-(1/\sigma_i).\ln(N_{ij})+\ln(p_{ij})$. As $\ln(p_{ij})\approx\ln(p_i)$ for any j with $k\geq1$, due to exceptionally low UVR, $(1/\sigma_i)$ goes to zero, and varieties are close to perfect substitutes with no difference in quality $\ln(Q_{ij})\approx\ln(p_i)\approx\ln(Q_i)$. The seven excluded countries in the AR(1) regression did not export for two consecutive months and accounted for just 1.5 per cent of US imports of tin in 2014.
[27] There is only one ten-digit product (HS8542310000) within the six-digit product (HS854231).

and using a microprocessor in place of a microcontroller is not economically viable, because the former is much more expensive than the latter. Therefore, microprocessors do not compete with microcontrollers and different microcontrollers do not necessarily compete among each other. Different ps&cs have different purposes, and it does not make much sense to say that one has a better quality than the other.

Table (2) also reports the annual unit values[28] of Japan's imports of ps&cs. They vary from less than a dollar per unit for uncased ps&cs to over fifty dollars on average per unit of hybrid ps&cs. The last row reports the unit value of ps&cs in aggregate. Because quantities and unit values of US imports of ps&cs are only observed in aggregate, it is clearly not possible to know to what extent unit values and quantities across countries' exports of ps&cs to the US differ because of the composition of the non-observed products or because of the quality levels and other features of each non-observed product. It should be noted Japan's annual unit values of each ps&cs are higher when imported from high-wage countries than from low-wage countries.[29]

Table (3) reports the annual unit values and composition of Japan's imports of ps&cs by products for some top exporting countries. Given the differences in the composition and unit values across the different types of ps&cs and exporting countries, quality estimates based on a demand regression using quantities and unit values for an aggregate of ps&cs are bound to be spurious.

Table (3): Annual unit values and quantity shares of processors and controllers by product and main exporting countries to Japan in 2014

Products	Exporting countries									
	Taiwan		Germany		PRC		USA		Korea	
	share	UV	share	UV	share	UV	share	UV	share	UV
Uncased	67%	1.35	19%	0.14	15%	1.05	34%	4.47	19%	4.09
Hybrid I.C.	1%	0.82	0%	0.03	1%	0.37	1%	0.79	1%	1.98
MPU	6%	7.69	0%	1247.14	1%	5.48	8%	163.05	12%	46.93
MCU	2%	4.97	0%	14.43	3%	4.58	44%	19.05	9%	18.59
DSP	0%	3.27	0%	2.16	52%	0.98	0%	1.69	0%	0.86
Other ones	24%	5.70	81%	10.06	26%	3.03	13%	7.40	58%	4.75
TOTAL	100%	1.58	100%	0.16	100%	0.85	100%	3.24	100%	1.50

PRC means People's Republic of China. Korea is the short name for The Republic of Korea.
Source: Calculated with data from the Ministry of Finance of Japan

Table (4) reports Japan's exports of ps&cs to the US by product in 2014. It reveals that the low aggregate unit value of ps&cs is largely due to a concentration of these exports in microcontrollers (MCU) and uncased ps&cs, which have both a much lower unit value than the other ps&cs. Clearly, quality estimates using US import data are bound to be wrong.

Table (4): Shares and unit values of Japanese exports of processors and controllers to the US in 2014

Processors and controllers	Uncased	Hybrid I.C.	MPU	MCU	DSP	Others	Total
quantity shares	8%	0%	2%	81%	0%	9%	100%
unit values in USD	1.62	16.38	6.34	2.15	6.29	4.43	2.40

Source: Calculated with data from the Ministry of Finance of Japan

Although the US data for ps&cs at the six-digit level is most likely to be too aggregated to estimate the quality of each variety, US import data for 2014 is examined to see if it is somehow possible to detect

[28] Annual unit values are always calculated in this paper as the ratio of the annual value (CIF in Japan) to the annual quantity. This is equivalent to a weighted arithmetic mean of the monthly unit values with weights given by quantities.
[29] I use a larger group of low-wage countries than the one used by Bernard et al. (2006) and Khandelwal (2010). Appendix Table (B.2) reports the list of high-wage countries used in this paper.

that the product is too aggregated. The system of regressions and equations from (5) to (10) is applied to the product.

Table (5) reports the main results. All demand regressions meet the condition CES>1.[30] Except for the regression with AR(1), DW statistics of all the other regressions suggest autocorrelation and/or misspecification. If quantities and unit values differ significantly for the exporting countries of each non-observed product within ps&cs, which seems likely in this case, then there is a measurement error, or a misspecification, in both the regressor and the regressand of the demand regression. The implication is that estimators for the demand regression are biased and inefficient. Hence, it is important to make sure that this type of error does not occur.

The large number of exporting countries, the wide range of unit values, and the large quality ladder (QL) estimates all provide further evidence that the product is most likely to be TAFQE. Although d= |DW-2| is just slightly over 0.15 for the regression with AR(1), both UVR and QL are extremely large. Recall that UVR and QL are measured in natural logs. Without logs, the top-quality variety is over eighty-three thousand times the lowest quality variety in the regression with AR(1). Clearly, there must be a ceiling for QL. If ps&cs is TAFQE, as the above results strongly suggest, CES≤1 may be a sufficient but not a necessary condition for a product to be TAFQE. The next section will test this hypothesis and bring more evidence that high d=|DW-2| and QL indicate that the product is likely to be TAFQE.

Table (5): Main results of regressions (5) to (10) applied to US imports of processors and controllers

HS 8542310000	AR(0)	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)	AR(6)	AR(7)	AR(8)	AR(9)	AR(10)
CES	1.199	1.197	1.232	1.312	1.317	1.292	1.176	1.214	1.330	1.290	1.361
d=|DW-2|	0.824	0.152	0.437	0.443	0.408	0.271	0.202	0.378	0.419	1.119	1.905
Cross-sections	80	53	46	45	45	45	44	42	41	41	41
UVR	10.299	8.799	8.369	8.369	8.369	8.369	8.369	8.369	8.369	8.369	8.369
QL	12.035	11.327	10.698	9.013	8.887	9.015	11.047	8.674	7.732	8.186	7.603

3.3) US imports of products of chapter HS84: "Nuclear reactors, boilers, machinery, and mechanical appliances; and parts thereof"

3.3.1) Applying the quality model on products known to be a basket of HS(10) products

The quality model given by equations (5) to (10) is now applied to a group of HS(6) product categories, containing at least two HS(10) product categories and for which data on quantity is available.[31] Our goal is to develop an empirical methodology to test which HS(10) products are likely to be TAFQE. By examining the results of the model for HS(6) products, indicators associated with the fact that these HS(6) products are indeed aggregate products may be revealed.

Fifteen HS(6) product categories are selected. They have the largest number of exporting countries in chapter 84 among those with information on quantity and at least two HS(10) products for each HS(6). As it has been argued, product categories with large numbers of exporting countries are more likely to be TAFQE and may reveal indicators that can make aggregation more easily detectable. As the number of exporting countries falls, the distinction between aggregate and non-aggregate products become subtler.

Three of these fifteen HS(6) product categories have quantities measured in two different units each. When measured in kilograms, the product category HS840991 has 73 exporting countries and contains seven HS(10) products, when measured in number of units, has 29 exporting countries and contains four

[30] P-values of CES and cross-country fixed effects are all equal to zero and, hence, not reported.

[31] Yue (2018) tests if quality rankings of the same exporting countries of each HS(6) product are correlated across importing countries, using the Spearman's rank correlation test. The objective is to see if rank correlations are in line or noisy across importing countries. It is not surprising that he finds them to be noisy. If HS(6) products are combinations of baskets of HS(x) products, x>6, with different and varying weights across importing countries, then prices and quantities are wrongly measured in each importing country, and relative quality rankings are bound to be noisy. Noise should decline with less aggregated products, but this cannot be tested because these products are unequaly defined across importing countries.

HS(10) products. When measured in kilograms, HS840999 has 105 exporting countries and contains six HS(10), when measured in number of units, has 41 exporting countries and contains three HS(10). HS848310 has 63 exporting countries and contains five HS(10) products, when measured in number of units, but contains just one HS(10) product, when measured in kilograms. This latter product measured in kilograms cannot be included, since it has only one HS(10) product. Hence, seventeen HS(6) products will be tested with the number of exporting countries ranging from 29 to 108.

Considering the total of two hundred and fifty-four HS(6) product categories of chapter 84, the mean and median of the number of exporting countries by product are 33 and 27, respectively. Our selected list of seventeen HS(6) products accounts for 28 per cent of the LDP value of US imports of chapter 84 and 48 per cent of the value of the top half of the products ranked by the number of exporting countries. Therefore, bearing in mind that I am looking for indicators of products with large numbers of exporting countries, the coverage seems reasonable both in terms of value and range of exporting countries with respect to the top half of HS(6) products.

A list of 47 HS(10) product categories is also selected, considering those with the largest numbers of exporting countries and some HS(10) products within the seventeen HS(6) products. These HS(10) product categories account for 36.2 per cent of the LDP value of US imports of chapter 84, considering the total of 1285 categories for which data on quantity is available. Eleven demand regressions for each HS(6) and HS(10) product categories are run for AR(k), k varying from 0 to 10. Some of the 47 HS(10) products belong to the mechanical machinery industry (MCH) and some belong to the electronic machines industry (ELT)[32]. Tables (A.1) and (A.2) in the Appendix report the descriptions, industry classification, and number of exporting countries of each of the 17 HS(6) and 47 HS(10) product categories, respectively.

Tables (6) and (7) report some descriptive statistics of the demand regression (5) applied to the 17 HS(6) and 47 HS(10) products, respectively.[33] As expected, the means and medians of CES are significantly smaller and closer to one for HS(6) products than for HS(10) products, for any given order of the AR variable.[34] Means and medians of CES for HS(10) products are significantly higher than one. The number of regressions for HS(6) aggregate products with CES≤1 is 40 per cent of all regressions, which is much higher than the 23 per cent for HS(10) products. The number of regressions for which d=|DW-2| is smaller than 0.15 is lower for HS(6) products than for HS(10) products, for any given order of the AR variable. The means and medians of the total number of exporting countries (cross-sections) are much larger for HS(6) than for HS(10) for any given AR variable. And the means and medians of UVRs are higher for HS(6) products than for HS(10) products. Hence, as expected, on average, aggregation tends to lower CES and the number of d=|DW-2|<0.15, and raise the number of exporting countries, the number of products with CES≤1 and the size of UVRs.

If CES is smaller or equal to one, the product category is considered TAFQE, but it might be too aggregated even if CES is larger than one but d=|DW-2|≥0.15, as in 60 of the 187 regressions for HS(6) products, as well as in the regressions for processors and controllers examined in the previous section. Therefore, demand regressions that show CES slightly larger than one, large d=|DW-2|, many exporting countries, and large UVR appear to indicate that the product is likely to be TAFQE.

[32] The MCH industry includes products within HS840991, HS840999, HS841330, HS841381, HS841480, HS847989, HS848180, and HS848190. The ELT industry includes products within HS847130, HS847141, HS847150, HS847160, HS847190, and HS847330.

[33] Tables (B.3) and (B.4) report the complete list of results of regressions for HS(6) and HS(10) products, respectively.

[34] Broda and Weinstein (2006, p.542) estimate thousands of elasticities of substitution and “document that varieties appear to be close substitutes in more disaggregate product categories”.

Table (6): Main results of regression (5) for the 17 HS(6) products of chapter 84

17 HS(6)	AR(0)	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)	AR(6)	AR(7)	AR(8)	AR(9)	AR(10)
CES											
Mean	1.112	1.063	1.041	1.023	1.031	1.007	1.032	1.032	0.989	1.033	1.099
Median	1.149	1.086	1.039	1.022	1.019	1.029	1.019	1.043	0.990	1.013	1.022
Number of regressions with d=|DW-2|<0.15											
Number	4	13	10	7	3	3	2	4	0	0	0
Share	24%	76%	59%	41%	18%	18%	12%	24%	0%	0%	0%
Number of exporting countries (cross-sections)											
Mean	79	53	46	43	41	39	38	37	36	36	34
Median	80	53	47	43	42	41	38	38	38	36	36
UVR											
Mean	8.266	6.744	5.957	5.849	5.762	5.625	5.481	5.277	5.456	5.019	4.803
Median	8.103	6.770	5.341	5.341	5.341	5.020	5.006	5.006	5.013	4.817	4.516

Table (7): Main results of regression (5) for the 47 HS(10) products of chapter 84

47 HS(10)	AR(0)	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)	AR(6)	AR(7)	AR(8)	AR(9)	AR(10)
CES											
Mean	1.155	1.177	1.150	1.191	1.211	1.146	1.245	1.305	1.572	1.128	1.100
Median	1.188	1.169	1.132	1.164	1.153	1.182	1.165	1.185	1.154	1.133	1.071
Number of regressions with d=|DW-2|<0.15											
Number	17	34	20	20	18	12	12	7	6	2	1
Share	36%	72%	43%	43%	38%	26%	26%	15%	13%	4%	2%
Number of exporting countries (cross-sections)											
Mean	48	33	29	27	26	25	23	22	21	21	20
Median	45	34	29	28	25	25	24	23	22	21	21
UVR											
Mean	6.397	5.071	4.673	4.444	4.360	4.385	4.200	4.018	3.947	3.973	4.153
Median	6.172	4.717	4.295	4.222	4.222	4.222	4.126	3.845	3.845	3.783	4.097

Using expressions (5) to (10), quality estimates are initially calculated for the varieties of each HS(6) and HS(10) product categories that meet the condition d<0.15, given the results for HS(6) products and processors and controllers. Tables (B.5) and (B.6) report the regressions for HS(6) and HS(10) product categories, respectively, that meet this condition, including quality ladder estimates (QL).

Table (8) reports some important linear relationships for QL and UVR, using the selected HS(10) product categories that meet the condition d<0.15 and the number of exporting countries reported in Table (B.6). QL is found to be linearly and strongly negatively correlated to CES and linearly and positively correlated to the natural log of the number of exporting countries LN(Ctries) in column 1. Since large numbers of exporting countries are associated with products that are TAFQE, now further evidence is found that large QL is also associated with product categories likely to be TAFQE. Since CES smaller than or equal to one implies product categories that are TAFQE, and CES marginally greater than one is associated with product categories likely to be TAFQE, QL also captures the effects of the levels of aggregation of HS(10) product categories on CES. Columns 2 and 3 show that replacing LN(Ctries) by the natural log of low-wage-exporting countries LN(LWCtries) or by the natural log of higher-wage-exporting countries LN(HWCtries) also works. In fact, the coefficients of correlation and the F significance levels indicate that the number of low-wage-exporting countries together with CES best explain quality ladders and have the best fit, respectively. Column 4 reveals UVR may replace the number of countries, though the coefficients of correlation and the F significance levels favour the regressions of the previous columns. Columns 5 to 7 show that UVR is not significant when together with CES and in any of the specifications of the number of exporting countries, and this is probably due to the correlations between UVR and the number of exporting countries shown in columns 8 to 10.

Therefore, QL seems to embody the positive relation of LN(Ctries.) and UVR, as well as the negative relation of CES with the level of aggregation of HS(10) product categories. The larger CES and the smaller the number of exporting countries and UVR are, the more disaggregated the HS(10) product category and the smaller QL are. Hence, QL together with the DW statistics may be used to distinguish those products that are likely to be TAFQE from those that are not.[35]

Unit values of differentiated varieties within a product are expected to reveal some level of dispersion and should be negatively related to their corresponding imported quantities, according to demand regression (5). Hence, for a given number of exporting countries and level of CES, the more differentiated varieties are, the larger the quality ladder is expected to be. However, if the quality ladder is too large, the product may be too aggregated and quality estimates are most likely to be wrong.

Table (8): Some linear (OLS) relationships for QL and UVR

Condition	Demand regressions meet d<0.15									
HS10 products	1	2	3	4	5	6	7	8	9	10
Regressands	QL	QL	QL	QL	QL	QL	QL	UVR	UVR	UVR
Regressors										
Constant	5.766	8.433	6.921	9.521	8.518	5.784	6.878	1.721	-1.163	-0.200
p-value	6.91E-08	5.19E-22	4.63E-11	3.39E-19	2.64E-19	7.14E-08	1.01E-10	1.54E-05	7.06E-02	7.24E-01
CES	-4.489	-4.639	-4.435	-4.205	-4.673	-4.541	-4.398			
p-value	8.94E-17	4.28E-18	1.05E-15	2.81E-12	3.99E-17	4.05E-16	9.02E-15			
LN(LWCtries)		1.614			1.649			1.433		
p-value		3.89E-13			6.59E-10			1.05E-13		
LN(ctries)	1.811					1.888			1.819	
p-value	5.31E-12					8.55E-09			1.66E-16	
LN(HWCtries)			1.644				1.589			1.745
p-value			4.86E-10				8.24E-07			2.17E-15
UVR				0.369	-0.025	-0.043	0.032			
p-value				1.52E-04	8.07E-01	6.90E-01	7.67E-01			
Adj.R-squared	0.52	0.54	0.49	0.39	0.54	0.52	0.49	0.32	0.38	0.36
Observations	143	143	143	143	143	143	143	143	143	143
F significance	1.31E-23	1.00E-24	1.11E-21	2.28E-16	1.02E-23	1.22E-22	1.0E-20	1.05E-13	1.66E-16	2.17E-15

Two of the 145 regressions were excluded because the number of low-wage countries was zero.
Source: Table (B.6)

Table (9) reports the main results of the regressions for the 17 HS(6) products. Whenever there is more than one regression for each product category, the selected regression is the one with the smallest QL. This condition should help to find a threshold for the quality ladder above which product categories are TAFQE. The last three columns report QL, based on equations (6) to (8), QL*, adding the error mean $\overline{\delta_{ij}} = \sum_{t=1}^{12}(\delta_{ijt}/12)$ to the cross-country fixed effect α_{ij}, and rho, the Spearman ranking correlation between QL and QL*.[36] Regressions that show d<0.10 are at the top of the table. Three products reveal CES≤ 1. Only one product does not meet the condition d<0.15. Indeed, this product reveals d>>0.15.[37]

If d<0.15 is imposed as one of the conditions for quality estimation, QL<4.04 or QL*<3.95 would also have to be imposed to exclude all the 17 HS(6) product categories known to be aggregate. However, if I impose the stricter condition d<0.10 to avoid more firmly the possible misspecification already discussed, QL<5.27 and QL* < 5.02 would be sufficient to exclude all the 17 HS(6) product categories. But recall that

[35] Using the elasticities of substitution of Broda and Weinstein (2006), Khandelwal (2010) does not find any correlation with quality ladders of industries.

[36] For calculating QL*, α_{ij} is replaced by $(\alpha_{ij} + \overline{\delta_{ij}})$ in equations (6), (7), and (7').

[37] QL is calculated for this product, despite d>>0.15, to emphasise the importance of the DW statistics to identify misspecification. The best DW for this product is well off the 2.0 target, though CES>>1, QL and QL* are much smaller than the mean and median of the other products, even when the three products with CES≤1 are excluded. Therefore, based only on CES and QL or QL*, the product would not necessarily be considered too aggregated for quality estimation, even though d=1.7>>0.15.

QL or QL* equal to 5.0 is measured in logs, which means that, without logs, the quality level of the top variety is 148 times the quality level of the one at the bottom of the quality ladder. This relative quality between the two extreme varieties is exceptionally large.[38] I will thus adopt from now on in this section and the next d<0.10 and QL<5.0, in addition to CES>1 and CES p-value<0.05, leaving a sensitivity analysis of the effects of assuming d<0.15 with QL<4.0, and QL*<0.395 to Section 5.

