The Cyclicality of Add-on Pricing

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Abstract

We show that once the add-on prices are accounted for, aggregate inflation and unemployment rate display a much stronger relationship than previously thought. This is the case because the add-ons' prices are much more cyclical than the base good prices. We use the data from a nationwide Canadian retailer of household durable goods and focus on one, uniform across products add-on good: extended warranty. We find that the prices of extended warranties respond strongly to the changes in local economic activity while prices of the base goods do not react to these changes. The cyclicality properties of extended warranties do not fade with aggregation. Warranties adjusted inflation moves in tandem with Canadian unemployment rate growth while its unadjusted counterparts do not display significant business cycle fluctuations.

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1 Introduction

The relationship between prices and economic activity over the past 60 years has not been stable over time. During some periods a clear trade-off between price inflation and unemployment rate occurred, during others the link disappeared. In this paper, we show that the relationship between consumer prices and economic activity is much stronger than previously found, once the Consumer Price Index (CPI) accounts for add-ons dynamics.

Add-ons improve quality of the base 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."[1] Add-ons are everywhere. The examples include the extra-leg room for the flight, mini bar for the hotel stay and extended warranty for most of durable goods. In spite of the growing importance of add-ons for revenues and profits in retail and services sectors, the consumer price indices do not account for their dynamics.[2]

In this paper, we show that once the add-on prices are accounted for, aggregate inflation and unemployment rate display a much stronger relationship than previously thought. This is the case because the movements of add-ons' prices are much more cyclical than those of the base good prices.

We use the data from a nationwide Canadian retailer of household durable goods. The retailer's data includes every one of the more than 6 million purchases that took place between 1999M12 and 2009M12. In this paper, we focus on one, uniform across products add-on good: extended warranty. We first study the relationship between the extended warranties and the economic activity at the regional level. To do this, we use unemployment rates for 55 Canadian economic regions and we aggregate our transaction data for each store and product category at the monthly frequency. We find that the prices of extended warranties respond strongly to the changes in local economic activity while prices of the base goods do not react to these changes. The strongest response of extended warranty prices is observed after 6 months to one year where a one percentage point increase in the local

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[1] See Ellison (2005)

[2] For instance, revenues from baggage fee between 2007 and 2016 in the US increased from 543 M to 4.2 B (Bureau of Transportation Statistics).

unemployment rate generates a drop in the price of extended warranty by 0.93%.

While many mechanisms can potentially generate the observed pro-cyclicality of extended warranties' prices, here, we study one of them. Specifically, the extended warranties are often sold at the very low prices outside official promotions. We call these unofficial promotions. The share of unofficial promotions increases in the regional unemployment rate. The strongest impact is again observed after six to twelve months. The observed pro-cyclicality of unofficial promotions suggests that they are a tool used during recessions to boost the sales of the base good.

The finding that extended warranty prices respond to changes in local economic activity does not guarantee that, on aggregate level, warranty price-based inflation varies with the national business cycle. The reason is that, different economic structures across Canadian regions imply that the responses to the same shocks will vary across regions and possibly cancel out on average. The impact of shocks might also be attenuated by the inter-regional factor mobility and the response of the Canadian Central Bank.

To remain as close as possible to the standard aggregate measures of the consumer prices, when calculating the CPI, we combine the BoC price data with ours and create extended warranty-adjusted CPI. More precisely, only the durable goods' price index is constructed from the retailers' price series. The remaining components of the CPI (semi-durables and non-durables) and corresponding weights are taken directly from the BoC. We study the cyclicality characteristics of this warranty adjusted CPI and compare them to its BoC and retailer's counterparts constructed without extended warranties. We find that only the warranty-adjusted CPI displays pro-cyclical behavior. Neither the retailer's unadjusted version of the CPI nor the one constructed by the BoC move in a pro-cyclical fashion.

As our sample includes the Great Recession in Canada which lasted between July 2007 and June 2009, we take a closer look at the dynamics of adjusted and unadjusted inflation rates during this period. Specifically, we compute the difference between adjusted and unadjusted series for the entire sample period and test for the existence of structural breaks. We find

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a structural break in the difference between two inflation rates the middle of the Great Recession, in July 2008. Before the break, during the boom leading to the Great Recession, the mean difference between adjusted and unadjusted inflations was positive and significant. After the break, during the Great Recession, the difference between inflations is not significantly different from zero implying very low prices of extended warranties on average. These results suggest that the add-ons are in fact the margin of adjustment for the retailer over the business cycle.

