The Cyclicality of Add-on Pricing

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Abstract

Prices generally fail to show sizeable fluctuations over the business cycle. In this paper, we show that these fluctuations may be hidden in the prices of add-on goods, which are unrecorded in official statistics. Using extended warranty data from a nationwide Canadian retailer of household durable goods, we show add-on prices respond strongly to changes in local economic activity whereas base-durable prices do not. This observed procyclicality is generated by changes in price setting behaviour during the Great Recession, when local stores significantly reduced extended warranty prices to boost sales of durable goods. The procyclicality of extended warranty prices survives aggregation. The aggregate cyclicality results from a higher number of transactions at (in-store) discounted prices during the Great Recession.

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Add-ons improve the quality of a good or service and "their prices are not advertised and would be costly or difficult to learn before one arrives at the point of sale" [Ellison, 2005]. They are widespread in the sales of airline tickets, hotel rooms, and durable goods, where retailers can add baggage fees on to airline tickets, the mini-bar on to hotel rates, and extended warranties to durable goods. In spite of their growing importance for revenues and profits in the retail and services sectors, they are unaccounted for in consumer price indices and, therefore, in studies of price dynamics.[1] In this paper, we show that, once add-on prices are accounted for, price fluctuations over the business cycle are more substantial than previously thought.

We use 10 years of transactions data from a nationwide Canadian retailer of household durable goods, data on every one of the more than 6 million customer purchases that took place between December of 1999 and December 2009. The data includes information on the prices of the base durable goods and extended warranties, a service that can be added on to most of retailer's products. The data puts us in a unique position to study the responses of add-on-adjusted prices to shifts in economic activity because add-on prices are generally difficult, if not impossible, to observe by definition. Moreover, our sample period is long and includes the Great Recession. Finally, our data covers the entire country, which is useful because there was substantial heterogeneity in how regions were impacted by the Great Recession.

Our baseline analysis investigates the relationship between regional (sub-provincial) prices and economic activity at the monthly level. We show that a one percentage point increase in the regional unemployment rate is followed by a $2.15 drop in the extended warranty price in the next month. The long-run cumulative effect of the regional unemployment rate on extended warranty price is large: a one percentage point increase in the unemployment rate

[1]For instance, airline revenues from baggage fees increased from 543 million to 4.2 billion dollars in the U.S. between 2007 and 2016 (Bureau of Transportation Statistics).

decreases the price of the extended warranty over the following year by $6.89 or 7.7 percent of the mean extended warranty price. There are no significant changes in the prices of durables in the following month, 6 months, or 1 year, after changes in the local unemployment rate.

This observed procyclicality in extended warranty prices is driven to a large extent by the price setting behavior of local stores during the Great Recession. In the Great Recession, local stores reduced extended warranty prices to zero or close to zero. We argue that the price reductions reflect efforts to boost sales of base goods in the face of weakened base good demand. We present direct evidence that these efforts boost base good sales. More specifically, we estimate a demand system which includes a measure of the effort to sell more of the base good via unofficial in-store promotions on extended warranties. We show that a one standard deviation increase in our measure increases the number of base goods sold by 0.56 units. We find no evidence of local stores attempting to boost base good sales via base good prices, which are already priced close to cost, consistent with the retailer not wanting to attract low income consumers who are unlikely to purchase extended warranties (*c.f.* Ellison [2005]).

Regional price cyclicality may be uninformative for cyclicality at the national level if regional differences in economic structures imply asymmetric responses to the same shocks, if the impact of aggregate shocks is attenuated by inter-regional factor mobility, or if the shocks are attenuated by Bank of Canada adjustments. Accordingly, we investigate the implications of price cyclicality on aggregate. We follow the Canadian statistical office (Statistics Canada) in how we aggregate prices and construct inflation rates for durable goods. We further compute inflation rates with and without the adjustment for the prices of extended warranties.[2] We complement the standard fixed-weights index, which lets us isolate pure price changes, with a transactions-weighted index, which lets us examine changes attributable to both prices

[2]See Chevalier and Kashyap [2019] for a detailed discussion on price aggregation strategies that allow for price discrimination.

and quantities.

We find inflation rates are acyclical when they are constructed using fixed weights. Inflation rates are procyclical, by contrast, when they are constructed using transaction-based weights, and are strongly procyclical for warranty-adjusted inflation measures. This result corroborates the micro-level evidence on unofficial in-store promotions because the procyclicality stems from an increase in the number of transactions at discounted prices during the Great Recession. More transactions translates into higher weights in the aggregate index during economic downturns.

This study contributes to a literature that examines the speed with which prices adjust to economic shocks. In an early influential study, using data from the U.S. Bureau of Labor Statistics, Bils and Klenow [2004] find that consumer prices adjust quite frequently. Nakamura and Steinsson [2008] show, however, that most of this price flexibility is due to temporary sales, which exhibit very different dynamics over the business cycle relative to regular prices. More recent work exploits regional variation to assess the speed of price adjustment. Stroebel and Vavra [2019] use detailed micro dataset to document the causal response of local retail prices to changes in local house prices, finding elasticities of 15-20 percent across housing booms and busts. Beraja, Hurst, and Ospina [2018] combine household and retail scanner data to document a strong relationship between unemployment rate and real wage growth.

Our study also contributes to a literature which examines changes in retail price setting and household shopping behaviour during recessions. Aguiar, Hurst, and Karabarbounis [2013] argue time spent on shopping increases during recessions, and Krueger and Mueller [2010] and Nevo and Wong [2019] show several measures of shopping intensity rose during the Great Recession. Coibon, Gorodnichenko, and Hong [2019] argue that, during recessions, consumers switch to low-cost stores.[3] Our focus is on price setting behavior and on demon-

[3]See Gagnon, López-Salido, and Sockin [2017] for a direct counterargument to this hypothesis.

strating how, during the Great Recession, the retailer was exploiting extended warranties to adjust prices. To this end, we propose a new mechanism of adjustment by the retailer and also show that consumers respond to this mechanism by increasing purchases of goods with discounted extended warranties.

1 Add-ons

Following [Ellison, 2005], we define add-ons as good or service that generates a vertical quality improvement in some basic product, where "[add-on] prices are not advertised and would be costly or difficult to learn before one arrives at the point of sale". Retailers can use low advertised prices on the basic product to encourage consumers to incur the time and travel cost of visiting their businesses. These sunk costs make it costly for the customer to visit competing businesses, and allow for higher markups on (add-on) goods that are only sold at the point of sale. Higher markups on add-ons may allow these businesses to earn positive profits in equilibrium.

Why should we expect more pronounced fluctuations in add-on relative to base good prices over the business cycle? One reason is the flexibility that seems inherent to add-on prices. If add-ons have a higher markups, then retailers have more room to adjust these prices downwards during a recession, when fewer consumers are visiting their stores, and when the consumers who do visit are more reluctant to buy. The propensity for downwards adjustments in add-on prices may be further enhanced by local salespersons who, because their outside option has deteriorated, may have stronger incentives to work hard during a recession [Lazear, Shaw, and Stanton, 2016].

2 Data

2.1. Base Durables and Extended Warranties. Our analysis is based on the data of a nationwide Canadian retail chain which specializes in the sale of household durables falling into one of two main categories: home appliances and consumer electronics. Almost all goods are offered with the option to extend the lifetime of the warranty beyond what the manufacturer offers. We follow the retailer, and other retailers, in calling this extension an extended warranty.

The data covers the universe of transactions between January 1 1999 and December 31 2009, involving more than 6 million transactions, more than 3 million consumers, and nearly 35,000 products. The data includes the prices paid for durables and extended warranties, whether an extended warranty was purchased, the *suggested* warranty price, as well as the cost of servicing claims made under the extended warranty. The suggested warranty price is the benchmark price set by the chain for different stores.

