

Price settings in online markets: Basic facts, international comparisons, and cross-border integration

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LAW OF ONE PRICE (LOOP)

- A very intuitive and simple concept
- Basic ingredient/assumption in many models in international economics
- In the data (country- or region-level):
 - Large/Heterogeneous deviations from LOOP
 - Slow (if any) convergence to LOOP
- Explanations:
 - Frictions (distance, information, tariffs)
 - Sticky prices
 - The data are “poor” (e.g., compare price indexes)

A twist to LOOP: EX Pass-Through

- Macro data
 - Campa and Goldberg (2005): The United States has among the lowest pass-through rates in the OECD, at approximately 25% in the short run and 40% over the longer run.
- Avoiding aggregation bias:
 - Imbs et al. (2005), Cruchini and Shintani (2008), Broda and Weinstein (2008): the pass-through and the speed of price adjustment are higher when individual, narrowly-defined goods are considered

Determinants of PT and Speed of Adjustment

- Factors affecting the size of the pass-through.
 - Market structure,
 - market power (including adjustment of mark-ups),
 - tariffs,
 - presence of multinationals
 - importance of non-traded inputs for price stickiness of final goods

Menon (1996), Cardasz and Stollery (2001), Gaulier, Lahreche-Revil, and Mejean (2006), Goldberg and Hellerstein (2012), Mayoral and Gardea (forthcoming)

What do we do?

We use online prices for estimating:

- Descriptive statistics
- Exchange Rate PT, speed of Adjustment
- Determinants of PT/SA

Why online prices?

ONLINE MARKETS

- Highly integrated and fast growing markets
- Easy search for best prices
- Price comparison for identical goods is easy across stores
- Negligible physical cost of changing prices
- Goods sold online are easy to ship and transactions costs are small
- Geographical location of stores and consumers is largely irrelevant
- Nearly impossible to discriminate consumers based on their location
- Easy to collect data

Research on Online Prices

- Brynjolfsson and Smith (2000) compare online and conventional stores prices on books and CDs.
 - online prices are 9-16% lower than prices in regular stores
 - the changes in online prices are much smaller for online prices,
 - quotes of internet prices are quite **dispersed** even for precisely defined goods.

Research on Online Prices

- Lunnemann and Wintr (2011) document stickiness of online prices in the U.S. and large European markets (Germany, France, Italy, and the U.K.).
 - internet prices change less often in the U.S. than in Europe (the opposite is true for conventional stores).
 - Online prices are more flexible than their offline counterparts with half of the spells ending within a month.

Dispersion in Online Markets

- Dramatic **dispersion** of prices in online markets because of
 - information frictions
 - sellers' ability to discriminate consumers (e.g., based on what sellers know about customers),
 - differences in advertisement (e.g., investment in building brand, reputation, etc.).

Baye and Morgan 2001, Baye and Morgan 2004, Morgan, Orzen, and Sefton 2006, Baye and Morgan 2009

Boivin et al. (2012)

- Dynamics of online price differences across three book sellers: Amazon.com (and Amazon.ca), BN.com (Barnes & Noble website), and Chapters.ca.
 - price differentials (or relative quantities) for books react to fluctuations in the relative price of foreign competition following exchange rate movement which is consistent with extensive market segmentation and pervasive violations of the law of one price.

Cavallo et al (2014)

- Prices for all products sold by Apple, IKEA, H&M, and Zara through their online retail stores in 85 countries.
 - the law of one price holds very well within currency unions, but does not hold outside currency unions
 - good-level real exchange rates reflect differences in prices at the time products are first introduced

