# The "Collapse in Quality" Hypothesis*

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**Abstract**

This paper evaluates the hypothesis that during the 2008-2009 collapse in international trade, imports of higher quality goods experienced larger reductions compared to low-quality imports, using data on U.S. imports disaggregated by HS-10 product category and source country. We find little, if any, robust econometric evidence in support of this hypothesis.

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# 1 Introduction

International trade collapsed dramatically during the current recession, by far more than the slowdown in economic activity would imply (Levchenko, Lewis and Tesar 2010). It appears that a key part of the explanation for why trade contracted by proportionally more than GDP or tradeable sector output is the composition of demand: international trade is concentrated in sectors in which demand fell the most (Eaton, Kortum, Neiman and Romalis 2010, Levchenko et al. 2010). An important facet of this explanation is the distinction between durables and non-durables. However, the compositional effect also appears at finer levels of disaggregation, suggesting that several types of compositional effects may be at work at the same time.

This paper evaluates the hypothesis that the much greater fall in international trade compared to aggregate consumption is due to agents reducing the quality of the goods they consume in response to the adverse income shock. If imports have, all else equal, higher quality than domestically produced goods – a phenomenon known as the Alchian conjecture – and demand for quality is elastic in income, the reduction in demand for top quality goods will affect imports disproportionately more than total consumption.[1]

Anecdotal evidence for this effect abounds. During the trade collapse episode, the popular press featured a large number of articles about consumers switching from higher- to lower-quality varieties of the same goods. Here is a representative quote:

> *"According to PwC, a consultancy, 93% of shoppers say they have changed their behaviour as a result of the economic downturn. Many have traded down from name-brand to store-brand products. Alarmingly for, say, Kellogg's or Heinz, lots have discovered that Tesco's cornflakes and Wal-Mart's baked beans taste no worse. A survey of 2,500 American households by Consumer Edge Research found that supermarkets' own labels have become increasingly popular, especially for staples such as milk, peanut butter, bottled water and cooking oil."* (The Economist, 14 Oct. 2010).

Observers also noted the connection between this phenomenon and international trade, in particular the relatively small reduction in Chinese exports, and their faster recovery:

> *"China is winning a larger piece of a shrinking pie. Although world trade declined this year because of the recession, consumers are demanding lower-priced goods and Beijing, determined to keep its export machine humming, is finding a way to deliver.*

[1] Fajgelbaum, Grossman and Helpman (2009) develop a theoretical framework in which goods are differentiated by quality and tastes are non-homothetic, and show that as income rises, a higher fraction of agents buys higher quality goods. The hypothesis that imports of higher quality goods fell during the current crisis can be thought of as a dynamic version of the Fajgelbaum et al. (2009) result.

> *. . . Because China produces a diversified portfolio of low-priced and essential items, analysts say the country's exports can hold up relatively well in a recession. Few other countries can match what has come to be called the 'China Price.' . . . [A]s consumers trade down the quality ladder, China can benefit."* (The New York Times, 13 Oct. 2009)

To determine whether trade fell more than output because it is composed of higher quality items than the domestic consumption bundle would not be feasible, because data on consumption of domestic goods do not exist at a sufficient level of disaggregation to measure quality. But we can test a closely related hypothesis: that imports fell by more for higher-quality goods. To do this, we use U.S. imports data disaggregated by HS-10 digit category and source country to examine whether U.S. imports of higher quality experienced larger reductions than imports of lower quality. The rich variation across both categories and partner countries allows us to control for a wide variety of unobserved factors that vary at the country and detailed product level.

We test two variants of this hypothesis. The first is that within an HS-10 category, imports from countries with higher pre-crisis quality fell by more. The specification includes HS-10 and country fixed effects, and thus reveals purely cross-source substitution within a highly specialized variety: switching purchases of men's button-down cotton shirts from Italy to China. As a preliminary step, we regress the drop in trade on the beginning-of-period unit values as the most simplistic indicator of quality. Next, we implement the quality estimation procedure developed by Berry (1994) and applied recently in the international trade context by Khandelwal (2009), which takes explicit account of market share as well as price in estimating product quality.

Substitution across source countries within a narrowly defined product category may be important, but it is not the only dimension in which quality might play a role. The second variant of the collapse in quality hypothesis is that consumers switched from higher- to lower-quality versions of the same good, regardless of the source country. Assessing this possibility requires a classification of HS-10 categories into different quality levels of essentially the same good. The HS-10 classification is not designed for this purpose, and not all HS-10 categories can be classified according to quality. Alessandria and Kaboski (2009), however, make an attempt to identify pairs of HS-10 products that represent lower- and higher-quality variants of the same good, using a number of dimensions: fresh vs. frozen, new vs. used, type of packaging, and size. We use the matched pairs of higher- and lower-quality HS-10 categories to determine whether imports of the higher-quality ones fell systematically by more.