Table (9): Selected regressions for the 17 HS(6) products

No.	HS6	Unit	No. HS10	AR	CES	d= |DW-2|	cross-sections	UVR	QL	QL*	rho
d<0.10											
1	848190	kg.	8	3	1.578	0.001	50	5.020	5.277	5.025	0.997
2	840991	no.	4	6	1.517	0.061	17	5.341	5.540	5.777	0.993
3	847160	no.	7	5	1.202	0.084	37	4.187	6.866	6.883	0.995
4	847141	no.	2	1	1.157	0.009	46	5.323	7.029	7.195	0.987
5	841330	no.	4	1	1.042	0.035	63	3.590	8.290	8.207	0.989
6	840999	kg.	6	1	1.008	0.082	76	4.882	8.439	15.383	0.978
7	848180	no.	35	2	1.030	0.098	61	7.650	8.566	8.615	0.996
8	841480	no.	21	1	1.004	0.059	57	7.733	8.854	8.710	0.993
9	848310	no.	5	0	0.966	0.046	63	8.147	9.310	9.305	1.000
10	847989	no.	12	1	0.767	0.001	59	9.281	13.088	12.378	0.988
11	841350	no.	5	4	0.631	0.025	32	7.164	13.141	13.159	0.993
0.10≤d<0.15											
12	840999	no.	3	7	1.261	0.103	13	1.874	4.042	3.951	0.857
13	840991	kg.	7	7	1.413	0.126	40	3.076	4.270	4.436	0.981
14	847180	no.	3	0	1.149	0.117	82	10.197	8.545	8.545	1.000
15	847150	no.	2	2	1.129	0.119	43	4.521	9.692	9.737	0.997
16	847170	no.	11	3	1.055	0.144	39	6.770	10.841	13.57	0.946
d≥0.15											
17	841381	no.	3	0	1.492	1.721	80	11.403	6.223	6.664	0.992

When there is more than one regression for the product, the one with lowest QL is selected.

Table (10) reports the main results for the selected regressions of the 47 HS(10) product categories. When there is more than one regression for one product and the product meets the conditions for quality estimation, the selected regression is the one with the largest number of exporting countries.[39] If the product does not meet the conditions for quality estimation, the regression with the smallest QL is selected. There are thirty-six HS(10) product categories that meet the condition CES>1 and d<0.10, but only sixteen meet the condition QL<5.0. Therefore, only thirty-four per cent of the 47 HS(10) products meet the conditions for quality estimation.

There are seven HS(10) with CES≤1 and four with d=|DW-2| much larger than 0.15, two of them have CES p-values larger than 0.05 and are reported at the bottom of Table (10). Given that UVRs have reasonable values for these two products, the varieties within them are not substitutes at all.

Considering all 43 quality ladders shown in Table (10), the QL for the products of the mechanical industry varies from 1.37 to 10.38, and its mean equals 5.51, while these figures for the machines of the

[38] This may be partially justified by the continental size of the USA and the cost differences to deliver the same product to various ports of destination in the country. See footnote 20.

[39] It makes sense to include the regression with the largest number of exporting countries to find the maximum share in total imports of the products that meet the conditions for quality estimation. When there is more than one regression with the largest number of exporting countries, I select the one with the lowest QL.

Table (10): Selected regressions for the 47 HS(10) products

No.	HS10	Unit	Industry	AR	Ctries.	CES	d	UVR	QL
1	8409911040	kg.	MCH	1	18	1.744	0.099	4.700	3.949
2	8409911060	kg.	MCH	4	11	1.327	0.016	2.317	1.916
3	8409911080	kg.	MCH	8	12	1.686	0.071	3.519	3.346
5	8409915010	no.	MCH	1	16	1.499	0.021	4.383	4.149
11	8409919990	kg.	MCH	4	29	1.262	0.054	2.513	3.929
12	8409991040	kg.	MCH	4	13	2.129	0.012	2.273	2.733
13	8409991060	kg.	MCH	4	8	1.131	0.084	3.875	1.368
14	8409991080	kg.	MCH	1	18	1.285	0.014	3.432	1.894
18	8409999290	kg.	MCH	8	17	1.204	0.017	2.230	3.426
19	8409999910	no.	MCH	5	12	1.271	0.085	2.526	4.018
29	8471601050	no.	ELT	2	28	1.243	0.097	4.213	4.954
31	8471607000	no.	ELT	1	32	1.123	0.017	5.484	4.123
33	8471609030	no.	ELT	1	18	1.211	0.011	6.183	4.606
34	8471609050	no.	ELT	1	42	1.471	0.013	5.551	4.935
40	8481901000	kg.	MCH	2	26	1.820	0.015	2.149	3.646
46	8481909081	kg.	MCH	1	25	1.246	0.064	6.803	4.964
4	8409913000	no.	MCH	8	14	1.225	0.038	5.149	6.261
7	8409915085	kg.	MCH	6	34	1.068	0.007	3.094	7.188
9	8409919290	kg.	MCH	0	38	1.136	0.055	4.610	5.629
16	8409999190	kg.	MCH	4	37	1.132	0.016	3.791	7.300
20	8409999990	kg.	MCH	1	67	1.178	0.023	4.952	7.284
22	8413810040	no.	MCH	1	45	1.008	0.066	8.168	6.949
23	8414800500	no.	MCH	1	51	1.119	0.041	4.508	7.953
24	8471300100	no.	ELT	3	37	1.828	0.008	4.117	5.776
26	8471410150	no.	ELT	1	46	1.160	0.013	5.323	7.015
27	8471500150	no.	ELT	1	46	1.073	0.026	5.299	10.413
32	8471608000	no.	ELT	3	30	1.210	0.063	5.665	7.413
36	8473301140	no.	ELT	2	37	1.382	0.045	6.513	6.709
38	8481809015	no.	MCH	1	51	1.059	0.090	8.473	7.631
39	8481809050	no.	MCH	1	53	1.065	0.093	7.250	7.093
41	8481903000	kg.	MCH	0	44	1.205	0.023	3.899	5.627
42	8481905000	kg.	MCH	1	35	1.242	0.038	4.723	6.181
43	8481909020	kg.	MCH	1	33	1.280	0.072	4.295	5.448
44	8481909040	kg.	MCH	1	43	1.287	0.050	4.711	5.733
45	8481909060	kg.	MCH	5	36	1.275	0.096	4.808	6.244
47	8481909085	kg.	MCH	1	56	1.378	0.084	7.071	5.969
6	8409915081	kg.	MCH	1	14	0.791	0.007	3.258	10.383
10	8409919910	no.	MCH	4	8	0.9999	0.094	3.696	4.705
15	8409999110	no.	MCH	7	10	0.970	0.007	2.597	3.646
21	8413301000	no.	MCH	0	91	0.855	0.076	6.207	9.770
30	8471602000	no.	ELT	3	26	0.854	0.070	4.796	8.475
35	8471900000	no.	ELT	0	73	0.942	0.066	8.179	8.745
37	8479899899	no.	MCH	2	45	0.778	0.059	9.510	10.094
8	8409919210	no.	MCH	0	9	1.250	0.739	3.370	-
17	8409999210	no.	MCH	0	15	1.397	0.463	0.463	-
25	8471410110	no.	ELT	1	4	**1.530**	2.651	4.051	-
28	8471601010	no.	ELT	0	5	**0.611**	2.000	2.394	-

If the conditions for quality estimation are met, the regression with the largest number of exporting countries is selected. Otherwise, the regression with the lowest QL is selected. Figures are in red when the conditions for quality estimation are not met, and CES is in bold when its p-value is larger than 0.05. The reader can use the numbers in the first column to find the product description more easily in Table (A.2).

electronic industry are 4.12, 10.41, and 6.65, respectively. This large dispersion of QL within industries suggests that aggregating QL by industry may yield misleading results. This is aggravated by the fact that QL cannot be calculated for some product categories, because there are clear signs of misspecification in the regressions or the hypothesis that CES is zero cannot be rejected.

3.3.2) Segmenting HS(10) products based on unit values

The principal objective of this subsection is to show that within product categories that do not meet the conditions for quality estimation there may be subsets of varieties that do. Segmentation is far from directly addressing the deficiencies of the existing import data because non-observed products remain hidden. To address the issue properly, new data on quantity and unit values for more detailed product descriptions would have to be provided.[40]

I examine the effect of segmenting countries' varieties into two subsets within HS(10) products: Lower-price and higher-price exporting varieties.[41] The positive relationship between QL and UVR suggests that segmenting HS(10) products in this way may reduce both UVR and QL. By reducing UVR through segmentation, I expect to obtain subsets of varieties that meet the conditions for quality estimation, thus providing further support to our argument that within too aggregated HS(10) product categories there may be short-ladder products. If one or both subsets meet the conditions for quality estimation, then a way of estimating the quality levels of a subset of exporting countries within the product has been developed, which the previous method proved unable to do it.

To segment exporting countries, the annual mean and median of unit values of all exporting countries of a product are calculated. The annual mean is simply the ratio of the import value to the import quantity of the product. The mean divides exporting countries into low-mean and high-mean groups. Low-mean groups tend to have a much smaller number of countries than high-mean groups, as lower unit values tend to be associated with larger quantities. The median is used to obtain two equal size groups of countries, if the total number is even. If the total number of exporting countries is odd, then the low-median group will have one more country than the high-median group. The quality model, given by expressions (5) to (10), is applied to each segment of exporting countries, separated by the mean and the median. The endogenous trimming method is also applied with the inclusion of AR(k), with k varying from zero to ten.

Table (11) reports the segmented and non-segmented HS(10) product categories that meet the conditions for quality estimation: CES>1; CES p-value<0.05; d<0.10; and QL<5.0.[42] It also includes the HS(10) product categories that do not meet these conditions, regardless of being segmented or not, because CES≤1, CES p-value≥0.05, d≥0.10, or QL≥5.0. Again, when there is more than one regression for a product or segment, I select the one that has the largest number of exporting countries, provided it meets the conditions for quality estimation. When a product or segment does not meet the conditions for quality estimation, I select the regression that has the lowest QL.

There are now thirty-four HS(10) product categories that meet the conditions for quality estimation, or seventy-two per cent of the forty-seven HS10 product categories. It should be noted that when both the lower- and higher-price segments of an HS(10) product category meet the conditions for quality estimation, just one HS(10) product category is counted. Hence, most of the HS(10) product categories meet the conditions for quality estimation after segmentation.[43] The remaining thirteen HS(10) product categories are still TAFQE.

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[40] Naturally, product descriptions of import classification change over time, as they should, to try to catch up with innovations. However, the pace of the latter is likely to outweigh the pace of the former. This may partly explain the observation that "median elasticities of substitution for a given disaggregate level tend to slightly fall over time", Broda and Weinstein (2006, p.542).

[41] See Chami Batista and Liu (2017) for an application of segmenting import markets based on unit values.

[42] The effect of adding the error term to QL is examined in Section 5.

[43] It is worth noting that the high-median segment of product HS8409919910 in Table (11) was obtained with AR(9) and has only two exporting countries. It shows the capacity of the methodology to search for varieties that meet the conditions for quality estimation.

Table (11): Selected regressions for segmented and non-segmented HS(10) products

No.	HS10	Unit	Industry	Segment	AR	Ctries.	CES	d	UVR	QL
1	8409911040	kg.	mech.m	not segmented	1	18	1.744	0.099	4.700	3.949
2	8409911060	kg.	mech.m	not segmented	4	11	1.327	0.016	2.317	1.916
3	8409911080	kg.	mech.m	not segmented	8	12	1.686	0.071	3.519	3.346
4	8409913000	no.	mech.m	high-mean	1	11	1.304	0.004	2.504	3.821
5	8409915010	no.	mech.m	not segmented	1	16	1.499	0.021	4.383	4.149
7	8409915085	kg.	mech.m	high-median	3	14	1.258	0.045	1.888	4.570
9	8409919290	kg.	mech.m	low-mean	1	9	1.036	0.068	1.187	4.625
10	**8409919910**	no.	mech.m	low-median	1	9	1.162	0.012	1.992	4.401
		no.	mech.m	high-median	9	2	1.155	0.069	1.592	0.512
11	8409919990	kg.	mech.m	not segmented	4	29	1.262	0.054	2.513	3.929
12	8409991040	kg.	mech.m	not segmented	4	13	2.129	0.012	2.273	2.733
13	8409991060	kg.	mech.m	not segmented	4	8	1.131	0.084	3.875	1.368
14	8409991080	kg.	mech.m	not segmented	1	18	1.285	0.014	3.432	1.894
18	8409999290	kg.	mech.m	not segmented	8	17	1.204	0.017	2.230	3.426
19	8409999910	no.	mech.m	not segmented	5	12	1.271	0.085	2.526	4.018
20	**8409999990**	kg.	mech.m	low-median	6	23	1.399	0.067	4.830	4.982
		kg.	mech.m	high-median	3	22	1.023	0.001	2.744	4.814
16	8409999190	kg.	mech.m	low-mean	6	6	2.432	0.092	2.457	1.417
22	8413810040	no.	mech.m	low-mean	2	9	1.212	0.064	2.591	4.856
23	8414800500	no.	mech.m	low-median	7	16	2.221	0.023	1.397	4.163
24	8471300100	no.	eletr.m	high-median	0	43	1.959	0.071	2.160	4.912
26	8471410150	no.	eletr.m	high-median	4	14	1.031	0.017	2.034	2.131
29	8471601050	no.	eletr.m	not segmented	2	28	1.243	0.097	4.213	4.954
30	8471602000	no.	eletr.m	high-median	0	20	1.229	0.049	3.677	4.305
31	8471607000	no.	eletr.m	not segmented	1	32	1.123	0.017	5.484	4.123
33	8471609030	no.	eletr.m	not segmented	1	18	1.211	0.011	6.183	4.606
34	8471609050	no.	eletr.m	not segmented	1	42	1.471	0.013	5.551	4.935
36	8473301140	no.	eletr.m	high-mean	7	12	1.613	0.059	1.843	4.632
40	8481901000	kg.	mech.m	not segmented	2	26	1.820	0.015	2.149	3.646
41	**8481903000**	kg.	mech.m	low-median	5	16	1.573	0.023	1.339	4.227
		kg.	mech.m	high-median	1	17	1.127	0.061	2.393	3.805
42	**8481905000**	kg.	mech.m	low-mean	0	10	1.569	0.040	0.802	4.849
		kg.	mech.m	high-median	1	17	1.070	0.033	2.889	4.488
43	**8481909020**	kg.	mech.m	low-median	2	18	1.361	0.067	3.245	4.617
		kg.	mech.m	high-median	1	14	1.093	0.091	3.734	4.005
44	**8481909040**	kg.	mech.m	low-mean	3	9	1.244	0.100	1.169	4.621
		kg.	mech.m	high-median	1	20	1.335	0.080	2.368	4.670
45	8481909060	kg.	mech.m	low-mean	5	6	1.776	0.011	1.070	4.403
46	8481909081	kg.	mech.m	not segmented	1	25	1.246	0.064	6.803	4.964
47	**8481909085**	kg.	mech.m	low-mean	3	8	1.307	0.010	0.681	4.462
		kg.	mech.m	high-median	1	24	1.682	0.058	4.259	4.475
39	8481809050	no.	mech.m	low-mean	7	11	1.115	0.057	2.535	5.647
32	8471608000	no.	eletr.m	not segmented	3	30	1.210	0.063	5.665	7.413
38	8481809015	no.	mech.m	not segmented	1	51	1.059	0.090	8.473	7.631
6	8409915081	kg.	mech.m	not segmented	1	14	0.791	0.007	3.258	10.383
15	8409999110	no.	mech.m	not segmented	7	10	0.970	0.007	2.597	3.646
21	8413301000	no.	mech.m	not segmented	0	91	0.855	0.076	6.207	9.770
35	8471900000	no.	eletr.m	not segmented	0	73	0.942	0.066	8.179	8.745
37	8479899899	no.	mech.m	not segmented	2	45	0.778	0.059	9.510	10.094
8	8409919210	no.	mech.m	not segmented	0	9	1.250	0.739	3.370	2.438
17	8409999210	no.	mech.m	not segmented	0	15	1.397	0.463	4.582	2.732
27	8471500150	no.	eletr.m	high-median	2	17	1.370	0.101	1.174	4.920
25	8471410110	no.	eletr.m	not segmented	1	4	**1.530**	2.651	4.051	-
28	8471601010	no.	eletr.m	not segmented	0	5	**0.611**	2.000	2.394	-

If the conditions for quality estimation is met, the regression with the largest number of exporting countries is selected. Otherwise, the regression with the lowest QL is selected. Figures are in red when the conditions for quality estimation are not met, and CES is in red and bold when its p-value is larger than 0.05.

Note that in 10 out of 16 of the non-segmented products that meet the conditions for quality estimation, QL is smaller than UVR, while only in 2 out of 25 of the segments that meet the same conditions QL is smaller than UVR. Therefore, in the former group, CES tends to reduce QL, while in the latter, UVR tends to lower QL. This again indicates that segmentation is not the best way to address the aggregation issue. Table (11) also reveals that QL varies significantly within each industry. In this circumstance, when QL is aggregated at the industry level, some products of a high QL industry may have low QL and vice-versa, particularly if the high (low) QL of the industry is due to a few products with high (low) QL and large weights. Again, aggregate QL by industry may produce misleading results.[44]

The industry of electronic machines and parts has thirteen HS(10) product categories, of which eight meet the conditions for quality estimation. The remaining five products do not meet the conditions for quality estimation and, in two of them, because the CES p-value is larger than 0.05 and d=|DW-2| is extremely high, there must be something wrong in their demand regressions. The industry of mechanical machinery and parts has thirty-four HS(10) product categories, of which twenty-six meet the conditions for quality estimation. The remaining eight products do not meet the conditions for quality estimation. In two of them, although QL and CES meet the conditions for quality estimation, DW shows clear misspecification in demand regressions. Thus, QL are wrongly estimated for some products of these two industries, even when QL meets the condition for quality estimation. This provides further evidence that aggregate QL is badly estimated at the industry level, in addition to its large dispersion within each industry.

Furthermore, segmenting an HS(10) product category that does not meet the conditions for quality estimation implies that the varieties of one segment are weak substitutes or no substitutes of the varieties of the other segment. Therefore, estimating the quality of countries' varieties that belong to different segments and comparing them does not make much sense. Table (11) provides some good examples of these products and segments, but it is more interesting to re-examine US imports of women's trousers in 1999, which was previously examined by Khandelwal (2010).

Table (12) reports the results of applying our quality model on these imports. Nothing less than one hundred and seven countries exported women's trousers to the US in 1999. Some of the reported demand regressions for non-segmented products meet the conditions CES>1 and d<0.10, but all regressions are far from meeting the condition QL<5.0. Hence, this product category is most likely to be TAFQE.

Table (12): Demand regression for imports of women's trousers in 1999

HS6204624020; unit: dozens						
Segment	AR	Ctries.	CES	d	UVR	QL
non-segmented	3	71	1.068	0.138	2.735	9.575
non-segmented	4	66	1.052	0.010	2.735	9.517
non-segmented	5	64	1.270	0.009	2.735	7.697
non-segmented	6	62	1.395	0.098	2.735	8.259
non-segmented	8	57	1.109	0.145	2.735	9.391
low-median	6	32	3.527	0.016	0.844	2.477
low-median	5	32	3.067	0.135	0.844	2.909
low-mean	4	28	2.844	0.051	0.757	3.087
low-mean	5	26	3.708	0.019	0.757	3.141
low-median	4	34	2.574	0.080	0.844	3.422
low-mean	8	24	2.830	0.123	0.757	4.028
low-median	1	42	1.837	0.136	0.876	5.830
high-median	0	53	1.125	0.142	2.303	9.805
high-mean	1	50	0.850	0.107	2.344	12.008

Source: Data from USITC dataweb.

[44] I will return to this point in Section 5 with further evidence together with a robustness check.