Contribution to literature

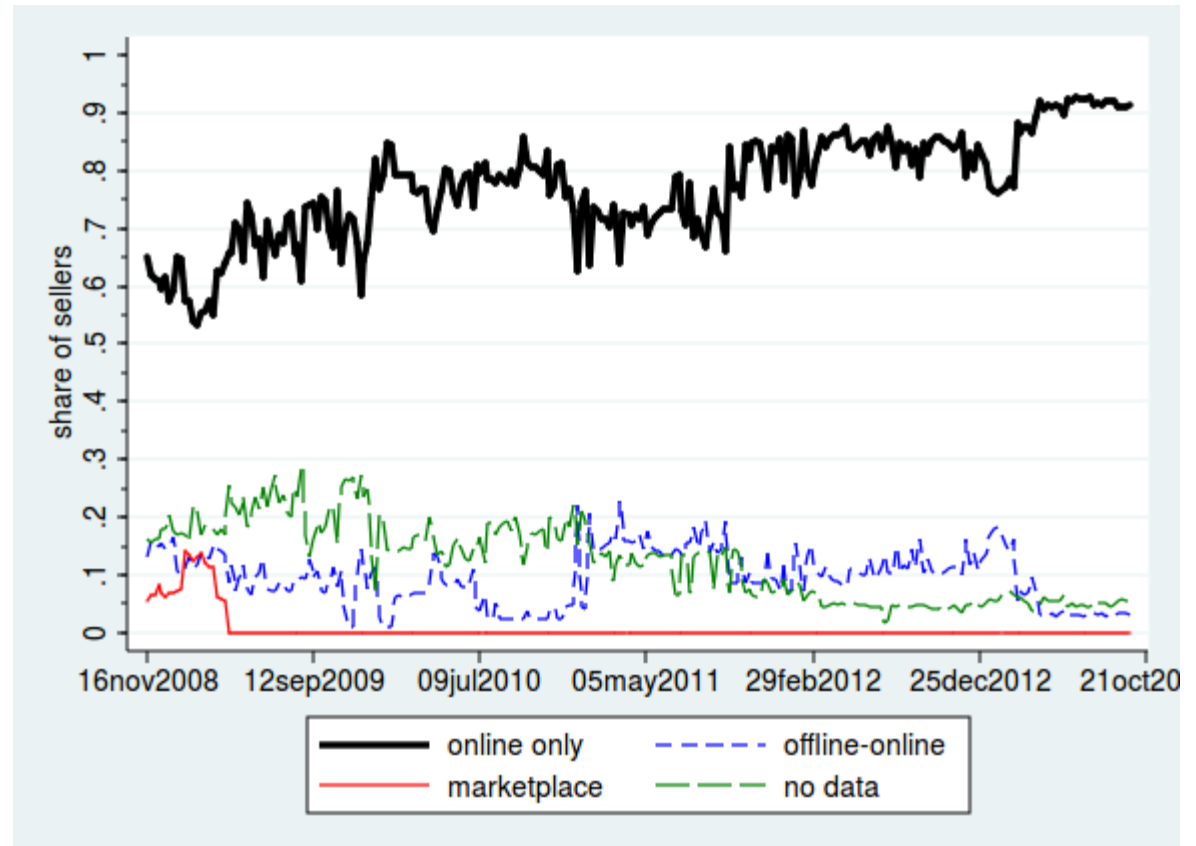
- We use unique characteristics of online markets to re-examine LOOP using prices from U.S. and Canadian online sellers.

DATA COLLECTION

- We use a popular price comparison website.
- Every Saturday at midnight, a Tcl/python script has been triggered to collect webpages with price information.
- The script extracts
 - good description,
 - unique manufacturing product number (MPN),
 - prices for each seller,
 - sellers' unique ids and reviews.
- Our price quotes are price *before* taxes and shipping/handling costs.
- What we have:
 - >140,000 goods
 - >14 million good-seller-week-country quotes.
 - 55 types of goods in four main categories: computers (20 types, e.g., laptops), electronics (14 types, e.g., GPS), software (11 type, e.g., computer games), and cameras (10 types, e.g., digital cameras).