Our results can be summarized as follows. First, it does appear that within an HS-10 category, imports with higher unit values fell by more, which is at first glance consistent with a disproportionate reduction in higher-quality imports. However, when we actually estimate quality using the

techniques suggested in the literature, it turns out that imports of higher quality goods did not fall more. If anything, higher-quality imports fell by less, though the coefficients are not robustly significant and small in magnitude. Second, there is also very little evidence that agents substituted from higher-quality HS-10 products to lower-quality versions.

This paper is part of a growing literature that together provides a comprehensive account of the 2008-09 collapse in international trade. While a wide variety of explanations have been proposed and tested (compositional effects, input-output linkages, inventories, and financial constraints, to name a few), the quality dimension has received almost no attention in the literature. Exceptions include Berthou and Emlinger (2010), who document that in the EU15, imports higher-priced goods fell by more than lower-priced goods, and Haddad, Harrison and Hausman (2010), who use detailed data for several countries and regions of the world to decompose the fall of total trade into movements in prices and quantities. Our results caution against using information on unit values to draw inferences about the behavior of higher-quality imports in the 2008-09 crisis.

## 2 Data, Methodology, and Results

We use data on monthly bilateral U.S. imports at the HS-10 level of disaggregation (up to 13,385 different product categories), obtained from the U.S. Census Bureau for the period of the trade collapse (2008-2009). For each HS-10 product and source country, we have information on both the total value of imports, as well as quantity.[2]

In the first empirical specification, we test for cross-country substitution within an HS-10 category, by estimating the following relationship:

$$\gamma_{hc} = \beta \text{QUALITY}_{hc} + \delta_h + \delta_c + \epsilon_{hc}, \tag{1}$$

where $h$ indexes HS-10 product categories, and $c$ indexes countries. The dependent variable is the percentage change in U.S. imports in product $h$ coming from country $c$, from quarters 2 and 3 of 2008 to quarters 2 and 3 of 2009.[3] At this level of disaggregation, there is a great deal of dispersion in percentage changes in trade flows: they range from -100 percent (trade disappearing altogether in that HS-10 category from that source country), to well over 100 percent (trade more than doubling). We drop observations for which trade increased by more than 200 percent, which account for a tiny share of overall trade but distort the magnitude of the left hand side variable. The main results are

[2]Though in principle import data are available for over 200 countries and jurisdictions, to keep the sample manageable we constrain the analysis to the top 59 largest trading partners with the U.S.. Together, these account for 97 percent of total pre-crisis U.S. imports.

[3]The peak of total U.S. imports was the third quarter of 2008 and the trough was in the second quarter of 2009. To avoid seasonality issues, we thus compute the growth rate on the middle two quarters in the two years. The results are the same if we instead use the first two quarters, or the first three quarters, of 2008 and 2009.

robust to alternative cutoff values. In the resulting sample, the mean percentage change in trade is -0.39, with a standard deviation of 0.64, and a range from -1 to 2. The specification includes both country and product fixed effects, and thus reveals how reductions in imports *within an HS-10 category across partner countries* are related to initial quality.

As a measure of quality, we first use information on the pre-crisis (2007 annual) unit value of product $h$ coming from country $c$. Then, we estimate quality by replicating the procedure in Khandelwal (2009).[4] The main quality estimation equation is:

$$\ln(s_{cht}) - \ln(s_{0t}) = \lambda_{1,ch} + \lambda_{2,t} + \alpha p_{cht} + \sigma \ln(ns_{cht}) + \lambda_{3,cht}, \tag{2}$$

where $\lambda_{1,ch}$ is the product $ch$ fixed effect, $\lambda_{2,t}$ is the time effect, and $\lambda_{3,cht}$ is the residual. On the left-hand side, $s_{cht}$ is the share of variety $h$ coming from country $c$ in year $t$ and $s_{0t}$ is the market share of the outside good (domestic production). Right-hand side variables include the price of variety $ch$, $p_{cht}$, and the share of product $ch$ in total imports in HS-10 category $h$, $ns_{cht}$. The price is instrumented with c.i.f. value duties charges and an interaction between the oil price and distance from $c$ to the U.S., and the import share is instrumented by the number of varieties exported and the number of countries exporting product $h$ to the U.S.. The procedure requires information on domestic output, and thus the HS-10 categories are grouped into 5-digit NAICS sectors, the finest level of disaggregation for which there is information on domestic production. Domestic output data are taken from the NBER-CES productivity database. Estimation of equation (2) is then carried out sector by sector. The procedure exploits variation over time, and thus the quality estimation sample covers the years 1997-2005.

