Journal of Economic Integration
26(1), March 2011; 110-135

Quality Competition Versus Price Competition Goods: An Empirical Classification

Richard E. Baldwin
Graduate Institute

Tadashi Ito
Okinawa University

Abstract

Based on theoretical distinctions suggested by the heterogeneous firms trade model and the quality heterogeneous firms trade model, we classify exports at the HS 6-digit level as being characterised by either quality or price competition. We find a high proportions of quality-competition goods for the major EU countries and lower proportions for Canada, Australia and China. However, the overlap of these quality-competition goods is not large which suggests that the HS-6 digit data is too aggregate; firm-level data may be needed. Our findings suggest that dumping investigations must pay careful attention to the exact definition of products, and the study of technological gaps across nations by analysing composition of their export basket (Hausman, Huang and Rodrik 2007) should be interpreted with caution.

• **JEL Classification:** F14

• **Keywords:** Quality vs Price Competition, Heterogeneous Firms Trade Model.

I. Introduction

Recent work on the theory and empirics of firm heterogeneity and trade provides

*Corresponding address: Richard E. Baldwin;11 Avenue de la Paix, 1202 Geneva, Switzerland; Baldwin@graduateinstitute.ch/Tadashi Ito; Aza-Kokuba 555, Naha, Okinawa, Japan; tadashiito@okinawa-u.ac.jp, Tadashi.Ito@graduateinstitute.ch.

new and wide ranging insights. In the mainstay model in this 'new new trade theory' – the heterogeneous firms trade model of Melitz (2003) – competitiveness of a firm's product depends upon price; the cheapest goods are the most competitive. A minor twist on this model (which was foreshadowed by a footnote in Melitz 2003) turns the standard heterogeneous firms trade (HFT) model into the quality heterogeneous firms trade (QHFT) model where the price-competitiveness link is reversed. If consumers care enough about quality, goods with the highest observed prices will be the most competitive because their quality-adjusted price is lower.[1]

This observation provides a simple way of empirically separating the HFT and QHFT models in trade data. Since trade costs rise with distance, the HFT model predicts that products with the lowest price get sold in the most distant markets while the opposite holds in the QHFT, i.e. the highest priced goods travel furthest. These diametrically opposed implications provide the foundation of a test of the models by Baldwin and Harrigan (2006), BH henceforth; that paper, however, pools across all categories of US exports thus implicitly assuming that all US exports are characterised either by a falling price-distant link (HFT) or by a rising price-distant link (QHFT).

Our paper follows up on the BH by estimating the price-distance relationship separately for each product using panel data. Our paper's main value-added is to establish a list of three types of products. Those where competition appears to be based on price, those where it is based on quality, and those that cannot be confidently placed in either category. Specifically we use export data for nine large exporting nations at the HS 6-digit[2] level of disaggregation. Our key findings are:

i) Of the HS 6-digit codes that can be clearly classified as quality or price competition, 50 to 60% of HS 6-digit codes exports of large European nations can be classified as 'quality goods', while about 40% of US and Japanese exports fall into this category.

We believe that the difference may lie in pervasive trade in parts and components stemming from US and Japanese companies' offshoring strategies that means nearby customers (the offshored factories) are a different type of buyers than the far away customers (arm's length purchasers).

ii) For commodity exporters like Canada and Australia, the fraction of quality goods is much lower, only 15-25%. The share of quality goods in China's exports

[1] See Baldwin and Harrigan (2010).
[2] In the text below, the terms 'HS 6-digit' and 'HS 6' are used interchangeably.

also fall in this range.

Taken together, these findings seem to match our priories that nations with a comparative advantage in raw materials should systematically see a lower incidence of quality-type goods in their export mix.

Our finding of price-distance link suggests some policy implications. Dumping investigations must pay careful attention to the exact definition of products. And the study of technological gaps across nations by analysing composition of their export basket (Hausman, Huang and Rodrik 2007) should be interpreted with caution.

A. Literature

One of the pioneering articles on the empirical front to use price as a proxy for quality is Schott (2004). It has documented a large difference in product prices within the most disaggregated level of product classification. Schott (2008) shows that the US consumers pay less for “Made in China” than for “Made in OECD” for similar goods. Fontagné, Gaulier, and Zignago (2008), analysing unit prices of HS 6-digit products of 200 countries, finds that the developed countries’ products are not directly competing with the developing countries’ products. Especially, because of their products’ superior quality, EU countries have less direct competition with the developing countries than Japan or the US does.

These findings have important policy relevance. It suggests that developed countries can maintain their competitiveness by climbing up the quality ladders within the existing industries rather than moving to a new industry. However, while quality matters for some goods, price rather than quality matters for other goods. Baldwin and Harrigan (2010) finds that US export prices at the HS 10-digit level are increasing in distance to foreign markets and suggests a quality-augmented Melitz model to back up this result. Helble and Okubo (2008), Kneller and Zhihong (2008) find similar results for EU15 countries and China, respectively.

The paper closest to ours is Johnson (2009). Employing the same approach as ours, namely the correlation between export thresholds and average export unit values, it proposes a rigorous procedure to study if quality is homogeneous or heterogeneous at SITC 4-digit level; the paper shows that heterogeneous quality is dominant. In order to increase the number of observations, Johnson (2009) uses the data of 125 (reporter and/or partner) countries in the year 2004. The key difference between Johnson (2009) and our paper is the goal of the investigation. Johnson (2009) convincingly showed that the pooling in Baldwin and Harrigan (2010) was not justified. The purpose of our paper is to classify goods into quality competition and price competition at the most disaggregated level and also to see the proportions of these two types of goods for the major exporter countries. In this sense, our paper can be viewed as the next obvious step in the direction taken by Johnson (2009).

B. Plan of paper

Section I briefly reviews the theory that structures our empirical exercise. Section II and III explain the data, estimation strategy, and results. Section IV discusses our robustness checks, and the final section our concluding remarks and discussion of policy implications.

1. Theoretical framework

To structure our empirical analysis, we briefly summarize the price competition and quality competition versions of the heterogeneous firms trade model, highlighting two simple empirically testable predictions.

The classic HFT model (Melitz 2003) can be thought of as the Dixit-Stiglitz monopolistic competition trade model where firms have randomly drawn marginal cost functions and face iceberg trade costs as well as a fixed cost of establishing a 'beachhead' in each market.

