Online Appendix – Data Description

to the paper

Quality Pricing-To-Market

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The data on car prices, quantities, and quality attributes used in this study is from Goldberg and Verboven (2001 and 2005). Their data set also includes relevant macroeconomic information such as exchange rates and inflation rates.[25] It covers cars sold on five European Markets (Belgium, France, Germany, Italy, and the UK) in the period from 1970 to 1999. Although we only have prices for cars sold in these markets, the cars originate from 14 countries.

Defining "Quality" Before describing the data in more detail, we construct a measure of car quality. Following Goldberg and Verboven (2005), we construct hedonistic indices of quality that relate the price of a car to its characteristics such as weight, horse power, and fuel efficiency. Since customers are willing to pay a higher price for more of an attribute such as "maximum speed" or lower "fuel consumption", these attributes reveal a car's quality.

In Table A1, the dependent variable is the natural logarithm of the car price net of VAT and in Special Drawing Rights (SDR).[26] All car prices in our sample are for the basic configuration of each car model, i.e. the cheapest version actually offered on a market. We estimate random effects panels since including fixed effects by car model would account for nearly all of the quality variation in our sample.

Goldberg and Verboven (2001 and 2005) find significant evidence of price discrimination across the European markets and we thus include market fixed effects to the regression. We also include consumer price inflation to the specification. Last, we include a trend

[25] The data is described in detail in Goldberg and Verboven (2005). It can be accessed on the webpages of either author.

[26] SDRs are a basket of major currencies with weights updated every 5 years.

to account for the fact that technological progress might make car production cheaper in general.

In Table A1 we take the baseline definition of a car model in Goldberg and Verboven (2001 and 2005). In the panel, a group is defined as one car model sold in one market so that we have 1554 groups and 379 car models.

In Column (1) of Table A1, we regress the logarithm of a car's price on a Luxury Dummy that equals 1 if the car is either counted as "Intermediate Class" or "Luxury Class" in official car guides. The interpretation of the coefficient of the luxury dummy is the following. If two car models are sold on the same market and in the same year, yet one is a Luxury or Intermediate car while the other one is not, the price differential is on average 0.698 log points (around 2−fold).

In Column 2 of Table A1, we relate car prices to "measurable" measures of quality. We include horsepower, fuel efficiency, cylinder volume, size, weight, and maximum speed. All measures have the expected sign except height, which has a negative coefficient, potentially because expensive sport cars tend to be flat. Conditional on the other car characteristics, a one KW stronger engine is associated with a 0.55% higher price. The overall fit of the model is very good, with an R^2 of 92.6%, but we can do even better by also including "soft" car attributes such as the car brand. In Column 3, we thus add brand dummies and class dummies to the estimation.

We next predict two indexes of car quality. We predict "Quality Index 1" from Column 2 of Table A1. Since conditional on the car characteristics, where and when a car is sold should not influence its quality, and since, moreover, consumer price inflation does not affect the quality of a car, we partial out these variables when predicting the quality index. We next predict "Quality Index 2" from the model in Column 3 of Table A1. For Quality Index 2, we again partial out the effect of when, where, and at what level of consumer prices a car was sold, but we include the brand and class dummies. After predicting, we standardize both indices of quality for better interpretability of the results.

Data description: which cars are traded? Having constructed the hedonistic quality indices, we describe our data in detail in Tables A2 and A3. Table A2 reports the summary statistics of our sample of cars. The structure of Table A2 is the following. We first summarize the whole sample in Panel A and then partition this sample into three subsamples. Panel B only summarizes only domestic prices – i.e. the retail prices charged

in one of the five countries (BEL, FRA, GER, ITA, and UK) of those cars that were produced locally. Panel C summarizes the retail prices charged in one the five countries of cars that were produced in one the five countries, but not locally. Finally, Panel D summarizes the retail prices changed in one of the five countries of cars produced in neither of the five countries.

For these four groups of cars, Table A2 reports the summary statistics for the quantity sold, prices, and quality. In addition to the usual statistics (un-weighted mean, un-weighted standard deviation, minimum, and maximum), we also report the weighted mean quality index. As smaller, less expensive car models tend to have much higher sales than luxury cars, the weighted average quality is negative on average. Table A2 documents that high-quality cars are exported more often. To confirm this observation, compare the average quality in Panel B to the one in Panel C: the weighted average of Quality Index 1 of those cars exported and sold domestically is -0.348, while the same average in the group of cars produced in one of the five markets and exported to the other four markets is 0.04 higher than that. Also when evaluating the alternative quality index and/or the unweighted means, exported cars tend to be of higher quality than domestically sold cars.