The chain has franchise as well as corporate stores. Franchises buy the durable goods at cost (the price of the manufacturer) plus the cost of keeping the durable good in inventory. We observe these transfer prices and use them to construct costs for all goods sold at both corporate and franchise stores. Our dataset also includes the claim costs for all claims made within our sample. We use this information to construct *ex post* extended warranty costs. Summary statistics of costs and prices are found in Table 1. The top panel of the table shows average price and cost for the base good. Customers pay 628.9 dollars for the durable which costs the retailer 549.7 dollars, on average. These costs include the manufacturer's price, commissions to salespersons for base durable sales (4 percent), the royalty costs to the retailer if the local store is a franchise (4 percent), inventory and marketing and advertisement costs (2.5 percent). The costs of the extended warranty include commissions on sales of extended warranties (15 percent), potential royalties to the retailer (4 percent), as well as the costs from

servicing claims on the extended warranty, such as parts, repair, and shipping. Although the prices of extended warranties are almost never advertised, the retailer calculates marketing and advertisement costs of 2.5 percent of total revenue, including that from the sales of extended warranties. We do the same.

The lower panel of the table shows figures for extended warranty. The suggested price exceeds the realized warranty price by about 50 percent. Customers extend the warranty 37 percent of the time, and pay 89.4 dollars, on average, to do so. The costs of the claimed warranties amount to 61.6 dollars on average implying a large average markup of 31 percent relative to the base-good markup of 13 percent. Such a high average markup suggests that extended warranties are highly profitable and, importantly, that the room for adjusting the extended warranty price is substantial. Note that this large markup is driven by the low frequency of claims (12 percent). The average cost of the realized claims is quite high, amounting to 488.6 dollars.

It is important to note that consumers must speak directly with store representatives to learn the extended warranty price. Moreover, once a consumer has visited one of the 200 or so stores in the chain, it becomes costly for them to visit another store in the same chain or a store in a competing chain.[4] The stores are usually housed in stand-alone buildings and located in regions with sprawl. Consumers must normally travel by car to learn the extended warranty prices at competing retailers. These sunk travel and time costs, together with the hidden nature of the price, allow for markups over the costs of extending the warranty.

The commission structure reinforces the notion that the chain has market power over the extended warranty price. The chain pays salespersons commissions for the sales of base goods and extended warranties. The commission on the extended warranty is 15 percent,

[4]Consumers and salespersons can interact in a number of ways. Salespersons can help consumers settle on a good. Alternatively, they can help them process the good after the consumer has settled on what they want. It is therefore difficult to know when precisely the salesperson makes the offer of the extended warranty [Jindal, 2015]. Later we will see, however, that our data lets us investigate whether the extended warranty is being used by salespersons to sell base durables.

Table 1: Summary statistics.

Base good			
	Price paid	Average cost	
	628.9	549.7	
	(613.89)	(526.98)	
Observations	6538033	4865375	
Extended Warranty			
	Suggested price	Price paid	Average cost
	133.9	89.4	61.6
	(109.01)	(93.62)	(261.70)
Observations	2585128	2576246	2583078
	Take up	Average claim cost	Claims frequency
	0.37	488.6	0.12
	(0.48)	(583.05)	(0.32)
Observations	6538033	306177	2585128

All prices and costs are in Canadian (CAD) dollars. Average cost for the base good includes the price paid for durable by retailer, inventory costs, 4 percent commission to the salesperson and 4 percent royalty to the retail chain. The suggested extended warranty price is the price recommended by the retailer's headquarters to the local stores and price paid is the one paid by the customer. The cost of extended warranty is computed as a sum of the total claims' costs, 15 percent commission and 4 percent royalty to the retail chain. Servicing covers 100 percent of the costs of a repair, including the costs of parts and labour, services that require a home visit by a technician, and in some cases the costs of replacement. If the extended warranty was purchased but no claim was made, the cost is set to zero. The average claim cost is calculated over the realized claims and the frequency indicates the number of claims made relative to the total number of purchased extended warranties in our sample. Figures in parentheses denote standard deviations and Observations the number of observations.

whereas the commission on the base good is 4 percent.[5]

Note that stores and salespersons have substantial discretion over extended warranty pricing. This discretion is often exploited as the average realized price is more than 45 dollars lower than the suggested price in Table 1.

Their discretion, along with fact that extended warranty prices are typically hidden, helps us emphasize the importance of transactions data for our purposes. Most other data sets, like list-price data collected by representatives of a statistical agency or by web-scraping will exclude add-on prices (*c.f.* Cavallo [2018]). The inherent unobservablity of add-on prices therefore makes it generally difficult, if not impossible, to draw reliable conclusions about the cyclical properties of add-on prices.[6] This argument was supported by our conversations with Statistics Canada and U.S. Bureau of Labour Statistics, wherein both noted that their respective consumer price indices (CPIs) do not include add-ons and extended warranty prices specifically.

2.2. Economic Activity and Inflation. Our baseline measure of economic activity is the unemployment rate from Statistics Canada (STATSCAN), which is seasonally-adjusted for each of 58 predefined administrative areas, referred to as Employment Insurance (EI) regions.[7] Each region contains several cities, and is almost always smaller than any one province. The regional unemployment rates are provided at the monthly frequency and computed as 3-month moving averages. We use the data between January of 2000 (2000M1) and December of 2009 (2009M12) for 55 regions. We exclude Yukon, Northwest Territories, and Nunavut because these territories are sparsely populated and because their unemployment is constant at a rate of 25 percent.

[5]The commission was 15 percent for almost the entirety of our sample, up until May of 2009 when it was reduced to 10 percent.

[6]This data issue is exacerbated by the fact that other goods typically have several different add-ons, all of makes a large-scale analysis more difficult.

[7]The unemployment rate for the EI region is used to determine the EI benefits an unemployed worker is eligible for.

Our macroeconomic analysis uses STATSCAN's aggregate seasonally-adjusted monthly unemployment rates for the same period. Note that the sample period covers the Canadian Great Recession between August 2007 and July 2009. The Canadian recession dates were determined by the OECD and can be downloaded from the St Louis FRED website: https://fred.stlouisfed.org/series/CANRECDM. In macroeconomic analysis, we also use durable-goods inflation measure from Statistics Canada between August 2007 and July 2009. The STATSCAN inflation measure tracks a large sample of representative goods and services to derive a robust estimate of the average price change facing consumers.

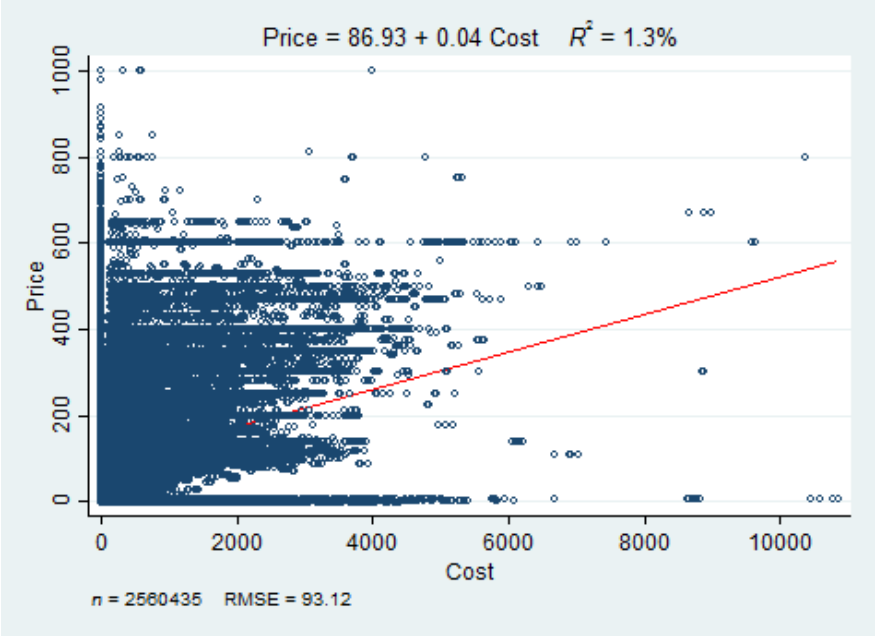
3 Descriptive Evidence

3.1. Prices and Costs for Base Goods and Extended Warranties. Figure 1 shows the relationship between the (variable) costs paid by the retailer and the prices charged for the base durable (top panel) and extended warranty (bottom panel).

The fitted line in Figure 1(a) shows that a 1 dollar increase in the variable cost of the base durable is associated with an approximately 1 dollar increase in the price. The fitted line in Figure 1(b) shows that a 1 dollar increase in the variable cost of the extended warranty is associated with a 4 cent increase in its price. The R^2 for the regression of the price on the cost of the durable is 94 percent, whereas its counterpart for extended warranties is 1.3 percent. The figures are consistent with a highly competitive market for the base good, local discretion in extended warranty pricing, as well as opportunities for marking up extended warranty prices (*c.f.* Ellison and Ellison [2009]).

