Add-on pricing over regional business cycles: Evidence from extended warranties

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Abstract

Add ons are features or services that can be added on to a base product or service to enhance their functionality or quality. They are pervasive. 37% of all Canadian CPI items have base goods or services with add on potential. Yet, we know very little about behavior of add-on prices over the business cycle. Using 10 years of extended warranty data from a nationwide Canadian retailer, we show that extended warranty prices respond strongly to changes in local economic activity whereas prices of underlying durable goods do not. The procyclicality is driven by a shift in price setting behavior, where local stores use extended warranty discounts to make demand for durable goods less price elastic. Discounts on extended warranties were especially sharp during the Great Recession. Durable goods price indices and their comparison with official statistics suggest add ons also amplify responses to the national business cycle. Our evidence suggests inflation rates for goods with add on potential display a larger bias during expansions.
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1 Introduction

Add ons are pervasive. 37% of all Canadian and 33% US CPI items have base goods or services with add on potential. Add ons improve the quality of a basic good or service vertically and "their prices are not advertised and would be costly or difficult to learn before one arrives at the point of sale" [Ellison, 2005]. The hidden nature of their prices and the inconvenience cost of learning them elsewhere enable firms to earn positive profits in equilibrium.[1] This capacity to use add-on prices to extract rents on the marginal transaction provides retailers with a natural means of adjustment to business cycle fluctuations.

This paper argues that add ons are used by sellers of durable goods to adjust prices to local business cycles. To make this argument, we study extended warranties on durable goods, a classic and pervasive add on. Our empirical analysis is guided by Ellison's [2005] seminal add-on pricing model. Ellison's model has several implicit predictions about the effects of recessions on durable goods and add-on prices. First, durable goods and add-on prices both decline during a recession. Second, add-on prices can decrease by more than base good prices. Third, stores can use their sales force to mitigate increases in the price sensitivity of consumers. Our baseline cyclicality regressions show business cycle fluctuations of warranty prices are more pronounced than durable goods prices. The procyclicality is driven by the responses of local stores to higher price sensitivity of consumers during the Great Recession, and resulting depressed demand for durable goods. Specifically, local stores use discounts on warranties to make consumers less price sensitive and boost durable goods sales.

Our empirical analysis draws on 10 years of confidential transactions data from a nation-wide Canadian retailer of household durables. The data is particularly suited to investigate add-on price cyclicality and the role of discounts for several reasons. First, it includes detailed price information on a textbook example of an add on, an extended warranty, a service that can be added on to most of the 35000 durables the retailer sells. Second, the data covers every one of the more than 6 million customer purchases, by more than 3 million customers, that took place all across Canada between December of 1999 and December 2009. This lets us exploit regional and time variation in economic activity to measure base-good and extended warranty price fluctuations over regional business cycles. Third, the data includes rich cost information, and the extended warranty prices headquarters suggest to stores. This information facilitates an examination of the mechanisms driving price fluctuations.

[1] The theoretical literature on add-on prices tries to explain why add ons and their hidden prices exist. See [Ellison, 2005] and [Gabaix and Laibson, 2006] for two prominent examples.

We first document basic facts about add ons and extended warranties specifically. We inspect CPI baskets in Canada and the United States and classify item categories on the basis of whether they include goods or services that can be added on to, and whether the add on can be an extended warranty. Our classification implies that 37% (33% in the US) of item or expenditure categories in current Canadian CPI basket have base goods or services that can be added on to. 17% (10% in the US) of item or expenditure categories have warranties that can be extended. These statistics suggest add ons and extended warranties make up a non negligible share of consumption baskets for Canadian and US households.

We then analyze the role of business cycles in Ellison's model. In the model, the base good is consumed by both low type (high marginal utility of income) and high type consumers, while only high types consume the add on. As a result, equilibrium base-good prices are determined by the *average* marginal utility of income, whereas equilibrium add-on prices are determined only by the marginal utility of high types. Since both marginal utilities tend to increase during recessions, we expect decreases in the prices of both durable goods and add ons. The model predicts add-on prices to drop by more than base-good prices during downturns for a realistic set of parameter values. The model further predicts that the higher the average marginal utility of income, the more price sensitive is base-good demand, and that increases in price sensitivity can be mitigated by higher sales agent effort.

We exploit these predictions to investigate empirically the cyclicality of add-on prices and the role of discounts on warranties. We find strong support for the model predictions. Base-good and extended warranty prices are lower when the unemployment rate is high or when consumers experience a negative income shock. The decreases are especially pronounced for extended warranty prices, suggesting that high unemployment or negative income shocks have adverse effect on high type consumers. A one percentage point increase in the regional unemployment rate is followed by a \$2.19 decrease in the extended warranty price in the next month. It is followed by a cumulative decrease of \$3.99, 4.5% of the mean extended warranty price, over the following year. We find small to negligible effects on base-good prices over similar time horizons. Sharp warranty discounts and relative base-good price rigidity suggest extended warranty prices are an important but hidden margin of adjustment to local business cycle fluctuations.

Our baseline estimates suggest warranty discounts may be a vehicle for stores to increase depressed consumer demand in recessions, when consumers are more price sensitive. We exploit our cost data to estimate an aggregate demand system where the base good is a function of the total price (sum of median prices for the base good and warranty). We

consider how this base-good demand elasticity varies with the warranty discount, before the onset of the Great Recession, and after. We show that the elasticity of base-good demand during the Great Recession was -0.52, triple the elasticity before its onset. We show warranty price discounts, our proxy for sales agent effort, lowered this price elasticity substantially in general and especially during the Great Recession. The price elasticity without the discount was -0.78 and the price elasticity with a 100% discount was -0.65, suggesting sales agent effort decreased the elasticity by 16.7%.