The Dixit-Stiglitz structure links the value of sales directly to operating profits, so the beachhead cost means that only sufficiently competitive firms export. Moreover, distance-linked iceberg trade costs imply that a firm's competitiveness is diminished in more distant markets, so export status displays a distance-marginal cost gradient. The threshold degree of competitiveness necessary to sell in markets rises with the market's distance, so average competitiveness of firms servicing a particular market rises with distance.

This basic distance-competitiveness link holds in both the HFT and QHFT models; the difference lies in the determinants of competitiveness. In HFT, price is the sole basis of competition, i.e. market entry thresholds can be written in terms of a maximum price. In QHFT, competitiveness depends upon quality-adjusted price, so market-entry thresholds are defined in terms of quality-adjusted price; lower quality-adjusted prices (unobserved) are associated with higher unadjusted (observed) prices, so firms only export the most expensive goods to the most distant markets.

The BH test of this prediction found that the QHFT provided a better explanation of the US export data for 2005. That finding, however, pools across all US exports, thus implicitly assuming that all US exports are marked either by quality competition or by price competition.

In this paper, we explore the hypothesis that some goods may fit HFT predictions while others fit the QHFT predictions (Johnson 2009). The hope is that we can identify a set of products which are – for a number of major exporting nations – characterised by either HFT or QHFT.

2. Data, and empirical model

Taking the distance-price prediction to the data requires some care in handling the theoretical predictions. Suppose we had the true product-level data, i.e. data on the prices and sales by particular firms of particular products in particular destination markets. If the baseline model is true, Dixit-Stiglitz mark-up pricing would imply that the producer price, i.e. FOB price, for each variety would be insensitive to distance. The selection of products however would generate a negative distance-average-price relationship (the set of varieties to the most distant markets would contain only the cheapest goods). In other words, the distance-price-gradient prediction stems from product/firm selection, not from firms' pricing behaviour.

However, as our goal is to establish a classification that could be useful to researchers in many areas, we want to work with data that is available for a broad range of nations and years. This leads us to work with publicly available trade data where the finest disaggregation available is HS 6-digit for all nations.[3] For the US, Japan and EU, data is available at finer levels for trade with these three nations, but not for trade among their partners. Given this, our measure of price is inevitably unit-value indices, i.e. a rough form of average price where the selection effects should be in effect. Specifically, we should find that the average export price rises with distance if competition is over quality (the QHFT model) or falls if the competition is over price (the HFT model).

The point can be illustrated with a simple example, take for instance HS 6 category 854449 which comprises "other electric conductors for a voltage less than or equal to 80 volts". Inside this category will be some high priced varieties and some low priced varieties (they coexist in both models due to product differentiation). The empirical leverage comes from the way the nation-specific product mix changes with distance of the market. If QHFT is correct, Germany's

[3]Below, we report some sensitivity analysis at the HS 9-digit level for Japan.

HS 854449 export basket to France will have more low priced varieties than its export basket to the US. Empirically, this will show up as a lower unit value index for Germany's HS 854449 exports to France. If the HFT model is correct, we should observe the opposite.

A. Empirical model

The empirical model we employ is akin to BH. The main difference lies in our use of log-linear distance (instead of distance bands) and our panel dimension.

BH uses a panel for US exports of different products to different destinations but for a single year. Our panel data looks at a given origin nation's exports of a given HS 6 product to all the destination countries over a ten years period (1997-2006). For example, as is shown below, 5,266 HS 6-digit lines have at least 20 observations for the whole period. We run 5,266 regressions for the US. We do the same for the other 8 exporters. In total, we estimate approximately 40,000 regressions.

The typical regression equation is:

$$p_{t,d} = \beta_0 + \beta_1 \log(DIST_d) + \beta_2 \log(GDP_{t,d}) + \beta_3 \log(GDPCAP_{t,d}) + \tilde{\beta}_4 D + \varepsilon_{t,d} \quad (1)$$

where $p_{t,d}$ is the log of the FOB unit value index to destination country d at time t (recall that each set of regressions is for a single origin nation, so there is no origin-nation subscript), $DIST_d$ is the bilateral distance from the origin-nation under study and destination country d, and $GDP_{t,d}$ is the destination-country GDP at time t; $GDPCAP_{t,d}$ is the corresponding GDP per capita, D is a vector of year dummies, and $\varepsilon_{t,d}$ is an iid error.

B. Data

The export data we use is for 9 exporters (the world's top 8 exporters plus Australia) for 1997 to 2006. These are taken from the UN COMTRADE database. The distance data are from CEPII; the GDP and population data are from the World Development Indicators of the World Bank.

Table 1. Global export rank and numbers exported HS 6 lines

	US	Germany	Japan	China	France	UK	Italy	Canada	Australia
Rank	1	2	3	4	5	6	7	8	26
Lines	4,842	4,550	4,150	4,557	4,674	4,751	4,664	3,465	3,942

Source: UN COMTRADE, Author's calculation.

For the nine exporting nations we work with, Table 1 shows the world export rank and the number of HS 6-digit lines with at least 20 observations.

III. Results

Table 2 summarises the results.[4] The first column shows the total number of HS 6 products exported. The second column shows the number of HS 6 products for which the distance coefficient is statistically significant (5% level). The third and fourth columns show the breakdown of these significant distance coefficients between those that are positive and those that are negative. The first three rows show the results for the US, Germany and Japan; we start the discussion with these three taking the US numbers first.

Out of the US's 4,842 HS 6-digit products, 2,383 products have statistically significant distance coefficients with 2,121 of these being positive. This suggests that about 44% of US HS 6 exports are 'quality goods', about 5% are 'price goods'. The remainder, 51%, cannot be classified, perhaps because the statistical groupings bundle together price and quality products.

The results for Japan are broadly consistent with those for the US, with 38% of the HS 6 lines displaying positive distance coefficients (suggesting quality

Table 2. Numbers of quality-competition and price-competition goods

	Total number of HS6 digit products exported	lines where distance is significant at 5%	Number with positive coefficient (quality competition)		Number with negative coefficient (price competition)	
USA	4,842	2,383	2,121	44%	262	5%
Germany	4,550	2,531	2,251	49%	280	6%
Japan	4,150	1,947	1,590	38%	357	9%
Overlap (J, D, US)	3,894	624	435	11%	3	0%
France	4,674	2,749	2,519	54%	230	5%
UK	4,751	2,464	2,232	47%	232	5%
Italy	4,664	3,136	2,994	64%	142	3%
Canada	3,465	754	510	15%	244	7%
Australia	3,942	1,255	1,075	27%	180	5%
China	4,557	1,722	946	21%	776	17%

Source: See text.