Nevertheless, when segmented, some regressions of lower-price segments meet the conditions CES>1, d<0.10, and QL<5.0, as well as d<0.15 and QL<4.0. On the other hand, none of the regressions of higher-price segments meets these conditions for quality estimation, because QL clearly indicates that the product segment is TAFQE.[45]

The United States imported Malaysian and Portuguese women's trousers in 1999 at unit values of $146 and $371, respectively. However, because annual wage in the apparel sector is much higher in Portugal than in Malaysia, Khandelwal (2010) argues that Portugal's much higher unit values and costs may reflect these different factor prices. Furthermore, idiosyncratic consumers' preferences for the horizontal attributes of Portuguese women's trousers would explain why they are purchased, even though they are more expensive and possess lower quality. However, without segmentation, all regressions lead to the conclusion that the product is most likely to be TAFQE. When the product is segmented, Malaysia's and Portugal's unit values place both countries in the high-price segment, and whatever the criterion for segmenting (mean or median), the high-price segment is TAFQE. Therefore, according to our results, Portuguese and Malaysian women's trousers are likely to belong to different and more disaggregated products than the observable HS(10) product category, implying that their quality levels are not comparable.

4) Competition between high- and low-wage countries

Low-wage countries account for 58 per cent of the US import value of the 1285 products of chapter 84 in 2014. If HS(10) product categories are ranked in ascending order of the number of exporting countries, the share of low-wage-exporting countries in the group of products above the median is 62 per cent. The share rises to 66 per cent in the group above the third quartile and to 69 per cent above the ninth decile. Low-wage-exporting countries account for 81 per cent of the total US import value of the 47 HS(10) product categories, most of them selected among the products with the largest numbers of exporting countries.[46] Hence, the share of low-wage countries tends to rise with the number of varieties within HS(10) products.[47]

Out of the selected forty-seven HS(10) product categories with large numbers of exporting countries, before data trimming, thirty-four turned out to be short-ladder products, as reported in Table (11), after various exporting countries were excluded through the endogenous data trimming procedure and product segmentation.[48] Table (13) examines these thirty-four HS(10) product categories for which quality is estimated. These products are divided in sixteen non-segmented product categories, eleven product categories with one segment, and seven with two segments, totalling forty-one products and segments.

Low-wage countries account for most of the exported quantities in twenty-three of the forty-one products and segments (56 per cent) and for most of the export revenue in twenty-one products and segments (51 per cent). Only in three segments these countries are not exporters.[49] As expected and in line with the literature, high-wage countries are at the top of the quality ladders in most of the forty-one products and segments, but low-wage countries occupy this position in fifteen products and segments (37 per cent). The leading country in quantity and value is a low-wage country in twenty-two (54 per cent) and twenty-one products and segments (51 per cent), respectively.

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[45] The main result would not change for conditions d<0.15 and QL<4.0 or QL*<3.95, as well as d<0.10 and QL*<5.0.

[46] Thirty-eight out of the forty-seven HS(10) products have the largest number of exporting countries of the 1285 products of chapter 84. Low-wage countries account for 82 per cent of the US import value of these thirty-eight products and 70 per cent of the remaining nine products.

[47] Regressing (OLS) the shares in quantity of the group of low-wage countries on the natural log of the number of exporting countries within each HS(10) product of chapter 84 (1285 observations) reveals a positive coefficient equal to 0.126 with p-value equal to 2.59E-29. But the independent variable explains little of the dependent variable as the adjusted coefficient of determination is only 0.09.

[48] A total of nine hundred and fifty-three exporting countries were excluded from the thirty-four products and six hundred ninety-four exporting countries remained.

[49] These three segments (HS8409913000; HS8409919910; and HS8471410150) are high-price segments and they account for small shares of US import quantities of their product categories: 7.7%, 2.6%, and 1.6%, respectively.

Table (13) also confirms that the unit value mean of high-wage countries is often higher than the one of low-wage countries within each product and segment for which quality is estimated. Nonetheless, there are eight exceptions, the vast majority of which are segments of products. Four of these exceptions are high-median segments in which low-wage countries account for relatively small shares in quantity and even in value in these exports, despite their higher unit values. Thus, their higher unit values are largely due to small quantities. Two are HS(10) product categories that have quite general descriptions (NESOI product categories), and the other two are low-mean segments with a small number of exporting countries in which China leads in quality, quantity, and value, thus has a higher-than-average unit value.[50] The descriptions of the latter four products and segments, engines, steel forging for taps/valves, pumps for liquids, and hand operated taps/valves do not specify the average size or capacity (e.g., horsepower) of each variety of these products or segments. If low-wage countries are more specialized in larger sizes or capacities for these products, this may explain their higher unit values rather than the quality of these countries' varieties.

Note that although low-wage countries reveal to be so competitive vis-à-vis high-wage countries in most of the products and segments, as shown in Table (13), the number of high-wage countries is larger than the number of low-wage countries in thirty-eight out of the forty-one products and segments (92.7 per cent). Without data on price and quantity of domestic products at the ten-digit level, it is not possible to estimate the elasticity of substitution between the domestic and imported varieties within products. However, given that the US is also a high-wage country, one would not be surprised to observe a large import penetration in this country in several of these short-ladder products, if ten-digit data were available.[51]

When I test the OLS correlation between quality estimates and the log of unit values for the varieties of each product and segment for which quality was estimated in Table (13), Table (A.3) shows clearly that it is not possible to reject the hypothesis that the coefficient of (ln uv) is zero (p-value>0.05) in all but one CES product for which the coefficient has an unexpected positive sign. This is in line with Khandelwal's (2010) results for short-ladder products.[52] However, contrary to Khandelwal (2010), based on equation (4)[53] and given that long-ladder products tend to have lower elasticities of substitution, one would expect quantities, instead of price, to have a heavier weight in determining quality.

Table (14) reports the breakdown of US import value of the forty-seven HS(10) product categories into the import value from the exporting countries of products and segments that meet the conditions for quality estimation (row of products and segments) and the import value from exporting countries dropped from the regressions (row of excluded countries). Exporting countries are excluded due to AR variables and when they export products and segments that do not meet the conditions for quality estimation. The first three columns of the table report US import values in billions of US dollars from high- and low-wage countries. The three columns on the right-hand side of the table reveal that low-wage countries account for most of the US import value for both products and segments that meet the conditions and those that do not.

The excluded countries account for just 0.6 per cent of imports in US dollars of the sixteen non-segmented products, 8.1 per cent of the seven products with two segments, but 84.5 per cent of products

[50] HS8409991080, HS8481909081, HS8413810040, and HS8481905000. See Table (A.2) for product descriptions.

[51] Bernard et al. (2006) reported that industries with large import penetration from low-wage countries suffer significant unemployment effects. Khandelwal (2010) argues that short-ladder industries with high exposure to low-wage countries suffer greater employment declines than long-ladder industries.

[52] Khandelwal (2010) finds a positive correlation between quality and unit values for long-ladder products and gives an example: HS(8525203080), "transmission receivers exceeding 400MHz", which has 37 exporting countries in 2001, 35 after data trimming. Applying the quality model presented here and using the same data of 2001, the regression with 37 exporting countries has a too large d=0.653. Quality ladder is in fact long (QL=6.3) for the 26 countries with AR(1). This means that the quality of the variety at the top is over four hundred and three times the quality of the variety at the bottom. However, quality ladders are short (CES>1, d<0.10 and QL<4.0) for the 15 exporting countries with AR(5) and AR(6). In all these cases, there is no correlation between QL and ln (uv) since it is not possible to reject the hypothesis that the coefficient of ln (uv) is zero (p-value>0.10 for this product). Therefore, what looks like a long-ladder product, when a few exporting countries are excluded, turns out to be a short-ladder product through an endogenous trimming procedure.

[53] See footnote 26.

with one segment. The proportion of the number of excluded products is on average 47 per cent among the non-segmented products, 46 per cent among those with two segments, and 75 per cent among those with just one segment. If the one-segment products and the thirteen products that did not meet the conditions for quality estimation could be more disaggregated, more products would likely meet these conditions. However, the countries excluded from non-segmented products and two-segment products are more likely to belong to products containing one variety only. Competition would still take place, as in the theoretical models of Grossman and Helpman (1991), but only the top-quality variety would sell in the market and the observed quality ladder would be zero. In any case, excluded products and segments are TAFQE rather than long-ladder products.

Table (13): Share of low-wage countries, top exporting countries and unit values

No.	HS10	Industry	Segment	AR	Ctries.	LDP Share	Low-wage countries			TOP qep_{ij}	TOP QTY	TOP LDP	UV	
							Ctries	Qty	LDP				High-wage	Low-wage
1	8409911040	mech.m	not sgmntd.	1	18	99.8%	8	31.2%	26.1%	Germany	Canada	Canada	$4.00	$3.12
2	8409911060	mech.m	not sgmntd.	4	11	85.9%	1	19.8%	9.5%	New Zealand	New Zealand	New Zealand	$15.78	$6.72
3	8409911080	mech.m	not sgmntd.	8	12	96.6%	5	45.4%	23.3%	Korea	China	Korea	$11.11	$4.06
5	8409915010	mech.m	not sgmntd.	1	16	99.9%	6	24.4%	19.9%	Japan	Canada	Japan	$7.54	$5.82
11	8409919990	mech.m	not sgmntd.	4	29	99.8%	10	74.2%	61.1%	Canada	China	China	$18.56	$10.12
12	8409991040	mech.m	not sgmntd.	4	13	99.4%	6	94.2%	88.8%	Brazil	Brazil	Brazil	$4.35	$2.02
13	8409991060	mech.m	not sgmntd.	4	8	59.6%	1	50.3%	19.3%	Austria	China	China	$14.10	$3.33
14	8409991080	mech.m	not sgmntd.	1	18	98.0%	5	33.0%	38.5%	Germany	Germany	Germany	$6.60	**$8.38**
18	8409999290	mech.m	not sgmntd.	8	17	95.0%	2	16.6%	7.1%	Germany	Germany	Germany	$28.80	$11.08
19	8409999910	mech.m	not sgmntd.	5	12	97.9%	6	16.4%	31.4%	UK	UK	UK	$74.00	$52.82
29	8471601050	eletr.m	not sgmntd.	2	28	99.5%	8	77.5%	65.1%	Israel	China	China	$331.62	$178.89
31	8471607000	eletr.m	not sgmntd.	1	32	99.4%	7	88.1%	63.8%	China	China	China	$188.02	$44.85
33	8471609030	eletr.m	not sgmntd.	1	18	98.8%	5	75.4%	51.2%	China	China	China	$43.46	$14.84
34	8471609050	eletr.m	not sgmntd.	1	42	99.9%	12	97.0%	86.4%	China	China	China	$61.49	$12.20
40	8481901000	mech.m	not sgmntd.	2	26	99.7%	8	73.6%	66.6%	Taiwan	China	China	$22.69	$16.23
46	8481909081	mech.m	not sgmntd.	1	25	99.8%	10	37.8%	52.4%	China	Italy	China	$4.03	**$7.29**
4	8409913000	mech.m	high-mean	1	11	14.5%	0	0.0%	0.0%	Canada	Japan	Japan	$161.57	-
7	8409915085	mech.m	high-median	3	14	2.0%	5	65.8%	54.3%	Brazil	Brazil	Brazil	$70.88	$43.69
9	8409919290	mech.m	low-mean	1	9	39.6%	4	62.7%	47.9%	Canada	Mexico	Canada	$8.99	$4.92
10	**8409919910**	mech.m	low-median	1	9	84.3%	6	71.2%	78.7%	Mexico	Mexico	Mexico	$6.06	$9.07
		mech.m	high-median	9	2	13.5%	0	0.0%	0.0%	Japan	Japan	Japan	$48.23	-
16	8409999190	mech.m	low-mean	6	6	45.5%	3	62.2%	48.1%	Germany	Germany	Germany	$6.96	$3.92
20	**8409999990**	mech.m	low-median	6	23	81.7%	10	69.8%	51.2%	Canada	Mexico	Mexico	$8.76	$3.97
		mech.m	high-median	3	22	17.9%	5	8.2%	17.6%	Tunisia	Italia	Italia	$25.61	**$61.43**
22	8413810040	mech.m	low-mean	2	9	44.0%	2	69.7%	71.9%	China	China	China	$8.17	**$9.10**
23	8414800500	mech.m	low-median	7	16	73.9%	8	93.0%	91.7%	Mexico	Mexico	Mexico	$386.18	$323.00
24	8471300100	eletr.m	high-median	0	43	1.4%	19	0.5%	0.5%	Taiwan	Taiwan	Taiwan	$878.04	$800.88
26	8471410150	eletr.m	high-median	4	14	5.8%	0	0.0%	0.0%	Israel	Japan	Japan	$1,647.62	-
30	8471602000	eletr.m	high-median	0	20	2.9%	4	70.7%	60.5%	Mexico	Mexico	Mexico	$182.51	$115.77
36	8473301140	eletr.m	high-mean	7	12	80.9%	4	68.3%	67.3%	Korea	Korea	Korea	$80.56	$76.92
41	**8481903000**	mech.m	low-median	5	16	92.4%	8	86.0%	73.2%	China	China	China	16.48	7.34
		mech.m	high-median	1	17	7.3%	2	1.9%	2.8%	UK	UK	UK	$39.37	**$58.80**
42	**8481905000**	mech.m	low-mean	0	10	78.6%	7	84.6%	90.9%	China	China	China	$8.07	**$14.67**
		mech.m	high-median	1	17	3.8%	2	24.1%	25.7%	Hungary	Hungary	Hungary	$73.87	**$80.35**
43	**8481909020**	mech.m	low-median	2	18	92.2%	5	28.4%	19.4%	Korea	Korea	Korea	$13.00	$7.88
		mech.m	high-median	1	14	7.8%	4	2.3%	11.1%	Singapore	France	France	$54.20	**$289.96**
44	**8481909040**	mech.m	low-mean	3	9	35.7%	4	53.6%	43.7%	China	China	China	$17.98	$12.06
		mech.m	high-median	1	20	31.6%	5	80.9%	75.0%	Singapore	Mexico	Mexico	$76.58	$54.05
45	8481909060	mech.m	low-mean	5	6	55.9%	5	95.8%	94.8%	China	China	China	$7.73	$6.20
47	**8481909085**	mech.m	low-mean	3	8	38.9%	3	72.3%	63.4%	Taiwan	China	China	$13.79	$9.16
		mech.m	high-median	1	24	7.0%	11	45.0%	53.4%	UK	UK	UK	$89.01	$124.38

Notes: (i) Recall from equation (8) that qep_{ji} is the quality level of a country *j* in product *i*; (ii) HS(10) product categories are in bold when they have two segments that meet the conditions for quality estimation; (iii) The LDP share calculates the ratio of US import value of the countries included in the regression of the product or segment in the table to the total US import of value of the product category including all countries; (iv) The shares of quantities and values for low-wage countries are the ratio of the US import of these countries to the total import of the product or segments; and (v) Unit values of low-wage countries are in bold when they are larger than the ones of high-wage countries.

Table (14): Breakdown of the US import value (LDP) of the 47 HS(10) products: QL<5.0 and QL≥5.0

Exporting countries	Total	High-wage	Low-Wage	Total	High-wage	Low-Wage
47 HS(10) products	US$$10^9$	US$$10^9$	US$$10^9$	share	share	share
products and segments*	$15.01	$5.78	$9.23	100%	39%	61%
excluded countries**	$75.45	$11.01	$64.44	100%	15%	85%
total	$90.46	$16.79	$73.67	100%	19%	81%
* CES>1, CES p-value<0.05, d<0.10, and QL<5.0; **otherwise						

Source: Table (B.7).

5) Sensitivity analysis

In this section, I analyse the sensitivity of the main results of this paper to changes in some assumptions made in previous sections. I start by assuming QL* instead of QL. This slightly changes quality-ladder estimates reported in Tables (9) and (10) but it does not change the products that meet the conditions d<0.10 and QL*<5.0 in Table (9) nor does it change the non-segmented products that meet these conditions in Table (10) and (11). In contrast, three segmented products with QL<5.0 in Table (11) do not meet the condition QL*<5.0. But their regressions can easily be replaced applying a higher AR order so that new regressions with smaller numbers of exporting countries meet the above conditions, as reported in Table (A.4).[54] Therefore, the number of short-ladder segments in Table (11) are robust to quality being measured as QL*.

If the condition d=|DW-2|<0.10 is somewhat relaxed and allowed to be smaller than 0.15, then to characterise all the selected HS(6) as aggregate products requires QL<4.0 and QL*<3.95, as seen in Table (9). Hence, the new conditions for quality estimation are: CES>1; d<0.15; QL<4.0 and QL*<3.95. Table (A.5) reports the regressions that meet these conditions. Note that there is no product or segment with quality ladder, QL or QL*, within the range between 3.95 and 4.0. The main effect of these new conditions is a reduction in the number of product categories that meet them, down to twenty-six from the thirty-four HS(10) products and segments that meet the previous conditions with d<0.10. This reveals that the binding effect of the reduction in QL or QL* more than offsets the expansive effect of the rise in d=|DW-2| on the number of product categories that meet the conditions for quality estimation. However, the number of products that meet the conditions for quality estimation with d<0.15 is the same with QL or QL*.

As to the dispersion of the quality ladders of products within industries, Table (A.6) reports the mean, minimum, and maximum of the quality ladders for the 47 HS(10) products and segments that belong to the electronic machines industry, the mechanical machinery industry, HS(4) headings, and HS(6) subheadings. The dispersion is large since the arithmetic means are often within or close to the 3.95 and 5.0 thresholds, while the minimum quality ladders (QL or QL*) are well below the lower threshold, and the maximum quality ladders are often well above the higher threshold. In a few cases, the maximum quality ladder is below but close to the higher threshold and in just one case it is below the lower threshold.

Note that quality ladders between 3.95 and 5.0 in natural log means that, measured without logs, the quality of the variety at the top varies from 52 to 148 times the quality of the variety at the bottom of the ladder. Thus, the adjective short in the expression short quality ladder is applied in this paper just to be in consonance with the literature, since quality ladders within this range are not short by any standard. Quality may be better estimated with QL<3.95 than with QL<5.0, but misspecifications are more likely with 0.10<d<0.15 than with d<0.10. Given that some descriptions of HS(10) products are quite general, it is likely that some non-observed product characteristics are still producing noise in relative quality levels for some products with 3.95<QL<5.0. Hence, a quality ladder is highly likely to be TAFQE if it is larger than

[54] The low-mean AR(1) regression of HS8409919290 is replaced by the AR(4) regression. The low-median AR(6) regression of HS 8409999990 is replaced by the low-mean AR(1) regression. The low-mean AR(2) regression of HS8413810040 is replaced by the low-mean AR(5) regression. The Spearman ranking correlations (rho) between the quality estimates of the forty-one products and segments computed with and without the error term are generally quite high: ρ≥0.99 (26.8%); 0.99< ρ≥0.95 (48.8%); 0.95< ρ≥0.90 (7.3%); 0.90< ρ≥0.86 (14.6%); and ρ=0.57 for one product (2.4%).

5.0, is highly likely not to be TAFQE if it is smaller than 3.95 and is somewhat ambiguous if it is between these two thresholds. Though this is not accurate, these thresholds appear to be adequate, considering the coarseness of HS(10) descriptions and the use of quantity and unit value data for the whole of the US.

Table (15) reports the distribution of US imports in value among the selected 47 HS(10) product categories, divided between products and segments that meet the conditions d<0.15, QL<4.0, and QL*<3.95, and those that do not (excluded countries), and between high- and low-wage countries. As compared to Table (14), there is a general fall in the value of products and segments that meet the conditions for quality estimation, including both low-wage and high-wage countries. However, it is important to note that low-wage countries still account for most of imports in both products and segments that meet the conditions for quality estimation and those that do not, shown in the last three columns. There is practically no significant change in these columns as compared to Table (14). This means that US import values of products with large numbers of exporting countries, as the 47 selected HS(10) products, are largely from low-wage-exporting countries, independently of meeting or not the conditions for quality estimation. This result is robust to d<0.10 or d<0.15, as well as to quality ladders being measured as QL or QL*.