Explicit add-on price collection is rare. It is more typical to collect base good prices alone.[2] Accordingly, we consider aggregate implications of regional add-on price cyclicality. We develop durable-goods indices that account for add ons, and consider whether their omission biases price measurements. We show warranties amplify the cyclicality of inflation in the aggregate for our retailer, and that there are important differences between the cyclicality in our data and the cyclicality of durable-goods prices in official statistics. Finally, we quantify inflation bias driven by add ons. We find that, on average, the bias equals 0.20 percentage points (pp) per year and it varies with the business cycle. During the Great Recession, the bias is small and equals 0.08. In contrast, during the preceding 2002m1-2007m7 expansion, it reached 0.30 pp. The biases align with the theory and microeconometric evidence. We see a lower bias during contractions precisely because many warranties are thrown in "for free".

We explore alternative interpretations of our data, including the possibility that we measure the differential effects on centralized (base-good) prices versus decentralized (warranty) prices [Gagnon and López-Salido, 2019], or that the price decreases reflect quality substitution by consumers [Bils and Klenow, 2001] rather than the additional price flexibility allowed for by warranties. While we find substantial evidence in support of the add-on pricing interpretation, we cannot rule out decentralization hypothesis unequivocally.

Similar to Chevalier, Kashyap, and Rossi [2003], Bils and Klenow [2004], Nakamura and Steinsson [2008], Hosken and Reiffen [2004], Kehoe and Midrigan [2015], Anderson et al. [2017], we study the role of temporary sales for characterizing the degree of price flexibility. In contrast to advertised sales, our study highlights the importance of unadvertised discounts on add ons and their impact on the base-good price elasticity.

Mounting empirical evidence indicates that households change their shopping behavior over the business cycle. Aguiar, Hurst, and Karabarbounis [2013] argue that time spent on

[2]These conclusions are based on numerous conversations with statistical agencies in Canada, the United States, and the Netherlands. In Canadian CPI basket (Appendix Table OA.7.1), we could only identify a single category that may have some items that qualify as add ons: insurance, licences, and other services for recreational vehicles.

shopping increases during recessions, and Krueger and Mueller [2010] and Nevo and Wong [2019] document a rise in several measures of shopping intensity during the Great Recession. Coibon, Gorodnichenko, and Hong [2019] show that, during economic downturns, consumers switch to low-cost stores.[3] Our paper is complementary to these studies as it offers a new mechanism of price adjustment by the retailer, implemented during the Great Recession.

The remainder of the paper is organized as follows. Section 2 documents the economic relevance of add ons using current CPI baskets in Canada and the US. Section 3 summarizes the transactions data and details the context. Section 4 describes the predictions of the add-on pricing game for price behavior over the business cycle. Section 5 presents our baseline estimates of the pricing response to changes in local unemployment rates and shows that the results are robust to using relatively cleaner shifter of demand. In Section 6, we estimate a demand system to identify the mechanism driving the observed procyclicality of extended warranty prices. Section 7 develops aggregate price indices and constructs the resulting inflation biases due to the lack of add ons. Section 8 considers alternative interpretations to add-on pricing. Section 9 concludes.

2 Economic relevance of add ons

To illustrate the pervasiveness of add ons for the economy as a whole, we study current CPI baskets in Canada and the United States and classify each item on the basis of add-on potential using several sources, including the internet, [Ellison, 2005], and our own judgment.

Our classification and CPI basket weights for 170+ item categories in the Canadian basket can be found in Online Appendix Table OA.7.1. For items with add-on potential, the table additionally lists base good and add on examples. Table OA.7.1 documents 37% of all items have base goods or services with add-on potential. The percentages for nondurable goods, durable goods, semi-durables, and services are 0%, 96%, 29%, and 65% respectively. 17% of all items have base goods or services with extended warranty potential. The corresponding percentages for nondurable goods, durable goods, semi-durables, and services are 0%, 92%, 24%, and 4%. The total basket weights for item categories with potential add ons and extended warranties are 36% and 18%, respectively.

The analogues for 200+ item categories in the US basket are found in Online Appendix OA.7.1. The patterns there are quite similar. 33% and 15% of all items have base goods or services with add on or extended warranty potential. The add on percentages for nondurable

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

goods, durable goods, semi-durables, and services are 0%, 87%, 19%, and 55%. The extended warranty percentages for nondurable goods, durable goods, semi-durables, and services are 0%, 81%, 15%, and 2%. The total basket weights for item categories with potential add ons and extended warranties are 33% and 10%.

Our classification, examples, and the basket weights suggest that add ons, and extended warranties specifically, represent nonnegligible expenditure shares of both Canadian and American households.

3 Data and context

3.1. Primary data. Our main analysis is based primarily on the data of a nationwide Canadian retail chain which specializes in the sale of household durables, especially home appliances and consumer electronics. The retail chain is among the top 4 in terms of market share in its relative subsector [Industry Canada, 2013]. 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. To sharpen the exposition, we will often use "warranty" in reference to "extended warranty", "base price" in reference to "durable good price", and "suggested price" in reference to the "suggested extended warranty price".

The data covers transactions that took place between January 1 1999 and December 31 2009, involving more than 6.54 million transactions, more than 3 million consumers, nearly 35,000 products, and around 270 stores. The data includes transaction prices 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 headquarters set for stores.

The chain has corporate and franchise stores. Franchises purchase the base good from the chain at cost (the price of the manufacturer) plus an inventory cost for holding the base good in the distribution centers. We observe these transfer prices for 9562 manufacturer-model combinations and use them to construct base-good costs for goods sold at both corporate and franchise stores. Specifically, we construct variable base-good costs by summing the transfer/manufacturer price, sales agent commissions for base good sales (4% of revenue), royalty costs to the chain if the store is a franchise (4% of revenue), inventory and marketing and advertisement costs (2.5% of revenue). Again to sharpen the exposition, we will often use variable base-good costs and base-good costs interchangeably.