One feature of the left panel of Figure 1(a) is worth mentioning, namely, that the base good price is often below cost. This is attributable to the pricing of individual product models over their lifecycle, wherein markups are initially positive upon introduction of the model, and become negative towards the end of the lifecycle. For instance, in our data, a

(a) Base Durable



(b) Extended Warranty

Figure 1: Prices and Costs of Base Durables and Extended Warranties.

CANON digital camera was brought to market in April 2008 with a highest mark-up of 15 percent and sold with a lowest mark-up of −11 percent in December 2009.[8] This pricing pattern is consistent with the decreasing trends of consumer electronics' prices observed during the last several decades.

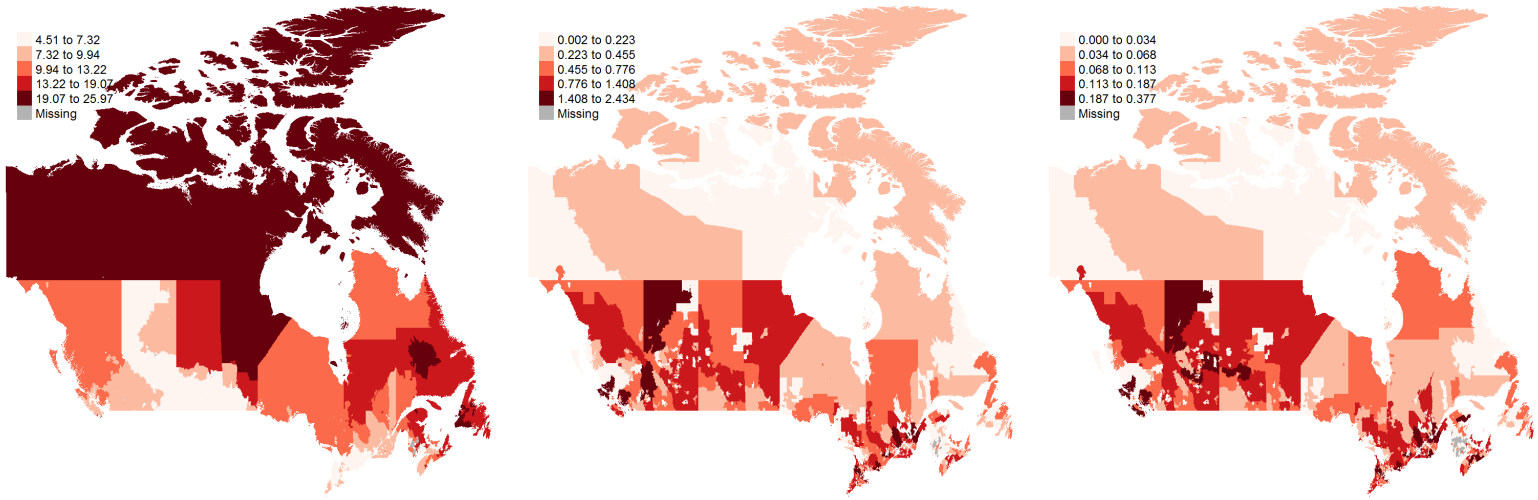
3.1.1. Unemployment and Prices over Space. Figure 2 presents the spatial distributions of the unemployment rates (2(a)), prices for the base good (2(b)) and extended warranty (2(c)). Warranty prices are lower in poorer regions where unemployment rates are high. In the northern territories, northern Manitoba, parts of Quebec and Eastern Canada, the unemployment rate ranges between 19 and 26 percent. Consumers in these areas pay relatively low prices for the base good and extended warranty. In Alberta and Southern Ontario, particularly around Toronto, the unemployment rate ranges around 4.5 to 7.3 percent. Consumers in these areas pay relatively high prices.

3.1.2. Prices over Time. To study the dynamics of base-good and extended warranty prices, we aggregate the transaction data to the month, product category and manufacturer for each store in the sample. This gives us a series that has the same frequency as the unemployment rate data and lets us define lags in the analysis naturally.[9] Figure 3 presents examples of these series.

The top left panel of Figure 3 depicts base-good price dynamics for Frigidaire freezers in Kingston, Ontario. The bottom left panel depicts base-good price dynamics for Whirlpool automatic washers in Oshawa, Ontario. The panels on the right plot extended warranty price dynamics for these same product categories. The dotted and solid lines show price dynamics for suggested and realized prices, respectively. Because suggested prices are set by

[8]Prices of the same model can somewhat vary across shops and therefore we talk about the highest and the lowest markups. We will discuss the extent of cross-sectional price variation later in this section.

[9]Note that not all the products are sold every day in every store. The aggregation allows us to have an observation every month and to control for persistence in prices.



(a) Unemployment Rates (b) Base-Good Prices (c) Warranty Prices

Figure 2: Regional Differences in Unemployment Rates, Base-Good Prices, and Extended-Warranty Prices. The figures are generated as follows. We first grouped consumers by the first three characters of their postal code. Postal codes in Canada have 6 characters. The first three characters refer to the forward sortation area. The first defines the province or a city in cases where the city has a large population. The second indicates whether the area is urban or rural. The third points to a specific rural region, city of medium size, or to a segment of a large metropolitan area. In all, there are about 1600 of these areas. In what follows, to keep things simple, we refer to these geographic identifiers as the postal code. For each group, we averaged the unemployment rate over the 130 plus months in our sample. We averaged prices over the 4000 plus days in our sample. We weighted prices by the population share of the group.

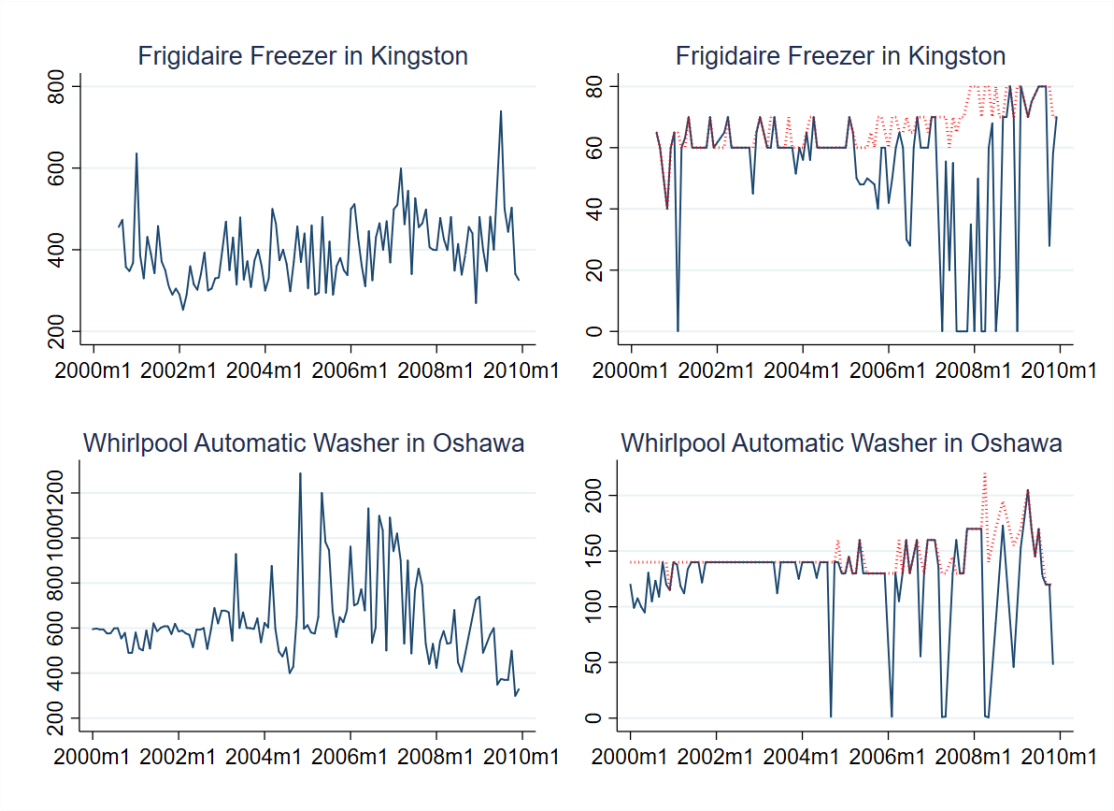


Figure 3: Base-good Prices and Suggested and Actual Prices of Extended Warranties. The left panels plot base-good prices. The right panels plot extended warranty prices. The dotted red lines plot the suggested extended warranty price and the solid lines correspond to the realized warranty prices (WP).

the chain, the difference between suggested and realized prices describes the extent to which stores exploit discretion over prices.