2   Add-ons

Following Ellison (2005), we define the add-on as a vertical quality improvement and a good or service for which "[the] prices are not advertised and would be costly or difficult to learn before one arrives at the point of sale". The increase in use of add-ons by retailers is driven by the idea that prices for base goods act simply as a tool for drawing the customer in. Low or loss-leader prices on base goods encourage customers to incur the time or travel cost of visiting a business. 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. These markups can provide businesses with the incentives to continue to produce even though they operate in markets where competition is notoriously fierce. There has been an explosion of retail price data, and of its use for learning about the price setting of the firm and resulting price dynamics at the aggregate level. This however includes information on base goods' prices only, and excludes information that allows one to identify add-on goods and their behavior.

More importantly, in spite of the growing importance of add-ons for retail and services sectors, current Consumer Price Indexes do not account for them. [3]

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[3]Both Statistics Canada and U.S. Bureau of Labour Statistics provided us with the information that the respective CPIs do not include add-ons and extended warranty prices specifically.

3 Data

3.1 Extended warranty

Our study is based on the data of a nationwide Canadian retail chain that specializes in the sale of household durables (furniture, appliances, and electronics). For the large majority of goods, the chain offers the consumer the option to extend the lifetime of the warranty beyond what the manufacturer offers and calls this extension an extended warranty. We will do the same.

Our data has detailed information on 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 price paid for the durable, whether an extended warranty was purchased, suggested warranty price, the price paid for the warranty, and the cost of servicing claims that were made under the extended warranty. Suggested warranty price is the benchmark price set by the retailer for different stores.

Summary statistics for these variables are found in Table 1.[4] On average, the consumer pays 611 Canadian dollars for the durable, extends the warranty about 37 percent of the time, and pays 88.65 Canadian dollars to do so. Suggested price is on average higher by almost 50 percent than the price at which extended warranty was purchased. The expected cost of servicing an extended warranty claim is less than 24 dollars. The 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.

The last column of Table 1 shows the mark-up: the difference between the price paid and the service cost for extended warranty when it is claimed. The markup is just over 65 dollars ($p < 0.01$), amounting to just under 75 percent of the extended warranty price. Its high value implies that room for adjusting the extended warranty price is substantial.

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[4]A more detailed breakdown, by the more than 140 product categories, is found at the end of the paper in Table 6.

Table 1: Summary statistics

Base good	Extended Warranty				
Price paid	Take Up	Suggested price	Price paid	Average cost	Price - Cost
610.90	0.37	134.21	88.65	23.49	65.16
(1727.80)	(0.48)	(109.28)	(93.40)	(164.34)	(0.12)

Column 6 uses a t-statistic that allows for unequal variances to test for a difference between the mean price and expected cost of the extended warranty. The standard error of the difference is in parentheses.

To learn the price of the extended warranty, the consumer must speak with a salesperson at the store.[5] It needs to be emphasized that, once the consumer has visited one of the 200 or so stores in the chain, it becomes costly for them to visit the store of competing chain. The stores are usually located in stand-alone buildings, in regions with sprawl (where the consumers usually needs a car to visit a store), and in places that are somewhat isolated from competing retailers. This, and the enormous land mass of Canada, implies the consumer would have to travel far 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 additional warranty.[6]

The commission structure at retail chain 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,[7] whereas

[5] Customers can interact with salesperson in a couple of different ways. The salesperson can help the customer settle on a good. They can help the customer process the good after they have settled on what they want. It thus difficult to know when precisely the salesperson makes the offer of the extended warranty. (Jindal, 2015) has show that it is difficult to distinguish which is which with most data sets on extended warranties. Later we will see that our data lets us speak to the possibility that the salesperson is using the extended warranty to sell the base good.

[6] The monopoly power is ex post because the consumer paid this travel and time cost to visit the retailer in the first place. *Ex ante*, the consumer can avoid the cost by not visiting the store at all. See Ellison (2005) and Ellison and Ellison (2009) for more details.

[7] The commission was 15 percent for almost the entirety of our sample, up until May of 2009 when it was reduced to 10 percent. We will exploit the change in the empirical analysis that is to come.

the commission on the base good is 4 percent (on average, depending on the product).

In addition, the chain gives stores and salespersons substantial discretion to set the extended warranty price. From comparing columns three and four of Table 1, it becomes clear that this discretion in price setting by salespersons is often used. The difference between the suggested and Their discretion, along with fact that the price is hidden will define the value of rich data at level of the transaction. It is unlikely that data on list prices, commonly used in the construction of consumer price indices, will include the prices of add ons like extended warranties. By definition this is information is difficult to find. It is even more unlikely that the list price will reflect the adjustments the salesperson makes in order to sell either the base good or the warranty.