Extended warranty variable costs include sales commissions (15% of revenue), royalties to the chain (4% of revenue) in the case of franchises, and the cost of servicing the claim discounted to the transaction date.[4] Servicing covers 100% of the repair costs, including parts and labour, services that require a home visit by a technician, and in some cases replacement. These costs are borne by the retailer. Although warranty prices are almost never advertised, the retailer calculates marketing and advertisement costs of 2.5% of total revenue, including revenue generated through warranty sales. We include these costs as well. Altogether, we construct warranty costs for approximately 26477 manufacturer-model combinations and approximately 2.58 million transactions.

3.2. Summary statistics. Basic summary statistics are found in Table 1. The top panel shows an average base-good price of 629 dollars against an average base-good cost of 550 dollars to the retailer. The middle and bottom panels of Table 1 show suggested prices exceed warranty prices by about 50%. Customers extend the warranty 40% of the time and pay 89 dollars on average to do so. Customers make claims on extended warranties 9% of the time. The average cost of an extended warranty claim is 483 dollars.[5][6]

The low claim rate in Table 1 raises questions about whether an extended warranty can be interpreted as an add on, as it only improves durable goods quality in a handful of cases. As a check on our interpretation, we investigate whether the relationship between consumer types and extended warranties in our setting mimics the relationship between consumer types and add ons in the canonical model of add-on pricing by [Ellison, 2005]. In particular, we verify that high type consumers are more likely to purchase the extended warranty for a given warranty price. See Online Appendix Figure OA.2 for details.

To learn the warranty price, consumers must speak directly with store representatives. Moreover, once a consumer has visited one of the stores in the chain, it becomes costly for them to visit a competing retailer. The stores are usually housed in stand-alone buildings and located in regions with sprawl so that consumers must travel by car to learn warranty

[4]Our dataset includes claim costs for all claims made within our sample. We observe claims and thus *ex post* extended warranty costs until about 2007. Later we use these claims to construct *ex ante* extended warranty costs for each manufacturer and product.

[5]The average claim cost has the fewest observations because claim costs are observed only when a claim is made. Price, average cost, and suggested price differ in the number of observations because data is missing deferentially for these variables.

[6]We replicate the summary statistics in Appendix Table OA.6.1 using a restricted sample of model-year-month combinations where at least one extended warranty was sold. We do this to show that the compositional differences across products purchased with and without extended warranties are minor. In line with this point, our main estimates are effectively the same if we use this alternative sample.

Table 1: Summary statistics

	Base good	
	Price	Average cost
	628.91	549.71
	(613.89)	(526.98)
Observations	6538033	4865375

	Extended warranty			
	Price	Average cost	Suggested price	Take up
	89.41	56.96	133.94	0.40
	(93.62)	(242.07)	(109.01)	(0.49)
Observations	2576246	2583077	2585128	6538033

	Claims on extended warranties	
	Average cost	Claim made
	483.23	0.09
	(526.10)	(0.32)
Observations	239215	2585128

Notes: Unit of observation is the transaction. All prices and costs are in Canadian (CAD) dollars. Extended warranty cost set to zero in cases where no claim was made. Average cost of extended warranty includes commissions on extended warranty sales, royalties and other fees that are paid to the chain, and the costs from servicing claims on the extended warranty. Average cost for claims is calculated over realized claims. Claims made is the number of claims made relative to the total number of purchased extended warranties in our sample. Standard deviations are in parentheses.

prices at competing retailers. These sunk travel and time costs, together with the hidden nature of the price, allow for markups over the warranty cost.

The commission structure indicates that the chain has price-setting power over warranty and base-good prices. The chain pays sales agents commissions on base-good and warranty revenue. The commission on warranty revenue is 15%, whereas the commission on base-good revenue is 4%.[7]

The average warranty price is approximately 44 dollars below the suggested price. This

[7]The commission was 15% until later part of our sample, April of 2009, when the commission was reduced to 10%.

price wedge highlights 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, exclude add-on prices (*c.f.* Cavallo [2018]). The inherent unobservablity of add-on prices therefore makes it difficult to draw reliable conclusions about their cyclical properties.

3.3. Cross-sectional and time series price variation. We document stark differences in base-good and warranty price movements in the cross section and over time.