[4]A separate file with the complete list of quality and price competition goods by country is available from the authors upon request.

competition) and 9% displaying negative coefficients.

Findings for the four large EU exporters, Germany, France, Britain and Italy, reveal a much higher share of quality goods. About 50% of German, French and British exports are classified as quality goods, while the figure for Italy is almost 60%. We also note that the share of unclassifiable lines is much lower for these nations, with the share range from 33% for Italy to 48% for Britain, while France and Germany both close to 40%.

To check whether this dominance of quality goods is universal – a result that would not be in line with prior expectations – we run the thousands of product-level regressions for nations who are more dependent on commodity exports. For thus, our priors are that price competition should be more important.

Australia and Canada are the nations we chose as they are both large exporters, heavily reliant on primary good exports and have excellent data. For these two nations the share of quality goods is only 15% (Canada) and 27% (Australia). The share of price goods is 7% for Canada, and 5% for Australia.

China presents an interesting case. Its exports are dominated by industrial goods, but it is widely perceived to be an export of varieties where low prices are the key to their success. In line with these priors, we find that about 21% of Chinese exports are quality-goods by our measure and 17% of its exports are price goods.

A. Overlap among US, German and Japanese quality goods

Our panel technique means that we classify HS 6 lines as price, quality or unclassifiable separately for each exporting nation. The next question is whether there is a great deal of overlap among the various exporter-level classifications. That is, do certain HS 6 lines consistently fall into one category or the other for most export nations?

The fourth row of Table 2 answers the question by showing the number of HS 6-digit lines that overlap among the US, Japanese and German categorisations. In particular, the fourth row shows the number of products where the statistically significant distance coefficient is of the same sign for all the three countries.

Out of 3,894 HS 6-digit product lines which were common for all the three countries, 624 show statistically significant coefficients for all the three countries. Out of the 624 product lines, 435 show statistically significant *positive* coefficient estimates (suggesting quality competition) for all the three countries. This consistent result suggests that products in these HS codes could be considered as marked by quality competition.[5] Only three HS 6-digit code has statistically significant negative coefficient estimate for all the three countries.

There are 164 products that show two positive signs and one negative sign, so maybe we could call these quasi-quality competition goods. 22 products show one positive sign and two negative signs. Similarly, we could call these quasi-price competition goods. The proportion of quality and quasi-quality competition goods is much higher than price and quasi-price competition goods.

The rather small proportion of the overlap of product codes across the three countries – just 11% of the common lines – suggests that the HS 6 level of disaggregation is not sufficiently fine to really provide a clear-cut classification that is valid globally.[6]

B. More detailed disaggregation

The fact that fewer than one out of ten lines can be unambiguously classified as quality or price goods suggests that there may be a great deal of heterogeneity (across exporters) among the basket of goods included in each HS 6 category. To investigate the hypothesis, we compare the analyses at HS 6 results with estimates on HS 9-digit data for Japan. To this end, we repeat the exercise for all the HS 9 lines within given HS 6 codes.

1. HS 9-digit versus HS 6-digit using Japan's data

Japan has approximately 5,000 lines at the HS 6 level and roughly 9,100 lines at the HS 9 level. Some HS 6 codes have only a single HS 9 code, rendering our test invalid so we discard all such HS 6 codes. Since the purpose here is a simple check, not an exhaustive analysis, we have conducted an analysis using a random sample from HS codes; specifically on a 1% random sample of the remaining HS 6 codes. For these randomly sampled HS 6 codes, we redo the equation (1) regressions for each of the constituent HS 9 lines. The central question is whether we find variation of the distance coefficients across the HS 9 categories that make up a particular HS 6 category.

Table 3 summarises the results. The left panel shows the HS 6 results, with the

[5] The 435 figure represents just 11% of the 3,905 HS 6-digit product lines exported (about 10% in terms of *export value*).

[6] The complete lists of Price-competition goods, Quality-competition goods, and the overlap among the three countries are not attached here since it exceeds 400 pages. They are available as the appendix data of our NBER Working Paper No. 14305 at http://www.nber.org/papers/w14305, or our HEID Working paper at http://www.graduateinstitute.ch/economics/working-papers.html

Table 3. HS 6 vs HS 9 estimates

HS 6 code	Distance coefficient	p	Coefficient sign	HS 9 code	Distance coefficient	p	Coefficient sign	Fit
30791	0.79	0	+	30791100	0.54	0.06		H
				30791100	0.81	0	+	
370252	0.23	0	+	370252000	0.2	0	+	F
				370252100	0.26	0	+	
390290	-0.03	0.73		390290100	0.11	0.13		F
				390290900	0.15	0.2		
500720	0.11	0.12		500720110	0.28	0.05		F
				500720120	0.09	0.13		
				500720190	0.15	0.07		
				500720200	0.19	0.2		
520544	0.21	0.01	+	520544100	0.04	0.77		N
				520544900	0.15	0.13		
520831	-0.24	0.01	-	520831100	-0.32	0.01	-	MH
				520831200	-0.05	0.62		
				520831300	-0.15	0.05	-	
				520831900	-0.21	0.04	-	
540744	-0.17	0.1		540744100	-0.18	0.3		F
				540744900	-0.14	0.17		
610690	0.33	0	+	610690100	0.51	0	+	H
				610690900	0.17	0.51		
610990	0.4	0	+	610990110	0.67	0	+	MH
				610990120	0.51	0	+	
				610990190	0.34	0	+	
				610990910	0.23	0.1		
				610990990	0.46	0.02	+	
611120	0.35	0	+	611120295	0.02	0.89		N
				611120300	0.12	0.49		
				611120900	0.01	0.95		
611610	-0.25	0	-	611610000	-0.36	0.02	-	H
				611610500	-0.14	0.14		
710692	0.94	0	+	710692100	0.82	0	+	F
				710692900	0.43	0	+	
841430	0.32	0	+	841430100	0.29	0	+	F
				841430900	0.24	0	+	
845630	0.2	0	+	845630110	0.18	0	+	F
				845630190	0.23	0	+	
				845630900	0.8	0	+	
854449	0.1	0.29		854449100	0.17	0.62		MH
				854449110	0.58	0	+	
				854449190	0.7	0	+	
				854449910	0.02	0.85		
				854449990	-0.05	0.71		

Table 3. HS 6 vs HS 9 estimates (continued)

901890	-0.06	0.32		901890110	0.12	0	+	
				901890190	0.2	0	+	
				901890200	0.59	0	+	
				901890311	0.05	0.61		N
				901890319	0.33	0	+	
				901890390	-0.31	0	-	
				901890900	0.12	0.25		

Source: See text.

first column displaying the HS 6 code, the second the distance coefficient and the third the p-value. The fourth column summarise the finding by putting a + or – where the distance coefficient is positive or negative at the 5% level respectively. The right panel shows similar statistics for the HS 9 codes that make up the corresponding HS 6 code. The final column summarises the match between the two; we denote this with an H (half-match), F (full-match) or MF (more-than-half-match) with N indicating no-match at all.