Table (15): Breakdown of the US import value (LDP) of the 47 HS(10) products: QL<4.0 and QL*<3.95

47 HS(10) products	Total	High-wage	Low-Wage	Total	High-wage	Low-Wage
	US$$10^9$	US$$10^9$	US$$10^9$	share	share	share
products and segments*	$6.14	$2.06	$4.07	100%	34%	66%
excluded countries**	$84.33	$14.73	$69.59	100%	17%	83%
total	$90.46	$16.79	$73.67	100%	19%	81%
* CES>1, CES p-value<0.05, d<0.15, QL<4.0 and QL*<3.95; **otherwise						

Source: Table (B.8).

The result that the import value of the row of products and segments is much lower than those of the row of excluded countries does not have any significant implication for our main results. However, one product alone (HS8471300100) could increase the import value of the row of products above the row of excluded countries. This product accounts for 17 per cent of the import value of all 1285 HS(10) products of chapter 84, and 45 per cent of the total import value of the 47 HS(10) products included in Tables (14) and (15). The high-mean segment with AR(6) and 27 exporting countries meets the conditions for quality estimation of Tables (14) and (15) and has an import value of US$40.79 billion. The 43-countries-high-medium segment was selected in Table (14), because it has the largest number of exporting countries but has an import value of only US$614.75 million. If the high-mean segment were selected, China would be included,[55] and the total US import value of the products and segments row in Table (14) would rise to US$55.18 billion and account for 61 per cent of the total US import value of the 47 HS(10) product categories.

The HS8471300100 category is described as laptops, weighing not more than 10 kilograms, and consisting of at least a CPU, keyboard, and a display. The first laptop computer in the market in 1981 weighed 11.3 kgs. There are today various mobile computer devices that differ in size and weight. Laptops weigh 2.3 kgs and are about 1.5 to 2.0 inches thick, while notebooks weigh 1.4 kilograms or less, are 0.5 to 1 inch thick, and with screen size of 15 inches or less. There are also netbooks (inexpensive notebook with basic features), ultrabooks (smaller, thinner notebooks with advanced features and a higher price) and tablets (on-screen keyboarding or an external keyboard).[56] Hence, this HS(10) product category could be disaggregated into four or five more disaggregated products, with different degrees of portability, that could

[55] This product seems to be an exception. No other low- or high-price segment of a product was found to have a larger export value with a smaller number of exporting countries. China accounts for 92 per cent of the total import value of the product.
[56] Information drawn from https://www.thebalancesmb.com/before-you-buy-a-laptop-or-notebook-computer-2946956 assessed on 8 July 2020.

have larger CES, smaller UVRs and QLs than the existing aggregate HS(10) product category. Therefore, this still is an aggregate product whose quality estimates could be improved with lower QL, if more disaggregated.

If the condition CES<1 was allowed, two additional CES product categories would meet the conditions CES p-value<0.05, d<0.10, QL<5.0, and QL*<5.0. They are numbered (10) and (15) in Table (10) and both meet the above conditions. However, Table (A.4) shows that the low- and the high-median segments of the former product category meet the conditions with CES>1. The latter product category meets the conditions CES>1, CES p-value<0.05, d<0.15, QL<4.0, and QL<3.95, and is shown in Table (A.5). Therefore, the number of products and segments that meets the conditions set in Tables (A.4) and (A.5) would not change if CES could be smaller than one.

Now that short quality ladders of some products and segments are estimated, their relationship with CES can once again be tested. Table (16) reports that quality ladder remains negatively related to CES and is now only positively related to the natural log of the number of low-wage-exporting countries LN(LWCtries). The negative relation with CES is robust to both measures of the quality ladder, QL and QL*. Furthermore, quality ladder is also robust to products and segments that meet: (i) CES>1, CES p-value <0.05, d<0.10, QL<5.0, shown in column 1 of Table (16), Tables (11) and (13); (ii) all the previous conditions plus QL*<5.0, shown in columns 2 and 3 of Table (16) and Table (A.4); and (iii) CES>1, CES p-value <0.05, d<0.15, QL<4.0 and QL*<3.95, shown in columns 4 and 5 of Table (16), Tables (15) and (B.8). Several variables were tested as alternatives to LN(LWCtries): LN(Ctries), LN(HWCtries), UVR, LN(quantity share of LWCtries), LN(value share of HWCtries), as well as combinations of these variables. None of them were significant at the five percent level of significance.

Table (16): Linear relations of quality ladder

Regressands	QL	QL	QL*	QL	QL*
Regressors	1	2	3	4	5
Constant	4.394	5.110	4.690	3.710	3.478
p-value	9.41E-10	2.07E-09	3.95E-10	1.16E-08	2.60E-08
CES	-1.394	-1.790	-1.419	-0.982	-0.811
p-value	6.44E-04	8.44E-04	1.77E-03	1.68E-03	6.53E-03
LN(LW ctries)	1.034	0.924	0.884	0.734	0.745
p-value	7.72E-06	9.76E-04	2.88E-04	6.59E-04	4.66E-04
Adj.R-squared	0.45	0.30	0.32	0.44	0.41
Observations	38	38	38	27	27
F significance	1.2176E-05	7.20E-04	4.88E-04	3.92E-04	6.23E-04

Products or segments without low-wage-exporting countries were excluded.

6) Conclusions

Measuring quality is a major challenge in the international trade literature, not just because quality levels of varieties are not observed in trade data but also because, for many products, important product characteristics observed by consumers are not described and not observed by econometricians. As a result, quantities and unit values data for some ten-digit products may be too aggregated for a reasonable quality estimation. When quantities and unit values are wrongly measured, estimated coefficients are biased and inefficient, regardless of the econometric method. Long-ladder HS(10) product categories with low elasticities of substitution are most likely to be too aggregated for quality estimation. If a product could be disaggregated into more detailed products, more short-ladder products would be found among them, as they were when segmented. More products would also be found with just one exporting country, thus quality ladder would be equal to zero for these products. The scope for vertical differentiation is not so heterogenous as short-ladder and long-ladder products may suggest, it is the level of detail of the descriptions of HS(10) products that is heterogenous.

Whether two varieties belong to the same product or to different products depends crucially on the elasticity of substitution. The very concept of a product market depends upon this elasticity. I have shown that a higher elasticity of substitution is the main driver of a shorter quality ladder (QL) for differentiated products, when controlling for the number of exporting countries or the unit value range (UVR). Varieties that are weak substitutes or no substitutes at all do not belong to the same differentiated product. Therefore, there must be a limit to the length of quality ladders. It is not conceivable that the quality level of the top variety is hundreds of times the quality level of the variety at the bottom in the same product market.

Quality ladders are shorter the higher the elasticity of substitution and the lower the number of exporting countries within products, especially the number of low-wage-exporting countries. Among the forty-one products and segments for which quality was estimated, high-wage countries have unit-value means higher than low-wage countries in 80 per cent of them and are at the top of the quality ladder in 63 per cent of them. Low-wage countries lead in quantity and value in 54 and 53 per cent of these products and segments, respectively. This provides some evidence of the relevance of specialization within products classified in the group of mechanical and electronic machines and parts.

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APPENDIX (A)

Table (A.1): HS(6) product descriptions

HS6	Unit	No. of Ctries	Product descriptions
840991	no.	29	ALUMINUM CYLINDER HEADS AND CONNECTING RODS FOR SPARK-IGNITION INTERNAL COMBUSTION PISTON ENGINE (INCLUDING ROTARY)
840991	kg.	73	PARTS FOR SPARK-IGNITION INTERNAL COMBUSTION PISTON ENGINES (INCLUDING ROTARY)
840999	kg.	105	PARTS, EXCEPT CONNECTING RODS, FOR COMPRESSION-IGNITION INTERNAL COMBUSTION PISTON ENGINES
840999	no.	41	CONNECTING RODS FOR COMPRESSION-IGNITION INTERNAL COMBUSTION PISTON ENGINES
841330	no.	101	FUEL PUMPS FOR ENGINES
841350	no.	75	OIL WELL AND OIL FIELD PUMPS, RECIPROCATING POSITIVE DISPLACEMENT
841381	no.	80	PUMPS FOR LIQUIDS
841480	no.	89	COMPRESSORS
847141	no.	76	DIGITAL ADP MACH COMPRISING IN SAME HOUSING AT LEAST A CPU AND AN INPUT AND OUPUT UNIT
847150	no.	84	PROCESS UNITS W/ CATHODE RAY TUBE AND DIGITAL PROCESSING UNITS EXCLUDE SUBHEADING 8471.41 OR 8471.49, MAY CONTAIN IN SAME HOUSING 1 OR 2 OF FOLLOWING: STORAGE, INPUT OR OUTPUT UNITS
847160	no.	81	ADP INPUT/OUTPUT UNITS
847170	no.	82	STORAGE UNITS SUCH AS DISK DRIVES
847180	no.	83	UNITS FOR AUTOMATIC DATA PROCESSING (ADP) MACHINES
847989	no.	80	MACHINES AND MECHANICAL APPLIANCES HAVING INDIVIDUAL FUNCTIONS
848180	no.	108	FAUCETS, TAPS AND VALVES
848190	kg.	91	PARTS OF TAPS, COCKS, VALVES AND SIMILAR APPLIANCES
848310	no.	63	CAMSHAFTS AND CRANKSHAFTS

Source: USITC dataweb.

Table (A.2): HTS(10) product descriptions

No.	HS10	UNIT	No. of Ctries	Industry	Product descriptions
1	8409911040	kg.	26	MCH	CAST-IRON PARTS, NOT ADVANCED BEYOND CLEANING, FOR SPARK-IGNITION (INC ROTARY) INTERNAL COMB PST ENG, FOR ROAD TRACTORS, BUSES, AUTOMOBILES OR TRUCKS
2	8409911060	kg.	36	MCH	CAST-IRON PARTS, NOT ADVANCED BEYOND CLEANING, FOR SPARK-IGNITION (INC ROTARY) INTERNAL COMBUSTION PISTON ENGINES FOR MARINE PROPULSION
3	8409911080	kg.	33	MCH	CAST-IRON PARTS, NOT ADVANCED BEYOND CLEANING, FOR SPARK-IGNITION (INC ROTARY) INTERNAL COMBUSTION PISTON ENGINES,NESOI
4	8409913000	no.	19	MCH	ALUMINUM CYLINDER HEADS FOR SPARK-IGNITION INTERNAL COMBUSTION PISTON ENGINES FOR VEHICLES OF SUBHEADING 8701.20, OR HEADING 8702, 8703, OR 8704
5	8409915010	no.	23	MCH	CONNECTING RODS FOR SPARK-IGNITION INTERNAL COMBUSTION PISTON ENGINES (INCLUDING ROTARY) FOR ROAD TRACTORS, MOTOR BUSES, AUTOMOBILES, OR TRUCKS
6	8409915081	kg.	19	MCH	STEEL FORGINGS FOR SPARK-IGNITION INTERNAL COMBUSTION PISTON ENGINES (INC ROTARY) FOR ROAD TRACTORS, MTR BUSES, AUTOS OR TRUCK
7	8409915085	kg.	53	MCH	PARTS, EXC CONN RODS & ALUM CYL HEADS, FOR SPARK-IGNITION INTERNAL COMBUSTION PISTON ENGINES (INC ROTARY) FOR ROAD TRACTORS, MTR BUSES, AUTOS OR TRUCK
8	8409919210	no.	9	MCH	CONNECTING RODS FOR SPARK-IGNITION INTERNAL COMBUSTION PISTON ENGINES (INCLUDING ROTARY) FOR MARINE PROPULSION
9	8409919290	kg.	38	MCH	PARTS, EXC CONN RODS, FOR SPARK-IGNITION INTERNAL COMBUSTION PISTON ENGINES (INC ROTARY) FOR MARINE PROPULSION
10	8409919910	no.	19	MCH	CONNECTING RODS FOR SPARK-IGNITION INTERNAL COMBUSTION PISTON ENGINES (INCLUDING ROTARY), NESOI
11	8409919990	kg.	59	MCH	PARTS, EXC CONNECTING RODS, FOR SPARK-IGNITION INTERNAL COMBUSTION PISTON ENGINES (INCLUDING ROTARY), NESOI
12	8409991040	kg.	30	MCH	CAST-IRON PARTS, NOT ADVANCED BEYOND CLEANING, FOR COMPRESSION-IGNITION INTERNAL COMBUSTION PISTON ENGINES FOR ROAD TRACTORS,BUSES,AUTOMOBILES,TRUCKS
13	8409991060	kg.	31	MCH	CAST-IRON PARTS, NOT ADVANCED BEYOND CLEANING, FOR COMPRESSION-IGNITION INTERNAL COMBUSTION PISTON ENGINES FOR MARINE PROPULSION
14	8409991080	kg.	28	MCH	CAST-IRON PARTS, NOT ADVANCED BEYOND CLEANING, FOR COMPRESSION-IGNITION INTERNAL COMBUSTION PISTON ENGINES, NESOI
15	8409999110	no.	23	MCH	CONNECTING RODS FOR COMPRESSION-IGNITION INTERNAL COMBUSTION PISTON ENGINES FOR ROAD TRACTORS, MOTOR BUSES, AUTOMOBILES, TRUCKS
16	8409999190	kg.	53	MCH	PARTS, EXC CONN RODS, FOR COMPRESSION-IGNITION INTERNAL COMBUSTION PISTON ENGINES FOR ROAD TRACTORS, MOTOR BUSES, AUTOMOBILES, OR TRUCKS
17	8409999210	no.	15	MCH	CONNECTING RODS FOR COMPRESSION-IGNITION INTERNAL COMBUSTION PISTON ENGINES FOR MARINE PROPULSION
18	8409999290	kg.	53	MCH	PARTS,EXCEPT CONNECTING RODS, FOR COMPRESSION-IGNITION INTERNAL COMBUSTION PISTON ENGINES FOR MARINE PROPULSION
19	8409999910	no.	37	MCH	CONNECTING RODS FOR COMPRESSION-IGNITION INTERNAL COMBUSTION PISTON ENGINES, NESOI
20	8409999990	kg.	100	MCH	PARTS, EXCEPT CONNECTING RODS, FOR COMPRESSION-IGNITION INTERNAL COMBUSTION PISTON ENGINES, NESOI
21	8413301000	no.	91	MCH	FUEL-INJECTION PUMPS FOR COMPRESSION-IGNITION ENGINES
22	8413810040	no.	76	MCH	PUMPS FOR LIQUIDS, NESOI
23	8414800500	no.	78	MCH	AIR COMPRESSORS, TURBOCHARGERS AND SUPERCHARGERS
24	8471300100	no.	87	ELT	PORTABLE DIGTL ADP MACHINES,WEIGHT NOT MORE THAN 10 KG,CONSISTING OF AT LEAST A CPU,KEYBOARD & A DISPLAY
25	8471410110	no.	9	ELT	DIGITAL ADP MACH COMPRISING IN SAME HOUSING AT LEAST A CPU AND AN INPUT AND OUPUT UNIT,WHET. OR NOT COMB.,W/CRT
26	8471410150	no.	76	ELT	DIGITAL ADP MACH COMPR. IN SAME HOUSING AT LEAST A CPU AND AN INPUT AND OUTPUT UNIT WHET. OR NOT COMB,WITHOUT CRT,NESOI
27	8471500150	no.	84	ELT	DIGITAL PROCESSING UNITS EXCLUDE SUBHEADING HS8471.41 OR HS8471.49, HOUSING 1 OR 2 OF FOLLOWING: STORAGE, INPUT OR OUTPUT UNITS, NESOI
28	8471601010	no.	6	ELT	COMBINED INPUT/OUTPUT UNITS, WITH CATHODE RAY TUBE (CRT), NESOI
29	8471601050	no.	50	ELT	COMBINED INPUT/OUTPUT UNITS, WITHOUT A CATHODE RAY TUBE (CRT), NESOI
30	8471602000	no.	40	ELT	KEYBOARD UNITS
31	8471607000	no.	45	ELT	INPUT/OUTPUT UNITS, NESOI, SUITABLE FOR PHYSICAL INCORPORATION INTO AUTOMATIC DATA PROCESSING MACHINES OR UNITS THEREOF
32	8471608000	no.	56	ELT	OPTICAL SCANNERS AND MAGNETIC INK RECOGNITION DEVICES
33	8471609030	no.	29	ELT	CARD KEY AND MAGNETIC MEDIA ENTRY DEVICES
34	8471609050	no.	62	ELT	ADP INPUT/OUTPUT UNITS, NESOI
35	8471900000	no.	73	ELT	MACHINES AND UNITS THEREOF FOR PROCESSING DATA, NESOI
36	8473301140	no.	67	ELT	PARTS AND ACCESSORIES OF AUTOMATIC DATA PROCESSING MACHINES AND UNITS NOT INCORPORATING CATHODE RAY TUBE, PRINTING CIRCUIT ASSEMBLIES, MEMORY MODULES
37	8479899899	no.	72	MCH	OTHER MACHINES AND MECHANICAL APPLIANCES HAVING INDIVIDUAL FUNCTIONS, NOT SPECIFIED OR INCLUDED ELSEWHERE IN CHAPTER HS84; PARTS THEREOF
38	8481809015	no.	73	MCH	REGULATOR VALVES, SELF-OPERATING, FOR CONTROLLING VARIABLES SUCH AS TEMPERATURE, PRESSURE, FLOW AND LIQUID LEVEL
39	8481809050	no.	73	MCH	OTHER TAPS, COCKS, VALVES, ETC., NESOI
40	8481901000	kg.	39	MCH	PARTS OF HAND OPERATED AND CHECK TAPS, COCKS, VALVES AND SIMILAR APPLIANCES OF COPPER
41	8481903000	kg.	44	MCH	PARTS OF HAND OPERATED AND CHECK TAPS, COCKS, VALVES AND SIMILAR APPLIANCES OF IRON OR STEEL
42	8481905000	kg.	48	MCH	PARTS OF HAND OPERATED AND CHECK TAPS, COCKS, VALVES AND SIMILAR APPLIANCES OF MATERIALS OTHER THAN COPPER, IRON OR STEEL
43	8481909020	kg.	40	MCH	VALVE BODIES OF VALVES FOR OLEO HYDRAULIC OR PNEUMATIC TRANSMISSIONS
44	8481909040	kg.	54	MCH	PARTS, EXCEPT VALVE BODIES, OF VALVES FOR OLEOHYDRAULIC OR PNEUMATIC TRANSMISSIONS
45	8481909060	kg.	60	MCH	VALVE BODIES, NESOI
46	8481909081	kg.	37	MCH	STEEL FORGINGS FOR TAPS, COCKS, VALVES AND SIMILAR APPLIANCES, NESOI
47	8481909085	kg.	80	MCH	PARTS OF TAPS, COCKS, VALVES AND SIMILAR APPLIANCES, NESOI

MCH-Mechanical Machinery and Parts; ELT-Electronic Machines and Parts

Source: USITC dataweb.