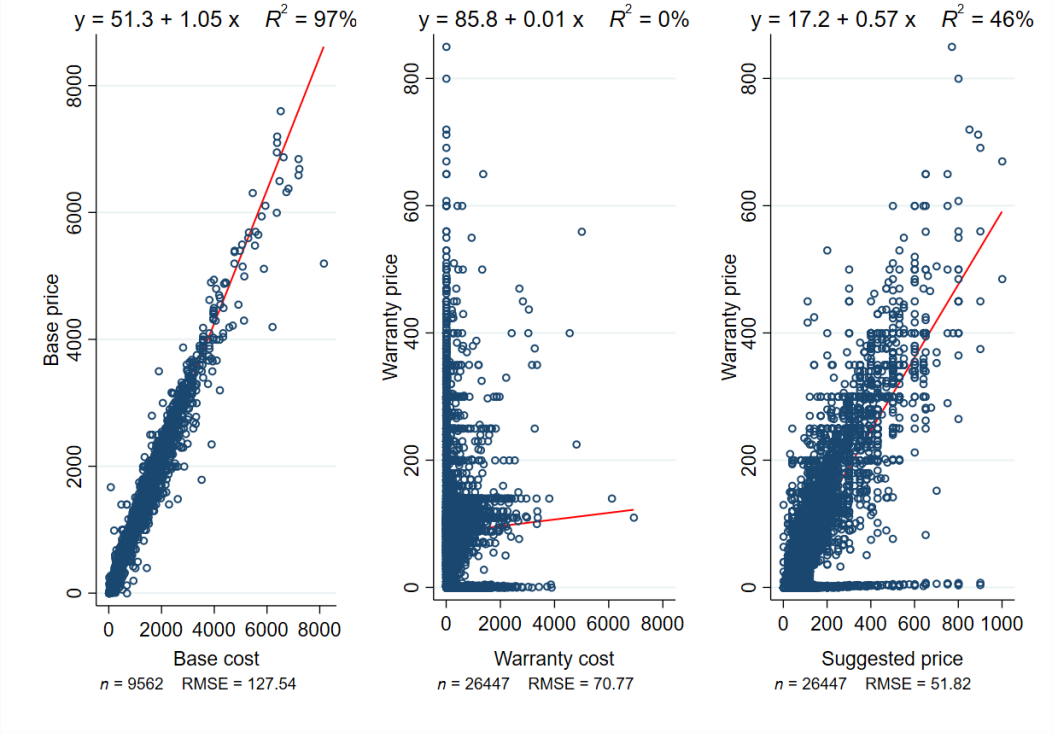
We illustrate the cross sectional relationship between prices, costs, and headquarter suggested warranty prices in Figure 1. Note that warranty costs (middle panel) account for the possibility that no claim is filed. The left panel shows a 1 dollar increase in variable base cost is associated with a 1.05 dollar increase in base-good price. The R^2 for the base good regression is 97%. In contrast, the middle panel of Figure 1 shows a 1 dollar increase in the variable warranty cost is associated with a 1 cent increase in warranty price. The R^2 for the warranty regression is close to 0%. The estimates suggest that warranty pricing is based on other factors than warranty costs. Finally, the right panel of Figure 1 shows that a 1 dollar increase in the suggested warranty price is associated with a 57 cent increase in warranty price. The R^2 for this regression is 46%. The figure shows that suggested prices are predictive of warranty prices, but that substantial variation is left unexplained.

We next analyze price dynamics with a focus on the Great Recession. For illustrative purposes, we document price movements for two representative products and their extended warranties (Figure 2). The top left panel of Figure 2 depicts base good price dynamics for Frigidaire freezers in Kingston, Ontario. The bottom left panel shows base good price dynamics for Whirlpool automatic washers in Oshawa, Ontario. The panels on the right plot warranty price dynamics for these same products. The dotted and solid lines show price dynamics for suggested and warranty prices, respectively.

Because suggested prices are set by headquarters, the difference between suggested and warranty prices reflects the extent to which stores exploit discretion over prices. To this end, note that suggested prices are above warranty prices most of the time. In fact, in our entire sample, the suggested price exceeds the warranty price 96.5 % of the time, in line with the mean differences for the entire sample (Table 1). Additionally, warranty prices exhibit extreme declines, especially during the Great Recession, when they were often close or equal to zero.

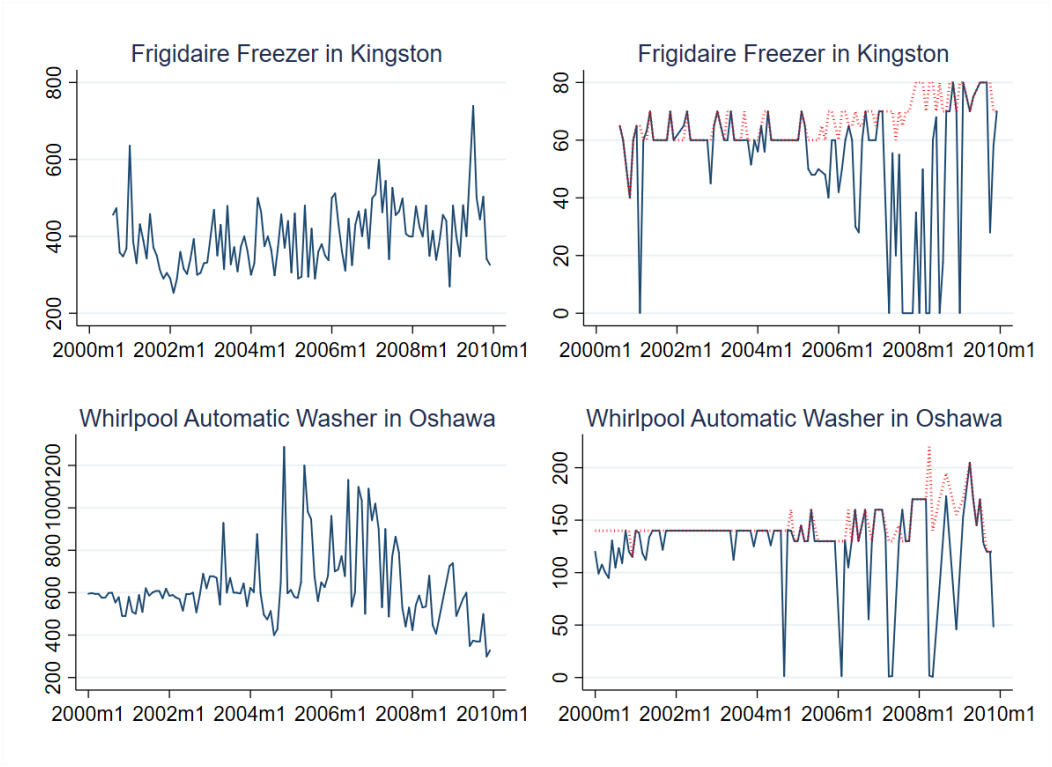
The left panels of Figure 2 show less extreme but substantial and systematic monthly volatility in base-good prices. The volatility suggests that stores have some discretion in

Figure 1: Prices and costs by model



Notes: Unit of analysis is the model. Model numbers are specific to each manufacturer. Figure uses median prices and costs by model. Base costs are the sum of the transfer/manufacturer price, sales agent commissions for base-good sales (4% of base revenue), royalties to the chain if the store is a franchise (4% of base revenue), inventory and marketing and advertisement costs (2.5% of base revenue). Warranty costs include sales commissions (15% of warranty revenue), royalties to the chain (4% of warranty revenue) in the case of franchises, marketing and advertisement costs (2.5% of warranty revenue), and servicing costs discounted to the date of the transaction.