Out of the total 16 HS 6-digit codes we checked, 7 have full fit and 3 have more than a half fit. Only 3 have no match. Closer examination of the no-match cases is revealing. In two of the cases (520544 and 611120), the distance coefficient is positive and significant for the data pooled at the HS 6 level, but none of the underlying HS 9 coefficients are significant. We note however that the HS 9 coefficients are positive. This suggests that the lack of variation in the HS 9 export destinations may account for the lack of statistical significance.

The remaining case of no match (901890) is very instructive. Here we see that most of the HS 9 coefficients are positive, but one is negative. The aggregate HS 6 coefficient is estimated to be negative but not significantly different from zero. This case suggests that the HS 6 classification is inappropriate for our purposes in that it pools price and quality goods. If this sort of result were widespread, then it would cast doubt on our HS 6 results, but the fact that it occurs in only one of the 16 cases provides some assurance that our HS 6 estimates are yielding useful results.

To interpret these results, note that if HS 9 heterogeneity is a key source of the low number of goods that can be clearly classified as quality or price goods, then we should see a stark mismatch between the results indicated by the HS 9 data and the more aggregated HS 6 data, i.e. many “N” in the final column. While further testing is required, using for example US HS 10, our exploratory investigation

Table 4. Germany, France and the UK at HS 6-digit, 1997-2006

	Total number of HS8 digit products exported	Number HS8 lines where distance is significant at 5%	Number with positive coefficient (qualiy competition)		Number with negative coefficient (price competition)		Unclassified
Germany	4,550	2,531	2,251	49%	280	6%	44%
France	4,674	2,794	2,519	54%	230	5%	41%
United Kingdom	4,751	2,464	2,232	47%	232	5%	48%
Overlap	4,313	1,056	950	22%	6	0%	78%

Source: See text.

suggests that analysis at HS 6 level provides a reasonably good indication of the underlying situation. It is particularly important to note that in no case did the HS 6 result indicate that the line was a quality or price good when the HS 9 data indicated otherwise.

2. HS 8-digit versus HS 6-digit using EU's data

Although the most disaggregated internationally harmonised classification code is at 6-digit, EU countries record their trade at a more detailed 8-digit. This feature allows us to check whether the share of classifiable goods changes significantly at a finer level of disaggregation.

To this end, we run the product-by-product regressions for each of the three largest EU traders first at the HS 9 level and compare the results with the HS 6 level results from above. Comparing Table 4, which reproduces the results at HS 6-digit, and Table 5, which shows the results at HS 8-digit, we notice two facts.

Table 5. Germany, France and the UK at HS 8-digit, 1997-2006

	Total number of HS8 digit products exported	Number HS8 lines where distance is significant at 5%	Number with positive coefficient (qualiy competition)		Number with negative coefficient (price competition)		Unclassified
Germany	7,690	4,969	4,410	57%	554	7%	35%
France	6,834	4,368	4,038	59%	330	5%	36%
United Kingdom	6,546	3,675	3,174	48%	501	8%	44%
Overlap	5,197	1,620	1,399	27%	10	0%	73%

Source: See text.

First, as expected, there is a lower share of lines that cannot be classified. Second, the increase in classification is not great – between 41% and 48% of lines are unclassifiable with HS 6 data, while the figures are 35% to 44% for HS 8 data. Moreover, there is little change in the share of classifiable goods that are quality and price goods between the two levels of aggregation. This serves as another indication for the appropriateness of using the data at HS 6-digit.

Our finding does not resolve the issue of the low number of clearly classifiable HS 6 codes. We return to this point in the concluding remarks.

C. Product categories by quality and price competition goods

We have seen above the proportions of quality-competition goods and price-competition goods by country. In this section, we look at which products are classified as quality goods or price goods. Table 6 and Table 7 show the top 20 quality-competition goods and the top 20 price-competition goods of US exports

Table 6. Top 20 quality-competition goods of US

HS 6 digit code	Product description	Coefficient estimates	p-value	Sign
710210	Diamonds unsorted whether or not worked	1.915	0.048	+
280480	Arsenic	1.647	0.000	+
251120	Natural barium carbonate (whitherite)	1.602	0.000	+
291300	Halogenated, sulphonated, nitrated or nitrosate	1.583	0.000	+
761290	Containers, alum, cap <300L, lined or heated, n	1.424	0.000	+
293311	Phenazone (antipyrin) and its derivatives	1.412	0.000	+
251720	Macadam of slag, dross or similar industrial wa	1.386	0.000	+
400122	Technically specified natural rubber, in primar	1.377	0.000	+
290316	1, 2-Dichloropropane (propylene dichloride) and	1.323	0.014	+
290329	Unsaturated chlorinated derivatives of acyclic	1.319	0.000	+
253020	Kieserite, epsomite (natural magnesium sulphate	1.312	0.000	+
283660	Barium carbonate	1.308	0.000	+
850611	Manganese dioxide primary cells&batt of an exte	1.283	0.000	+
852732	Radio broad rece not combi with sound record ing	1.176	0.000	+
252210	Quicklime	1.165	0.000	+
731811	Screws, coach, iron or steel	1.147	0.000	+
731029	Cans, iron or steel, capacity <50 litres nes	1.130	0.000	+
841451	Fans: table,roof etc with a self-cont elec mtr	1.122	0.000	+
282738	Barium chloride	1.121	0.000	+
530129	Flax, hackled or otherwise processed, but not s	1.109	0.000	+

Source: See text.