Table (A.3): OLS regressions of quality estimates (qep_{ji}) on unit values ($\ln uv_{ji}$)

No.	HS10	Unit	Segment	AR	Constant		ln uv		No. of
					coeffic.	p-value	coeffic.	p-value	obs.
1	8409911040	kg.	non-segmented	1	0.280	0.645	-0.128	0.607	18
2	8409911060	kg.	non-segmented	4	-1.352	0.020	0.517	0.018	11
3	8409911080	kg.	non-segmented	8	0.655	0.482	-0.245	0.460	12
4	8409915010	no.	non-segmented	1	0.796	0.310	-0.255	0.260	16
11	8409919990	kg.	non-segmented	4	-1.032	0.343	0.348	0.332	29
12	8409991040	kg.	non-segmented	4	-0.034	0.954	0.021	0.950	13
13	8409991060	kg.	non-segmented	4	0.266	0.571	-0.089	0.545	8
14	8409991080	kg.	non-segmented	1	0.276	0.557	-0.097	0.530	18
18	8409999290	kg.	non-segmented	8	-0.536	0.579	0.161	0.570	17
19	8409999910	no.	non-segmented	5	-2.350	0.349	0.602	0.341	12
29	8471601050	no.	non-segmented	2	1.470	0.416	-0.235	0.411	28
31	8471607000	no.	non-segmented	1	-0.288	0.758	0.051	0.751	32
33	8471609030	no.	non-segmented	1	1.166	0.261	-0.246	0.240	18
34	8471609050	no.	non-segmented	1	1.193	0.101	-0.224	0.091	42
40	8481901000	kg.	non-segmented	2	-1.156	0.313	0.344	0.305	26
46	8481909081	kg.	non-segmented	1	0.833	0.189	-0.248	0.148	25
4	8409913000	no.	high-mean	1	2.156	0.412	-0.380	0.407	11
7	8409915085	kg.	high-median	3	4.949	0.165	-1.196	0.162	14
9	8409919290	kg.	low-mean	1	4.091	0.360	-1.901	0.354	9
10	**8409919910**	no.	low-median	1	-0.742	0.697	0.346	0.683	9
16	8409999190	kg.	low-mean	6	-0.666	0.538	0.397	0.527	6
20	**8409999990**	kg.	low-median	6	0.691	0.310	-0.265	0.267	23
20	**8409999990**	kg.	high-median	3	-0.516	0.692	0.157	0.686	22
22	8413810040	no.	low-mean	2	-1.338	0.283	0.807	0.231	9
23	8414800500	no.	low-median	7	-5.295	0.119	0.954	0.118	16
24	8471300100	no.	high-median	0	2.952	0.141	-0.408	0.140	43
26	8471410150	no.	high-median	4	2.927	0.163	-0.373	0.162	14
30	8471602000	no.	high-median	0	-0.165	0.924	0.029	0.924	20
36	8473301140	no.	high-mean	7	1.017	0.760	-0.208	0.758	12
41	**8481903000**	kg.	low-median	5	2.830	0.159	-1.061	0.155	16
41	**8481903000**	kg.	high-median	1	0.643	0.713	-0.155	0.709	17
42	**8481905000**	kg.	low-mean	0	-0.377	0.939	0.157	0.938	10
42	**8481905000**	kg.	high-median	1	0.625	0.749	-0.133	0.745	17
43	**8481909020**	kg.	low-median	2	1.145	0.404	-0.336	0.393	18
43	**8481909020**	kg.	high-median	1	-1.055	0.519	0.241	0.508	14
44	**8481909040**	kg.	low-mean	3	-1.749	0.675	0.666	0.671	9
44	**8481909040**	kg.	high-median	1	0.770	0.724	-0.165	0.721	20
45	8481909060	kg.	low-mean	5	-4.683	0.209	2.534	0.202	6
47	**8481909085**	kg.	low-mean	3	-3.050	0.418	1.230	0.416	8
47	**8481909085**	kg.	high-median	1	0.314	0.779	-0.062	0.775	24

The high-median segment of HS8409919910 is excluded because it has only two exporting countries.
Source: Table (13)

Table (A.4): Selected regressions targeting d<0.1, QL<5.0, and QL*<5.0

No.	HS(10)	Unit	Industry	Segment	AR	Ctries.	CES	d	UVR	QL	QL*
1	8409911040	kg.	MCH	not segmented	1	18	1.744	0.099	4.700	3.949	4.087
2	8409911060	kg.	MCH	not segmented	4	11	1.327	0.016	2.317	1.916	1.737
3	8409911080	kg.	MCH	not segmented	8	12	1.686	0.071	3.519	3.346	3.107
4	8409913000	no.	MCH	high-mean	1	11	1.304	0.004	2.504	3.821	3.859
5	8409915010	no.	MCH	not segmented	1	16	1.499	0.021	4.383	4.149	4.185
7	8409915085	kg.	MCH	high-median	3	14	1.258	0.045	1.888	4.570	4.403
9	8409919290	kg.	MCH	low-mean	4	8	1.077	0.015	1.187	4.499	4.215
10	**8409919910**	no.	MCH	low-median	1	9	1.162	0.012	1.992	4.401	4.665
10	**8409919910**	no.	MCH	high-median	9	2	1.155	0.069	1.592	0.512	0.612
11	8409919990	kg.	MCH	not segmented	4	29	1.262	0.054	2.513	3.929	4.349
12	8409991040	kg.	MCH	not segmented	4	13	2.129	0.012	2.273	2.733	2.636
13	8409991060	kg.	MCH	not segmented	4	8	1.131	0.084	3.875	1.368	1.459
14	8409991080	kg.	MCH	not segmented	1	18	1.285	0.014	3.432	1.894	2.351
16	8409999190	kg.	MCH	low-mean	6	6	2.432	0.092	1.115	1.417	1.465
18	8409999290	kg.	MCH	not segmented	8	17	1.204	0.017	2.230	3.426	3.728
19	8409999910	no.	MCH	not segmented	5	12	1.271	0.085	2.526	4.018	4.087
20	**8409999990**	kg.	MCH	low-mean	1	9	1.443	0.051	4.269	3.348	3.385
20	**8409999990**	kg.	MCH	high-median	3	22	1.023	0.001	2.744	4.814	4.718
22	8413810040	no.	MCH	low-mean	5	9	1.217	0.078	2.591	4.620	4.998
23	8414800500	no.	MCH	low-median	7	16	2.221	0.023	1.397	4.163	4.139
24	8471300100	no.	ELT	high-median	0	43	1.959	0.071	2.160	4.912	4.914
26	8471410150	no.	ELT	high-median	4	14	1.031	0.017	2.034	2.131	2.450
29	8471601050	no.	ELT	not segmented	2	28	1.243	0.097	4.213	4.954	4.795
30	8471602000	no.	ELT	high-median	0	20	1.229	0.049	3.677	4.305	4.303
31	8471607000	no.	ELT	not segmented	1	32	1.123	0.017	5.484	4.123	4.073
33	8471609030	no.	ELT	not segmented	1	18	1.211	0.011	6.183	4.606	4.489
34	8471609050	no.	ELT	not segmented	1	42	1.471	0.013	5.551	4.935	4.892
36	8473301140	no.	ELT	high-mean	7	12	1.613	0.059	1.843	4.632	4.469
40	8481901000	kg.	MCH	not segmented	2	26	1.820	0.015	2.149	3.646	3.728
41	**8481903000**	kg.	MCH	low-median	5	16	1.573	0.023	1.339	4.227	4.153
41	**8481903000**	kg.	MCH	high-median	1	17	1.127	0.061	2.393	3.805	3.429
42	**8481905000**	kg.	MCH	low-mean	0	10	1.569	0.040	0.802	4.849	4.850
42	**8481905000**	kg.	MCH	high-median	1	17	1.070	0.033	2.889	4.488	3.589
43	**8481909020**	kg.	MCH	low-median	2	18	1.361	0.067	3.245	4.617	4.718
43	**8481909020**	kg.	MCH	high-median	1	14	1.093	0.091	3.734	4.005	4.026
44	**8481909040**	kg.	MCH	low-mean	3	9	1.244	0.0999	1.169	4.621	4.423
44	**8481909040**	kg.	MCH	high-median	1	20	1.335	0.080	2.368	4.670	4.331
45	8481909060	kg.	MCH	low-mean	5	6	1.776	0.011	1.070	1.002	4.417
46	8481909081	kg.	MCH	not segmented	1	25	1.246	0.064	6.803	4.964	4.749
47	**8481909085**	kg.	MCH	low-mean	3	8	1.307	0.010	0.681	4.462	4.530
47	**8481909085**	kg.	MCH	high-median	1	24	1.682	0.058	4.259	4.475	4.216
32	8471608000	no.	ELT	not segmented	3	30	1.210	0.063	5.665	7.413	7.270
38	8481809015	no.	MCH	not segmented	1	51	1.059	0.090	8.473	7.631	7.514
39	8481809050	no.	MCH	low-mean	7	11	1.115	0.057	2.535	5.647	5.326
6	8409915081	kg.	MCH	not segmented	1	14	0.791	0.007	3.258	10.383	9.908
15	8409999110	no.	MCH	not segmented	7	10	0.970	0.007	2.597	3.646	4.169
21	8413301000	no.	MCH	not segmented	0	91	0.855	0.076	6.207	9.770	13.373
35	8471900000	no.	ELT	not segmented	0	73	0.942	0.066	8.179	8.745	8.745
37	8479899899	no.	MCH	not segmented	2	45	0.778	0.059	9.510	10.094	10.175
27	8471500150	no.	ELT	high-median	2	17	1.370	0.101	1.174	4.920	4.994
8	8409919210	no.	MCH	not segmented	0	9	1.250	0.739	3.370	2.438	2.437
17	8409999210	no.	MCH	not segmented	0	15	1.397	0.463	4.582	4.582	2.732
25	8471410110	no.	ELT	not segmented	1	4	**1.530**	2.651	4.051	-	-
28	8471601010	no.	ELT	not segmented	0	5	**0.611**	2.000	2.394	-	-

If the conditions, CES>1, CES p-value<0.05, d<0.10, and QL<5.0, for quality estimation is met, the regression with the largest number of exporting countries is selected. Otherwise, the regression with the lowest QL is selected. Figures are in red when the conditions for quality estimation are not met, and CES is in red and bold when its p-value is larger than 0.05.

Table (A.5): Selected regressions targeting d<0.15, QL<4.0, and QL*<3.95

No.	HS10	Unit	Industry	Segment	AR	Ctries.	CES	d=|DW-2|	UVR	QL	QL*
1	**8409911040**	kg.	MCH	low-median	1	11	1.886	**0.142**	1.613	3.438	3.561
		kg.	MCH	high-median	1	7	1.598	0.037	2.992	3.368	3.578
2	8409911060	kg.	MCH	non-segmented	4	11	1.327	0.016	2.317	1.916	1.737
3	8409911080	kg.	MCH	non-segmented	8	12	1.686	0.071	3.519	3.346	3.107
4	8409913000	no.	MCH	high-mean	1	11	1.304	0.004	2.504	3.821	3.859
5	8409915010	no.	MCH	non-segmented	9	10	1.526	**0.138**	4.383	3.324	3.603
10	**8409919910**	no.	MCH	low-mean	3	4	1.460	0.041	0.426	2.754	2.539
		no.	MCH	high-median	9	2	1.155	0.069	1.592	0.512	0.612
11	8409919990	kg.	MCH	low-median	5	15	1.399	**0.132**	1.443	3.486	3.481
12	8409991040	kg.	MCH	non-segmented	0	30	1.490	**0.139**	7.147	3.843	3.841
13	8409991060	kg.	MCH	non-segmented	4	8	1.131	0.084	3.875	1.368	1.459
14	8409991080	kg.	MCH	non-segmented	1	18	1.285	0.014	3.432	1.894	2.351
15	8409999110	no.	MCH	non-segmented	8	10	1.028	**0.111**	2.597	3.541	3.878
16	8409999190	kg.	MCH	low-mean	6	6	2.432	0.092	1.115	1.417	1.465
18	8409999290	kg.	MCH	non-segmented	8	17	1.204	0.017	2.230	3.426	3.728
19	8409999910	no.	MCH	non-segmented	7	10	1.438	0.011	2.018	3.395	3.668
20	8409999990	kg.	MCH	low-mean	1	9	1.443	0.051	4.269	3.348	3.385
26	8471410150	no.	ELT	high-median	4	14	1.031	0.017	2.034	2.131	2.450
29	8471601050	no.	ELT	non-segmented	3	25	1.396	0.063	2.771	3.858	3.948
31	**8471607000**	no.	ELT	low-mean	0	6	1.290	0.086	0.623	3.819	3.821
		no.	ELT	high-mean	4	15	1.186	0.078	3.630	3.353	3.523
33	8471609030	no.	ELT	high-median	0	14	1.159	0.011	4.065	3.608	3.608
34	8471609050	no.	ELT	low-median	8	16	1.162	0.007	3.308	3.686	3.138
40	8481901000	kg.	MCH	non-segmented	2	26	1.820	0.015	2.149	3.646	3.728
41	**8481903000**	kg.	MCH	low-median	7	15	1.682	0.061	1.339	3.832	3.790
		kg.	MCH	high-median	1	17	1.127	0.061	2.393	3.805	3.429
42	8481905000	kg.	MCH	low-mean	9	6	2.985	0.059	0.739	1.952	2.513
44	8481909040	kg.	MCH	low-median	3	19	1.304	**0.123**	1.883	3.935	3.728
45	8481909060	kg.	MCH	low-mean	6	5	1.787	0.017	0.417	2.921	2.726
46	8481909081	kg.	MCH	non-segmented	3	19	1.327	**0.123**	4.606	3.422	3.431
7	8409915085	kg.	MCH	high-median	3	14	1.258	0.045	1.888	4.570	4.403
9	8409919290	kg.	MCH	low-mean	4	8	1.077	0.015	1.187	4.499	4.215
22	8413810040	no.	MCH	low-mean	5	9	1.217	0.078	2.591	4.620	4.998
23	8414800500	no.	MCH	low-median	7	16	2.221	0.023	1.397	4.163	4.139
24	8471300100	no.	ELT	high-median	0	43	1.960	0.071	2.322	4.912	4.914
27	8471500150	no.	ELT	high-median	2	17	1.370	**0.101**	1.174	4.920	4.994
30	8471602000	no.	ELT	high-median	0	20	1.229	0.049	3.677	4.305	4.303
32	8471608000	no.	ELT	not segmented	3	30	1.210	0.063	5.665	7.413	7.270
36	8473301140	no.	ELT	high-mean	7	12	1.613	0.059	1.843	4.632	4.469
38	8481809015	no.	MCH	not segmented	1	51	1.059	0.090	8.473	7.631	7.514
39	8481809050	no.	MCH	low-mean	7	11	1.115	0.057	2.535	5.647	5.326
43	**8481909020**	kg.	MCH	low-median	2	18	1.361	0.067	3.245	4.617	4.718
		kg.	MCH	high-median	1	14	1.093	0.091	3.734	4.005	4.026
47	**8481909085**	kg.	MCH	low-mean	3	8	1.307	0.010	0.681	4.662	4.530
		kg.	MCH	high-median	1	24	1.682	0.058	4.259	4.475	4.216
35	8471900000	no.	ELT	not segmented	0	73	0.942	0.066	8.179	8.745	8.745
21	8413301000	no.	MCH	not segmented	0	91	0.855	0.076	6.207	9.770	13.373
37	8479899899	no.	MCH	not segmented	2	45	0.778	0.059	9.510	10.094	10.175
6	8409915081	kg.	MCH	not segmented	1	14	0.791	0.007	3.258	10.383	9.908
8	8409919210	no.	MCH	not segmented	0	9	1.250	0.739	3.370	2.438	2.437
17	8409999210	no.	MCH	not segmented	0	15	1.397	0.463	4.582	2.732	2.732
25	8471410110	no.	ELT	not segmented	1	4	**1.530**	2.651	4.051	-	-
28	8471601010	no.	ELT	not segmented	0	5	**0.611**	2.000	2.394	-	-

If the conditions, CES>1, CES p-value<0.05, d<0.15, and QL<4.0 or QL*<3.95, for quality estimation are met, the regression with the largest number of exporting countries is selected. Otherwise, the regression with the lowest QL is selected. Figures are in red when the conditions for quality estimation are not met, and CES is in red and bold when its p-value is larger than 0.05. d=|DW-2| is in bold when 0.10<d>0.15.

Table (A.6): Dispersion measure of quality ladders for the 47 selected HS(10) products

QL<5.0				QL*<5.0			
Industry	Mean	Minimum	Maximum	Industry	Mean	Minimum	Maximum
ELT	5.062	2.131	8.745	eletr.m	5.036	2.450	8.745
MCH	4.289	0.512	13.373	mech.m	4.365	0.612	13.373
HS4	Mean	Minimum	Maximum	HS4	Mean	Minimum	Maximum
8409	3.640	0.512	10.383	8409	3.559	0.612	9.908
8471	5.104	2.131	8.745	8471	5.093	2.450	8.745
8481	4.474	1.002	7.631	8481	4.533	3.429	7.514
HS6	Mean	Minimum	Maximum	HS6	Mean	Minimum	Maximum
840991	4.070	0.512	10.383	840991	3.964	0.612	9.908
840999	3.125	1.368	4.814	840999	3.073	1.459	4.718
847160	4.292	3.353	7.413	847160	4.970	4.073	7.270
848190	4.141	1.002	4.964	848190	4.243	3.429	4.850
QL<4.0				QL*<3.95			
Industry	Mean	Minimum	Maximum	Industry	Mean	Minimum	Maximum
ELT	4.615	2.131	8.745	eletr.m	4.599	2.450	8.745
MCH	4.157	1.459	13.373	mech.m	4.191	1.459	13.373
HS4	Mean	Minimum	Maximum	HS4	Mean	Minimum	Maximum
8409	3.576	1.368	10.383	8409	3.473	1.459	9.908
8471	4.614	2.131	8.745	8471	4.610	2.450	8.745
8481	4.173	1.952	7.631	8481	4.122	2.513	7.514
HS6	Mean	Minimum	Maximum	HS6	Mean	Minimum	Maximum
840991	4.023	1.916	10.383	840991	3.869	1.737	9.908
840999	3.658	1.368	9.770	840999	2.945	1.459	3.878
847160	4.292	3.353	7.413	847160	4.230	3.138	7.270
848190	3.680	1.952	4.662	848190	3.662	2.513	4.718

HS(4) and HS(6) that contain only one or two HS(10) products are ignored.
Source: Tables (11) and (A.5)

APPENDIX (B)

Table (B.1): Population in 2014 of Exporting Countries to the US in log of the number of people in millions