Figure 2: Base-good, warranty and suggested price dynamics



Notes: Left panels plot base-good monthly prices. Right panels plot warranty and suggested warranty prices. Base-good and warranty prices are solid blue. Suggested prices are dotted red.

setting base-good prices.

4 A framework for add-on pricing

Why would warranty prices decrease by more than base-good prices during recessions? To answer this question, we turn to the canonical add-on pricing framework of [Ellison, 2005]. We use the equilibrium prices in his model to show how base-good and add-on prices are expected to change over the business cycle. Additionally, we illustrate the expected effect of a recession on the price elasticity of base-good demand. The intuition developed here will guide our empirical strategy.

4.1. Add-on pricing and business cycles in theory. In Ellison's add-on pricing game, there are two horizontally differentiated firms (left and right). Each firm sells two vertically differentiated products: high quality product (with an add on and quality v) denoted by H, and low quality product (without the add on and quality $v - w$), denoted by L. Thus, the perceived value of the add on is w. The marginal cost of both goods equals c.

There are unit masses of high, h, and low type, l, consumers. Each consumer purchases either base good or base good with an add on or nothing at all. High and low types differ in their marginal utilities of income, α_h and α_l, where $0 < \alpha_h < \alpha_l$. A type j consumer, with $j \in \{h, l\}$, values a good of quality q from firm i at $v_q - d_i - \alpha_j p_{iq}$ where $v_q \in \{v - w, v\}$ is the value of the stream of services generated by the good, d_i is distance to firm i, p_{iq} is the price. Consumers correctly infer the add-on price in equilibrium, but cannot correctly infer small deviations from the equilibrium add-on price, and pay a sunk cost to visit the other firm.

There is an equilibrium where all low types buy the base good from the closest firm and all high types buy the add on. In this equilibrium, firm i charges for the base good:

$$p_{iL} = c + \frac{2 - w}{2\bar{\alpha}} \tag{1}$$

with $\overline{\alpha} = \frac{\alpha_l + \alpha_h}{2}$. The firm charges $p_{iH} = p_{iL} + \frac{w}{\alpha_h}$ for the base good with an add on, such that the add-on price is:

$$p_{iH} - p_{iL} = \frac{w}{\alpha_h} \tag{2}$$

The firm may increase the base-good price above marginal cost or decrease the base-good

price below marginal cost, depending on whether $w \leq 2$ or $w > 2$. The firm may be willing therefore to take a loss on the base good in equilibrium. Note that we do observe some losses in practice, see Figure 1(left).

Equations (1) and (2) can help us predict expected changes in base-good prices and add-on prices during recessions. Suppose that high (low) type consumers are high (low) income consumers. We expect the marginal utility of income for low types α_l to increase during recessions because recessions tend to impose a heavy burden on low income households. This translates into a reduction of the equilibrium base-good price in Equation (1), as long as the firm is not taking a loss on the base good. If a recession also reduces the income of high type consumers, their marginal utility of income α_h will increase as well. By Equations (1) and (2), this will reduce the add-on price as well as the base-good price. The bigger the effect on high type consumers, the larger the increase in their marginal utility of income, α_h, and the sharper will be the drop in the add-on price. As long as high types are affected by the recession, we expect the add-on price to decline by more than the base-good price alone.[8]

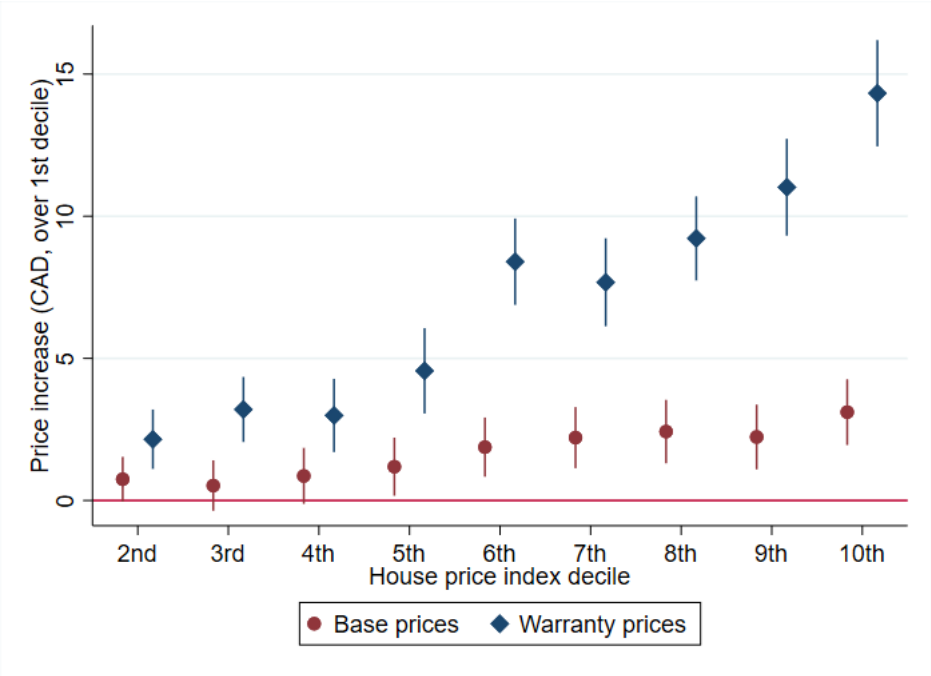
It is important to note that the firm *always* wants to increase the add-on price, but is constrained in doing so by the marginal utility of income of high type consumers, α_h. As a result, the firm will be more profitable during expansions when α_h is low and the firm can increase add-on prices by more. During contractions, it will be less profitable because it can increase add-on prices by less. We therefore expect the variation of add-on price over business cycle to be more pronounced than that of the base good. This hypothesis will be at the core of our empirical analysis.