3.2 Economic activity and inflation data

Our baseline measure of economic activity is the unemployment rate from Statistics Canada. In Canada, the government tabulates the (seasonally-adjusted) unemployment rate, for each of 58 predefined regions. These are referred to as Employment Insurance (EI) regions. Each contains several cities, and is almost always smaller than any one province.[8] The regional unemployment rates are provided at the monthly frequency and computed as 3 months moving averages. We use the data between 2000M1 and 2009M12 for 55 regions. We dropped Yukon, Northwest Territories and Nanavut because for these 3 regions, unemployment rates are constant in the dataset at 25 percent.

In the macroeconomic analysis, we use monthly aggregate Canadian unemployment rates between 2000M1 and 2009M12 from Statistics Canada. In addition, we use different measures of inflation and compute our own aggregated series. For this purpose we use the CPI for all-goods provided by Statistics Canada and weights attributed to each of the price indexes also from Statistics Canada. The detailed description of the way we construct

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[8] The regional unemployment is used to determine benefits an unemployed worker can receive from the employment insurance program.

the aggregate price indices is contained in section 4.1.

That said, prices for extended warranties are not currently collected for the CPI program for operational reasons. These expenditures represent a very small share of the consumer basket. The CPI is a sample survey and does not track all prices of goods and services; rather, it tracks a large sample of representative products and services to derive a robust estimate of average price change facing consumers. Furthermore, expenses for such warranties are not always reported separately from the purchase of the good itself, limiting options for calculating a separate index; for example, respondents often report the price of such items as a television to include warranties.

4   Descriptive Evidence

4.1   Costs versus Prices for base good and add-ons

Figure 1 shows the relationship between the cost paid by the retailer and the price it charged for the base good (the left panel) and the extended warranty (right panel). Costs for the base good include the manufacturer's price, commissions to salespersons for base good sales, and the costs of keeping inventories. The costs of the extended warranty include the costs incurred when the claim on the warranty was made and those include commissions to salesperson and potentially parts, repair and shipping costs.

Figure 1:   Relationship between prices and costs of base good and extended warranties
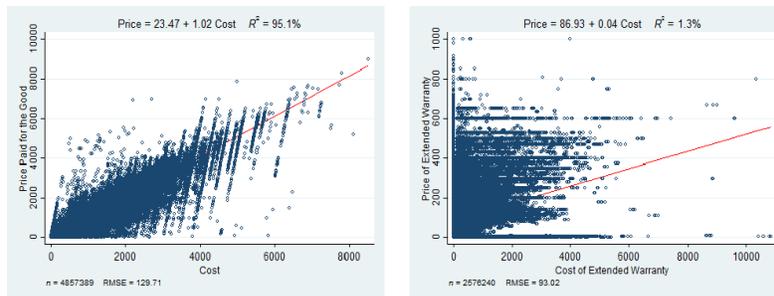
The left panel of the figure shows that prices for durables are almost perfectly explained by their costs. A one dollar increase in cost is associated with just over one dollar price increase. The R^2 from a regression of the base good price on costs exceeds 95 percent. In contrast, the extended warranty cost has no explanatory power. A one dollar increase in cost increases the extended warranty price by four cents. The R^2 is 1.3 percent.

4.1.1 Unemployment and Extended Warranty Price in Space

Figure 3 presents the spatial distributions of the unemployment rates (top panel), prices for the base good (middle panel) and extended warranty (bottom panel).

The raw data suggests that warranty prices are lower in poor regions, where the unemployment rates are higher. In the northern territories, northern Manitoba, parts of Quebec and Eastern Canada, the unemployment rate hovers 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 hovers around 4.5 to 7.3 percent. Consumers in these areas pay higher prices.

4.1.2 Base Good and Extended Warranty Prices over Time

We study the price dynamics at the product category level. For this purpose, we aggregate the data to the monthly series of product category for each store in the sample. Figure 3 shows a few examples of these series.

The panels on the left of Figure 3 plot the base good prices. The top panel shows the price behavior for a category freezer in one of the shops in Kingston. The bottom left panel plots the time series for category theater speaker in one of the stores in Southern Coastal British Columbia. The panels on the right of Figure 3 plot the prices of extended warranties for these two categories of goods. The red lines correspond to the suggested prices for the extended warranty and the blue lines are the actual prices at which the warranties were sold. Because the suggested price is decided by the retailer's headquarters, the difference between the two prices shows to which extent th salespersons use their price setting discretion.