Table 7. Top 20 price-competition goods of US

HS 6 digit code	Product description	Coefficient estimates	p-value	Sign
271121	Natural gas in gaseous state	-2.109	0.000	-
530521	Raw albaca fibres	-2.001	0.011	-
890190	Cargo vessels nes and other vessels for the tra	-1.222	0.000	-
283422	Nitrates of bismuth	-1.191	0.000	-
481710	Envelopes of paper or paperboard	-0.922	0.000	-
710590	Natural or synthetic precious or semi-precious	-0.904	0.000	-
530490	Sisal, etc (excl. raw), not spun; tow and waste	-0.844	0.009	-
701110	Glass envelopes (including bulbs/tube) for ele	-0.755	0.000	-
262011	Hard zinc spelter	-0.685	0.050	-
841012	Hyd turbines & wa ter wheels of a power exc 1000	-0.663	0.002	-
853224	Electrical capacitors, fixed, ceramic dielectri	-0.579	0.018	-
842111	Cream separators	-0.544	0.000	-
284420	Enriched uranium and plutonium and their compou	-0.504	0.012	-
920930	Strings, musical instrument	-0.497	0.000	-
850519	Permanent magnets and articles intended to beco	-0.492	0.006	-
370610	Cinematographic film, exposed and developed, wi	-0.490	0.000	-
846031	Sharpening (tool or cutter grinding) mach n/c f	-0.478	0.000	-
846130	Broaching machines by removing metatal	-0.469	0.015	-
841011	Hydraulic turbines & water wheels of a power no	-0.460	0.002	-
847432	Machines for mixing mineral substances with bit	-0.447	0.001	-

Source: See text.

respectively.

"Diamonds" comes as the most quality-competition goods while "Natural gas" is the most price-competition goods. These goods are within the scope of our imagination because they are more or less familiar to us. However, many other goods of HS 6 digit categorisation are beyond our imagination mainly because most of them are not consumer goods, but intermediate goods.

Thus, in order to better capture the categorisation of goods into quality-competition and price-competition goods, we count the number of quality-competition goods and price-competition goods by ISIC Revision 3 two digit codes. Table 8 shows the matrix of the number of quality-competition goods by country and industry. The industries are ordered by the total number of quality-goods across countries. ISIC code 24: Manufacture of chemicals and chemical products registers the highest total number of quality-competition goods. In most countries, this industry has the highest number of quality-competition goods. But

Table 8. Quality-competition goods by industry and country

ISIC code	Industry description	USA	Germany	Japan	France	United Kingdom	Italy	Canada	Australia	China	Total by Industry
24	Manufacture of chemicals and chemical products	392	349	390	319	385	393	76	169	191	2664
17	Manufacture of textiles	298	221	65	314	235	448	28	49	44	1702
29	Manufacture of machinery and equipment n.e.c.	146	200	253	199	130	328	80	175	69	1580
15	Manufacture of food products and beverages	141	221	60	237	184	211	71	84	76	1285
27	Manufacture of basic metals	254	193	162	163	158	208	22	47	66	1273
18	Manufacture of wearing apparel; dressing and dyeing of fur	65	78	39	196	162	217	42	45	69	913
28	Manufacture of fabricated metal products, except machinery and equipment	112	143	86	132	108	178	9	74	31	873
01	Agriculture, hunting and related service activities	92	97	21	117	93	101	24	28	64	637
26	Manufacture of other non-metallic mineral produ	64	97	47	89	87	119	7	40	56	606
36	Manufacture of furniture; manufacturing n.e.c.	37	76	50	79	95	116	5	45	26	529
25	Manufacture of rubber and plastics products	63	83	62	72	77	85	16	41	19	518
33	Manufacture of medical, precision and optical instruments, watches and clocks	48	56	62	76	70	72	21	66	17	488
31	Manufacture of electrical machinery and apparat	52	60	61	68	59	80	15	72	14	481
21	Manufacture of paper and paper products	57	65	59	79	65	89	11	16	39	480
32	Manufacture of radio, television and communication equipment and apparatus	48	37	22	42	50	45	15	31	11	301
14	Other mining and quarrying	46	41	13	38	35	39	11	9	36	268
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	23	48	12	46	26	48	5	17	29	254
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	27	19	23	41	26	49	6	6	11	208
35	Manufacture of other transport equipment	25	24	22	29	18	32	8	11	7	176
34	Manufacture of motor vehicles, trailers and semi	20	29	17	31	27	28	5	7	9	173
22	Publishing, printing and reproduction of recorded	21	17	9	25	20	27	1	11	5	136
05	Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing	16	12	10	22	26	14	7	3	10	120
30	Manufacture of office, accounting and computing	18	7	14	18	17	13	7	14	6	114
02	Forestry, logging and related service activities	11	16	4	22	11	14	1	3	11	93
23	Manufacture of coke, refined petroleum products	8	13	5	14	13	9	5	3	6	76
13	Mining of metal ores	5	4	0	4	8	3	0	0	2	26
10	Mining of coal and lignite; extraction of peat	1	4	0	4	4	2	1	1	3	20
16	Manufacture of tobacco products	1	2	0	2	1	3	0	1	0	10
11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying	1	0	0	2	3	1	1	0	0	8
12	Mining of uranium and thorium ores	0	0	0	0	0	0	0	0	0	0

Note: ISIC (International Standard Industry Classification) Revision 3.
Source: See text.