The panels on the right show suggested extended warranty prices are higher than realized extended warranty prices most of the time. In fact, in our entire sample the realized exceed the suggested prices 96.5 % of the time, in line with the mean differences for the entire sample (Table 1). There are several dips in realized extended warranty prices, most notably during the Great Recession, when realized prices were often close or equal to zero. There were no obvious and systematic dips in base-good prices during the Great Recession, although over the entire sample, they exhibit greater month-to-month variation than realized extended warranty prices.

To better understand price patterns before and after the Great Recession, we compute a measure of price similarity before and after the third quarter of 2007. Specifically, as in DellaVigna and Gentzkow [2017], for each pair of stores s and s', we calculate absolute difference in the average quarterly price and average this difference across quarters and product categories:

$$a_{s,s'} = \frac{1}{N_{q,c}} \sum_{q,c} |\overline{p}_{scq} - \overline{p}_{s'cq}| \tag{1}$$

where $\overline{p}_{scq}$ denotes the average price for product category c in store s and quarter q, and $N_{q,c}$ is the number of quarters and product categories.

Note that the mean of the $a_{s,s'}$-distribution for base-good prices is smaller than the mean of the $a_{s,s'}$-distribution for extended warranty prices. For base goods, the mean is 58.90 dollars, representing less than 10 percent of the average base-good price. For extended warranties, the mean is 66.97 dollars, representing more than 75 percent of the average extended warranty price. This suggests that while base goods are priced uniformly across stores, extended warranties are not.[10]

[10] DellaVigna and Gentzkow [2017] also find that the same chain applies uniform pricing across stores for the base goods but they do not study add-on pricing. Here we show that the price heterogeneity across

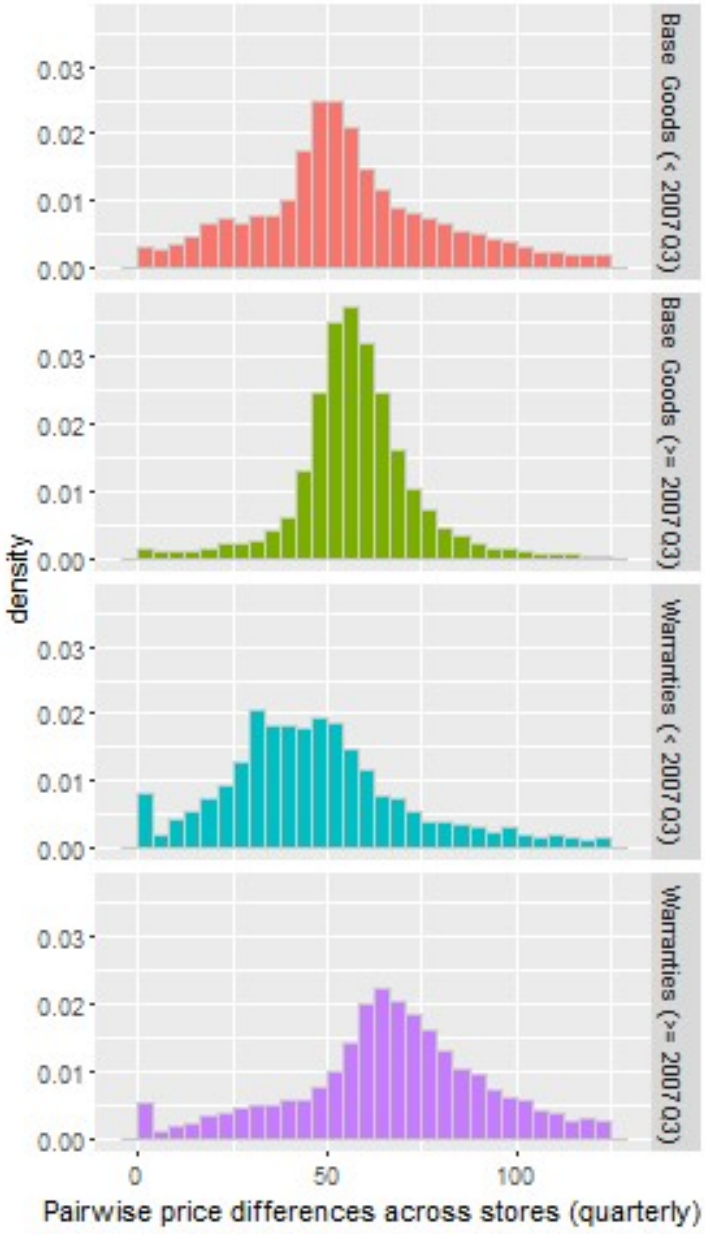


Figure 4: Across-Store Differences in Actual Base-good and Extended Warranty Prices Before and After the Onset of the Great Recession. The top 2 panels are histograms of the pairwise (across store) differences in base-good prices before and after the onset. The bottom two panels are histograms of the pairwise (across store) differences in extended warranty prices before and after the onset.

Figure 4 plots the $a_{s,s'}$-distribution over all store pairs in the sample, for base-good (top 2 histograms) and extended warranty prices (bottom 2 histograms), both before (histograms 1 and 3) and after (histograms 2 and 4) the onset of the Great Recession. A comparison of the top 2 histograms reveals little change in the distribution for base-good price differences from before to after the onset. While the distribution has fatter tails before the recession, the median changes little, going from 52.72 dollars before the recession to 56.79 dollars after the onset. A comparison of the bottom 2 histograms reveals significant changes in the distribution for extended warranty price differences. The median for extended warranties goes from 44.79 dollars before the recession to 67.30 after. The pre-recession distribution (histogram 3) is right-skewed with a large mass of small price differences across stores. The post-onset distribution (histogram 4) is left-skewed with a large mass of large price differences across stores.

Figure 5 plots the $a_{s,s'}$-distribution for suggested extended warranty prices before and after the onset of the Great Recession. Note that the mean for the overall distribution is small (11 percent of the mean suggested price) and shows little change from before to after the onset. A comparison of Figure 5 with the bottom 2 histograms in Figure 4 suggests that, because the distribution of suggested price differences has not changed, the change in the distribution of paid extended warranty prices reflects changes in the use of discretion by salespersons, rather than changes in the pricing strategy of the retailer.

3.2. Price Responses to Economic Activity. We investigate how base good prices and extended warranty prices respond to changes in local economic activity. We use aggregated data such that the unit of observation is defined by the month, product category, manufacturer, and store. The resulting dataset has 421,741 observations.

We test for cyclicality of prices of extended warranties and base goods, p_{tscm}, using the

stores is, in fact, generated by add-on pricing.