Figure 2: Regional unemployment rate, base good and extended warranty prices
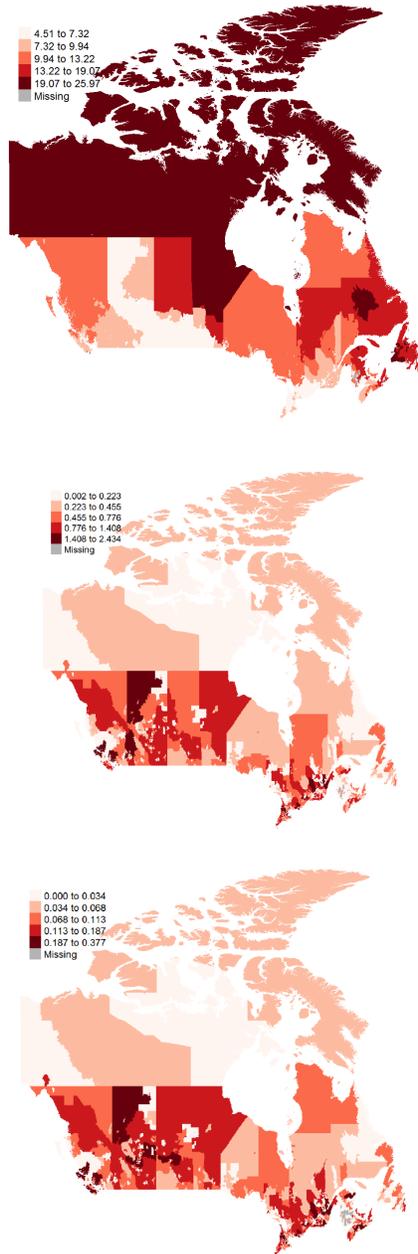
The figures are generated as follows. We first grouped consumers by the first three characters of their postal code. Postal codes in Canada have 6 characters. The first three characters refer to the forward sortation area. The first defines the province or a city in cases where the city has a large population. 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
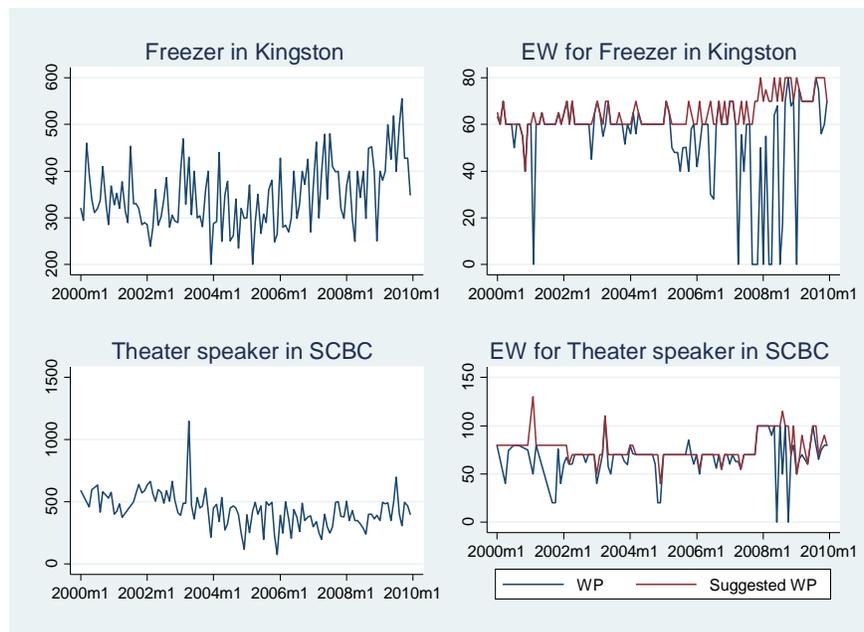
The left panels plot the base good prices. The right panels plot the extended warranty prices. The red line plots the suggested extended warranty price and the blue line corresponds to the effective warranty price (WP).

The first striking observation from Figure 3 is that most of the time the suggested warranty price is above the paid one. In fact, only in 3.5% of the total number of observations, the paid warranty price is larger that the suggested warranty price. This feature of the data is also reflected in the difference in means for entire sample showed in Table 1. The average suggested price is 50% higher than the average paid price.

Second, we often observe effective warranty prices to be very low, zero or close to zero. In the two right panels of Figure 3, these low prices occur more frequently during the Great Recession. The base good prices, plotted in the left panels, do not exhibit this behavior. They display higher, but constant in time, frequency of changes relative to the extended warranty prices. *Compute frequency of changes of prices etc...*

4.2 The response to changes in economic activity: extended warranty versus base good

Figure 3 suggests that the base good prices change more frequently but the extended warranty prices change vary a lot towards the end of the sample period, during the Great Recession. We investigate how base good prices and extended warranty prices respond to changes in local economic activity. Because the regional unemployment rate series are available on monthly bases, we aggregate the transaction data to monthly frequency as well. We compute the median price for each product category of the base good and for each store. After the aggregation, we have a total of $482,908$ observations. We estimate the relationship between the extended warranty price and the base good price and local unemployment rate using the following specification:

$$p_{tsc} = \beta u_{t-1,r} + \rho p_{t-1sc} + \alpha_c + \gamma_t + \delta_r + \gamma_t^c * \alpha_c + \varepsilon_{tsc} \tag{1}$$