Exporting ctries to the US	Ln(pop)	Source	Exporting ctries to the US	Ln(pop)	Source	Exporting ctries to the US	Ln(pop)	Source	Exporting ctries to the US	Ln(pop)	Source
Algeria	3.66	1	Dominican Rep	2.34	1	Lesotho	0.75	1	Russia	4.97	1
Andorra	-0.16	3	Ecuador	2.77	1	Liberia	1.48	1	Samoa	-1.65	1
Anguilla	-4.24	1	Egypt	4.50	1	Liechtenstein	-3.29	2	San Marino	-3.41	1
Argentina	3.76	1	El Salvador	1.81	1	Lithuania	1.07	1	Sao Tome & Prin	-1.68	1
Australia	3.16	1	Estonia	0.27	1	Luxembourg	-0.59	1	Saudi Arabia	3.43	1
Austria	2.14	1	Ethiopia	4.57	1	Macao	-0.55	1	Senegal	2.69	1
Azerbaijan	2.26	1	Faroe Islands	-3.04	2	Macedonia	0.73	1	Serbia	1.96	1
Bahamas	-0.96	1	Fiji	-0.12	1	Madagascar	3.16	1	Seychelles	-2.34	1
Bahrain	0.31	1	Finland	1.70	1	Malaysia	3.40	1	Sierra Leone	1.84	1
Bangladesh	5.07	1	Fr Polynesia	-1.30	2	Maldive Is	-1.03	1	Singapore	1.71	1
Barbados	-1.26	1	Fr.Southern	-8.38	4	Mali	2.84	1	Sint Maarten	-3.28	1
Belarus	2.25	1	France	4.19	1	Malta	-0.87	1	Slovak Republic	1.69	1
Belgium	2.42	1	Gambia	0.66	1	Marshall Is	-2.86	2	Slovenia	0.73	1
Belize	-1.04	1	Georgia	1.39	1	Mauritius	0.24	1	Somalia	2.60	1
Bermuda	-2.77	1	Germany	4.39	1	Mexico	4.83	1	South Africa	3.99	1
Bolivia	2.36	1	Ghana	3.29	1	Moldova	1.40	1	Spain	3.83	1
Bosnia-Hercegov	1.34	1	Gibraltar	-3.39	2	Monaco	-3.29	2	Sri Lanka	3.03	1
Br Virgin Is	-3.52	1	Greece	2.40	1	Mongolia	1.07	1	St Helena	-4.85	3
British Indian O Territory	-5.99	5	Grenada Is	-2.24	1	Montenegro	-0.48	1	St Kitts-Nevis	-2.92	1
Brazil	5.33	1	Guadeloupe	-0.91	4	Montserrat Is	-5.28	1	St Lucia Is	-1.69	1
Brunei	-0.87	1	Guatemala	2.77	1	Morocco	3.52	1	St Vinc & Gren	-2.21	1
Bulgaria	1.97	1	Guinea	2.51	1	Mozambique	3.30	1	Suriname	-0.62	1
Burkina Faso	2.87	1	Guinea-Bissau	0.59	1	Namibia	0.88	1	Swaziland	0.24	1
Cambodia	2.73	1	Guyana	-0.27	2	Nauru	-4.44	1	Sweden	2.27	1
Cameroon	3.13	1	Haiti	2.36	1	Netherlands	2.83	1	Switzerland	2.11	1
Canada	3.57	1	Honduras	2.07	1	New Caledonia	-1.32	2	Taiwan	3.15	1
Cape Verde	-0.67	1	Hong Kong	1.98	1	New Zealand	1.50	1	Tanzania	3.92	1
Cayman Is	-2.83	1	Hungary	2.29	1	Nicaragua	1.79	1	Thailand	4.22	1
Chile	2.88	1	Iceland	-1.12	1	Niger	2.95	1	Trin & Tobago	0.30	1
China	7.22	1	India	7.17	1	Nigeria	5.18	1	Tunisia	2.41	1
Christmas Is	-6.30	5	Indonesia	5.54	1	Niue	-6.44	5	Turkey	4.35	1
Cocos Is	-7.52	5	Ireland	1.54	1	Norway	1.64	1	Turkmenistan	1.67	1
Colombia	3.87	1	Israel	2.07	1	Oman	1.44	1	Turks & Caic Is	-3.39	1
Congo (ROC)	1.51	1	Italy	4.09	1	Pakistan	5.22	1	Uganda	3.63	1
Cook Is	-4.60	3	Jamaica	1.02	1	Panama	1.35	1	Ukraine	3.81	1
Costa Rica	1.56	1	Japan	4.84	1	Papua New Guin	2.07	2	United Arab Em	2.21	1
Cote d`Ivoire	3.10	1	Jordan	2.00	1	Paraguay	1.88	1	United Kingdom	4.16	1
Croatia	1.45	1	Kazakhstan	2.85	1	Peru	3.43	1	Uruguay	1.23	1
Curacao	-1.86	1	Kenya	3.80	1	Philippines	4.60	1	Vatican City	-6.91	5
Cyprus	-0.12	1	Korea	3.91	1	Poland	3.65	1	Venezuela	3.42	1
Czech Republic	2.36	1	Kuwait	1.32	1	Portugal	2.34	1	Vietnam	4.53	1
Denmark	1.73	1	Latvia	0.69	1	Qatar	0.78	1	Zambia	2.76	1
Dominica Is	-2.63	1	Lebanon	1.72	1	Romania	2.98	1			

(1) Penn World Table version PWT 9.0; (2) World Development Indicators WDI-World Bank; (3) United States Census Bureau; (4) UN Data; (5) The populations of these countries and territories are very small and were estimated based on data from Wikipedia and IndexMundi

Table (B.2): High-wage Countries in 2014

Andorra	Korea, Republic
Aruba	Kuwait
Australia	Latvia
Austria	Liechtenstein
Bahamas, The	Lithuania
Bahrain	Luxembourg
Barbados	Macao
Belgium	Maldive Island
Bermuda	Malta
Brunei Darussalam	Monaco
Canada	Netherlands
Cayman Islands	New Caledonia
Chile	New Zealand
Croatia	Norway
Curacao	Oman
Cyprus	Poland
Czech Republic	Portugal
Denmark	Qatar
Eq Guinea	San Marino
Estonia	Saudi Arabia
Faeroe Islands	Seychelles
Finland	Singapore
French Polynesia	Sint Maarten
France	Slovak Republic
Germany	Slovenia
Gibraltar	Spain
Greece	St Kitts-Nevis
Greenland	Sweden
Hong Kong	Switzerland
Hungary	Taiwan
Iceland	Trinidad & Tobago
Ireland	United Arab Emirates
Israel	United Kingdom
Italy	Uruguay
Japan	Vatican City

Countries are high wage when they are classified as developed countries by the World Bank. Argentina, Russia, and Venezuela were classified as developing countries based on their classification in 2013 and 2015. Some small countries are not classified either as developed or developing countries by the World Bank: British Indian Ocean Territory, British Virgin Islands, Coco Islands, Gibraltar, Guadeloupe, Liechtenstein, Nauru, St. Lucia Island, St. Vincent and Grenadines, and Vatican City. Countries found to be high-wage according to various other sources are in the above table, otherwise they are low-wage.
Source: The World Bank

Table (B.3): CES, DW, cross-sections, and UVR of the list of 17 HS(6) products

CES													
HS(6)	No.HS(10)	UNIT	AR(0)	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)	AR(6)	AR(7)	AR(8)	AR(9)	AR(10)
840991	4	no.	1.263	1.293	1.297	1.212	1.183	1.029	1.517	1.427	1.793	**0.000**	1.095
840991	7	kg.	1.338	1.222	1.136	1.127	1.322	1.343	1.374	1.413	1.309	1.478	1.594
840999	6	kg.	1.063	1.008	0.967	1.005	0.944	0.798	0.739	0.544	0.629	0.765	0.885
840999	3	no.	1.193	1.127	1.074	1.097	1.018	1.088	1.173	1.261	**0.000**	1.262	1.370
841330	4	no.	0.997	1.042	0.951	1.004	1.111	1.120	1.141	1.296	1.320	1.006	0.976
841350	5	no.	0.526	0.444	0.442	0.429	0.631	0.524	0.370	0.391	0.434	1.284	0.994
841381	3	no.	1.492	1.088	1.020	0.941	0.861	0.867	0.877	0.895	0.814	0.800	0.787
841480	21	no.	0.954	1.004	0.919	0.804	0.750	0.787	0.763	0.806	1.006	1.020	1.144
847141	2	no.	1.158	1.157	1.185	1.120	1.090	1.034	1.052	0.976	0.950	0.879	1.022
847150	2	no.	1.264	1.069	1.129	1.157	1.096	1.070	0.984	1.101	0.937	1.004	1.365
847160	7	no.	1.291	1.239	1.280	1.221	1.185	1.202	1.210	1.043	0.990	1.151	1.000
847170	11	no.	1.115	1.088	1.091	1.055	1.081	1.076	1.076	1.184	1.147	1.379	1.555
847180	3	no.	1.149	1.086	1.039	1.022	0.988	1.008	0.981	0.986	0.998	1.013	0.991
847989	12	no.	0.775	0.767	0.760	0.764	0.729	0.711	0.620	0.590	0.544	0.306	**0.000**
848180	35	no.	1.078	1.036	1.030	1.012	1.019	1.002	1.019	1.057	1.053	1.023	1.068
848190	8	kg.	1.285	1.523	1.548	1.578	1.775	1.750	1.871	1.708	2.066	2.619	2.834
848310	5	no.	0.966	0.884	0.823	0.839	0.747	0.717	0.775	0.872	0.827	0.568	**0.000**
d=|DW-2|													
HS(6)	No.HS(10)	UNIT	AR(0)	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)	AR(6)	AR(7)	AR(8)	AR(9)	AR(10)
840991	4	no.	0.578	0.016	0.280	0.245	0.117	0.139	0.061	0.1505	0.171	0.763	1.765
840991	7	kg.	0.266	0.144	0.270	0.573	0.253	0.156	0.126	0.126	0.436	0.643	1.900
840999	6	kg.	0.198	0.082	0.104	0.194	0.245	0.290	0.465	0.569	0.542	1.804	1.952
840999	3	no.	0.462	0.076	0.090	0.327	0.487	0.560	0.469	0.103	0.314	0.191	1.667
841330	4	no.	0.199	0.035	0.053	0.093	0.290	0.314	0.393	0.306	0.542	0.800	1.946
841350	5	no.	0.189	0.189	0.061	0.202	0.025	0.029	0.229	0.144	0.312	0.729	1.926
841381	3	no.	1.721	0.645	1.085	1.189	1.261	1.202	1.079	0.845	0.457	0.260	2.227
841480	21	no.	0.278	0.059	0.114	0.360	0.452	0.678	0.853	0.777	0.687	0.962	1.892
847141	2	no.	0.052	0.009	0.1501	0.037	0.259	0.402	0.572	0.842	1.177	1.358	1.867
847150	2	no.	0.191	0.090	0.119	0.018	0.091	0.153	0.389	0.417	0.748	0.886	1.886
847160	7	no.	1.156	0.026	0.328	0.226	0.191	0.084	0.325	0.097	0.548	1.016	1.943
847170	11	no.	0.376	0.035	0.244	0.144	0.201	0.225	0.207	0.451	0.315	0.675	1.871
847180	3	no.	0.117	0.149	0.054	0.067	0.203	0.214	0.180	0.370	0.231	0.231	1.944
847989	12	no.	0.265	0.001	0.292	0.382	0.499	0.376	0.630	0.801	0.758	0.917	1.946
848180	35	no.	0.115	0.178	0.098	0.160	0.234	0.311	0.328	0.353	0.912	0.713	1.960
848190	8	kg.	0.240	0.480	0.061	0.001	0.270	0.565	0.390	0.832	0.788	1.235	1.913
848310	5	no.	0.046	0.118	0.045	0.126	0.329	0.274	0.364	0.513	0.703	1.199	1.852
cross-sections													
HS(6)	No.HS(10)	UNIT	AR(0)	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)	AR(6)	AR(7)	AR(8)	AR(9)	AR(10)
840991	4	no.	29	22	19	19	18	17	17	17	16	16	16
840991	7	kg.	73	51	48	46	43	43	41	40	40	39	39
840999	6	no.	105	76	63	55	51	50	49	48	46	45	42
840999	3	no.	41	25	22	19	16	15	13	13	12	12	11
841330	4	no.	101	63	48	43	42	41	40	40	39	39	37
841350	5	no.	75	48	40	35	32	31	31	31	30	28	27
841381	3	no.	80	79	76	73	70	67	66	61	60	55	50
841480	21	no.	89	57	47	45	44	41	38	38	38	38	36
847141	2	no.	76	46	42	38	36	34	33	33	32	32	29
847150	2	no.	84	50	43	40	39	37	37	37	36	34	34
847160	7	no.	80	53	45	40	38	37	36	36	36	36	35
847170	11	no.	80	48	41	39	37	36	35	34	32	32	30
847180	3	no.	82	53	49	45	42	42	39	39	38	36	36
847989	12	no.	80	59	49	47	46	44	43	40	39	38	37
848180	35	kg.	108	68	61	59	54	53	50	50	50	50	50
848190	8	no.	91	59	51	50	50	49	48	48	47	46	45
848310	5	no.	63	44	40	36	35	32	31	30	28	28	26
UVR													
HS(6)	No.HS(10)	UNIT	AR(0)	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)	AR(6)	AR(7)	AR(8)	AR(9)	AR(10)
840991	4	no.	5.839	5.341	5.341	5.341	5.341	5.341	5.341	5.341	5.341	5.341	5.341
840991	7	kg.	8.10	4.969	3.973	3.973	3.076	3.076	3.076	3.076	3.076	3.076	3.076
840999	6	no.	8.011	4.882	3.996	3.996	3.996	3.996	3.996	3.996	3.996	3.996	3.996
840999	3	no.	6.650	4.636	3.157	3.157	2.583	2.583	1.874	1.874	1.874	1.874	1.874
841330	4	no.	6.329	3.590	3.590	3.590	3.590	3.590	3.590	3.590	3.590	3.590	3.590
841350	5	no.	9.623	9.623	7.164	7.164	7.164	7.164	7.164	7.164	7.164	5.420	5.420
841381	3	no.	11.403	11.403	11.403	11.403	11.403	11.403	11.403	9.054	9.054	8.810	8.423
841480	21	no.	7.854	7.733	7.733	7.733	7.733	5.810	5.310	5.310	5.310	5.310	5.310
847141	2	no.	6.428	5.323	4.628	4.628	4.628	4.628	4.628	4.628	4.628	4.628	4.516
847150	2	no.	7.356	5.299	4.521	4.521	4.521	4.521	4.521	4.521	3.982	3.627	3.627
847160	7	no.	7.109	5.664	4.266	4.187	4.187	4.187	4.187	4.187	4.187	4.187	4.187
847170	11	no.	8.283	6.770	6.770	6.770	6.770	6.770	6.770	5.648	5.648	5.648	5.648
847180	3	no.	10.197	8.064	5.607	5.607	5.607	5.607	4.363	4.363	4.363	4.363	4.363
847989	12	no.	10.396	9.281	9.281	9.281	9.281	9.281	9.281	9.281	9.281	8.103	8.103
848180	35	kg.	9.680	7.650	7.650	7.650	7.650	7.650	7.650	7.650	7.650	7.650	7.650
848190	8	no.	9.111	7.263	5.020	5.020	5.020	5.020	5.020	5.020	5.020	5.020	5.020
848310	5	no.	8.147	7.163	7.163	5.405	5.405	5.006	5.006	5.006	5.006	5.006	5.006

If CES p-value is larger than 0.05, we cannot reject the hypothesis that CES is zero and we assign this value to it.

Table (B.4): CES, DW, cross-sections, and UVR of the list of 47 HS(10) products

CES											
HS(10)	AR(0)	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)	AR(6)	AR(7)	AR(8)	AR(9)	AR(10)
8409911040	1.496	1.744	1.754	1.811	1.865	2.019	2.285	2.117	1.829	1.600	
8409911060	1.432	1.418	1.415	1.389	1.327	1.444	1.679	1.623	1.581	1.702	1.539
8409911080	1.352	1.424	1.452	1.502	1.435	1.439	1.387	1.661	1.686	1.405	0.669
8409915081	1.020	0.791	0.677	1.240	1.907	**0.000**	**0.000**	3.164	**0.000**	**0.000**	3.765
8409915085	0.668	0.826	0.923	0.695	0.431	0.881	1.068	0.785	0.794	0.875	**0.000**
8409919290	1.136	1.111	1.107	1.095	1.121	0.878	0.843	0.831	0.976	0.848	1.534
8409919990	1.212	1.241	1.318	1.263	1.262	1.337	1.249	1.218	1.032	1.132	1.550
8409913000	1.187	1.143	1.097	1.140	1.030	0.961	1.041	1.242	1.225	0.389	0.291
8409915010	1.494	1.499	1.425	1.546	1.498	1.507	1.362	1.370	1.308	1.526	1.124
8409919210	1.250	**0.000**	**0.000**	**0.000**							
8409919910	1.243	0.979	0.914	0.896	1.000	0.992	0.976	0.664	0.643	0.208	0.632
8409991040	1.490	1.811	2.296	2.278	2.129	2.450	2.627	2.885	2.216	0.585	1.222
8409991060	1.119	1.124	1.211	1.299	1.131	1.167	1.017	1.080	0.969	0.889	
8409991080	1.401	1.285	1.329	1.302	1.277	1.294	1.192	1.182	1.027	1.064	0.000
8409999110	0.940	0.520	0.739	0.770	0.743	0.848	0.849	0.970	1.028	1.555	1.608
8409999210	1.397	1.548									
8409999910	1.027	1.045	1.089	1.067	1.015	1.271	1.336	1.438	0.869	0.709	0.563
8409999190	1.007	1.143	1.066	1.113	1.132	1.126	1.132	1.111	1.183	1.186	1.191
8409999290	1.144	1.030	1.090	1.082	1.060	1.095	1.115	1.214	1.204	1.349	0.632
8409999990	1.179	1.178	1.091	1.133	1.119	1.181	1.165	0.932	1.173	1.192	1.119
8413301000	0.855	0.787	0.778	0.811	0.797	0.751	0.769	0.695	0.706	0.416	0.403
8413810040	0.957	1.008	0.943	0.902	0.941	0.954	0.965	1.079	1.093	1.034	0.917
8414800500	1.243	1.119	0.975	1.000	1.100	1.109	1.275	1.365	1.431	1.384	1.617
8471300100	1.831	1.848	1.793	1.828	1.866	2.181	2.718	3.475	2.651	2.013	2.495
8471410110	**0.000**	**0.000**	**0.000**								
8471410150	1.158	1.160	1.186	1.121	1.090	1.035	1.051	0.973	0.949	0.872	1.032
8471500150	1.060	1.073	1.135	1.153	1.101	1.070	0.983	1.102	0.937	1.005	1.367
8471601010	**0.000**										
8471601050	1.276	1.355	1.243	1.396	1.417	1.315	1.017	0.748	0.751	0.611	**0.000**
8471602000	1.075	1.063	1.021	0.854	0.575	**0.000**	**0.000**	**0.000**	0.612	**0.000**	1.203
8471607000	1.188	1.123	1.154	1.209	1.253	1.053	1.180	1.065	0.887	**0.000**	**0.000**
8471608000	1.170	1.195	1.132	1.210	1.231	1.315	1.357	1.280	1.329	1.354	1.220
8471609030	1.155	1.211	1.027	1.096	1.153	1.224	1.261	0.927	0.895	1.090	**0.000**
8471609050	1.519	1.471	1.527	1.562	1.474	1.338	1.373	1.188	1.205	1.135	1.133
8471900000	0.942	0.924	0.896	0.889	0.891	0.955	0.928	1.020	1.037	1.029	1.012
8473301140	1.320	1.416	1.382	1.430	1.384	1.364	1.446	1.499	1.342	1.335	1.351
8479899899	0.804	0.813	0.778	0.796	0.769	0.735	0.695	0.664	0.629	0.526	0.730
8481809015	1.090	1.059	1.035	1.045	1.038	1.046	1.056	1.065	1.085	1.077	1.053
8481809050	1.074	1.065	1.030	1.035	1.042	1.069	1.054	1.114	1.079	1.133	0.988
8481901000	1.635	1.792	1.820	1.744	1.604	1.647	1.683	1.815	2.196	2.332	1.753
8481903000	1.205	1.243	1.173	1.174	1.158	1.194	1.261	1.400	1.460	1.585	1.717
8481905000	1.231	1.242	1.203	1.251	1.199	1.240	1.165	1.103	1.571	1.616	2.191
8481909020	1.209	1.280	1.218	1.315	1.241	1.182	1.135	1.207	1.515	0.357	0.534
8481909040	1.299	1.287	1.285	1.287	1.297	1.486	1.489	1.328	1.136	1.630	1.891
8481909060	1.209	1.200	1.093	1.081	1.087	1.275	1.064	1.000	1.075	1.280	1.071
8481909081	1.237	1.246	1.304	1.327	1.597	1.265	1.638	1.679	2.120	2.197	1.701
8481909085	1.332	1.378	1.279	1.255	1.297	1.280	1.426	1.521	1.528	1.390	1.036