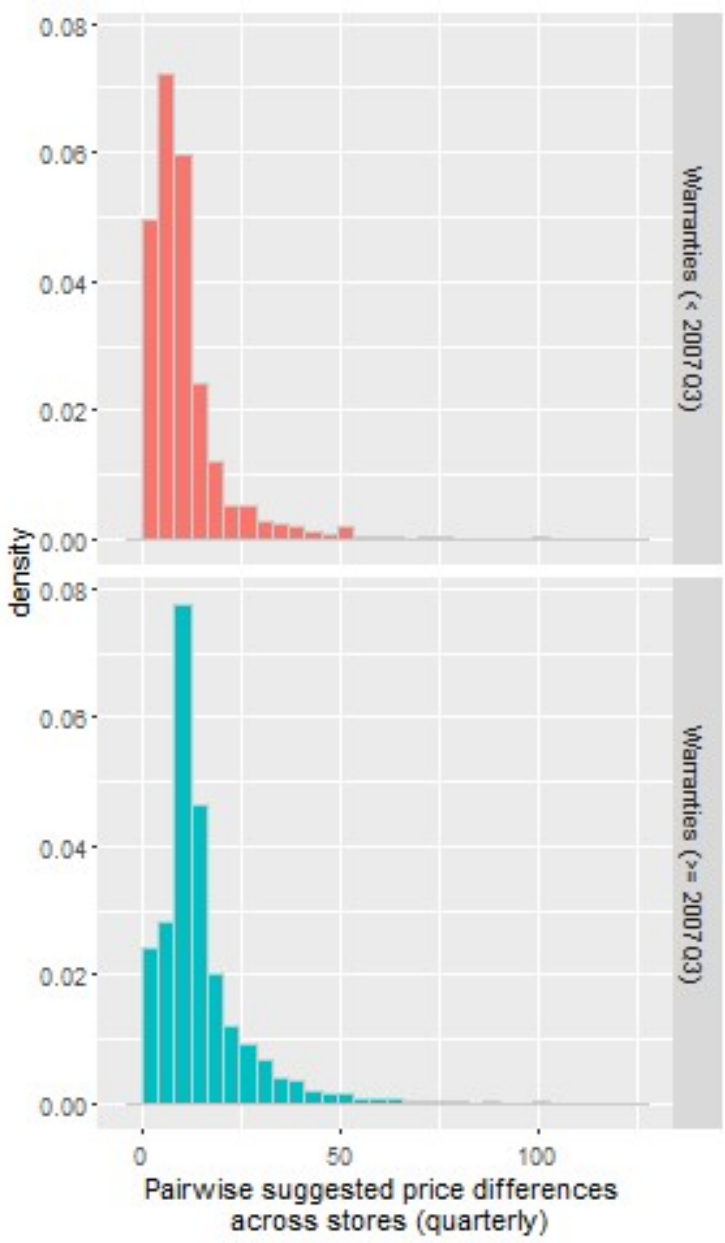


Figure 5: Across-Store Differences in Suggested Extended Warranty Prices Before and After the Onset of the Great Recession. The first histogram depicts pairwise (across store) differences in suggested extended warranty prices before the onset of the Great Recession. The second histogram describes the pairwise (across store) differences after the onset.

following specification:

$$p_{tscm} = \beta u_{t-\ell,r(s)} + \rho p_{t-l,scm} + \alpha_{r(s)} + \gamma_{tcm} + \varepsilon_{tscm} \tag{2}$$

where t is the calendar month, s is the store, c is the product category, and m is the manufacturer. $u_{t-\ell,r(s)}$ is the unemployment rate at time $t-\ell$, in the region r to which store s belongs. We consider alternative lags ℓ of the unemployment rate, 1, 6, and 12 months, because changes in economic conditions impact prices with lags of several months. We also compute long-run (cumulative) impact of local unemployment rate on prices where we include 12 lags for both prices and unemployment rate in the specification (2). $\alpha_{r(s)}$ and γ_{tcm} are fixed effects for region and month-category-manufacturer combination. ε_{tscm} is a random variable reflecting idiosyncratic price changes.

Our interest is in the parameter β, which measures the cyclicality of prices with respect to lagged unemployment rate, our proxy for local economic activity. Cyclicality estimates can be interpreted causally if $E[\varepsilon_{tscm}|u_{t-\ell,r(s)}, p_{t-1scm}, r(s), tcm] = 0$. It is unlikely that lagged warranty prices or base good prices at the level of product category, store, and manufacturer influence local unemployment rates. Unobserved heterogeneity generated, for instance, by the sector of production is captured by region fixed effects. Month-category dummies help with unobserved time-varying heterogeneity in the category-manufacturer combination, such as differential propensities for obsolescence or shifting demands across products and manufacturers. The month-category-manufacturer fixed effects capture movements in the national business cycle, implying, among other things, that our cyclicality estimates reflect response to the movements in local economic conditions and partial out the impact of aggregate business cycle.

Estimates of the baseline specification are reported in the first two panels of Table 2. The leftmost and middle panel report estimates of β for extended warranty and base-good

Table 2: Price Responses to Local Economic Activity. The unit of observation is defined by the calendar month, store, product category, and manufacturer. Regressions include fixed effects for the month-category-manufacturer combination, fixed effects for the employment insurance region, as well as lags of the dependent variable. The variable Warranty Price Reduction equals the absolute value of the difference between the realized and suggested extended warranty price. σ denotes the standard deviations for lags of the local unemployment rate (UR), which for 1 lag is 2.72. Long run effects are cumulative effects in regressions with 12 lags of the unemployment rate and 12 lags of the dependent variable. Standard errors for long run effects are computed via the Delta Method. All standard errors (in parentheses) are clustered at the level of the employment insurance region. $***$ and $**$ denote statistical significance at the 1 and 5 percent levels.

	Warranty Price			Base Good Price			Warranty Price Reduction		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Local Unemployment Rate at									
t - 1	-2.152***			-0.711			1.795**		
	(0.595)			(0.641)			(0.565)		
t - 6		-2.161***			-0.627			1.810**	
		(0.604)			(0.769)			(0.570)	
t - 12			-2.186***			-0.462			1.789**
			(0.584)			(0.812)			(0.547)
Implied effect of a 1σ	-5.851***	-5.876***	-5.944***	-1.933	-1.705	-1.256	4.881***	4.921***	4.864***
increase in Lagged UR Rate	(1.618)	(1.642)	(1.588)	(1.743)	(2.091)	(2.208)	(1.536)	(1.550)	(1.487)
Long-Run Effect		-6.894***			-0.155			5.694***	
		(1.950)			(1.380)			(1.926)	
Mean of Dependent Variable		79.869			582.176			36.456	
Observations	530615	511142	490949	1156770	1123359	1085902	530615	511142	490949
R^2	0.565	0.560	0.554	0.879	0.878	0.877	0.457	0.453	0.450

prices, respectively. Moving left to right within each panel shows how the estimates differ depending on the lag length of the unemployment rate. The lower half of the table puts the estimates into context, reporting: the effects of a one standard deviation increase in the unemployment rate; long-run effects, in regressions with 12 lags of the unemployment rate and 12 lags of the dependent variable; the mean of the dependent variable. Note that standard errors are clustered at the level of the employment insurance region.

The estimate in the first column of the left panel implies that a one percentage point increase in the local unemployment rate is followed by a $2.15 drop in the extended warranty price in the next month. The estimated effects are similar if we use 6 and 12 month lags of the unemployment rate. The lower half of the table shows that a one standard deviation increase in local unemployment rate (2.72 percentage points) decreases the extended warranty price by $5.85, or 6.5 percent of the mean extended warranty price. The long-run effect of local unemployment rate on extended warranty price is large: a one percentage point increase in the unemployment rate decreases the price of the extended warranty over the following year by $6.89 ($p < 0.01$), or 7.7 percent of the mean extended warranty price. All the estimates for extended warranty prices are statistically significant at the one percent level. The middle panel shows that none of the estimated cyclicality coefficients for base-good prices are statistically significant at conventional significance levels.

Our estimates of Equation (2) are based on data which is aggregated to the product category and manufacturer level. One concern with estimating specifications at this level of aggregation relates to whether our estimates reflect recession-induced consumption shifts from luxury to more basic quality goods within the same manufacturer (*c.f.* Coibion et al., 2015). Such shifts would also generate a negative relationship between prices and unemployment rates. To ensure that our estimates do capture responses of prices, rather than shifting consumption patterns, we estimate the analogous specification at the transaction level while controlling for unobserved heterogeneity for each manufacturer's model (See Appendix Table

A1). The estimates therein support our findings here.

3.3. Cyclicality of Unofficial (in store) Promotions. The patterns in Figure 3 suggest local stores may be "throwing in" extended warranties for the purposes of boosting base-good sales during recessions. Appendix Figure A1 shows further that a disproportionate share of extended warranties are sold with a price close to zero. These patterns arise outside of official promotions on extended warranties, which happen in only 0.1 percent of all transactions. Accordingly, we construct a variable that measures the degree to which stores are holding unofficial in-store promotions, where extended warranty prices are reduced relative to their suggested prices, in order to study the cyclical properties of unofficial in-store promotions.