Quality in year $t$ for variety $h$ from country $c$ is then obtained by

$$\hat{\lambda}_{cht} = \hat{\lambda}_{1,ch} + \hat{\lambda}_{2,t} + \hat{\lambda}_{3,cht}. \tag{3}$$

That is, quality is the sum of the $ch$-fixed effect, the time effect, and the residual. We average these values across years in each product $h$ coming from country $c$. The procedure follows as closely as possible Khandelwal (2009), which should be consulted for the details of the implementation and the description of the resulting quality estimates.

The first four columns of Table 1 report the results of estimating equation (1), using the pre-crisis unit values as measures of quality. Since the variation in unit values within each HS-10 product category is very wide, and the unit values have different meanings across HS-10 product categories, we use the percentile of country $c$'s unit value in the distribution of unit values in product $h$.[5] All

[4] When using unit value as the independent variable, we do not constrain the sample to particular industries. Following Khandelwal (2009), quality is only estimated for manufacturing industries classified by Rauch (1999) as differentiated. Restricting the unit value regressions similarly does not significantly affect the results.

[5] The results are the same if we instead standardize the unit value variable to have mean zero and standard deviation of 1 within each HS-10, or if we use log of the unit value.

of the specifications include country and HS-10 fixed effects. We can see that products with higher unit values fell more, an effect that is robust to controlling for initial value of country $c$'s imports of $h$. The coefficient is significant, but the magnitude is relatively small. Moving from the 10th to the 90th percentile in the distribution of unit values – a RHS variable change of 0.8 – implies a 2.9 percent larger reduction in imports (using the coefficient in column 2), which is minor compared the 34 percent fall in aggregate imports.

The table then evaluates two additional hypotheses regarding the variation in unit values and imports. The first is that imports of higher-unit-value goods will fall more in sectors in which the elasticity of substitution is higher. To that end, we use the elasticity estimates from Broda and Weinstein (2006), interacting them with the initial unit values. There does not appear to be a significant difference in the response of imports to unit values in sectors with different elasticities of substitution. Second, one might expect imports of higher-unit-value goods to fall more in sectors with higher degree of quality differentiation. To test for this possibility, we interact the initial unit value with Khandelwal (2009)'s measure of the quality ladder length. The interaction coefficient is positive, implying that higher unit value imports fell by *less* in sectors with a greater extent of quality differentiation.

Columns (5) through (8) of Table 1 report instead the results of regressing the fall in imports on estimates of quality as implied by (3). It turns out that the conclusions we reach are the opposite to what we found with unit values. If anything, goods of higher quality experienced smaller reductions in imports, though the impact is not robustly significant and always small in economic terms. We conclude from this exercise that there is no robust positive relationship between quality and the fall in imports across partner countries within an HS-10 category.

Substitution across source countries within the same HS-10 product category is not the only way quality downgrading could have happened. Agents might have also switched from higher-quality HS-10 products to different, lower-quality HS-10 products. This type of substitution is much harder to measure, because the HS-10 classification was not designed with quality differentiation in mind. However, for a subset of HS-10 products, Alessandria and Kaboski (2009) examined the product descriptions and built pairings of HS-10 categories in which one is plausibly the higher-quality version of the other. They used keywords, such as fresh vs. frozen, new vs. used, packaging size or unit price. As an example, STRAWBERRIES, FRESH (HS0810100000) is classified as the higher-quality product compared to STRAWBERRIES, UNCOOKED/COOKED BY WATER, FROZEN (HS0811100000), since the former is fresh, and presumably more desirable than frozen. We should emphasize that such an exercise, which involves assuming that certain attributes signal higher quality, can be quite imprecise. For instance, according to this scheme, INSTANT COFFEE,

NOT FLAVORED, DECAFFEINATED, PACKAGED FOR RETAIL SALE (HS2101102131) is a higher-quality version of INSTANT COFFEE, NOT FLAVORED, DECAFFEINATED, NOT PACKAGED FOR RETAIL SALE (HS2101102139), because the former is packaged for retail, while the latter is not, presumably implying that it is in bulk. The procedure is described in detail in Alessandria and Kaboski (2009). Though it has its limitations, it is the only one we are aware of that provides a ranking of quality *across* HS-10 categories.

Using the paired high- and low-quality sectors, we then estimate the following specification:

$$\gamma_{hc} = \beta \text{QUALITY}_h + \delta_{group} + \delta_c + \epsilon_{hc}, \tag{4}$$

where now $\text{QUALITY}_h$ is the dummy variable that sector $h$ is the higher-quality version in a particular sector pairing, and $\delta_{group}$ is the pairing fixed effect. This specification thus tests whether the higher-quality version of the same good (fresh strawberries) fell by more than the lower quality version (frozen strawberries), controlling for how much strawberry imports, fresh or frozen, fell on average.