where p_{tsc} is a log price of the extended warranty or the base good belonging to a category c sold at time (month) t in store s. u_{t-1r} is log unemployment rate at time $t-1$, in region r. Because it takes typically several months before a change economic conditions affects prices, we test alternative specifications with the lagged unemployment rates from 6 months ago, u_{t-6r}, and a year

ago, u_{t-12r}. α_c are product category fixed effects, γ_t time (month-year) fixed effects, δ_r control for regional fixed characteristics and $\gamma_t^c * \alpha_c$ for time-varying characteristics at the product category level. Time dummies γ_t capture the Canadian business cycle and therefore the coefficient β in equation (1) should be interpreted as the price elasticity to changes in local economic activity which are not captured by the national ones. In our preferred specification, we also include the price from the previous month, p_{t-1sc}, since Figure 3 shows that both prices exhibit a certain level of persistence. We cluster the standard errors at the store level.

<div align="center">

Table 2: Price elasticities estimates

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	Warranty price: wp_{trc}			Base good price: bgp_{trc}		
$u_{t-1,r}$	-0.80**			0.002		
	(0.25)			(0.011)		
$u_{t-6,r}$		-0.94***			0.004	
		(0.24)			(0.011)	
$u_{t-12,r}$			-0.93**			0.005
			(0.27)			(0.012)
$p_{t-1,r,c}$	0.20***	0.20***	0.20***	0.17***	0.17***	0.17***
	(0.012)	(0.012)	(0.012)	(0.01)	(0.01)	(0.01)
α_c	√	√	√	√	√	√
γ_t	√	√	√	√	√	√
δ_r	√	√	√	√	√	√
$\gamma_t^c * \alpha_c$	√	√	√	√	√	√
Obs	$482,908$	$482,908$	$482,908$	$482,908$	$482,908$	$482,908$

The table shows results of the fixed effects estimation of the specification: $p_{tsc} = \beta u_{t-1,r} + \rho p_{t-1sc} + \alpha_c + \gamma_t + \delta_r + \gamma_t^c * \alpha_c + \varepsilon_{tsc}$. All the variables are in logs. u_{t-1r} is a log unemployment rate and p_{t-1rc} indicates the one period lagged extended warranty price in the left panel and one period lagged base good price in the right panel. α_c, γ_t and δ_r are product category, time and region fixed effects, respectively. $\gamma_t^c * \alpha_c$ is an interaction effect of the time dummy and category dummy. Obs denotes the number of observations. Standard errors are clustered at the store level.

Estimates of the baseline specification are presented in Table 2. The left panel of the table shows the results for the extended warranty price as the dependent variable and the right panel for the price of the base good.

All the regressions presented in Table 2 include category, time, region fixed effects and interaction effect of the time dummy and category dummy.

Both prices exhibit a certain level of persistence as the lagged coefficients are of non-negligable size, significant and, in line with Figure 3, extended warranty prices are more persistent than the base good prices. The elasticity estimates in the left panel show that an increase in the local unemployment rate by 1 percentage point generates a drop in the price of extended warranty by 0.8 percent in the following month. The impact of local economic activity increases over time and is the highest after 6 months to one year. The right panel of Table 1 shows that the base good price does not respond to the changes in the local economic activity.

4.3 Response to changes in economic activity through promotions on extended warranties

Figure 3 shows that the effective warranty prices often drop to zero or a very low value. In fact, in many cases, the warranty price is sold at the very low price different from zero, below 2 CAD. We could imagine that the extended warranty is given for free (or sold at a very low price) during the recessions in order to boost sales of the base good product. The dataset provides us with the information on all the promotions that took place in our sample. The share of these is 2.5 % of the total number of observations and seems too small to explain the cyclical variation of the warranty prices. Very low prices of extended warranties are however also observed outside official promotions. In fact, they occur much more frequently than the official promotions and prices below 2 CAD represent 20 percent of the total number of observations.[9]

If unofficial promotions are a tool used to boost the sales of the base good during recessions, their share should be procyclical. Because the dataset does not include enough of promotions at the store level, we aggregate the data to the economic region level at the monthly frequency. We test weather

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[9]The threshold of 2 CAD is arbitrary here however we have tested the dynamics of unofficial promotions with lower (1 CAD) and higher (3 CAD) threshold and qualitative results are the same.

the share of promotions increases with the local unemployment rate by estimating a following equation:

$$pm_{trc} = \beta u_{t-i,r} + \alpha_c + \gamma_t + \delta_r + \gamma_t^c * \alpha_c + \varepsilon_{trc} \qquad (2)$$

where pm_{trc} is a share of promotions in month t, region r and product category c. α_c is product category dummy, γ_t is the time dummy and δ_r regional dummy. $\gamma_t^c * \alpha_c$ is the category, time dummy interaction effect. Table 3 shows the results of the specification 3 for the unofficial promotions.