We present some more information about the variability of our changes in Table A3. The upper part of Table A3 presents summary statistics for the annualized change in the natural logarithm of a model's price, changes in the exchange rates, and annual CPI inflation. We also display the annual change in the logarithm of the relative price. The relative price is the ratio of the price of a car in the importer market divided by the price of the same car in the market of production. In the main specifications that we present below, we focus on car models that are produced in Belgium, Italy, Germany, France, or the UK and sold on one of the other four markets. We thus present the summary statistics only for this group of observations.[27]

There are no outliers for the annual exchange rate fluctuation or for the annual inflation rates. However, some of the year-to-year price changes (and more so for relative price changes) are quite large. The lower part of Table A3 lists any observation where either the nominal or the real price changed by more than 0.5 log points (a 64% change) from year to year. Such a large price change does never occur for the same model. The underlying

[27] When using the full sample, we drop all cars from former Yugoslavia that went through a hyperinflation episode during the early 90's.

reason for these fluctuations is that the base model is sometimes discontinued in some markets, while other versions are still offered. Since Goldberg and Verboven (2001 and 2005) always use the price of the base model that is actually available on a market (and do not treat this as a new model) the price may jump from year to year. Nevertheless, we include these observations in the main regression because in such incidences drastic changes in the nominal price and in the observed car quality concur and are thus controlled for in our regressions.

Table A1 - Quality Attributes and Prices: Random Effects Estimations

	(1) Luxury Dummy	(2) Quality Index 1	(3) Quality Index 2
Dependent variable: Ln price in SDR, net of taxes			
Luxury Dummy (Cla= 4,5)	0.698 [0.017]**		
Horsepower (in kW)		0.0055 [0.0003]**	0.0047 [0.0003]**
Fuel efficiency (L/100 km)		-0.0143 [0.0016]**	-0.0138 [0.0016]**
Cylinder volume (in l)		0.18467 [0.0122]**	0.16784 [0.0119]**
Weight (in t)		0.2145 [0.0282]**	0.10811 [0.0282]**
Length (in m)		0.2316 [0.0149]**	0.1474 [0.0169]**
Width (in m)		0.0464 [0.0547]	-0.1031 [0.0539]
Height (in m)		-0.4514 [0.0603]**	-0.3620 [0.00058639]**
Maximum speed (km/hour)		0.0013 [0.0003]**	0.0011 [0.0003]**
Trend (year)	y	y	y
CPI inflation	y	y	y
Market Dummies	y	y	y
Class Dummies			y
Brand Dummies			y
Observations	11510	11510	11510
Number of groups	1554	1554	1554
R-Sq.within	82.8%	84.6%	84.8%
R-Sq. between	82.1%	94.4%	96.3%
R-Sq. total	81.9%	92.9%	94.5%

Notes: In all specifications of Table A1, the dependent variable is the natural logarithm of the price in Special Drawing Rights (SDR) and net of taxes. All models include a year trend, CPI inflation, and import market dummies. A group is identified by a model (co_loc) sold on one market. The specification uses “Li” as measure of fuel efficiency (average of “Li1”, “Li2”, “Li3”); robust standard errors in parenthesis; * significant at 5%; ** significant at 1%.

Table A2 - Data Description (Cars and Quality)

	(1)	(2)	(3)	(4)	(5)
Variable	***Mean***		***Std. Dev.***	***Min***	***Max***
	weighted	***unweighted***	***unweighted***		
Panel A: all models, all markets, and all years (11510 model-market-years, 1554 model-years, and 379 models)					
Price in SDR	6010	6627	4512	681	39665
Quality Index 1	-0.337	0	1	-2.247	3.927
Quality Index 2	-0.331	0	1	-1.949	3.855
Quantity (per market and year)	-	19868	37771	51	433694
Panel B: models produced and sold domestically in market of production (BEL, FRA, GER, ITA, or UK) (2097 model -years and 255 models)					
Price in SDR	5785	6214	4330	681	35398
Quality Index 1	-0.348	-0.055	1.005	-2.247	3.927
Quality Index 2	-0.288	-0.006	0.993	-1.949	3.855
Quantity (per market and year)	-	65505	65660	300	433694
Panel C: models produced in BEL, FRA, GER, ITA, or UK and exported to other 4 markets (6161 model-market-years, 833 model - years, and 241 models)					
Price in SDR	6345	6518	4698	691	39665
Quality Index 1	-0.304	-0.009	1.022	-2.247	3.927
Quality Index 2	-0.277	0.047	1.013	-1.949	3.854
Quantity (per market and year)	-	10726	15196	51	175812
Panel D: models produced outside of BEL, FRA, GER, ITA, or UK (3252 model-market-years, 466 model-years, and 110 models)					
Price in SDR	6354	7099	4223	963	34561
Avg. Quality Index 1	-0.36	0.052	0.950	-2.020	3.396
Avg. Quality Index 2	-0.48	-0.086	0.973	-1.913	2.956
Quantity (per market and year)	-	7759	13602	53	157612

Notes: In Table A2, there are in total 379 models, of which 14 are only exported and not sold in the home market. The quality indexes are predicted from the respective model in Table A1 partialling out the effect of inflation, year, and market. The quality indexes are also standardized. For the Relative Avg. Quality Index, each the average of car quality is weighted by the quantity sold, and this average is then demeaned by year (but not by market).