Continuation of Table (B.4)

d=|DW-2|											
HS(10)	AR(0)	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)	AR(6)	AR(7)	AR(8)	AR(9)	AR(10)
8409911040	0.145	0.099	0.318	0.279	0.440	0.446	0.957	1.147	0.804	0.874	
8409911060	0.162	0.183	0.307	0.432	0.016	0.109	0.335	0.759	0.628	0.839	1.556
8409911080	0.447	0.164	0.514	0.341	0.225	0.159	0.463	0.179	0.071	0.878	1.800
8409915081	0.698	0.007	0.074	0.247	0.402	0.458	0.357	1.339	1.117	1.943	1.556
8409915085	0.402	0.102	0.402	0.403	0.247	0.253	0.007	0.468	1.134	0.829	1.879
8409919290	0.055	0.195	0.063	0.118	0.061	0.040	0.143	0.453	0.471	0.928	1.246
8409919990	0.014	0.168	0.127	0.043	0.054	0.197	0.253	0.455	0.500	1.156	1.846
8409913000	0.758	0.018	0.318	0.168	0.095	0.204	0.044	0.190	0.038	0.779	1.733
8409915010	0.300	0.021	0.121	0.219	0.245	0.079	0.099	0.341	0.684	0.138	1.800
8409919210	0.739	0.886	1.629	0.079							
8409919910	0.118	0.281	0.605	0.371	0.094	0.313	0.239	0.072	0.104	0.432	1.667
8409991040	0.128	0.138	0.183	0.173	0.012	0.129	0.022	0.158	0.436	1.271	0.998
8409991060	0.542	0.346	0.228	0.353	0.084	0.009	0.076	0.172	0.520	0.012	0.042
8409991080	0.373	0.014	0.070	0.047	0.076	0.238	0.137	0.033	0.515	0.819	1.333
8409999110	0.501	0.090	0.247	0.054	0.029	0.052	0.216	0.007	0.111	0.278	1.636
8409999210	0.463	0.911									
8409999910	0.193	0.331	0.119	0.317	0.208	0.085	0.087	0.011	0.439	0.245	1.750
8409999190	0.435	0.107	0.184	0.216	0.016	0.263	0.216	0.482	0.602	1.208	1.929
8409999290	0.140	0.008	0.013	0.033	0.021	0.065	0.120	0.334	0.017	1.088	1.765
8409999990	0.018	0.023	0.080	0.184	0.363	0.116	0.474	0.532	0.756	1.469	1.892
8413301000	0.076	0.017	0.450	0.605	0.541	0.571	0.680	1.027	0.860	1.508	1.929
8413810040	0.045	0.066	0.148	0.032	0.335	0.361	0.369	0.224	0.284	0.844	1.862
8414800500	0.160	0.041	0.188	0.252	0.316	0.479	0.475	0.524	0.645	1.118	1.857
8471300100	0.099	0.072	0.020	0.008	0.158	0.397	0.294	0.653	0.557	1.343	2.000
8471410110	2.545	2.651	0.008								
8471410150	0.026	0.013	0.151	0.038	0.266	0.403	0.573	0.834	1.174	1.352	1.867
8471500150	0.190	0.090	0.118	0.019	0.091	0.154	0.391	0.417	0.747	0.884	1.886
8471601010	2.000										
8471601050	0.288	0.176	0.097	0.063	0.005	0.081	0.128	0.068	0.505	0.696	1.765
8471602000	0.276	0.108	0.383	0.070	0.186	0.427	0.629	0.640	0.307	0.631	1.750
8471607000	0.297	0.017	0.214	0.193	0.276	0.191	0.413	0.581	0.911	1.437	1.818
8471608000	0.174	0.017	0.200	0.063	0.346	0.315	0.401	0.601	1.044	1.258	1.905
8471609030	0.178	0.011	0.091	0.170	0.345	0.277	0.208	0.863	0.479	0.310	1.429
8471609050	0.197	0.013	0.174	0.025	0.093	0.301	0.122	0.106	0.426	0.431	1.909
8471900000	0.066	0.028	0.454	0.446	0.451	0.538	0.424	0.492	0.621	1.121	1.889
8473301140	0.065	0.006	0.045	0.087	0.102	0.195	0.281	0.235	0.850	1.406	1.826
8479899899	0.258	0.043	0.059	0.131	0.251	0.220	0.502	0.634	0.517	0.650	1.871
8481809015	0.182	0.090	0.007	0.141	0.156	0.218	0.443	0.319	0.604	0.847	1.882
8481809050	0.338	0.093	0.462	0.644	0.629	0.672	0.464	0.655	1.114	0.715	1.886
8481901000	0.411	0.159	0.015	0.168	0.010	0.206	0.207	0.006	0.111	0.411	1.810
8481903000	0.023	0.128	0.171	0.104	0.330	0.279	0.218	0.363	0.886	1.650	1.826
8481905000	0.108	0.038	0.183	0.245	0.339	0.321	0.312	0.327	0.646	0.961	1.913
8481909020	0.262	0.072	0.103	0.187	0.107	0.404	0.868	1.488	1.288	1.035	1.800
8481909040	0.163	0.050	0.413	0.391	0.558	0.913	0.948	0.785	0.749	1.093	1.875
8481909060	0.511	0.012	0.461	0.425	0.193	0.096	0.307	0.490	0.447	1.020	1.929
8481909081	0.130	0.064	0.200	0.123	0.036	0.036	0.122	0.225	0.160	1.339	1.733
8481909085	0.304	0.084	0.012	0.029	0.208	0.310	0.344	0.302	0.373	0.617	1.949

Continuation of Table (B.4)

cross-sections											
HS(10)	AR(0)	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)	AR(6)	AR(7)	AR(8)	AR(9)	AR(10)
8409911040	28	18	15	14	14	13	12	12	10	10	
8409911060	36	20	19	14	11	11	10	10	8	8	8
8409911080	33	25	22	18	17	17	16	13	12	11	10
8409915081	18	14	13	11	10	10	10	9	9	9	8
8409915085	53	43	40	39	36	36	34	34	33	32	32
8409919290	38	29	25	24	19	17	16	15	14	14	13
8409919990	59	41	34	29	29	28	26	25	25	25	25
8409913000	19	18	17	17	16	15	15	14	14	14	14
8409915010	23	16	14	12	11	11	10	10	10	10	10
8409919210	9	3	2	2							
8409919910	19	14	10	10	8	8	8	7	6	6	6
8409991040	29	17	16	15	13	13	12	11	11	10	10
8409991060	31	18	13	10	8	8	6	4	4	3	2
8409991080	28	18	12	10	8	6	6	6	6	6	5
8409999110	23	16	13	11	10	10	10	10	10	10	10
8409999210	15	6									
8409999910	37	21	17	15	12	12	10	10	9	9	8
8409999190	53	44	42	38	37	36	35	33	29	29	28
8409999290	53	31	25	24	23	22	20	19	17	17	16
8409999990	100	67	56	50	49	46	43	43	39	39	36
8413301000	91	59	42	37	34	33	32	32	32	32	28
8413810040	76	45	41	35	35	33	31	31	30	28	28
8414800500	78	51	41	38	37	35	31	31	29	29	27
8471300100	86	49	41	37	37	36	34	34	33	31	29
8471410110	9	4	1								
8471410150	76	46	42	38	36	34	33	33	32	32	29
8471500150	84	46	41	39	39	37	37	37	36	34	34
8471601010	5										
8471601050	50	33	28	25	23	20	18	17	17	16	16
8471602000	40	34	28	26	23	20	20	18	17	16	15
8471607000	45	32	25	23	20	19	18	15	13	13	11
8471608000	56	37	34	30	30	27	24	23	22	21	21
8471609030	29	18	17	13	11	10	9	8	7	7	6
8471609050	61	42	39	34	32	30	27	26	24	24	22
8471900000	73	51	46	42	41	41	40	37	37	36	35
8473301140	67	43	37	32	30	29	28	26	24	24	22
8479899899	72	51	45	43	41	40	38	35	34	34	30
8481809015	73	51	46	41	37	36	35	34	34	34	33
8481809050	73	53	45	43	42	39	36	35	35	34	34
8481901000	39	30	26	25	24	23	21	20	20	20	20
8481903000	44	37	35	33	30	29	25	25	25	23	22
8481905000	48	35	31	29	25	25	25	25	24	23	23
8481909020	40	33	29	26	25	24	23	23	21	19	19
8481909040	54	43	40	36	35	33	31	31	31	31	31
8481909060	60	43	40	39	39	36	34	30	28	28	28
8481909081	37	25	22	19	16	16	16	16	16	15	14
8481909085	80	56	50	47	46	44	43	43	42	39	39

Continuation of Table (B.4)

UVR											
HS(10)	AR(0)	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)	AR(6)	AR(7)	AR(8)	AR(9)	AR(10)
8409911040	5.851	4.700	2.976	2.976	2.976	2.976	2.953	2.953	2.953	2.953	
8409911060	4.676	3.231	2.330	2.330	2.317	2.317	2.317	2.317	1.592	1.592	1.592
8409911080	4.885	3.831	3.519	3.519	3.519	3.519	3.519	3.519	3.519	3.519	3.519
8409915081	3.258	3.258	3.258	2.948	2.497			2.497			1.991
8409915085	7.723	4.686	3.739	3.443	3.094	3.094	3.094	3.094	2.547	2.547	
8409919290	4.610	3.541	3.541	3.541	3.541	3.541	3.541	3.541	3.541	3.541	3.017
8409919990	8.103	4.694	3.363	2.513	2.513	2.513	2.513	2.513	2.513	2.513	2.513
8409913000	5.346	5.346	5.346	5.346	5.346	5.346	5.346	5.149	5.149	5.149	5.149
8409915010	6.061	4.383	4.383	4.383	4.383	4.383	4.383	4.383	4.383	4.383	4.383
8409919210	3.370	1.117	0.512	0.512							
8409919910	6.232	5.134	3.696	3.696	3.696	3.696	3.696	3.371	3.371		
8409991040	7.147	3.525	3.525	2.273	2.273	2.273	2.198	2.198	2.198		
8409991060	6.172	3.875	3.875	3.875	3.875	3.875	2.165	0.651	0.651	0.502	
8409991080	4.606	3.432	3.275	3.166	3.166	3.051	3.051	3.051	3.051	3.051	
8409999110	4.989	2.791	2.597	2.597	2.597	2.597	2.597	2.597	2.597	2.597	2.597
8409999210	4.582	4.567									
8409999910	4.867	3.507	3.507	3.272	2.526	2.526	2.018	2.018	2.018	2.018	2.018
8409999190	5.173	5.173	3.817	3.817	3.791	3.817	3.791	3.791	3.791	3.791	3.791
8409999290	5.969	5.594	4.222	4.222	4.222	4.222	4.222	2.230	2.230	2.230	2.230
8409999990	7.782	4.952	4.269	4.269	4.269	4.269	3.646	3.646	3.646	3.646	3.646
8413301000	6.207	3.357	3.357	3.357	3.357	3.357	3.357	3.357	3.357	3.357	
8413810040	11.335	8.168	8.168	7.795	7.795	7.795	7.795	7.795	6.890	6.890	6.890
8414800500	6.988	4.508	4.508	4.508	4.508	4.498	4.200	4.200	4.200	4.200	4.200
8471300100	4.981	4.281	4.117	4.117	4.117	4.117	4.117	4.117	4.117	3.775	3.775
8471410110											
8471410150	6.428	5.323	4.628	4.628	4.628	4.628	4.628	4.628	4.628	4.628	4.516
8471500150	7.356	5.299	4.521	4.521	4.521	4.521	4.521	4.521	3.982	3.630	3.630
8471601010	2.394										
8471601050	4.446	4.446	4.213	2.771	2.771	2.540	2.540	2.540	2.540	2.540	
8471602000	5.847	5.847	4.796	4.796	4.796				4.796		3.426
8471607000	6.211	5.484	5.484	5.484	4.591	4.591	4.591	3.524	2.699		
8471608000	6.486	5.684	5.665	5.665	5.665	5.665	5.665	5.665	5.665	4.762	4.762
8471609030	6.806	6.183	6.183	4.126	4.126	4.126	4.126	4.126	2.407	2.407	
8471609050	7.690	5.551	5.551	5.453	5.453	5.453	5.453	5.453	5.453	5.453	4.097
8471900000	8.179	7.945	7.945	7.945	7.945	7.945	6.189	6.189	6.189	6.189	6.189
8473301140	8.748	7.090	6.513	6.513	6.513	6.513	6.513	5.635	5.635	5.635	5.635
8479899899	11.507	9.510	9.510	9.510	9.510	9.510	8.307	8.307	8.307	8.307	8.307
8481809015	9.564	8.473	8.081	8.055	6.896	6.896	6.179	6.179	6.179	6.179	6.179
8481809050	10.437	7.250	7.112	7.112	7.112	7.112	7.112	7.112	7.112	7.112	7.112
8481901000	3.114	2.149	2.149	2.149	2.149	2.149	2.149	2.149	2.149	2.149	2.149
8481903000	3.899	3.899	3.899	3.899	3.899	3.899	3.899	3.899	3.899	3.899	3.899
8481905000	5.787	4.723	4.723	4.723	4.723	4.723	4.723	4.723	4.723	4.723	4.723
8481909020	4.711	4.295	4.295	4.295	4.295	4.295	4.295	4.295	4.295	4.295	4.295
8481909040	4.923	4.711	4.711	4.295	4.295	4.295	4.295	4.295	4.295	4.295	4.295
8481909060	8.772	4.852	4.852	4.852	4.852	4.808	4.155	4.155	4.155	4.155	4.155
8481909081	7.522	6.803	5.326	4.606	4.606	4.606	4.606	4.606	4.606	4.606	4.606
8481909085	8.526	7.071	5.371	3.745	3.745	3.745	3.745	3.745	3.745	3.745	3.745

If CES p-value is larger than 0.05, we cannot reject the hypothesis that CES is zero and we assign this value to it. Cells are blank if the demand regression cannot be run, because there is a near singular matrix or an insufficient number of observations.

Table (B.5): HS(6) products that meet the conditions CES p-value<0.05 and d=|DW-2|<0.15

HS6	Unit	HS10	AR	countries	CES	d=|DW-2|	UVR	QL
840991	kg.	7	7	40	1.413	0.126	3.076	4.270
840991	kg.	7	6	41	1.374	0.126	3.076	4.489
840991	kg.	7	1	51	1.222	0.144	4.969	8.342
840991	no.	4	6	17	1.517	0.061	5.341	5.540
840991	no.	4	1	22	1.293	0.016	5.341	6.136
840991	no.	4	4	18	1.183	0.117	5.341	7.156
840991	no.	4	5	17	1.029	0.139	5.341	8.184
840999	kg.	6	1	76	1.008	0.082	4.882	8.439
840999	kg.	6	2	63	0.967	0.104	3.996	9.404
840999	no.	3	7	13	1.261	0.103	1.874	4.042
840999	no.	3	1	25	1.127	0.076	4.636	6.663
840999	no.	3	2	22	1.074	0.090	3.157	7.188
841330	no.	4	1	63	1.042	0.035	3.590	8.290
841330	no.	4	3	43	1.004	0.093	3.590	8.406
841330	no.	4	2	48	0.951	0.053	3.590	8.916
841350	no.	5	4	32	0.631	0.025	7.164	13.141
841350	no.	5	5	31	0.524	0.029	7.164	16.209
841350	no.	5	2	40	0.442	0.061	7.164	23.112
841350	no.	5	7	31	0.391	0.144	7.164	24.439
841480	no.	21	1	57	1.004	0.059	7.733	8.854
841480	no.	21	2	47	0.919	0.114	7.733	8.558
847141	no.	2	3	38	1.120	0.037	4.628	7.227
847141	no.	2	0	76	1.158	0.052	6.428	7.217
847141	no.	2	1	46	1.157	0.009	5.323	8.536
847150	no.	2	3	40	1.157	0.018	4.521	10.175
847150	no.	2	2	43	1.129	0.119	4.521	9.692
847150	no.	2	4	39	1.096	0.091	4.521	10.970
847150	no.	2	1	50	1.069	0.090	5.299	10.967
847160	no.	7	5	37	1.202	0.084	4.187	6.866
847160	no.	7	7	36	1.043	0.097	4.187	7.759
847160	no.	7	1	53	1.239	0.026	5.664	8.314
847170	no.	11	3	39	1.055	0.144	6.770	10.841
847170	no.	11	1	48	1.088	0.035	6.770	11.143
847180	no.	3	0	82	1.149	0.117	10.197	8.545
847180	no.	3	1	53	1.086	0.149	8.064	9.254
847180	no.	3	3	45	1.022	0.067	5.607	9.405
847180	no.	3	2	49	1.039	0.054	5.607	9.293
848180	no.	35	2	61	1.030	0.098	7.650	8.565
848180	no.	35	0	108	1.078	0.115	9.680	9.415
848190	kg.	8	3	50	1.578	0.001	5.020	5.277
848190	kg.	8	2	51	1.548	0.061	5.020	5.529
848310	no.	5	0	63	0.966	0.046	8.147	9.310
848310	no.	5	3	36	0.839	0.126	5.405	10.693
848310	no.	5	1	44	0.884	0.118	7.163	10.718
848310	no.	5	2	40	0.823	0.045	7.163	11.105
847989	no.	12	1	59	0.767	0.001	9.281	13.088

Table (B.6): HS(10) products that meet the conditions CES p-value<0.05 and d=|DW-2|<0.15

HS10	AR	Ctries.	LWCtries	HWCtries	CES	d	UVR	QL
8409911040	0	26	11	15	1.496	0.145	5.851	4.615
8409911040	1	18	8	10	1.744	0.099	4.700	3.949
8409911060	4	11	1	10	1.327	0.016	2.317	1.916
8409911060	5	11	1	10	1.444	0.109	2.317	1.692
8409911080	8	12	5	7	1.686	0.071	3.519	3.346
8409913000	1	18	4	14	1.143	0.018	5.346	7.002
8409913000	4	16	4	12	1.030	0.095	5.346	10.076
8409913000	6	15	4	11	1.041	0.044	5.346	8.254
8409913000	8	14	4	10	1.225	0.038	5.149	6.261
8409915010	1	16	6	10	1.499	0.021	4.383	4.149
8409915010	2	14	5	9	1.425	0.121	4.383	4.536
8409915010	5	11	4	7	1.507	0.079	4.383	3.708
8409915010	6	10	3	7	1.362	0.099	4.383	3.902
8409915010	9	10	3	7	1.526	0.138	4.383	3.324
8409915081	1	14	5	9	0.791	0.007	3.258	10.383
8409915081	2	13	4	9	0.677	0.074	3.258	12.993
8409915085	1	43	18	25	0.826	0.102	4.686	11.934
8409915085	6	34	14	20	1.068	0.007	3.094	7.188
8409919290	0	38	13	25	1.136	0.055	4.610	5.629
8409919290	2	25	8	17	1.107	0.063	3.541	6.253
8409919290	3	24	7	17	1.095	0.118	3.541	6.142
8409919290	4	19	6	13	1.121	0.061	3.541	5.983
8409919290	5	17	6	11	0.878	0.040	3.541	7.743
8409919290	6	16	5	11	0.843	0.143	3.541	7.033
8409919910	0	19	6	13	1.243	0.118	6.232	4.089
8409919910	4	8	3	5	1.000	0.094	3.696	4.705
8409919910	7	7	3	4	0.664	0.072	3.371	13.267
8409919910	8	6	3	3	0.643	0.104	3.371	5.855
8409919990	0	59	23	36	1.212	0.014	8.103	6.731
8409919990	2	34	12	22	1.318	0.127	3.363	7.000
8409919990	3	29	10	19	1.263	0.043	2.513	3.976
8409919990	4	29	10	19	1.262	0.054	2.513	3.929
8409991040	0	30	17	13	1.490	0.128	7.147	3.850
8409991040	1	17	7	10	1.811	0.138	3.525	3.120
8409991040	4	13	6	7	2.129	0.012	2.273	2.733
8409991040	5	13	6	7	2.450	0.129	2.273	2.481
8409991040	6	12	6	6	2.627	0.022	2.198	1.293
8409991060	4	8	1	7	1.131	0.084	3.875	1.368
8409991060	5	8	1	7	1.167	0.009	3.875	1.420
8409991060	6	6	0	6	1.017	0.076	2.165	1.681
8409991060	9	3	0	3	0.889	0.012	0.502	0.212
8409991080	1	18	5	13	1.285	0.014	3.432	1.894
8409991080	2	12	5	7	1.329	0.070	3.275	2.653
8409991080	3	10	4	6	1.302	0.047	3.166	2.510
8409991080	4	8	3	5	1.277	0.076	3.166	2.562
8409991080	6	6	2	4	1.192	0.137	3.051	1.565
8409991080	7	6	2	4	1.182	0.033	3.051	1.832
8409999110	1	16	5	11	0.520	0.090	2.791	16.352
8409999110	3	11	5	6	0.770	0.054	2.597	7.897
8409999110	4	10	4	6	0.743	0.029	2.597	5.580
8409999110	5	10	4	6	0.848	0.052	2.597	4.819
8409999110	7	10	4	6	0.970	0.007	2.597	3.646
8409999110	8	10	4	6	1.028	0.111	2.597	3.541

to continue

Continuation of table (B.6)