Table 3: Cyclicality of promotions

$pm_{trc} = \beta u_{t-i,r} + \alpha_c + \gamma_t + \delta_r + \gamma_t^c * \alpha_c + \varepsilon_{trc}$		
$u_{t-1,r}$	0.05^{***}		
	(0.01)		
$u_{t-6,r}$		0.06^{***}	
		(0.01)	
$u_{t-12,r}$			0.06^{***}
			(0.01)
pm_{t-1rc}	0.31^{***}	0.31^{***}	0.31^{***}
	(0.02)	(0.02)	(0.02)
α_c	✓	✓	✓
γ_t	✓	✓	✓
δ_r	✓	✓	✓
$\gamma_t^c * \alpha_c$	✓	✓	✓
Obs	$44,633$	$44,633$	$44,633$

The table shows results of the fixed effects estimation of the specification: $p_{tsc} = \beta u_{ts} + \rho p_{t-1sc} + \alpha_c + \gamma_t + \delta_r + \varepsilon_{tsc}$. u_{tr} is a log unemployment rate and p_{t-1rc} indicates the one period lagged extended warranty price in the left panel and one period lagged base good price in the right panel. α_c, γ_t and δ_r are product category, time and region fixed effects, respectively. $\gamma_t^c * \alpha_c$ is an interaction effect of the time dummy and category dummy. Obs denotes the number of observations. The sample does not include the unofficial promotions.

The share of unofficial promotions increases in the regional unemployment rate. Similar to the extended warranty prices, the strongest impact is observed after six to twelve months.

5 Price cyclicality at the aggregate level

The finding that extended warranty prices respond to changes in local economic activity does not imply that, on aggregate level, warranty price-based inflation varies with the national business cycle. First, even if the same shock hits all the regions, local and aggregate elasticities are quantitatively different because of factor mobility, and central bank's response to shocks. Second, different regional economic structures imply that the responses to the same shocks will vary across regions and possibly cancel out on average.

We aggregate price data in the following way. First, we create an extended warranty adjusted, durable goods price index and a price index without extended warranties for our retailer. Because our dataset includes only one retailer of durable goods, we also study cyclicality of the durable goods price index provided by the Bank of Canada which collects the data from multiple retailers. Second, we construct the all-goods CPI index where the non-durable and semi-durable goods indexes are directly taken from the Bank of Canada.

5.1 Price aggregation

We create an extended-warranty adjusted durable goods price index and a price index without extended-warranty (naive) for our retailer:

$$P_t^{1*} = \frac{P_t^1}{P_0} = \frac{1}{C} \sum_{c=1}^{C} \left(p_t^{c,bg} + p_t^{c,w} \right) \tag{3}$$

where $p_t^{c,bg}$ is the base good price and $p_t^{c,w}$ is the extended warranty price for category c. The index, P_t^{1*}, weighs equally all the categories and economic regions. The second, population weighted index is computed as follows:

$$P_t^{2*} = \frac{P_t^2}{P_0} = \sum_{r=1}^{R} w_r \left(p_{t,r}^{c,bg} + p_{t,r}^{c,w} \right), \ R = 55 \tag{4}$$

where $p_{t,r}^{c,bg}$, $p_{t,r}^{c,w}$ are prices for base good and extended warranty in region r and weights, w_r, are computed based on the population figures for each

region r in either 2000 or 2010. For both indices we set the base month to be 2000M7: $P_0 = 2000m1$.

From indices P_t^{1*} and P_t^{2*}, we compute the year on year monthly durable goods inflation rates in a standard way:

$$\pi_t^1 = \ln P_t^{1*} - \ln P_{t-12}^{1*} \tag{5}$$

and for population weighted CPI:

$$\pi_t^2 = \ln P_t^{2*} - \ln P_{t-12}^{2*}. \tag{6}$$

where $t - 12$ indicates the variable lagged one year.

We also create all-goods consumer price index where we combine the retailer's durable goods data with semi- and non-durables series from the Bank of Canada. We create an extended warranty-adjusted goods price index in each month t:

$$P_t^* = \sum_{i=1}^{3} w_i P_t^i, \tag{7}$$

where P is the price index and i indicates the type of good. Because we compare the cyclicality of the retailer's inflation rate to the official one used by the Bank of Canada, we remain as close as possible to their definitions and divide goods into three categories: durables, semi-durables and non-durables. The weights attributed to each of these categories in the CPI index, w_i, are taken from Statistics Canada and correspond to 2009.[10] Year on year inflation is computed as before:

$$\pi_t^* = \ln P_t^* - \ln P_{t-12}^* \tag{8}$$

Table 4 reports descriptive statistics for the inflation rates created based on the retailer's transactions and for the Bank of Canada series. The top panel of Table 4 displays statistics for durable goods inflation only and the lower panel for all goods. The adjusted measures take into account the

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[10] The cosumer baseket weights do not change substantially over the years and are adjusted only a few times per decade. See Statistics Canada for details.

extended warranty prices. The column indicated with retailer title includes inflation measures computed with the retailer's data but without extended warranty prices.