Table 9. Price-competition goods by industry and country

ISIC code	Industry description	USA	Germany	Japan	France	United Kingdom	Italy	Canada	Australia	China	Total by Industry
24	Manufacture of chemicals and chemical products	30	72	46	58	55	29	39	23	89	441
29	Manufacture of machinery and equipment n.e.c.	66	12	27	21	47	12	17	5	184	391
17	Manufacture of textiles	5	43	101	11	18	2	26	14	65	285
15	Manufacture of food products and beverages	20	18	25	26	15	15	28	36	43	226
27	Manufacture of basic metals	3	21	18	18	20	8	26	18	10	142
33	Manufacture of medical, precision and optical instruments, watches and clocks	10	6	11	15	12	15	1	4	64	138
36	Manufacture of furniture; manufacturing n.e.c.	12	12	15	10	9	10	7	4	56	135
28	Manufacture of fabricated metal products, except machinery and equipment	9	13	19	7	6	1	8	1	51	115
31	Manufacture of electrical machinery and apparatus n.e.c.	14	7	12	12	5	3	4	0	49	106
01	Agriculture, hunting and related service activities	8	6	2	8	8	6	11	25	14	88
18	Manufacture of wearing apparel; dressing and dyeing of fu	17	17	19	4	3	1	6	4	17	88
26	Manufacture of other non-metallic mineral products	9	7	9	8	6	3	14	0	25	81
25	Manufacture of rubber and plastics products	8	10	10	4	2	2	7	2	25	70
32	Manufacture of radio, television and communication equipment and apparatus	6	5	15	8	2	6	2	1	22	67
21	Manufacture of paper and paper products	8	11	2	1	4	4	18	7	3	58
34	Manufacture of motor vehicles, trailers and semi-trailers	5	4	9	1	4	6	4	7	5	45
35	Manufacture of other transport equipment	6	3	2	4	2	3	4	3	13	40
30	Manufacture of office, accounting and computing machine	1	4	4	4	2	0	2	0	9	26
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	3	3	3	1	0	0	1	1	11	23
14	Other mining and quarrying	1	0	3	1	0	2	4	5	4	20
22	Publishing, printing and reproduction of recorded media	3	1	2	1	1	0	3	0	5	16
05	Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing	2	1	1	1	1	6	1	1	1	15
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	4	0	0	0	0	1	2	0	2	9
02	Forestry, logging and related service activities	2	2	0	0	2	0	0	1	1	8
23	Manufacture of coke, refined petroleum products and nuclear fuel	1	0	0	1	1	0	2	1	1	7
10	Mining of coal and lignite; extraction of peat	2	0	0	0	0	0	0	3	1	6
13	Mining of metal ores	0	0	0	0	0	1	2	3	0	6
11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying	1	0	0	0	1	0	0	1	1	4
16	Manufacture of tobacco products	1	0	0	0	1	0	1	0	0	3
12	Mining of uranium and thorium ores	0	0	0	0	0	0	0	0	0	0

Note: ISIC (International Standard Industry Classification) Revision 3.
Source: See text.

the large numbers of US, Japan and the European countries stand out. This is in line with our a priori notion that US, Japan and some European countries have sophisticated chemical industries, such as pharmaceutical industry. Next comes ISIC code 17: Manufacture of textiles. The number of Italy is outstanding. France also has a high number. This result is what we expect because the textiles of Italy and France are well known for its high quality. ISIC code 29: Manufacture of machinery and equipment ranks the number three. Japan and Italy, the countries known for its competency in machinery have high ranking. In ISIC code 15: Manufacture of food products and beverages, there is a clear difference between European countries and other countries. While European countries have high numbers, the other countries have much lower numbers.

Table 9 hows the case of price-competition goods. In terms of the total numbers of price-competition goods, the order of industries is similar to the case of quality-competition goods. This indicates that within the same industry some goods are quality-competition goods while others are price-competition goods. The most noteworthy is the highest numbers registered by China in many industries. China's numbers are much higher than the other countries in some industries such as ISIC code 29: Manufacture of machinery and equipment n.e.c., ISIC code 15: Manufacture of food products and beverages, ISIC code 33: Manufacture of medical, precision and optical instruments. This is opposite to the case of quality-competition goods where China has generally lower numbers than the other

Table 10. Classification results using Seemingly Unrelated Regressions model

	Total Number of HS 6-digidt	Number HS6 lines where distance is significant at 5%	Number with positive coefficients (quality competition)		Number with negative coefficients (price competition)		Unclassified (Mixture of the two)
USA	4,097	1,221	1,023	25%	198	5%	70%
Japan	3,457	1,169	961	28%	208	6%	66%
Germany	3,795	1,644	1,465	39%	179	5%	57%
Overlap (Japan, Germany, US)	3,109	240	144	5%	1	0%	95%
China	3,725	1,203	548	15%	655	18%	68%

Source: See text.

countries.

D. Robustness Check

Our empirical strategy – separate estimation of a panel for each product for each exporting nation – was driven by practical concerns. When we first started the project in 2008, the computing facilities at our disposal could not handle the millions of the fixed effects that would be necessary to estimate the coefficients in a cross-product, cross-partner, and cross-year panel. At the suggestion of the econometrician Jaya Krishnakumar, we explored the robustness of the product-by-product approach by estimating the whole system with the seemingly unrelated regressions (SUR) model.

1. Seemingly Unrelated Regressions model

The SUR model can improve the efficiency of estimates if there is a significant correlation across regression errors. The standard test here is the Bresch-Pagan test. As a preliminary check, we investigate the correlation across 100 HS 6 digit codes, selecting the lines that have the largest number of observations in German data across periods and partners.

The choice of doing the test on a subset of the HS 6 lines is driven by two considerations: The first is computational (see Appendix), the second is that 100 lines is sufficient to investigate the correlation of errors that would suggest that SUR is superior to OLS. Indeed, the Bresch-Pagan test of independence of errors is rejected at 0.1% significance level; this indicates that there is indeed a correlation across errors and SUR is appropriate.

Table 11. With the data for longer period: USA 1991-2006, Germany 1988-2006, Japan 1988-2006

	HS6 digit products exported	lines where distance is significant at 5%	Number with positive coefficient (quality competition)		Number with negative coefficient (price competition)		Unclassified
USA	5331	2,772	2,481	47%	291	5%	48%
Germamy	4746	3,147	2,851	60%	296	6%	34%
Japan	4454	2,354	1,886	42%	468	11%	47%
Overlap (J, G, US)	4208	941	634	15%	1	0%	85%

Source: See text.

With this result in hand, we proceed to re-estimate the entire set of equations for the US, Japan and Germany (over 15,000 equations) in a SUR set up. The computational demands for this exercise are rather extreme (it took our server 45 days to complete the regressions).

As the SUR model works on cross-equation correlations, it places restrictions on the number of equations and observations. As there are thousands of HS 6 lines but only about hundreds of observations, we grouped the HS 6 lines according to ISIC industries to satisfy the technical constraint that the number of observations must exceed the the number of equations – a necessary condition for estimating the SUR model.[7] As a result, the total number of HS 6-digit products we consider here is smaller than in the case of OLS (some HS 6-digit products which are not concorded to ISIC code). Table 10 shows the regression result using SUR model.

As the table shows, the SUR regressions did not boost the number of HS lines that could be classified. Moreover the SUR model leads to a similar qualitative pattern in terms of the share of price verse quality goods for each of the three nations.