Table 2 reports the results of estimating equation (4). Since only a small minority of HS-10 sectors can be paired this way, the sample size is much smaller. The first four columns consider individual attributes according to which products are paired: fresh vs. frozen, new vs. used, packaging size, and unit price. We can see that the only marginally significant coefficient is on the fresh-frozen dimension. The economic significance of the coefficient is large as well, implying that fresh versions of the same good fell 16.5 percentage points more than the frozen ones. However, for the other characteristics, the effect is not significant. The last column pools all the observations. The coefficient has the right sign, but is not statistically significant and small in economic terms, implying that on average the high-quality versions fell by 1.8 percentage points more than the low-quality versions.

## 3 Conclusion

The 2008-2009 collapse in international trade has been dramatic, generating a great deal of interest among both researchers and policymakers. In the spirit of the times, the popular press highlighted the phenomenon that consumers became much more frugal in response to the recession, trading down the quality ladder and buying more basic versions of the same goods. It has been suggested that some of this behavior may have manifested itself in international trade by affecting higher-quality imports disproportionately, providing a partial explanation for why, for instance, imports from China fell by less, and recovered more quickly, than imports from other countries.

This paper examines this hypothesis econometrically using highly disaggregated data on U.S.

imports. All in all, we find very little evidence that imports of higher-quality goods fell by more than lower-quality goods. This suggests that other explanations for the collapse are potentially more promising. Our results also caution against using unit values as proxies for quality, especially when drawing conclusions about the role of quality differentiation in the recent trade collapse.

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**Table 1.** Quality and Within-Category Substitution

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| *Dep. Var: Percentage Change in Imports* | | | | | | | | |
| Initial Unit Value (pctile) | -0.0797*** | -0.0365*** | -0.0369** | -0.0829*** | | | | |
| | (0.00788) | (0.00792) | (0.0154) | (0.0220) | | | | |
| Initial Quality (pctile) | | | | | 0.0120 | 0.0190** | 0.0221 | -0.0160 |
| | | | | | (0.00805) | (0.00833) | (0.0157) | (0.0213) |
| Initial Total Value (pctile) | | 0.272*** | 0.250*** | 0.223*** | | 0.238*** | 0.226*** | 0.238*** |
| | | (0.00788) | (0.0101) | (0.00992) | | (0.00954) | (0.0110) | (0.00954) |
| UV×Elasticity | | | 0.000463 | | | | | |
| | | | (0.00936) | | | | | |
| UV×Ladder Length | | | | 0.0177** | | | | |
| | | | | (0.00772) | | | | |
| Quality×Elasticity | | | | | | | 0.00409 | |
| | | | | | | | (0.0106) | |
| Quality×Ladder Length | | | | | | | | 0.0139* |
| | | | | | | | | (0.00778) |
| Observations | 104,420 | 104,420 | 67,525 | 74,796 | 83,152 | 78,556 | 60,808 | 78,556 |
| $R^2$ | 0.201 | 0.211 | 0.183 | 0.214 | 0.200 | 0.208 | 0.189 | 0.208 |
| Exporter FE | yes | yes | yes | yes | yes | yes | yes | yes |
| HS10 FE | yes | yes | yes | yes | yes | yes | yes | yes |

Notes: Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. This table reports estimates of equation (1). The dependent variable is the percentage reduction in U.S. imports in an HS-10 category from 2008q2+q3 to 2009q2+q3. The independent variable of interest is the quality, measured as unit value (columns 1 through 4), or as implied by equation 3 (columns 5 through 8). The quality measures are the percentile in quality occupied by a country within an HS-10 product. Initial Total Value is the total value of imports of the country in the HS-10 sector before the crisis, expressed as the percentile in the distribution of total imports across countries within an HS-10 product. Elasticity is the (log) elasticity of substitution among varieties in the industry, as estimated by Broda and Weinstein (2006). Ladder Length is the (log) length of the quality ladder in the HS-10 product category, estimated following the procedure described in Khandelwal (2009).

**Table 2.** Quality and Cross-Category Substitution

| | (1) Freshness | (2) New or Used | (3) Packaging | (4) Price | (5) Pooled |
|---|---|---|---|---|---|
| High Quality | -0.165* | 0.0230 | 0.178 | -0.0452 | -0.0182 |
| | (0.0925) | (0.0598) | (0.171) | (0.0802) | (0.0368) |
| Observations | 430 | 665 | 110 | 299 | 1,504 |
| $R^2$ | 0.347 | 0.208 | 0.447 | 0.248 | 0.157 |
| Exporter FE | yes | yes | yes | yes | yes |
| Group FE | yes | yes | yes | yes | yes |

Notes: Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. This table reports estimates of equation (4). The dependent variable is the percentage reduction in U.S. imports in an HS-10 category from 2008q2+q3 to 2009q2+q3. The independent variable of interest is the 0/1 indicator of whether the HS-10 category is the higher-quality one in a particular pair.