Table 4: Summary statistics of various inflation neasures

Moment	Durable Goods		
	Adjusted	Unadjusted	
	inflation	Retailer	BoC
Mean	0.9%	−0.3%	−1.6%
StDev	5%	6%	2%
Skew	−0.03	−0.01	−0.97
	All Goods		
Mean	1.9%	1.5%	1.3%
StDev	2.3%	2.3%	1.8%
Skew	−0.34	−.64	−0.50

The table shows the summary statistics of the year on year inflation measures. Top panel shows inflations for durable goods only and the lower panels displays figures for inflation for all goods. Adjusted inflation is computed using equal weights for 55 Canadian economic regions and product categories. The weights for computation of the goods inflation are for 2009 and are taken from the Statistics Canada website. StDev indicates standard deviation and Skew skewness.

Both durable goods inflation rates based on our retailer's prices are higher than the one calculated by the Bank of Canada. Given that we account for extended warranty prices, it is not surprising that the average adjusted inflation rate is higher. It is however unclear why its unadjusted inflation rate is higher than in case of the Bank of Canada series.

The volatility of durable goods inflation of the retailer is 2.5 times higher that the one computed by the Bank of Canada. This is as expected since we use actual transaction data.

In aggregation, we attach the weight of 13% to the durable goods prices and the impact of the higher mean and volatility of our retailer's measures decreases. The lower panel of Table 4 shows that the adjusted inflation is still higher than the one computed by the Bank of Canada but the magnitude of volatility of both measures is similar.

5.2 Cyclicality

We asses the extent of the cyclicality of inflation by estimating a time-series specification of the following form:

$$\pi_t^{*i} = \alpha + \beta_t u_t + \varepsilon_t$$

where π_t^{*i} is year on year all goods inflation rate either computed for the retailer ($i = 1, 2$) or calculated by the Bank of Canada ($i = 3$). Durables' price index is computed using the population weights and, in the appendix, we report qualitatively unchanged results for equally weighted index, P_t^{1*}. u_t stands for the year on year unemployment rate change.[11] Negative and significant β_t indicates that the inflation rate is procyclical.

Table 5: Cyclicality of aggregate inflation

	$\pi_t^{*i} = \alpha + \beta_t u_t + \varepsilon_t$					
	Adjusted inflation		Naive inflation			
			Retailer		BoC	
$u_{t-6,s}$	-0.03**		-0.01		0.004	
	(0.01)		(0.01)		(0.009)	
$u_{t-12,s}$		-0.06**		0.002		0.015
		(0.02)		(0.015)		(0.014)
π_{t-1}^i	0.66***	0.81***	0.76***	0.78***	0.84***	0.83***
	(0.07)	(0.09)	(0.07)	(0.08)	(0.06)	(0.06)
Obs	100	100	100	100	100	100

The table shows results of the time-series estimation of the cyclicality regression $\pi_t^i = \alpha + \beta_t u_t + \varepsilon_t$. We use Newey-West adjustment for standard errors. π_t^{*i} denotes year on year inflation rate for all goods. u_t stands for year on year unemployment rate. Adjusted inflation indicates inflation including extended warranty prices. Naive inflation dos not include warranty prices. Retailer columns include the results of estimations with inflation built on durables index of the retailer. BoC indicates that durables price index is take from the Bank of Canada dataset.

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[11] Note that the specification at the aggregate level is different form 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 root.

Table 5 shows the cyclicality coefficients β_t for the time-series regressions of various inflation measures on growth rate of unemployment rate. Columns entitled 'Adjusted inflation' use as dependent variable inflation that includes warranty prices and columns names 'naive inflation' does not contain them. The columns entitled 'retailer' indicate that inflation in the regression used durable goods' index computed from our retailer dataset. The column BoC indicates that all the prices are based on the Bank of Canada data.

The results in Table 5 indicate that only adjusted inflation displays procyclicality. When unemployment rate growth increases the adjusted inflation rate drops. The strongest impact on adjusted inflation is observed after one year. The right panel of Table 5 demonstrates that neither the inflation constructed by the Bank of Canada nor the one using transaction data of our retailer exhibit cyclicality. The procyclicality found in the adjusted inflation must be therefore driven by extended warranty prices rather than the specificities of the retailers' data.