2. With the data of longer period

Since unit price data are sparse and notoriously noisy, a large number of observations are required to correctly assess the impact of explanatory variables. To check whether this is an issue for our OLS results, we extended the coverage of the data to the maximum period possible (this varies by exporter nation).

The results are shown in Table 11. In accordance with our priors, the number of

Table 12. Only for differentiated goods by Rauch classification

	Total number of HS6 digit products exported	Number HS6 lines where distance is significant at 5%	Number with positive coefficient (quality competition)		Number with negative coefficient (price competition)		Un-classi-fied
USA	3094	1397	1214	39%	183	6%	55%
Germamy	2729	1456	1291	47%	165	6%	47%
Japan	2561	1207	979	38%	228	9%	53%
Overlap (J, G, US)	2481	352	234	9%	1	0%	91%

Source: See text.

[7]See Appendix for detail.

classifiable goods increases. However, the ratios of quality goods and price goods have almost no change from the original case and the increase in classifiability is modest.

3. Only for differentiated goods by Rauch classification

While the theoretical foundations on which we base our analysis assume differentiated goods, our OLS results include the full range of goods. As this means that some homogeneous goods are included, it is worth checking whether the results are better if only differentiated goods are considered.

To this end, we use the Rauch classification (Rauch 1999) to select goods that are differentiated. The OLS results on these goods are shown in Table 12. While there are some differences between these results and the results for the full set of goods, the differences do not change the basic conclusions from Table 2.

IV. Conclusion

Recent theoretical advances in the heterogeneous firms trade model literature suggest that it may be useful to think of some goods as being characterised by price competition while others are characterised by quality competition. As BH showed, a simple empirical test can be used to separate the two. If the basis of competition is price, then the average price of varieties sold in distant markets should be lower than the average price of varieties sold in nearby markets (assuming distance-linked costs select varieties according to their competitiveness).

This paper follows up on this insight, and the result by Johnson (2009) that products cannot be pooled as in BH, by trying to establish an empirical classification of HS 6 digit products between price and quality goods. Working with HS 6 level data for 9 exporting nations and about 100 destination nations, we run over 40,000 regressions to divide products into one of three categories: quality goods (the distance coefficient is positive), price goods (the distance coefficient is negative), and unclassifiable goods (i.e. where the distance coefficient is insignificant).

For individual exporting nations, we are able to classify up to half the goods as being marked by either price or quality competition. Within the set of classifiable goods, the most common type of competition is that of quality. Indeed, the number of quality competition goods is between two and ten times more numerous than the price competition goods. This, of course, is in line with the BH finding that quality competition dominates when all products are pooled.

In line with our priors, quality goods are more prevalent in the exports of the advanced industrialised nations – the US, Japan and Europe – than they are in nations that rely more on commodity exports – e.g. Canada and Australia. Furthermore, of the goods that can be clearly classified, we find that the major EU countries are leading the quality competition race with 50 to 60 % of their exports being goods in which quality seems to matter. For Japan and the US the figures are lower at 38 and 42 % respectively. Canada, Australia and China have much lower proportions of quality-competition goods.

When looking across all countries, however, we find little concordance among the list of quality and price goods. For example, we find that only about 11% of universe of HS 6 codes are consistently classified as either price or quality goods for the US, Germany and Japan.

The lack of classifiability led us to conjecture that the HS 6 aggregation was too broad; in essence HS 6 exports from the US were different goods than those exported from Japan under the same HS 6 heading. To check this intuition, we analysed Japan's export data at the HS 9-digit level and its aggregation into the HS 6 scheme. What we found did not confirm our conjecture. We find little difference in the inferences that come from analysis at the HS 9 versus HS 6 level. We also perform a comparison using EU data at 8-digit and 6-digit and find qualitatively identical results.

These results lead to one constructive implication. As we did not find a great deal of inconsistencies between the HS 6 and HS 9 level data, the use of HS 6 data – the most detailed level available for most nations and most time periods – should not be viewed as problematic taking one exporter at a time. Problems could arise, by contrast, if HS 6 data is pooled across different exporters. A second less constructive implication is that there are only relatively few HS 6 headings that seem to be uncontrovertially 'quality-competition' goods, or 'price-competition' goods.

A. Policy implications

Our results are primarily positive in nature as we seek to classify goods into those marked by price competition and those marked by quality competition. More broadly, however, we can take our results as informing several classic issues in economics.

For example, many trade disputes in trade concern so-called dumping, which is said to occur when a firm sells its product for less in one foreign market than it does in either its own market or third markets. What our results show is that dumping investigations must pay careful attention to the exact definition of products. For some products, for example Chemical and Chemical Products, we find that the average price of the basket of varieties exported from, for example, the US will rise with the distance of the market. In our model, this occurs purely due to selection effects – that is, only the highest quality products are able to overcome the disadvantages of distance so the US basket of Chemical and Chemical Products varieties sold to, say, Japan, will be higher priced than those sold to, say, Canada. If Canadian trade investigators were not careful, they might confuse this selection effect across baskets with dumping (the price of the basket sold to Canada would be below that of the basket sold to Japan).

Another example comes from the study of technological gaps across nations by studying composition of their export basket (Hausman, Huang and Rodrik 2007). This approach implicitly assumes that a nation's HS 6-digit categories consist of the same basket of good regardless of destination. Our results show that this is not the case. For quality-competition goods, the basket tends toward higher prices in more distant markets, while the opposite is true for price-competition goods. This suggests that the policy recommendations from Hausan, Huang and Rodrik (2007) need to be interpreted with caution.

Acknowledgements

We are grateful to Robert Johnson for excellent discussion at 2009 SNB/CEPR Conference in Zurich as well as other seminar participants.We also thank Fukunari Kimura, Masahiro Endo, Toshiyuki Matsuura and seminar participants at Keio economic seminar in Tokyo. We appreciate useful comments from Eiichi Tomiura at Japan Economic Society's 2009 annual conference. We thank the participants of the 2008 Workshop of Swiss Trade Economists Cooperative, above all, Olivier Cadot, Marcelo Olarreaga, Jaya Krishnakumar, Mathias Thoenig, Marius Brulhart, Madina Kukenova, for their comments. Tadashi Ito thanks Roger Newson, Rosen Marinov, Elisa Gamberoni for sharing their knowledge on statistical software techniques.

Received 26 November 2010, Revised 0 December 2010, Accepted 0 January 2011

References

Baldwin, Richard (1988), Hysteresis in Import Prices: The Beachhead Effect, American Economic Review, *American Economic Association*, **78**(4), 773-85, September.