Table A3 - Summary Statistics of Yearly Fluctuations and List of Outliers

Sample consists of all car models that are produced in BEL, FRA, ITA, Ger, and UK and exported to the other 4 markets

	Observations	Mean	St Dev.	Min	Max
dExrate = change Ln(bilateral exchange rate)	5216	-0.0005858	0.0703469	-0.266955	0.266955
dPrice = change Ln(price in local currency)	5216	0.0700733	0.0869908	-0.8905315	0.8134804
dRelativePrice = change Ln(price destination/price home) local currencies	4976	-0.0041548	0.1012984	-0.9666461	0.7753934
dCPI = change Ln(CPI destination)	5216	0.0592325	0.0440829	-0.0024832	0.2170054
dRelativeCPI change Ln(CPI destination / CPI home)	5216	0.0004058	0.0435519	-0.1593031	0.1593031

List of Observations with |dPrice|>0.5 or |dRelativePrice|>0.5

Year	Importer (ma)	Exporter (loc)	Car Model	dPrice	dPrice_Relative	Change of Q1	Level of Q1
74	Italy	Germany	Opel Record	0.6032	0.4798	0.0000	0.3566
75	Italy	Germany	Opel Record	0.5163	0.4440	0.4816	0.8382
75	Belgium	Italy	Fiat 124	0.5991	0.1291	0.5722	0.0898
75	France	Italy	Fiat 124	0.5728	0.1028	0.5722	0.0898
75	UK	Italy	Fiat 124	0.6705	0.2005	0.5722	0.0898
76	UK	Germany	VW Beetle 1200	0.3793	0.5065	0.0000	-1.0821
77	UK	Italy	Fiat Argenta	0.5054	0.1929	0.4228	0.8267
79	Belgium	Germany	VW Beetle 1200	0.6118	na	0.3029	-0.7792
81	Germany	France	Peugeot 504	0.7080	0.6024	0.5107	0.8290
84	Italy	Germany	Audi 100/200	0.7056	0.6729	0.7017	1.3252
93	Belgium	Italy	Lancia Delta	0.8135	0.7754	1.5782	1.6892
94	Belgium	Italy	Lancia Delta	-0.8905	-0.9666	-1.6259	0.0632
95	Belgium	France	Renault 19	-0.1199	-0.6930	0.0000	-0.2130
95	Germany	France	Renault 19	0.0123	-0.5608	-0.2066	0.0171

Notes: The upper part of Table A3 presents summary statistics for changes of exchange rates, prices, and CPI inflation. The summary statistics are presented for all cars that are produced in BEL, FRA, ITA, GER, and the UK and that are sold on at least one of four possible export markets in our sample. The models that are not sold in the country of production and thus have no "Home Market Price" are dropped. The lower part of Table A3 lists outliers that had year-to-year price changes of more than 0.5 log points in absolute terms or a relative price change of more than 0.5 log points in absolute terms.

Table A4 - Exchange Rate Pass-Through (Fixed Effects Panel Regressions)

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline	CPI IA	PPI	PPI IA	co	zcode
Dependent Variable: Change Ln price (local currency, net of taxes)						
dExrate	0.143**	0.141**	0.099*	0.098*	0.249**	0.267**
= Ln change exchange rate	[0.040]	[0.040]	[0.041]	[0.041]	[0.041]	[0.042]
Quality Index 1	0.062**	0.063**	0.058**	0.057**	0.063**	0.026
	[0.015]	[0.015]	[0.019]	[0.019]	[0.018]	[0.015]
dExrate* Quality Index 1	-0.084*	-0.068	-0.099**	-0.101**	-0.106**	-0.100*
	[0.038]	[0.038]	[0.036]	[0.036]	[0.038]	[0.039]
CPI inflation importer	0.810**	0.674**				
	[0.057]	[0.065]				
CPI infl. * Quality Index 1		-0.239**				
		[0.070]				
PPI inflation importer			0.018	0.034		
			[0.054]	[0.060]		
PPI infl. * Quality Index 1				0.037		
				[0.057]		
Trend (year)	-0.002**	-0.002**	-0.004**	-0.004**	-0.002**	-0.001
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Observations	4,976	4,976	3,855	3,855	4,976	4,976
Number of groups	719	719	582	582	204	144
R-squared	0.0808	0.0722	0.00655	0.00642	0.0364	0.0874
R-squared (between)	0.0846	0.0631	7.67e-05	9.40e-05	0.00439	0.0944
R-squared (within)	0.0900	0.0929	0.0234	0.0235	0.0808	0.0759

Notes for Table A4: all results are from fixed effects estimations, where Market-Co-Location variation is absorbed. "Co" is the narrow car model definition of Goldberg and Verboven (2005)). The sample consists of all models that are produced in and exported to BEL, FRA, ITA, GER and UK. Robust standard errors reported in parentheses * significant at 5%; ** significant at 1%.