It is important to note that although the cyclicality coefficients are small, they result from including the price of one add-on only to one category of goods. Because in reality, we observe multiple add-ons being important for all durable goods and services, we would expect the coefficients to be much higher.

5.3   Add-ons adjusted inflation and Great Recession

Figure 4 plots adjusted inflation rate (dotted line) and the Bank of Canada inflation rate (solid green line) and growth rate in Canadian unemployment rate (black line). The grey area corresponds to the Great Recession in Canada which lasted between July 2007 and June 2009.

The figure suggests that the adjusted inflation is higher than the naive one during booms, when the unemployment rate growth decreases. In contrast, during the Great Recession, the difference between two inflation rates seems negligible. We formally test if there was a change in the mean of difference between adjusted and unadjusted inflations using structural break tests. We compute the difference between the two inflation rates:

**Figure 4:** Great Recession and adjusted and non-andjusted inflation rates
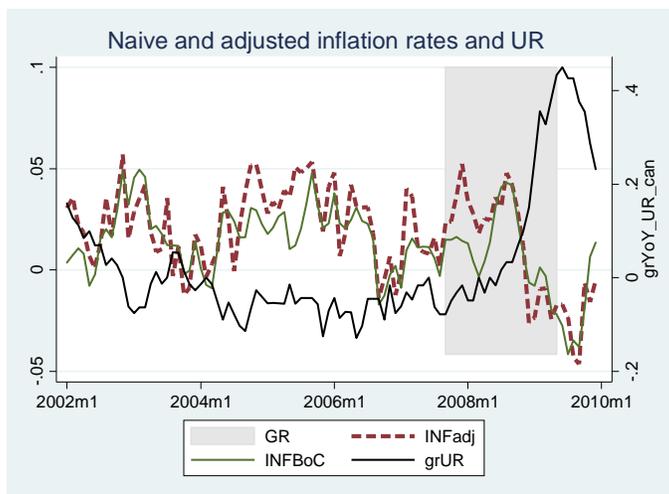
Figure plots naive inflation rate (green solid line) which is entirely computed from the Bank of Canada price series. Adjusted inflation rate (dotted brown line) takes the durables' price index from our retailer and adjusts for extended warranty prices. The black solid line corresponds to the Canadian unemployment rate growth. All the series are calculated as year on year changes. The left axis corresponds to both inflation measures. The right axis corresponds to the unemployment rate growth. GR denotes Great Recession.

$$d\pi_t = \pi_t^{*i} - \pi_t^{*3}, i = 1, 2$$

where π_t^{*i} is inflation rate computed for our retailer with either equal $(i = 1)$ or population weights $(i = 2)$, and π_t^{*3} is the Bank of Canada inflation rate. We test for structural breaks in the difference between the inflation rates $d\pi_t$ and in growth of unemployment rate. We implement the procedure proposed by Bai and Perron (1998, 2003). The results are reported in Table 6.

Table 6: Estimated structural breaks

Inflation difference		Unemployment rate growth	
Mean: 2000M1-2009m12	0.6% ***	Mean: 2000M1-2009m12	3%
	(0.001)		(0.3)
Estimated break date	2008M7	Estimated break dates	2002M12, 2008M10
Mean: 2000M1-2008M7	0.8% ***	Mean: 2002M12-2008M10	-4% ***
	(0.002)		(0.004)
Mean: 2008M8-2009M12	-0.3%	Mean: 2008M11-2009M12	25% ***
	(0.003)		(0.03)

The table shows results of the multiple structural break tests by Bai and Perron (1998, 2003) applied to the mean of the difference between adjusted and unadjusted inflation rates $d\pi_t$ and the mean of th unemployment rate growth u_t.

The right panel of Table 6 reports the results of structural break tests for unemployment rate growth. We find two structural breaks in the mean Canadian unemployment rate growth. The first one occurs in December 2002 and corresponds to a short-lived recession dated by the OECD. It is worth noting that the Bank of Canada does not date this period as a recession. The second break found in the unemployment rate growth occurs in the middle of the Great Recession, in October 2008. Before the second break, the unemployment rate was actually decreasing at the annual rate of 4%. After the break, we find that the unemployment rate grew at the dramatic average rate of 25%. This is also visible in Figure 4.

The difference between adjusted and unadjusted inflation rates displays

similar time-series dynamics. The left panel of Table 6 shows that we find a structural break in the mean of inflation difference in July 2008. Before that break, the adjusted inflation rate is significantly higher by 0.6% on average, than the naive inflation. This finding shows that the retailer exploited the boom and raised considerably the prices of extended warranties. After the break and during the Great Recession the difference between the two inflation measures is not significantly different from zero.

6 Conclusion

References

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