Our variable is given by:

$$pm_{tscm} = |wp_{tscm} - swp_{tscm}|$$

where $|\cdot|$ denotes the absolute value, wp_{tscm} is the median of the realized extended warranty price, and swp_{tscm} is the median of the suggested extended warranty price in month t, store s, product category c, and the manufacturer m. Because the suggested price is larger than the realized price in 96.5 percent of all transactions, pm_{tscm} generally measures the extent to which stores are discounting the realized relative to the suggested price. Accordingly, we will call this variable warranty price reductions. Estimates of the effect of the unemployment rate on pm_{tscm} are found in the rightmost panel of Table 2.

The estimates align largely with the results for realized extended warranty prices presented in the left panel of Table 2. The cyclicality coefficients for extended warranty price reductions are smaller, suggesting that the retailer's suggested prices account, to some extent, for business cycle fluctuations. The differences between the coefficients in the leftmost and rightmost panels are also small, however, implying that most of the cyclical price adjustment is done by local stores.

The estimates raise questions as to why stores use extended warranty rather than base-good prices to boost base-good sales. One reason, suggested by Figure 1, is that stores have less wiggle room with base goods, which are already priced close to cost. Alternatively, stores may be hesitant to take a loss on the base good for the purposes of selling extended warranties, because while low base-good prices may draw in consumers, there is no guarantee that they will extend the warranty. Extended-warranty purchases are even less likely if, as others have theorized [Ellison, 2005], loss-leader pricing tends to attract dollar-conscious consumers.

3.4. Unofficial Promotions and Sales. We present direct evidence of warranty price reductions helping local sellers boost sales of base goods. We estimate the following demand system:

$$Q_{tscm} = \beta_1 pm_{tscm} + \beta_2 wp_{tscm} + \beta_3 bgp_{tscm} + \mathbf{X}_{tscm}\mathbf{\Gamma} + \alpha_{r(s)} + \gamma_{tcm} + \varepsilon_{tscm} \tag{3}$$

where Q_{tscm} is either the number of extended warranties or base goods sold in month t, store s, product category c, and the manufacturer m and bgp_{tscm} is the median price of base goods, pm_{tscm} is the again the difference between the realized and suggested extended warranty price, and wp_{tscm} extended warranty prices. $\mathbf{X}_{tscm}$ is a vector of controls that includes the unemployment rate lagged one month, number of extended warranties sold, and number of base goods sold. Our goal here is to identify β_1, which measures the effect of unofficial in-store promotions on base-good quantities sold.

Identification of the demand system is based on an instrumental variables strategy. We instrument unofficial promotions pm_{tscm} using its lag pm_{t-1scm}, for the realized extended warranty price wp_{tscm} using the suggested extended warranty price, and for the base-good price using the base-good cost to stores. Estimates are found in Table 3. Columns 3 to 5 report first-stage estimates. Note that the $Kleibergen - Paap\ rk\ Wald\ F\ statistic$ is

Table 3: Unofficial Promotions and Sales of Extended Warranties and Base Goods. The unit of observation is defined by the calendar month, store, product category, and manufacturer. The variable Warranty Price Reduction equals the absolute value of the difference between the realized and suggested extended warranty price. Standardized variables are standardized using means and standard deviations for the entire sample. Regressions include fixed effects for the month-category-manufacturer combination, fixed effects for the employment insurance region, as well as lags of the unemployment, extended warranty quantity, and base-good quantity. Standard errors are clustered at the level of the employment insurance region and are in parentheses. The *Kleibergen − Paap rk Wald F statistic* is 41.116, suggesting that the first stage is relevant. $***$ and $**$ denote statistical significance at the 1 and 5 percent levels.

	IV Estimates		First Stage		
	Extended Warranty Quantity	Base Good Quantity	Warranty Price Reduction	Extended Warranty Price	Base Good Price
	(1)	(2)	(3)	(4)	(5)
Warranty Price Reduction (Standardized)	0.183***	0.564***			
	(0.046)	(0.088)			
Median Warranty Price (Standardized)	-0.416***	-0.345***			
	(0.061)	(0.089)			
Median Base-Good Price (Standardized)	0.252***	-0.373***			
	(0.077)	(0.097)			
Warranty Price Reduction $(t-1)$			0.208***	-0.212***	0.024***
			(0.017)	(0.017)	(0.007)
Median Suggested Warranty Price			0.534***	0.433***	0.898***
			(0.031)	(0.031)	(0.082)
Median Base Good Cost			-0.005	0.009***	0.797***
			(0.003)	(0.003)	(0.027)
Observations	421741	421741	421741	421741	421741
R^2	0.619	0.625	0.495	0.574	0.955

41.116, suggesting that the first stage is powerful. Columns 1 and 2 report IV estimates of the effects of promotions and prices on extended warranty and base-good quantities. Our primary estimates are found in the top rows of Columns 1 and 2.

Column 3 shows some persistence in warranty price reductions, larger warranty price reductions for durables with high suggested extended warranty prices, and no warranty price reduction for high cost durables. The positive correlation with the median suggested warranty price likely arises because there is more room to adjust extended warranty prices. Column 4 shows extended warranty prices are lower following months when warranty prices were reduced, higher if the suggested price is higher, and higher if the base good costs more. The positive correlation with the cost of the base good arises because more expensive durables typically have more expensive extended warranties. Column 5 shows base-good prices are higher following months when warranty prices were reduced, if the base good has a higher suggested warranty price, and if the base good is more costly for the retailer to sell.

The IV coefficient estimates for prices are intuitive. A one standard deviation increase in the median extended warranty price decreases the number of warranties and base goods sold by 0.42 and 0.35 ($p < 0.01$), respectively. A one standard deviation increase in the median base-good price increases the number of warranties sold by about 0.25 ($p < 0.01$) and decreases the number of base goods sold by 0.37 ($p < 0.01$). The base-good price increases the number of warranties sold because consumers have a greater propensity for insuring more expensive products.

The IV coefficient estimates for warranty price reductions show that a one standard deviation increase in warranty price reductions increases the number of warranties by 0.183 units. It increases the number of base goods sold by 0.56 units. The effect on base-good quantities suggests that unofficial in-store promotions on extended warranties are indeed a vehicle for selling more of the base good.

4 Price Cyclicality in the Aggregate

Our microeconomic evidence shows significant procyclicality in extended warranty prices at the regional level, and that lower extended warranty prices allow local stores to boost base-good sales in the face of waning consumer demand. Regional procyclicality can, however, vanish with aggregation. In this section, we create durable-goods price indices to investigate whether add-ons like extended warranties change price dynamics in the aggregate.

4.1. Price Aggregation. To distinguish pure price changes from quantity shifts, we construct two durable-goods indices, one with fixed product category weights and the other with time-varying product category weights. Both types of weights are based on transaction shares but in the first case the weights are held constant at their category-region specific means. The time-varying weights are calculated for each of the product categories within each store and are based on the number of realized transactions each month. To aggregate the regional fixed-weight indexes to the national durable-goods' CPI, we use the population weights in 2001. It is worth noting that while our methodology follows closely that of Statistics Canada, the category weights most probably differ because we observe the data of one retailer only and this retailer only sells a subset of the durables included in the Canadian CPI basket. In contrast, the population weights that we use should overlap with the ones implemented by Statistics Canada. We will examine the statistical properties of the indices to evaluate whether our measures differ from theirs.

The fixed-weight index is given by:

$$P_t^{1*} = \frac{P_t^1}{P_0} = \sum_{c,r}^{N_{cr}} \omega_{rc} (p_{trc}^{bg})^I \left(p_{trc}^{bg} + p_{trc}^{w} \right)^{1-I} \tag{4}$$

where p_{trc}^{bg} and p_{trc}^{w} are the base-good and extended warranty prices in month t, region r

and category c. I is an indicator for whether only the base good was purchased, and ω_{rc} is the constant weight for each category and each region with N_{cr} being the number of category-region combinations.

The transaction-weighted index is given by:

$$P_t^{2*} = \frac{P_t^2}{P_0} = \frac{1}{N_{Qt}} \sum_{q}^{N_{Qt}} (p_{qt}^{bg})^I \left(p_{qt}^{bg} + p_{qt}^{w} \right)^{1-I} \tag{5}$$

where p_{qt} denotes price paid in transaction q that took place in month t and Qt is total number of transactions in month t. Note that the number of transactions varies across months so that the index can shift either because of changes in prices p_{qt} or the number of transactions realized at these prices N_{Qt}. For both indices, we set the base month to January of 2000, $P_0 = 2000M1$. Because there is a strong end-of-year surge in the sales of durables in our sample, we seasonally adjust the time-varying weights-based indices using a standard U.S. Census Bureaus X-13 seasonal adjustment tool.