4.2. High types versus low types and the Great Recession. So far, we have assumed that high (low) types can be proxied by high (low) income individuals. We now test this assumption directly using the add-on pricing framework. Specifically, pricing equations (1) and (2) predict that base-good prices depend on both, marginal utility of income of low and high types, α_l and α_h but add-on prices depend on marginal utility of high types, α_h, only. If high types are high income households we can assume that they tend to be home owners. Because marginal utility of income decreases in income, Equation (2) implies that the add-on prices should be higher in the neighborhoods populated by high incomes, where house prices are high.

To test this hypothesis, we use house price index data from Teranet and the National Bank

[8]In Online Appendix OA.1, we show that it holds under very realistic parameter restrictions.

Figure 3: House price deciles and warranty and base prices.



Notes: Unit of observation is the transaction. Figure plots estimated coefficients from a regression of base or warranty price on decile dummies, year-month-model fixed effects, and FSA fixed effects. Decile dummies indicate whether house prices in the FSA of the consumer are in the 1st-10th decile of the house price distribution for the year. The base group is the 1st decile. Each coefficient thus measures base or warranty price changes relative to the first (lowest) decile.

of Canada (`https://housepriceindex.ca/`) at the lowest level of aggregation available. The data covers each quarter in our sample period, and each of 1600 forward sortation areas (FSA: 3 digit postcode) in Canada. We classify each FSA on the basis of its house price index decile in each year. We then regress base-good and warranty prices on decile dummies, year-month-model fixed effects, and FSA fixed effects. We plot the coefficient estimates for the decile dummies in Figure 3. Each coefficient measures the change in the base-good or warranty prices relative to the first (lowest) decile of FSA.

We see a steep positive gradient for warranty prices. Consumers in the highest FSA decile for a given year pay $15 more for the extended warranty than the lowest decile consumers. Consumers is the 2nd decile pay $2 more. By contrast, we see a relatively flat gradient for base-good prices. Consumers is the highest FSA decile for a given year pay $3 more for the base good than the lowest decile consumers. The gradients imply that warranty price variation reflects high type consumers marginal utility of income. This is not the case

for base-good price variation. Both patterns support the intuition of the add-on pricing framework, where, high (low) incomes proxy high (low) types.

We can expect the add-on prices to decline by more than the base-good prices during the Great Recession only if high incomes were also affected by this downturn. While all the economic downturns are known to hit low income households, not all of them are equally harmful for high incomes. However, a defining characteristic of the Great Recession is that it reduced incomes all along the income distribution. Although relatively mild in Canada, the Financial Crisis initially decreased all major capital income components, which are predominantly concentrated in hands of the richest households (see [Arsenault and Sharpe, 2009]). In fact, income inequality declined during the Great Recession in Canada, as documented in Figure OA.6.2 of the Online Appendix, suggesting that incomes of high types dropped by more than those of low types. Accordingly, it would be unsurprising to see especially sharp declines in warranty prices during the Great Recession.

4.3. Elasticity of base-good demand in a recession. We use [Ellison, 2005]'s model to derive the price elasticity of base-good demand and to show how this elasticity is expected to change during recessions. The intuition developed here will be useful to (i) interpret the elasticity estimates and (ii) to understand the role of retailer's add-on price setting.

The consumer decides first which firm to visit (1 or 2). Because the add-on price is unknown, this decision depends on the base good prices in both stores: p_{1L} and p_{2L} and on the distance to firm 1, $d_1 = \theta$, which is uniformly distributed on [0,1]. $1 - \theta$ is the distance to firm 2. A type (θ, α_j) consumer will visit firm 1 if

$$v - w - \theta - \alpha_j p_{1L} \geq v - w - (1 - \theta) - \alpha_j p_{2L} \quad \Longleftrightarrow \quad \theta \leq \frac{1}{2} + \frac{\alpha_j}{2}(p_{2L} - p_{1L}).$$

The demand for the base good at firm 1 $D(p_{1L})$ is thus:

$$D(p_{1L}) = N\mathbb{P}(q_{1L} = 1 \text{ or } q_{1H} = 1) = N(1 + \overline{\alpha}(p_{2L} - p_{1L}))$$

where N is the total mass of consumers, q_{1L} is an indicator which equals 1 if the consumer buys base good at firm 1 and q_{1H} is an indicator which equals 1 if the consumer buys a base good with and add on at firm 1 and $\mathbb{P}$ is the probability. The price elasticity of demand at firm 1 is:

$$\varepsilon^D = \frac{\partial D(p_{1L})}{p_{1L}} \frac{\partial p_{1L}}{D(p_{1L})} = \frac{-\overline{\alpha} p_{1L}}{(1 + \overline{\alpha}(p_{2L} - p_{1L}))}$$

As in [Ellison, 2005], assume that both firms are symmetric and thus charge the same base good price in equilibrium: $p_{2L} = p_{1L} = c + \frac{2-w}{\overline{\alpha}}$. The price elasticity of demand can be written as:

$$\varepsilon^D = -\overline{\alpha}c + 2 - w \tag{3}$$

with c being marginal cost of production. Equation (3) shows that the elasticity is determined by the average marginal utility of income $\overline{\alpha}$, the marginal cost of production c, and the quality difference between the base good with and without the the add on, w. We know that $\overline{\alpha}$ increases in recessions and hence the price elasticity ε^D is also expected to rise. To test this hypothesis empirically, we will design and estimate a demand system and retrieve the empirical counterpart of ε^D.