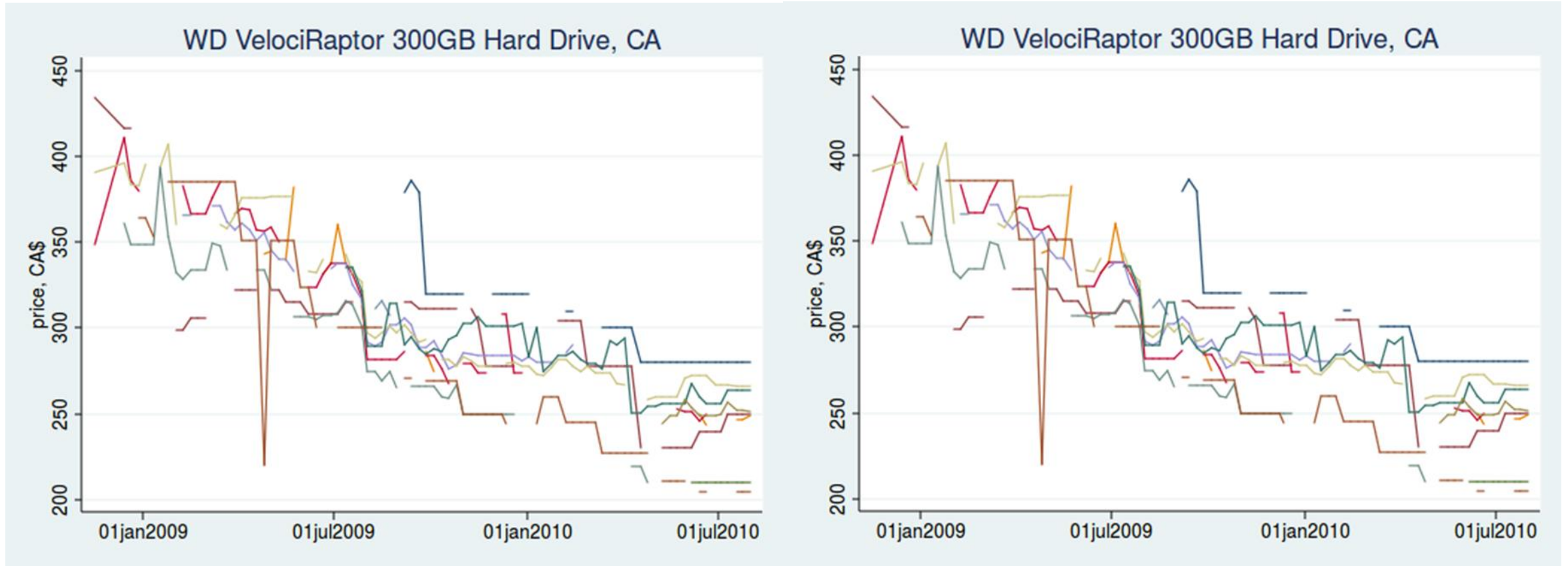
Sample composition

	USA	Canada
1	TheNerds.net	Agile Electronics
2	Rakuten.com	PC-Canada
3	NextWarehouse.com	Cendirect.com
4	SeaBoom.com	OnHop
5	TechLoops.com	Mostly Digital
6	CompSource Inc.	FrontierPC.com
7	LACC.com	Ashlin.ca
8	ValleySeek Store	DirectDial Canada
9	PROVANTAGE	Computer Valley
10	TigerDirect	Comtron