The aggregation techniques described in Equations (4) and (5) are used to construct price indexes for durable-goods and then to compute monthly year-on-year inflation rates:

$$\pi_t^i = \ln P_i^{1*} - \ln P_{t-12}^{i*} \tag{6}$$

where $i = 1, 2, ..., 4$ depending on the price index and $t-12$ indicates a lag of one year. Table 4 summarizes our constructed inflation rate series for durables and compares them with the series from Statistics Canada (last column).

Table 4 has several notable features. First, the average fixed-weights inflation rate has a similar magnitude, and the same negative sign, as the measure provided by Statistics Canada. We find it reassuring that our retailer's index also captures this negative trend. Second, the average fixed-weights inflation rate is much lower than the average transactions-weighted

Table 4: Summary Statistics for Durable-Goods' Inflation. The table reports summary statistics for various year-on-year durable-goods' inflation measures. Warranty-Adjusted inflation uses the durable and extended warranty prices from our retailer. Unadjusted inflation discards extended warranty prices. STATSCAN inflation refers to durable-goods' inflation provided by Statistics Canada. Fixed weights' indexes are computed as described in Equation (4). Time-varying (TV) weights are calculated using Equation (5). StDev is standard deviation.

Moment	Durable Goods' Inflation				
	Retailer				STATSCAN
	Warranty-Adjusted		Unadjusted		
	Fixed weights	TV weights	Fixed weights	TV weights	
Mean	−1.7%	2.3%	−2.3%	1.9%	−1.7%
StDev	7.7%	5.5%	8.1%	7.1%	1.8%

inflation rate. It has the opposite (negative) sign, in fact. This comparison highlights the potentially stark differences between fixed-weight indices, which capture pure price changes, and transaction-weighted indices, which capture changes in both prices and quantities. We can attribute the differences to shifts in the number of transactions in our sample.

While the average fixed-weight inflation rates are similar to the ones computed by Statistics Canada, our retailer-based measures are more volatile. The standard deviation for our retailer-based measures is approximately four times the standard deviation for the Statistics Canada measure. The volatility difference is attributable to several features of our data. First, we observe transaction prices rather than the list prices obtained by the price collectors at Statistics Canada. Transaction prices will generally have more variability because they can easily vary from transaction to transaction because of official or unofficial promotions or discounts. Second, our data comes from one rather than several retailers. Even a relatively small change in price has a large weight and hence effect on the overall price index change.

4.2. Aggregate Cyclicality. To assess the aggregate cyclicality of durable-goods' inflation, we estimate the following time-series specification:

$$\pi_t^{*i} = \alpha + \beta_\ell u_{t-\ell} + \varepsilon_t \tag{7}$$

where π_t^{*i} is the year-on-year inflation rate for type i where $(i = fw, tvw)$ and fw stands for fixed weights and tvw for time-varying weights. $u_{t-\ell}$ is the year-on-year change in the Canadian unemployment rate in month $t - \ell$.[11] β_ℓ is the parameter of interest. If $\beta_\ell < 0$ then the durable-goods' inflation rate is procyclical. If the inflation rate is computed with fixed weights, then any observed cyclicality stems from price fluctuations. If the inflation is calculated with time-varying weights, any observed cyclicality stems from either price or quantity fluctuations.

Estimates are found in Table 5. The top panel uses fixed-weight inflation rates. The bottom panel uses inflation measures that have time-varying weights. The first three columns use inflation rates that are adjusted for extended warranty prices. The middle three columns use unadjusted inflation rates. For the purposes of comparison, the last three columns include estimates for the STATSCAN durable-goods' inflation rate.

None of the three fixed-weights measures exhibits significant fluctuations over the business cycle. The measures with time-varying weights display significant fluctuations, both for the adjusted and unadjusted measures, especially for longer lags of unemployment rate growth. The procyclicality of the measures with time-varying weights, but not the fixed-weight measures, suggests that the procylicality originates in shifts in the number of transactions, particularly transactions which include extended warranties.

In fact, our evidence jointly implies that the take-up of extended warranties is counter-

[11] Note that the specification at the aggregate level is different from the one at the micro-level. Specifically, here we take the first differences of both dependent and independent variables. While there were no non-stationarity issues with the data at the micro level, once aggregated, both prices and Canadian unemployment rate series contain unit roots.

Table 5: Cyclicality Estimates of Durable-Goods Inflation. The table reports the results of cyclicality regressions as defined in 7. The top panel reports estimates for inflation constructed using fixed weights. The bottom panel reports estimates for inflation constructed using variable (time-varying) weights. $***$ and $**$ denote statistical significance at the 1 and 5 percent levels.

	Fixed Weights								
	Retailer						Statistics Canada		
	Warranty-Adjusted Inflation			Unadjusted Inflation					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Growth in Canadian Unemployment Rate at									
$t-1$	-0.036			-0.038			-0.005		
	(0.025)			(0.024)			(0.005)		
$t-6$		-0.007			0.034			0.004	
		(0.027)			(0.026)			(0.006)	
$t-12$			0.083			0.098			0.002
			(0.043)			(0.061)			(0.009)
Long-Run Effect		0.457			0.282			0.034	
		(0.565)			(0.402)			(0.032)	
Observations	101	96	90	101	96	90	101	96	90
	Time-Varying Weights								
	Retailer						Statistics Canada		
	Warranty-Adjusted Inflation			Unadjusted Inflation					
Growth in Canadian Unemployment Rate at									
$t-1$	-0.043			-0.006					
	(0.039)			(0.049)					
$t-6$		-0.142***			-0.139				
		(0.029)			(0.075)				
$t-12$			-0.214***			-0.335**			
			(0.060)			(0.106)			
Long-Run Effect		-0.544			-0.547				
		(0.305)			(0.484)				
Observations	101	96	90	101	96	90			

cyclical because the retailer uses them to boost the sales of the base goods during downturns. To this end, it is worth noting that the sales of consumer electronics are particularly sensitive to the unemployment changes (Appendix Table A3). This is unsurprising, given that consumer electronics category contains a substantial share of luxury products and their demand is price sensitive.

Note that the prices adjusted for extended warranty are effectively much lower during recessions than in booms due to unofficial in-store promotions. The procyclicality of the time-varying weights-based inflation thus comes from a higher number of transactions at discounted warranty-adjusted prices in recessions.

5 Conclusion

Studies of price dynamics generally show moderate to negligible price fluctuations over the business cycle. However, these studies are unable to account for the prices of add-ons to basic goods, as add-on prices are typically hidden and thus difficult to measure by definition. This study shows prices fluctuate substantially once add-on prices are accounted for.

Specifically, we draw on 10 years (1999-2009) of extended warranty data from a nationwide Canadian retailer of household durables to show that there are large decreases (increases) in extended warranty prices, and no change in base-prices, following a regional contraction (expansion) in economic activity. We explain how the procyclicality of extended warranty prices is generated by changes in price setting behavior during the Great Recession, and in particular changes in the behavior of local stores, who were using extended warranty price reductions to boost sales of the base durable good. We show that the procyclicality of extended warranty prices survives aggregation. High aggregate unemployment rates are associated with low transactions-weighted and warranty-adjusted durable-goods' inflation, and have no association with unadjusted durable-goods' inflation. The aggregate procycli-

cality aligns with local store efforts to boost sales, as it results from a higher number of transactions at discounted prices during the Great Recession.