5 Cyclicality of prices

Based on the predictions derived from [Ellison, 2005], we verify whether the business cycle fluctuations of warranty prices are more pronounced than those of the base good prices. To do so we first estimate a baseline cyclicality regression where local unemployment rate is used as a proxy of economic activity. Second, we estimate the effect of a demand shift on base-good and add-on prices, using a change in oil price as a demand shifter for some provinces more than others.

5.1. Baseline cyclicality regressions. Our baseline measure of local economic activity is the unemployment rate from Statistics Canada, which is seasonally-adjusted for each of the 58 EI regions. Regional unemployment rates are provided on a monthly basis and computed as 3-month moving averages. We use data from January of 2000 (2000M1) to December of 2009 (2009M12) for 55 regions. We exclude Yukon, Northwest Territories, and Nunavut because of their sparse populations and because their unemployment rate is fixed at 25%.

We aggregate the transaction data to the year-month-store-model combination. We use median prices at this level of aggregation. Aggregation produces series that have the same frequency as the unemployment rate data and lets us define lags in the analysis naturally.[9] It also lets us estimate a demand system using base good quantities later on, a task which is infeasible at the transactions level because transactions are observed only when a base good

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

is sold. That said, we replicate our regression analysis here at the transaction level in Table OA.6.2 in the appendix.

We estimate

$$p_{tsm} = \beta u_{t-\ell,r(s)} + \rho p_{t-\kappa,sm} + \alpha_{r(s)} + \gamma_{tm} + \varepsilon_{tsm} \tag{4}$$

where p_{tsm} is the median base or warranty price in year-month t at store s for model m. $u_{t-\ell,r(s)}$ is the unemployment rate at time $t-\ell$ in the EI region r of store s. We consider the effects of alternative lags ℓ of the unemployment rate, at 1, 6, and 12 months, because shifts in the economic environment may affect prices with lags of several months. κ is the lag length on prices. We also compute the long-run (cumulative) impact of the local unemployment rate on prices using 12 lags for prices and 1 lag for the unemployment rate. $\alpha_{r(s)}$ and γ_{tm} are fixed effects for region and year-month-model combination. ε_{tsm} is a random variable reflecting idiosyncratic price changes.

Our interest is in β, which measures the response of the median price to the lagged unemployment rate for the region. Estimates can be interpreted causally if

$$E[\varepsilon_{tsm}|u_{t-\ell,r(s)}, p_{t-\kappa,sm}, r(s), tm] = 0. \tag{5}$$

It is unlikely that lagged warranty prices or base-good prices at the level of store and model influence local unemployment rates. Unobserved heterogeneity generated, for instance, by the sector of production is captured by EI region fixed effects. Year-month-model fixed effects capture unobserved time-varying heterogeneity across models, relating to obsolescence rates, inventories, or shifting demands across manufacturers, models, and quality levels. They also reflect the centralized part of price dynamics over the life cycle of a product as noted earlier. Year-month-model fixed effects also capture movements in the national business cycle, implying that our cyclicality coefficient estimates reflect responses to local economic conditions and partial out the effects of the aggregate business cycle.

Estimates are reported in Columns (1)-(6) of Table 2. The leftmost and middle panels report estimates of β for extended warranty and base-good prices, respectively. Moving left to right within each panel shows how the estimates differ depending on lag length for the unemployment rate. Long run effects are found in the bottom panel.