Baldwin, Richard and Harridan, James (2010), Zeros, Quality and Space: Trade Theory and Trade Evidence, *American Economic Journal Microeconomics*, forthcoming.

Biørn, Erik (2004), Regression systems for unbalanced panel data: a stepwise maximum likelihood procedure, *Journal of Econometrics*.

Fontagné, Gaulier, and Zignago. (2008), Specialization across varieties and North-South competition, *Economic Policy*, January 2008, 53-91.

Hausmann, Ricardo, Jason Hwang and Dani Rodrik (2007), What you export matters, *Journal of Economic Growth*, **12**(1), 1-25.

Helble, Matthias C. and Okubo, Toshihiro (2008), Heterogeneous Quality Firms and Trade Costs, *World Bank Policy Research Working Paper No*. 4550.

Johnson, Robert. (2009), Trade and Prices with Heterogeneous Firms, Working paper available on line, sites.google.com/site/robjohnson41/Johnson_TPHF_05_2010.pdf

Kneller, Richard and Zhihong Yu. (2008), Quality Selection, Chinese Exports and Theories of Heterogeneous Firm Trade, Unpublished Manuscript, University of Nottingham.

Krugman, P. (1980), Scale Economies, Product Differentiation and the Pattern of Trade, *American Economic Review*, **70**, 950-959.

McDowell, Allen (2004), From the help desk: Seemingly unrelated regression with unbalanced equations, The STATA journal.

Melitz, Marc J. (2003), The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity, *Econometrica*, **71**(6), 1695-1725.

Moulton, Brent R. (1990), An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Units, *The Review of Economics and Statistics*, **72**(2), 334-338.

Nguyen, Minh Cong (2008), XTSUR: Stata module to estimate seemingly unrelated regression model on unbalanced panel data, *Working paper* (Institution unknown).

Rauch, James E. (1999), Networks versus markets in international trade, *Journal of International Economics*, **48**(1), 7-35.

Schott, Peter. (2008), The relative sophistication of Chinese exports, *Economic Policy*, January 2008, 7-49.

Schott, Peter. (2004), Across-Product versus Within-Product Specialization in International Trade, *Quarterly Journal of Economics*, **119**(2), 647-678.

Srivastava, Virendra K. and Giles, David E. A, Seemingly Unrelated Regression Equations Models, 1987, *New York*, Dekker.

Appendix

Appendix for Section III, part A, number 1.

When dealing with SUR model, there are two issues we should bear in mind. The first one is theoretical. The second one is technical.

The first issue is that the number of observations in each equation in a system should exceed the number of equations in the system. Otherwise, the variance-covariance matrix will be singular, and thus non-invertible, rending estimations impossible.[8] For example, if we try to run a SUR regression which estimates 100 equations as a whole system, we need to have more than 100 observations for each equation. Since we have more than 4000 HS 6-digit codes and the number of observations for each HS 6-digit code (equation) is much smaller than 4000, it is theoretically impossible to estimate a SUR model for the whole HS 6-digit codes. Thus, we need to divide HS 6-digit codes into groups. A natural categorisation is by industry. We should also bear in mind that the above is a necessary condition. Depending on the data, the variance-covariance matrix might still be singular.

The second issue is a technical limitation of STATA, the statistical software we are using. SUR model in STATA requires balanced data, while our data are highly unbalanced. In STATA's SUR regression, any additional observations that are available for some equations, but not for all, are discarded, potentially resulting in a loss of efficiency. As trade data like ours are highly unbalanced, this is a serious drawback. While making use of information from other equations, we lose much information within the equation. Thus, running SUR regression in STATA's usual command does not guarantee the improvement on efficiency.

One possible solution for this technical limitation of STATA is proposed by Minh Cong Nguyen (2008). He constructed an ado file for STATA to implement SUR on unbalanced data based on a theoretical work by Biørn (2004). However, we have found that it does not work for our data because this ado file encounters another technical problem when there are a very large number of zeros in data as in our case.

Another potential solution was proposed by McDowell (2004). It proposes to transform the shape of the data in a way we can perform estimations through the generalized estimating equations (GEE) model developed in statistics literature.[9]

---

[8]For further detail, see Srivastava and Giles.
[9]For detail, see McDowell (2004).

Shortly speaking, GEE is a general estimation model which nests many estimation methods we are familiar with, including SUR model. Through this transformation of data and the use of GEE, we can be free from the above two problems.[10]

Robustness-check appendix

We describe below several other robustness checks we have performed.[11]

Clustering

To address the possibility of correlated errors within the same destination, which may cause a downward bias of standard errors, we have run the same OLS, "clustering" the data.[12] We have found that the results are almost exactly the same with the simple OLS.

Measure of trade cost: "Mirror" method

Our measure of trade cost in the above analysis is distance, probably a good proxy for trade cost. However, some products are usually shipped by air, and others by sea. In that case, distance might not be a good proxy for trade costs. It is conceptually possible to compute actual trade costs by looking at 'mirror' data,[13] i.e., from the importers' side, because importers report Cost-and-Freight or CIF prices while exporters report FOB prices. However, when we match German data and the data from the importers' side by year and HS 6 digit code, we find that only 58% of all the observations are matched. We guess that many developing countries' classifications are not precise or they report incorrect data. Furthermore, when we discard those data which have different units, another 15% are dropped. Thus, we do not think that we can get a reliable result from 'mirror' analysis.

Regressions by income groups

Since demand for quality may differ in rich and poor countries, we have run the regressions by income groups, i.e., high income countries, middle-income countries, low income countries. The regressions yield almost the same results as

[10]However, because of the large number of systems and also search procedures in the Maximum Likelihood Estimation used in GEE, the computational burden is extreme. It has taken 50 days for our 16 GB RAM Big Iron computer to run regressions for the three countries (US, Germany and Japan).

[11]We Marius Brulhart and Robert Johnson for their comments that lead us to undertake many of these robustness checks.

[12]See Moulton (1990) for the details of downward bias.

[13]We thank Marcelo Olarreaga for this idea.

those in Table 2.

Pooled regression

We have also checked if running pooled regression across all the 9 origin countries can be justified. A large number of observations are desirable because of the above mentioned notoriously noisy unit price data. The pooling substantially increases the number of observations. However, the Chow test rejects the null hypothesis of origin country heterogeneity.