8409999190	1	44	15	29	1.143	0.107	7.300	7.370
8409999190	4	37	11	26	1.132	0.016	3.791	5.173
8409999290	0	53	16	37	1.144	0.140	5.969	5.547
8409999290	1	31	5	26	1.030	0.008	5.594	6.906
8409999290	2	25	5	20	1.090	0.013	4.222	5.847
8409999290	3	24	5	19	1.082	0.033	4.222	5.981
8409999290	4	23	5	18	1.060	0.021	4.222	6.296
8409999290	5	22	5	17	1.095	0.065	4.222	6.335
8409999290	6	20	3	17	1.115	0.120	4.222	4.886
8409999290	8	17	2	15	1.204	0.017	2.230	3.426
8409999910	2	17	7	10	1.089	0.119	3.507	6.075
8409999910	5	12	6	6	1.271	0.085	2.526	4.018
8409999910	6	10	5	5	1.336	0.087	2.018	3.911
8409999910	7	10	5	5	1.438	0.011	2.018	3.395
8409999990	0	100	50	50	1.179	0.018	7.782	7.929
8409999990	1	67	28	39	1.178	0.023	4.952	7.284
8409999990	2	56	21	35	1.091	0.080	4.269	7.884
8409999990	5	46	15	31	1.181	0.116	4.269	7.915
8413301000	0	91	49	42	0.855	0.076	6.207	9.770
8413301000	1	59	22	37	0.787	0.017	3.357	10.66
8413810040	0	76	35	41	0.957	0.045	11.335	6.949
8413810040	1	45	17	28	1.008	0.066	8.168	6.949
8413810040	2	41	12	29	0.943	0.148	8.168	7.984
8413810040	3	35	10	25	0.902	0.031	7.795	8.145
8414800500	1	51	19	32	1.119	0.041	4.508	7.953
8471300100	0	86	39	47	1.831	0.099	4.981	7.146
8471300100	1	49	15	34	1.848	0.072	4.281	6.717
8471300100	2	41	10	31	1.793	0.020	4.117	6.764
8471300100	3	37	8	29	1.828	0.008	4.117	5.776
8471410150	0	76	32	44	1.158	0.026	6.428	7.255
8471410150	1	46	16	30	1.160	0.013	5.323	7.215
8471410150	3	38	10	28	1.121	0.038	4.628	7.222
8471500150	1	50	34	16	1.069	0.090	5.299	10.971
8471500150	2	43	13	30	1.129	0.118	4.521	10.563
8471500150	3	40	12	28	1.156	0.019	4.521	10.964
8471500150	4	39	12	27	1.096	0.091	4.521	11.669
8471601050	2	28	8	20	1.243	0.097	4.213	4.954
8471601050	3	25	6	19	1.396	0.063	2.771	3.858
8471601050	4	23	6	17	1.417	0.005	2.771	4.927
8471601050	5	20	5	15	1.315	0.081	2.540	4.029
8471601050	6	18	5	13	1.017	0.128	2.540	4.113
8471601050	7	17	5	12	0.748	0.068	2.540	8.193
8471602000	1	34	9	25	1.063	0.108	5.847	6.613
8471602000	3	26	8	18	0.854	0.070	4.796	8.475
8471607000	1	32	7	25	1.123	0.017	5.484	4.123
8471608000	1	37	10	27	1.195	0.017	5.684	8.135
8471608000	3	30	8	22	1.210	0.063	5.665	7.413
8471609030	1	18	5	13	1.211	0.011	6.183	4.606
8471609030	2	17	5	12	1.027	0.091	6.183	6.216

to continue

Continuation of table (B.6)

8471609050	1	42	12	30	1.471	0.013	5.551	4.935
8471609050	3	34	9	25	1.562	0.025	5.453	4.510
8471609050	4	32	9	23	1.474	0.093	5.453	5.901
8471609050	6	27	7	20	1.373	0.122	5.453	6.638
8471609050	7	26	6	20	1.188	0.106	5.453	7.700
8471900000	0	73	31	42	0.942	0.066	8.179	8.745
8471900000	1	51	20	31	0.924	0.028	7.945	9.073
8473301140	0	67	30	37	1.320	0.065	8.748	8.209
8473301140	1	43	16	27	1.416	0.006	7.090	7.061
8473301140	2	37	13	24	1.382	0.045	6.513	6.709
8473301140	3	32	13	19	1.430	0.087	6.513	7.130
8473301140	4	30	12	18	1.384	0.102	6.513	7.417
8479899899	1	51	15	36	0.813	0.043	9.510	12.005
8479899899	2	45	12	33	0.778	0.059	9.510	10.094
8479899899	3	43	11	32	0.796	0.131	9.510	10.818
8481809015	1	51	17	34	1.059	0.090	8.473	7.631
8481809015	2	46	14	32	1.035	0.007	8.081	7.860
8481809015	3	41	11	30	1.045	0.141	8.055	7.880
8481809050	1	53	15	38	1.065	0.093	7.250	7.093
8481901000	2	26	8	18	1.820	0.015	2.149	3.646
8481901000	4	24	8	16	1.604	0.010	2.149	4.931
8481901000	7	20	6	14	1.815	0.006	2.149	4.174
8481901000	8	20	6	14	2.196	0.111	2.149	3.717
8481903000	0	44	14	30	1.205	0.023	3.899	5.627
8481903000	1	37	10	27	1.243	0.128	3.899	5.486
8481903000	3	33	10	23	1.174	0.104	3.899	5.782
8481905000	0	48	17	31	1.231	0.108	5.787	5.783
8481905000	1	35	10	25	1.242	0.038	4.723	6.181
8481909020	1	33	10	23	1.280	0.072	4.295	5.448
8481909020	2	29	8	21	1.218	0.103	4.295	5.255
8481909020	4	25	7	18	1.241	0.107	4.295	5.269
8481909040	1	43	14	29	1.287	0.050	4.711	5.733
8481909060	1	43	14	29	1.200	0.012	4.852	6.995
8481909060	5	36	10	26	1.275	0.096	4.808	6.244
8481909081	0	37	11	26	1.237	0.130	7.522	4.088
8481909081	1	25	10	15	1.246	0.064	6.803	4.964
8481909081	3	19	7	12	1.327	0.123	4.606	3.422
8481909081	4	16	6	10	1.597	0.036	4.606	2.599
8481909081	5	16	6	10	1.265	0.036	4.606	4.113
8481909081	6	16	6	10	1.638	0.122	4.606	3.019
8481909085	1	56	23	33	1.378	0.084	7.071	5.969
8481909085	2	50	19	31	1.279	0.012	5.371	6.286
8481909085	3	47	16	31	1.255	0.029	3.745	6.259

There are 43 HS(10) products and 145 regressions. Four products are excluded, two due to CES p-value>0.05 and two due to d>0.15.

Table (B.7): US imports of the 47 HTS(10) products with CES>1, d<0.10, and QL<5.0

No.	HS(10)	Prod.&Seg.	AR	Ctries. in regressions		US imports (USD) of prod. and seg.		All countries		Total US imports (USD)	
				h-w	l-w	high-wage	low-wage	h-w	l-w	high-wage	low-wage
1	8409911040	non-segmented	1	10	8	$96,766,522	$34,140,855	15	11	$96,830,921	$34,284,447
2	8409911060	non-segmented	4	10	1	$7,941,315	$834,048	28	8	$9,262,651	$948,793
3	8409911080	non-segmented	8	7	5	$70,951,653	$21,570,438	23	10	$73,418,794	$22,358,647
5	8409915010	non-segmented	1	11	5	$169,416,124	$42,129,261	14	9	$169,551,918	$42,259,614
11	8409919990	non-segmented	4	19	10	$274,810,516	$431,214,825	36	23	$275,993,702	$431,685,438
12	8409991040	non-segmented	4	7	6	$37,762,087	$314,989,040	17	12	$38,207,492	$316,704,388
13	8409991060	non-segmented	4	7	1	$3,445,207	$823,350	24	7	$4,259,047	$2,902,000
14	8409991080	non-segmented	1	13	5	$7,197,556	$4,500,021	19	9	$7,383,262	$4,554,801
18	8409999290	non-segmented	8	15	2	$79,471,872	$6,087,087	37	16	$82,615,616	$7,482,250
19	8409999910	non-segmented	5	6	6	$26,429,690	$27,109,265	23	14	$27,472,836	$27,224,033
29	8471601050	non-segmented	2	20	8	$90,811,362	$169,115,239	31	19	$91,666,443	$169,499,116
31	8471607000	non-segmented	1	25	7	$34,169,141	$60,344,283	30	15	$34,389,404	$60,680,689
33	8471609030	non-segmented	1	13	5	$18,538,458	$19,423,127	21	8	$18,764,182	$19,652,980
34	8471609050	non-segmented	1	30	12	$128,644,907	$816,545,616	37	24	$128,773,854	$816,983,644
40	8481901000	non-segmented	2	18	8	$133,932,539	$267,587,365	25	14	$134,606,952	$268,047,283
46	8481909081	non-segmented	1	15	10	$38,465,333	$42,330,449	26	11	$38,582,089	$42,364,467
4	8409913000	high-mean	1	11	0	$126,141,557	$0	15	4	$156,132,578	$711,764,686
7	8409915085	high-median	3	9	5	$33,068,020	$39,218,668	32	21	$2,034,209,710	$1,616,223,186
9	8409919290	low-mean	1	5	4	$20,262,979	$18,655,111	25	13	$78,576,928	$19,589,860
10	**8409919910**	low-median	1	3	6	$4,968,571	$18,392,853	13	6	**$9,310,295**	**$18,392,853**
		high-median	9	2	0	$3,729,062	$0				
16	8409999190	low-mean	6	3	3	$326,114,661	$301,752,375	31	22	$774,468,166	$604,213,143
20	**8409999990**	low-median	6	13	10	$501,849,192	$525,740,916	50	50	**$689,140,263**	**$568,771,516**
		high-median	3	17	5	$185,703,126	$39,756,407				
22	8413810040	low-mean	2	7	2	$49,382,693	$126,324,080	41	35	$246,384,626	$152,605,092
23	8414800500	low-median	7	8	8	$54,838,804	$607,034,926	43	35	$274,393,761	$620,985,332
24	8471300100	high-median	0	25	18	$611,914,640	$2,836,731	46	40	$922,602,118	$41,785,253,816
26	8471410150	high-median	4	14	0	$115,929,838	$0	44	32	$370,597,243	$1,613,706,216
30	8471602000	high-median	0	16	4	$9,128,263	$13,973,560	29	11	$57,246,187	$741,307,137
36	8473301140	high-mean	7	8	4	$1,769,254,595	$3,646,448,421	37	30	$2,357,182,882	$4,336,260,855
41	**8481903000**	low-median	5	8	8	$87,868,898	$239,779,276	30	14	**$114,069,832**	**$240,577,135**
		high-median	1	15	2	$25,262,255	$726,792				
42	**8481905000**	low-mean	0	3	7	$25,146,235	$251,305,913	31	17	**$91,284,272**	**$260,615,189**
		high-median	1	15	2	$10,005,978	$3,456,578				
43	**8481909020**	low-median	2	13	5	$145,948,250	$35,152,630	28	12	**$159,574,600**	**$36,933,374**
		high-median	1	10	4	$13,569,019	$1,691,629				
44	**8481909040**	low-mean	3	5	4	$89,310,001	$69,217,531	34	20	**$267,426,786**	**$176,091,540**
		high-median	1	15	5	$35,110,190	$105,262,788				
45	8481909060	low-mean	5	1	5	$24,172,753	$440,393,578	33	27	$378,400,669	$453,407,099
47	**8481909085**	low-mean	3	5	3	$240,539,605	$416,897,817	47	33	**$1,055,442,046**	**$632,868,600**
		high-median	1	13	11	$55,165,194	$63,140,181				
6	8409915081	-	-	-	-	-	-	-	-	$46,090,548	$119,553,283
8	8409919210	-	-	-	-	-	-	-	-	$1,420,182	$33,893
15	8409999110	-	-	-	-	-	-	-	-	$45,491,881	$109,312,147
17	8409999210	-	-	-	-	-	-	-	-	$3,512,978	$0
21	8413301000	-	-	-	-	-	-	-	-	$390,242,842	$351,670,199
25	8471410110	-	-	-	-	-	-	-	-	$359,081	$80,241
27	8471500150	-	-	-	-	-	-	-	-	$1,129,050,655	$13,693,401,185
28	8471601010	-	-	-	-	-	-	-	-	$78,722	$66,502
32	8471608000	-	-	-	-	-	-	-	-	$362,809,023	$354,920,726
35	8471900000	-	-	-	-	-	-	-	-	$248,410,803	$924,379,720
37	8479899899	-	-	-	-	-	-	-	-	$2,171,709,544	$430,507,557
38	8481809015	-	-	-	-	-	-	-	-	$486,793,922	$386,836,900
39	8481809050	-	-	-	-	-	-	-	-	$639,834,995	$438,792,928

Table (B.8) : US imports of the 47 HTS(10) products with CES>1, d<0.15, QL<4.0, and QL*<3.95

No.	HS(10)	Prod.&Seg.	AR	Ctries. in regressions		US imports (USD) of prod. and seg.		All countries		Total US imports (USD)	
				h-w	l-w	high-wage	low-wage	h-w	l-w	high-wage	low-wage
1	8409911040	low-median	1	5	6	$68,546,046	$33,872,056	15	11	**$96,830,921**	**$34,284,447**
		high-median	1	5	2	$28,220,476	$268,799				
2	8409911060	non-segmented	4	10	1	$7,941,315	$834,048	28	8	$9,262,651	$948,793
3	8409911080	non-segmented	8	7	5	$70,951,653	$21,570,438	23	10	$73,418,794	$22,358,647
4	8409913000	high-mean	1	11	0	$126,141,557	$0	15	4	$156,132,578	$711,764,686
5	8409915010	non-segmented	9	7	3	$169,073,078	$41,031,232	14	9	$169,551,918	$42,259,614
10	**8409919910**	low-mean	3	2	2	$4,894,039	$10,507,317	13	6	**$9,310,295**	**$18,392,853**
		high-median	9	2	0	$3,729,062	$0				
11	8409919990	low-median	5	9	6	$156,104,787	$383,449,522	36	23	$275,993,702	$431,685,438
12	8409991040	non-segmented	0	17	13	$38,207,492	$316,704,388	17	13	$38,207,492	$316,704,388
13	8409991060	non-segmented	4	7	1	$3,445,207	$823,350	24	7	$4,259,047	$2,902,000
14	8409991080	non-segmented	1	13	5	$7,197,556	$4,500,021	19	9	$7,383,262	$4,554,801
15	8409999110	non-segmented	8	6	4	$45,169,883	$108,776,688	15	8	$45,491,881	$109,312,147
16	8409999190	low-mean	6	3	3	$326,114,661	$301,783,475	31	22	$774,468,166	$604,213,143
18	8409999290	non-segmented	8	15	2	$79,471,872	$6,087,087	37	16	$82,615,616	$7,482,250
19	8409999910	non-segmented	7	5	5	$26,334,552	$26,946,159	23	14	$27,472,836	$27,224,033
20	8409999990	low-mean	1	5	4	$17,279,999	$484,001,048	50	50	$689,140,263	$568,771,516
26	8471410150	high-median	4	14	0	$115,929,838	$0	44	32	$370,597,243	$1,613,706,216
29	8471601050	non-segmented	3	19	6	$90,761,483	$168,558,336	31	19	$91,666,443	$169,499,116
31	**8471607000**	low-mean	0	3	3	$1,613,515	$52,902,513	30	15	**$34,389,404**	**$60,680,689**
		high-mean	4	13	2	$31,576,399	$7,336,421				
33	8471609030	high-median	0	12	2	$5,485,572	$90,958	21	8	$18,764,182	$19,652,980
34	8471609050	low-median	8	13	3	$72,353,031	$792,096,099	37	24	$128,773,854	$816,983,644
40	8481901000	non-segmented	2	18	8	$133,932,539	$267,587,365	25	14	$134,606,952	$268,047,283
41	**8481903000**	low-median	7	7	8	$86,718,765	$239,779,276	30	14	**$114,069,832**	**$240,577,135**
		high-median	1	15	2	$25,262,255	$726,792				
42	8481905000	low-mean	9	2	4	$25,067,712	$251,076,443	31	17	$91,284,272	$260,615,189
44	8481909040	low-median	3	14	5	$232,138,190	$70,029,119	34	20	$267,426,786	$176,091,540
45	8481909060	low-mean	6	1	4	$24,172,753	$440,016,714	33	27	$378,400,669	$453,407,099
46	8481909081	non-segmented	3	12	7	$38,372,587	$41,638,823	26	11	$38,582,089	$42,364,467
7	8409915085	-	-	-	-	-	-	-	-	$2,034,209,710	$1,616,223,186
9	8409919290	-	-	-	-	-	-	-	-	$78,576,928	$19,589,860
22	8413810040	-	-	-	-	-	-	-	-	$246,384,626	$152,605,092
23	8414800500	-	-	-	-	-	-	-	-	$274,393,761	$620,985,332
24	8471300100	-	-	-	-	-	-	-	-	$922,602,118	$41,785,253,816
27	8471500150	-	-	-	-	-	-	-	-	$1,129,050,655	$13,693,401,185
30	8471602000	-	-	-	-	-	-	-	-	$57,246,187	$741,307,137
32	8471608000	-	-	-	-	-	-	-	-	$362,809,023	$354,920,726
36	8473301140	-	-	-	-	-	-	-	-	$2,357,182,882	$4,336,260,855
38	8481809015	-	-	-	-	-	-	-	-	$486,793,922	$386,836,900
39	8481809050	-	-	-	-	-	-	-	-	$639,834,995	$438,792,928
43	8481909020	-	-	-	-	-	-	-	-	$159,574,600	$36,933,374
47	8481909085	-	-	-	-	-	-	-	-	$1,055,442,046	$632,868,600
35	8471900000	-	-	-	-	-	-	-	-	$248,410,803	$924,379,720
21	8413301000	-	-	-	-	-	-	-	-	$390,242,842	$351,670,199
37	8479899899	-	-	-	-	-	-	-	-	$2,171,709,544	$430,507,557
6	8409915081	-	-	-	-	-	-	-	-	$46,090,548	$119,553,283
8	8409919210	-	-	-	-	-	-	-	-	$1,420,182	$33,893
17	8409999210	-	-	-	-	-	-	-	-	$3,512,978	$0
25	8471410110	-	-	-	-	-	-	-	-	$359,081	$80,241
28	8471601010	-	-	-	-	-	-	-	-	$78,722	$66,502