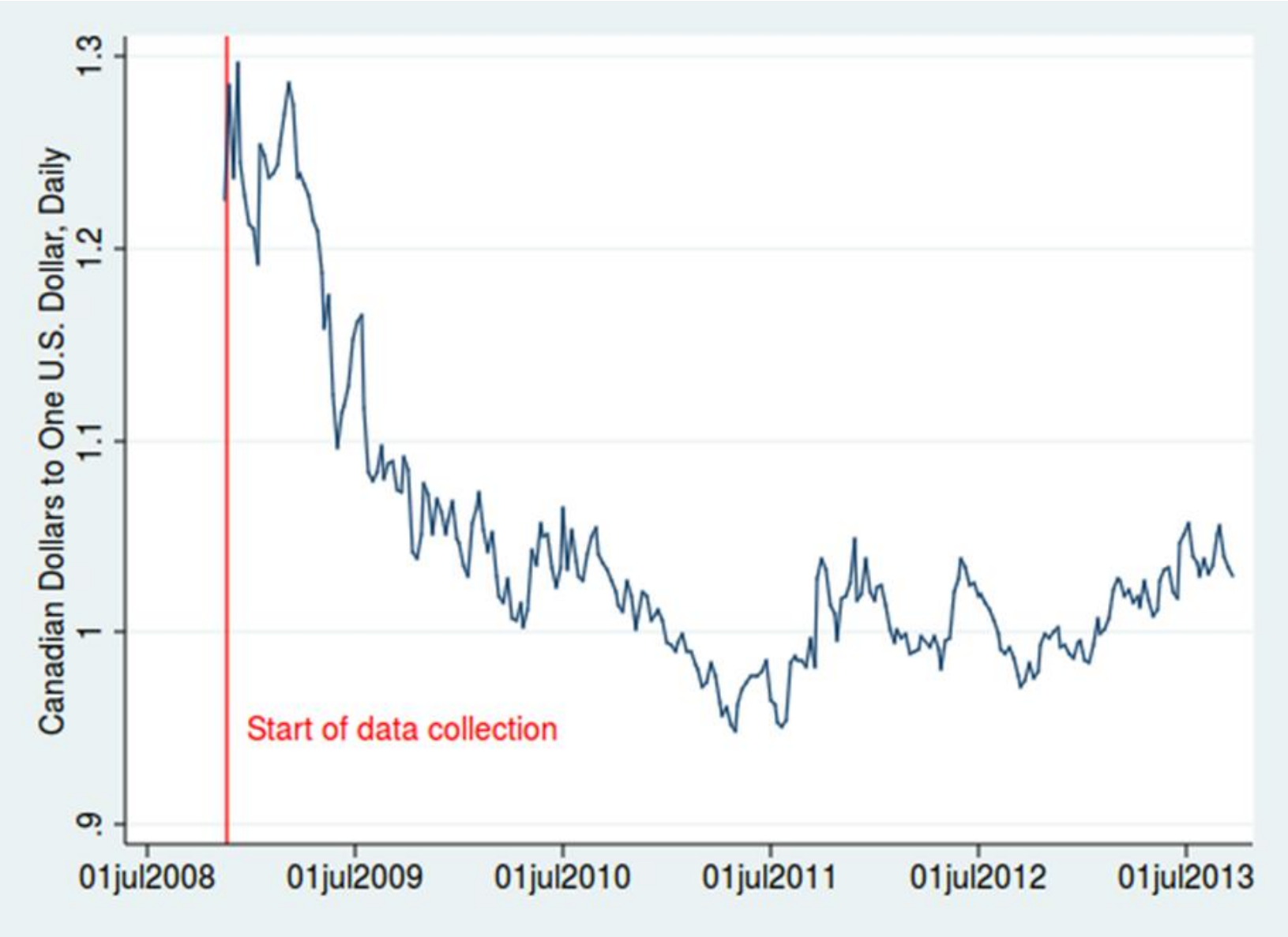
By goods-per-week

US vs CA



Composition

Category	Type	Quotes	Goods	Sellers	Goods/Seller
Cameras (10 categories)	35mm SLR lens Accessories, Bags and Cases, Binoculars, Camcorders, Camcorder Batteries, Camcorder Accessories, Dedicated Flashes, Digital Cameras, SLR Lenses, Tripods	1,398,396	12,215	405	62
		(542,440)	(1,193)	(298)	(29)
Computers (20 categories)	Cases, Desktops, Flash Memory, Flat Panel LCD monitors, Hard Drives, Hubs, Keyboards, Laptop, Laptop Memory, Microphones and Headsets, Modems, Motherboards, Network Adapters, Power Supply, Processors, Scanners, Speakers, Storage Media, UPSS, Webcams	11,260,217	50,240	815	69
		(8,356,822)	(12,679)	(689)	(45)
Electronics (13 categories)	Audio Cables, AV Accessories, Calculators, Cash Registers, GPS, Headphones, MP3 players, Portable Device Accessories, Projectors, Projection Screens, Plasma/LCD TV, TV Accessories, Video Cables	4,313,179	38,883	676	60
		(2,699,271)	(8,949)	(506)	(26)
Software (12 categories)	Anti-Virus, Audio/Video Utilities, Computer Games, Engineering and Design, Databases, Financial and Legal Software, Graphics and Publishing, Office Suites, Programming, Security, System Utilities, Windows Operating Systems	1,628,044	16,648	382	100
		(725,544)	(1,308)	(297)	(52)



DESCRIPTIVE STATISTICS

	Canada		USA	
	Mean	St.Dev	Mean	St.Dev
	(1)	(2)	(3)	(4)
Cross-sectional distribution of prices				
St.dev. log(Price)	0.128	0.090	0.159	0.113
IQR log(Price)	0.111	0.083	0.173	0.138
Median log(Price)	5.402	1.407	5.327	1.415
Median duration of price spell (weeks)	1.172	0.545	1.601	1.097
Size of price changes				
Median dlog(Price)	-0.006	0.019	-0.006	0.033
Median abs(dlog(Price))	0.029	0.044	0.042	0.052
Synchronization of price changes	0.230	0.209	0.187	0.124
Properties of sellers				
Number of sellers	2.425	1.208	3.367	1.916
Stability	0.900	0.065	0.887	0.052

INTERNATIONAL PRICE COMPARISONS

	Mean	St.Dev	AR1 OLS	N
	(1)	(2)	(4)	(5)
Panel A: Mean prices (net)				
Relative exchange rate	0.074	0.225	0.917	1,737,703
Real exchange rate	0.051	0.218	0.911	1,737,703
Panel B: Mean prices (gross)				
Relative exchange rate	0.070	0.201	0.893	1,342,314
Real exchange rate	0.069	0.202	0.893	1,342,314

$$\text{Relative exchange rate} \equiv \log(P_{it}^{CA} / P_{it}^{US})$$

$$\text{Real exchange rate} \equiv \log(EX_t^{-1} \times P_{it}^{CA} / P_{it}^{US})$$

PASS-THROUGH

$$\text{Pass-through (PT): } \log \left(\frac{P_{it}^{CA}}{P_{it}^{US}} \right) = \alpha EX_t + \text{Controls} + \text{error}_{it}, \quad (1)$$

- The long-run pass-through and is similar to specifications estimated in Goldberg and Knetter (1997), Campa and Goldberg (2005), Goldberg and Hellerstein (2012).
- The law of one price predicts that α should be equal to one and larger values of α correspond to smaller departures from the law of one prices.

