

The “Collapse in Quality” Hypothesis\*  
SUPPLEMENTARY WEB APPENDIX

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## Appendix A Quality Estimation

The main quality estimation equation is:

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

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 (A.1) 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

$$\hat{\lambda}_{cht} = \hat{\lambda}_{1,ch} + \hat{\lambda}_{2,t} + \hat{\lambda}_{3,cht}. \quad (\text{A.2})$$

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.<sup>1</sup>

## Appendix B Supplementary Tables

Table A1 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.<sup>2</sup> As evident from columns 1 and 3, there does

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<sup>1</sup>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.

<sup>2</sup>To reduce the impact of high-elasticity outliers, we use the natural log of the elasticity value. The results are the same if we instead use percentiles of the elasticity distribution, or standardize the elasticity variable to have mean zero and standard deviation of 1.

not appear to be a significant difference in the response of imports to either initial unit values or estimated quality in sectors with different elasticities of substitution. Second, one might expect imports of higher-quality goods to fall more in sectors with higher degree of quality differentiation. To test for this possibility, in columns 2 and 4 we interact the initial unit value and quality with Khandelwal (2009)’s measure of the quality ladder length. The interaction coefficient is positive, implying that higher unit value and quality imports actually fell by *less* in sectors with a greater extent of quality differentiation.

Next, Table A2 checks whether the estimates are driven by small import values. It estimates equation (1) using weighted OLS, in which the weight of each observation corresponds to the pre-crisis value of imports. In this way, larger import values are given higher weight in the estimates. The results largely confirm the main finding. If anything, imports of higher-quality goods fell even less in value-weighted terms.

Table A3 breaks down HS-10 import categories according to their end use. To do that, it maps the HS-10 products into the U.S. EndUse classification, which categorizes goods into intermediate inputs (“industrial supplies and materials”), capital goods, non-automotive consumer goods, and the automotive sector, which includes both finished vehicles as well as engines and parts. We can see that by and large, the different categories behaved similarly: in all categories, imports of with higher unit values fell by about 3.5 percentage points more, matching the magnitude of the pooled estimates. When quality is used on the right-hand side, however, the coefficients are positive and not robustly significant.

Finally, Table A4 breaks the movements of total import values into quantities and prices (unit values). It appears that when initial values are used on the right-hand side, the negative coefficient is driven entirely by the fall in unit values: in higher initial unit-value categories, prices fell the most, while quantities did not move disproportionately more. When quality is used on the right-hand side, it appears that quantities are largely responsible for the positive coefficient on total values.

## References

- Broda, Christian and David Weinstein, “Globalization and the Gains from Variety,” *Quarterly Journal of Economics*, May 2006, 121 (2), 541–85.
- Khandelwal, Amit, “The Long and Short (of) Quality Ladders,” October 2009. Forthcoming *Review of Economic Studies*.

Rauch, James E., "Networks versus Markets in International Trade," *Journal of International Economics*, June 1999, 48 (1), 7–35.

**Table A1.** Elasticity of Substitution and Quality Ladder Length

	(1)	(2)	(3)	(4)
<i>Dep. Var: Percentage Change in Imports</i>				
Initial Unit Value (pctile)	-0.0369** (0.0154)	-0.0829*** (0.0220)		
Initial Quality (pctile)			0.0221 (0.0157)	-0.0160 (0.0213)
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)
Initial Total Value (pctile)	0.250*** (0.0101)	0.223*** (0.00992)	0.226*** (0.0110)	0.238*** (0.00954)
Observations	67,525	74,796	60,808	78,556
R <sup>2</sup>	0.183	0.214	0.189	0.208
Exporter FE	yes	yes	yes	yes
HS10 FE	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 1-2), or as implied by equation A.2 (columns 3-4). 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 A2.** Initial Value-Weighted Estimates

	(1)	(2)
<i>Dep. Var: Percentage Change in Imports</i>		
Initial Unit Value (pctile)	0.00361 (0.0383)	
Initial Quality (pctile)		0.0626* (0.0322)
Initial Total Value (pctile)	-0.0215 (0.0703)	0.0694 (0.0684)
Observations	88,915	68,871
R-squared	0.582	0.561
Exporter FE	yes	yes
HS10 FE	yes	yes

Notes: Robust standard errors in parentheses; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%. This table reports estimates of equation (1), in which observations are weighted by initial size of the import flow from country  $c$  in category  $h$ . 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 (column 1), or as implied by equation A.2 (column 2). 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.

**Table A3.** Estimates by Import Category

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Dep. Var: Percentage Change in Imports</i>						
	<i>Intermediate Inputs and Capital Goods</i>		<i>Consumer Goods</i>		<i>Automotive Vehicles, Engines, and Parts</i>	
Initial Unit Value (pctile)	-0.0356*** (0.0101)		-0.0384*** (0.0128)		-0.0395** (0.0160)	
Initial Quality (pctile)		0.0265** (0.0109)		0.00544 (0.0129)		0.0136 (0.0142)
Initial Total Value (pctile)	0.203*** (0.0102)	0.155*** (0.0124)	0.356*** (0.0126)	0.345*** (0.0152)	0.372*** (0.0156)	0.167*** (0.0154)
Observations	59,519	44,690	44,901	33,866	32,434	27,337
R-squared	0.192	0.191	0.233	0.226	0.218	0.211
Exporter FE	yes	yes	yes	yes	yes	yes
HS10 FE	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), breaking down by type of import. Columns 1 and 2 reports the results for intermediate inputs and capital goods; columns 3 and 4, for non-automotive consumer goods, and 5 and 6, automotive vehicles, engines, and parts. 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, 3, and 5), or as implied by equation A.2 (columns 2, 4, and 6). 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.

**Table A4.** Quantities and Prices

	(1)	(2)	(3)	(4)
<i>Dep. Var: Percentage Change in Imports</i>				
	<i>Quantities</i>		<i>Unit Values</i>	
Initial Unit Value (pctile)	0.000645 (0.00717)		-0.0778*** (0.00906)	
Initial Quality (pctile)		0.0159** (0.00778)		0.000353 (0.00869)
Initial Total Value (pctile)	0.347*** (0.00695)	0.317*** (0.00848)	0.0328*** (0.00998)	0.0571*** (0.0115)
Observations	118,898	87,896	71,259	56,412
R-squared	0.194	0.189	0.184	0.181
Exporter FE	yes	yes	yes	yes
HS10 FE	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. import quantity (columns 1-2), or unit value (columns 3-4) in an HS-10 category from 2008q2+q3 to 2009q2+q3. The independent variable of interest is the quality, measured as unit value (columns 1-2), or as implied by equation A.2 (columns 3-4). 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.