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Appendix A.1 Additional Tables and Robustness

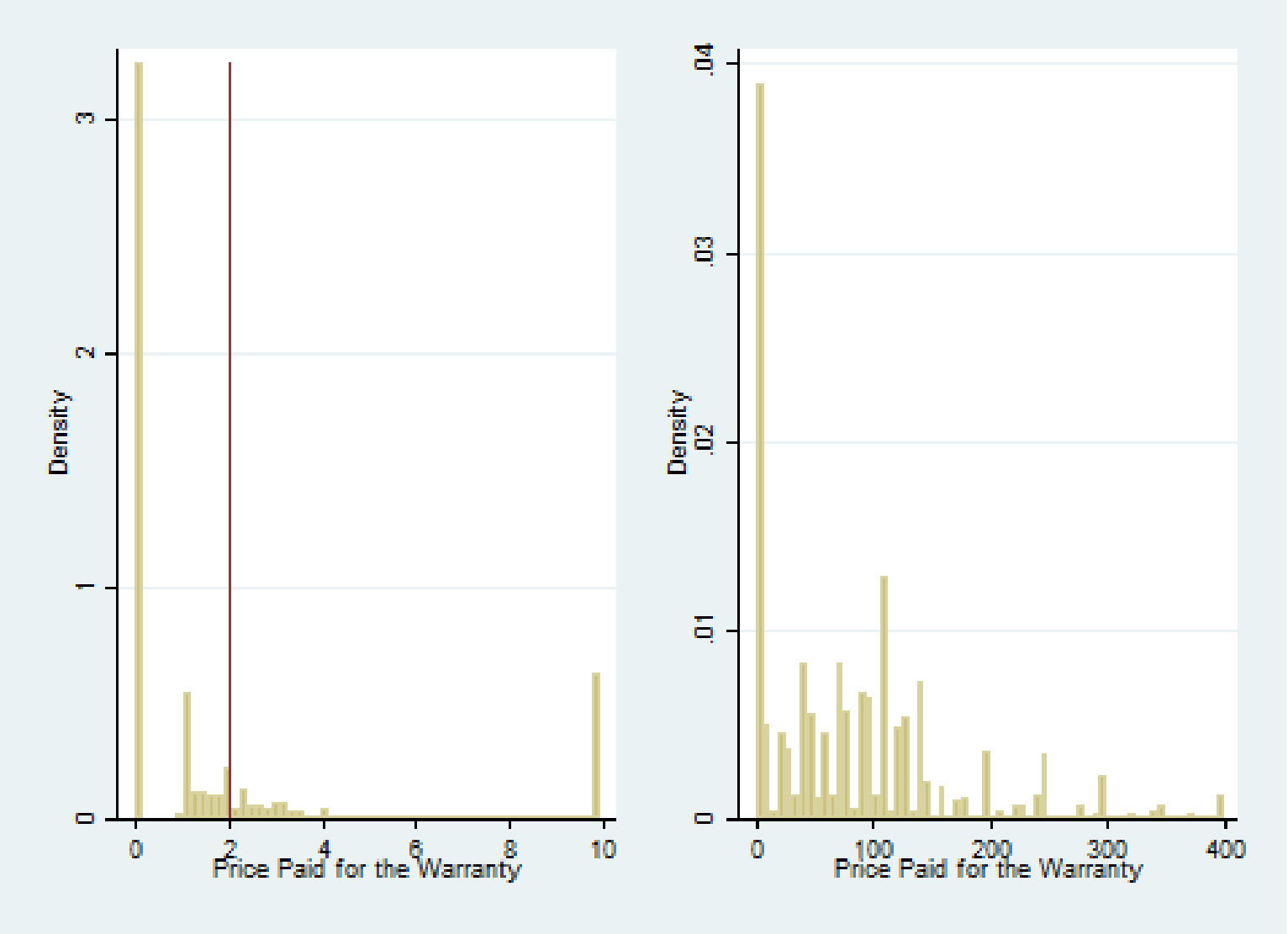

Figure A1: Distribution of Extended Warranty Prices. The histograms show that a disproportionate share of extended warranties are sold with a price which is close to zero. The left panel plots the histogram for prices between 0 and 10 dollars. The right panel plots the histogram for prices between 0 and 400 dollars, which is essentially the full support, less outliers.

Table A1: Price Responses to Local Economic Activity (Transaction Level Data). The unit of observation is defined by transaction. Regressions include fixed effects for the month-category-manufacturer-model combination and lags of the unemployment. Long run effects are cumulative effects in regressions with 12 lags of the unemployment rate and 12 lags of the dependent variable. Standard errors for long run effects are computed via the Delta Method. Standard errors are clustered at the level of the employment insurance region and are in parentheses.

	Warranty Price			Base Good Price			Warranty Price Reduction		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Local Unemployment Rate at									
t - 1	-2.536**			-0.708			2.028**		
	(0.810)			(0.369)			(0.730)		
t - 6		-2.500**			-0.657			1.948**	
		(0.819)			(0.362)			(0.745)	
t - 12			-2.579***			-0.662**			1.993**
			(0.745)			(0.318)			(0.682)
Implied effect of a 1σ	-5.851***	-5.876***	-5.944***	-1.933	-1.705	-1.256	4.881***	4.921***	4.864***
increase in Lagged UR Rate	(1.618)	(1.642)	(1.588)	(1.743)	(2.091)	(2.208)	(1.536)	(1.550)	(1.487)
Long-Run Effect		-3.669**			-0.854**			2.914**	
		(1.126)			(0.434)			(1.036)	
Mean of Dependent Variable		79.869			582.176			36.456	
Observations	2,281,497	2,190,674	2,115,712	5,900,342	5,699,837	5,535,294	2,281,497	2,190,674	2,115,712
R^2	0.491	0.481	0.485	0.981	0.981	0.981	0.452	0.449	0.447

Table A2: Unofficial Promotions and Sales of Extended Warranties and Base Goods. The table reports OLS and reduced form (RF) estimates of the relationships between quantities and the endogenous and excluded instrumental variables discussed in Table A2. The unit of observation is defined by the calendar month, store, product category, and manufacturer. The variable Warranty Price Reduction equals the absolute value of the difference between the realized and suggested extended warranty price. Standardized variables are standardized using means and standard deviations for the entire sample. Regressions include fixed effects for the month-category-manufacturer combination, fixed effects for the employment insurance region, as well as lags of the unemployment, extended warranty quantity, and base-good quantity. Standard errors are clustered at the level of the employment insurance region and are in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5 percent levels.

	Extended-Warranty Quantity		Base-Good Quantity	
	OLS	RF	OLS	RF
	(1)	(2)	(3)	(4)
Warranty Price Reduction (Standardized)	-0.107***		0.071	
	(0.015)		(0.051)	
Median Warranty Price (Standardized)	-0.206***		-0.066	
	(0.028)		(0.053)	
Median Base-Good Price (Standardized)	0.373***		-0.124	
	(0.075)		(0.092)	
Warranty Price Reduction $(t-1)$ (Standardized)		0.115***		0.179***
		(0.021)		(0.027)
Median Suggested Warranty Price (Standardized)		-0.042		0.178
		(0.035)		(0.092)
Median Base Good Cost (Standardized)		0.138**		-0.285***
		(0.059)		(0.073)
Unemployment Rate $(t-1)$	0.011	0.009	-0.033	-0.035
	(0.026)	(0.026)	(0.046)	(0.045)
Observations	421741	421741	421741	421741
R^2	0.625	0.625	0.655	0.655

Table A3: Cyclicality Estimates of Consumer Electronics and Household Equipment Inflations: Time-Varying Weights. The table shows the results of cyclicality regressions as defined in 7. Top panel shows the estimates for inflation unadjusted for extended warranty prices and the lower panel shows adjusted inflation. The left panels display inflation measures for consumer electronics and the right panels for household equipment. Price indexes are computed using time-varying weights as described in 5.

	Unadjusted Inflation					
	Consumers Electronics			Household Equipment		
	(1)	(2)	(3)	(4)	(5)	(6)
Growth in Canadian Unemployment Rate at						
$t-1$	0.002			0.016		
	(0.025)			(0.011)		
$t-6$		-0.015			-0.012	
		(0.039)			(0.014)	
$t-12$			-0.159			-0.026
			(0.649)			(0.022)
Long-Run Effect		-0.996			-0.021	
		(0.9383)			(0.045)	
Observations	101	96	90	101	96	90
	Adjusted Inflation					
	Consumers Electronics			Household Equipment		
	(1)	(2)	(3)	(4)	(5)	(6)
Growth in Canadian Unemployment Rate at						
$t-1$	0.020			-0.046		
	(0.057)			(0.040)		
$t-6$		-0.128***			0.125**	
		(0.035)			(0.038)	
$t-12$			-0.200**			-0.097
			(0.075)			(0.113)
Long-Run Effect		-0.326**			-0.044	
		(0.140)			(0.102)	
Observations	101	96	90	101	96	90