SPEED OF PRICE ADJUSTMENT

Speed of price adjustment:

$$d \log \left(\frac{P_{it}^{CA}}{P_{it}^{US}} \right) = \beta \left(\log \left(\frac{P_{i,t-1}^{CA}}{P_{i,t-1}^{US}} \right) - \alpha EX_{t-1} \right) \quad (2)$$
$$+ \phi_1 d \log \left(\frac{P_{i,t-1}^{CA}}{P_{i,t-1}^{US}} \right) + \lambda_1 dEX_{t-1} + Controls + error_{it}$$

- It is set in the error-correction/cointegration form where β quantifies how quickly the deviation from equilibrium is eliminated.
- In Specification (2), equilibrium relationship between relative and the exchange rate are determined according to Specification (1).
- While the equilibrium relationship nests the law of one price, it also allows deviations from the law of one price (i.e., α can be less than one).

Basic Results: Net Prices

	PT	Speed
	(1)	(2)
Mean Price	0.671*** (0.086)	-0.154*** (0.007)
Median Price	0.666*** (0.089)	-0.168*** (0.007)
Minimum Price	0.620*** (0.045)	-0.162*** (0.007)

Within-seller	0.206*** (0.060)	-0.100*** (0.027)
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GOOD-SPECIFIC PASS-THROUGH

Pass-through (PT): $\log\left(\frac{P_{it}^{CA}}{P_{it}^{US}}\right) = \alpha EX_t + Controls + error_{it},$

Speed of price adjustment: $d \log\left(\frac{P_{it}^{CA}}{P_{it}^{US}}\right) = \beta \left(\log\left(\frac{P_{i,t-1}^{CA}}{P_{i,t-1}^{US}}\right) - \alpha EX_{t-1} \right) + \phi_1 d \log\left(\frac{P_{i,t-1}^{CA}}{P_{i,t-1}^{US}}\right) + \lambda_1 d EX_{t-1} + Controls + error_{it}$

Estimate α and β for each good separately and related variation of α and β across goods to “fundamentals” such returns to search, price stickiness, etc.

DETERMINANTS OF PASS-THROUGH AND SPEED OF PRICE ADJ.

Regressors	Path through		Speed of Adjustment	
	Mean price	Median price	Mean price	Median price
	(1)	(2)	(3)	(4)
Log(Median Price)	0.214** (0.089)	0.329*** (0.088)	0.051*** (0.008)	0.048*** (0.009)
Log(Median Price) ²	-0.023*** (0.008)	-0.032*** (0.008)	-0.004*** (0.001)	-0.004*** (0.001)
Freq. of price change	1.963*** (0.193)	1.982*** (0.183)	-0.127*** (0.017)	-0.134*** (0.017)
Log(Sellers)	0.689*** (0.169)	0.691*** (0.177)	-0.010 (0.019)	-0.008 (0.021)
Log(Sellers) ²	-0.417*** (0.084)	-0.401*** (0.091)	0.010 (0.008)	0.005 (0.009)
Stability of Sellers	0.250 (0.660)	0.520 (0.591)	0.871*** (0.075)	0.963*** (0.082)
Synchronization	-0.349** (0.158)	-0.375** (0.153)	0.037** (0.017)	0.016 (0.016)
Average Reputation	-0.129** (0.058)	-0.138** (0.055)	-0.016*** (0.005)	-0.018*** (0.006)
Freq. of sales	1.068 (0.763)	1.182 (0.804)	-0.396*** (0.055)	-0.382*** (0.057)
Convenient Prices	0.123 (0.101)	0.188* (0.096)	0.024** (0.011)	0.030** (0.014)
Observations	21,666	21,605	21,995	22,042
R2	0.15	0.15	0.16	0.16

Concluding remarks

- Online retail is closer to a frictionless ideal market
 - More flexible prices
- Law of one price is a reasonable approximation
 - Mildly persistent price differentials
 - Pass-through is relatively high
 - Speed of price adjustment is high
 - All margins are working to eliminate price differentials
- Large variation across goods
 - This variation can be systematically related to “fundamentals”
- Soaring internet retail can bring the law of one price closer to reality