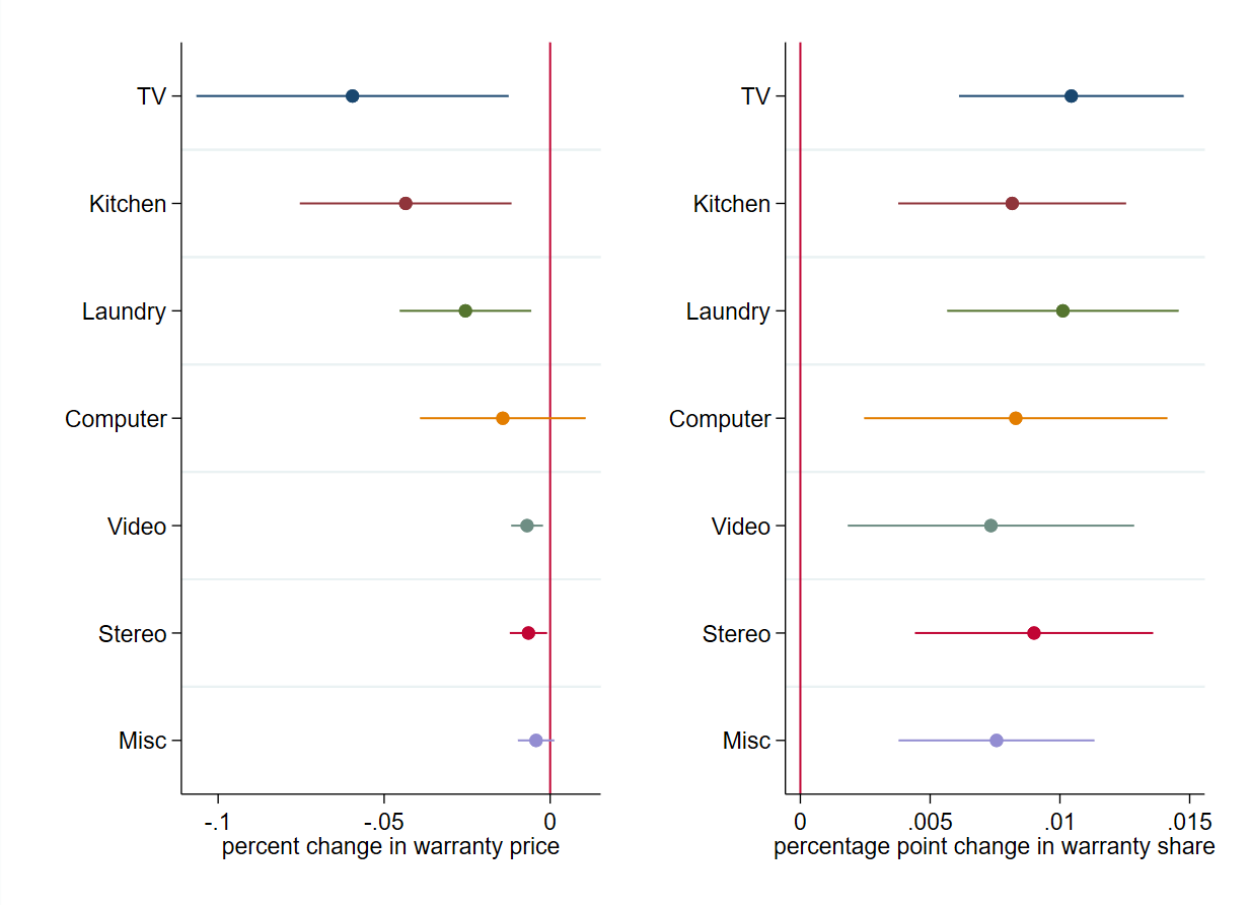
The column (1) estimate implies that a one percentage point increase in the unemployment rate is followed by a warranty price decrease of \$2.19 in the next month. Over the longer run, a one percentage point increase in the unemployment rate reduces the warranty price over the following year by \$4.01, or 4.5% of the mean warranty price. Effect sizes

Table 2: Pricing and local economic activity

	Warranty price			Base price			Warranty discount		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EI region unemployment rate at									
t - 1	-2.194***			-0.580			1.873***		
	(0.659)			(0.424)			(0.657)		
t - 6		-2.306***			-0.620			1.936***	
		(0.716)			(0.456)			(0.673)	
t - 12			-2.306***			-0.609			1.924***
			(0.698)			(0.398)			(0.659)
Long-Run Effect	-3.989***	-3.989***	-3.989***	-0.827	-0.827	-0.827	3.369***	3.369***	3.369***
	(1.207)	(1.207)	(1.207)	(0.611)	(0.611)	(0.611)	(1.139)	(1.139)	(1.139)
Observations	682755	656079	630720	1932782	1871852	1807999	682803	656099	630732
R^2	0.560	0.556	0.551	0.983	0.983	0.983	0.514	0.511	0.508

Notes: Unit of observation is year, month, store, and model. Model identifiers are specific to the manufacturer. Regressions include fixed effects for year-month-model combination and EI region, as well as lags of dependent variable. Warranty price discount equals the maximum of 0 and the suggested price less the warranty price. Standard errors clustered on EI region and in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5% levels.

Figure 4: Pricing and local economic activity by product category



Notes: Regression estimates of the effect of one lag of the unemployment rate on warranty prices (left) and shares (right) in Alberta. Dots denote coefficient estimates. Lines denote 95% confidence interval. Unit of analysis for regressions is year, month, store, and model. Regressions include one lag of dependent variable and fixed effects for year-month-model combination and EI region. Prices in natural logarithms. Confidence intervals constructed using standard errors that are clustered on the EI region. Warranty shares are share of transactions in a year, month, store, model cell that included an extended warranty.

are similar if 6 and 12 month lags of unemployment rate are used. The estimates are all highly significant statistically. By contrast, the analogues in Columns (4)-(6) show that the cyclicality coefficients for base good prices are economically small, especially relative to the mean base good price, and statistically insignificant. We show that the results are robust to using the natural logarithm of prices as the dependent variable in Online Appendix Table OA.6.3.

Previous research has documented substantial differences in price changes across product categories [Bils and Klenow, 2004, Nakamura and Steinsson, 2008]. We study heterogeneity in the warranty price response across product categories in the left panel of Figure 4. We follow the product categorization of the retail chain, which groups products into the following categories: TV, kitchen appliances, laundry, computer, video, stereo, or miscellaneous small appliances (misc for short). We examine the effect on log prices because it facilitates comparison across product categories. The left panel of Figure 4 shows that a one percentage point increase in the unemployment rate decreases warranty prices for TV by 6%, kitchen by 4.4%, laundry by 2.6%, computer by 1.4%, both video and stereo by 0.7%, and misc by 0.42%. All the coefficients are negative. 5 out of 7 are statistically significant at the 5% level. Note that the mean base good prices for these categories are 1154.9 for TV, 769.2 for kitchen appliances, 681.4 for laundry, 591.4 for computer, 258 for video, 321 for stereo, and 300 for misc.

There is some ambiguity whether the unemployment rate measures shocks to demand or supply and thus whether β measures demand or supply responses. To address this concern, we construct a relatively clean shifter of demand to estimate β.

5.2. Evidence from an oil price shock. Canada has 10 provinces which differ considerably in their economic activities. The province of Alberta, in particular, is especially dependent on income from sectors relating to the production, distribution, and export of oil and natural gas, with it making up to 27.8% of GDP, on average, from 1999 to 2010, compared to the average of 9.5% for the other provinces. The second most important producer of oil and gas is Saskatchewan with the average share of 16.26% of GDP derived from activities related to oil and gas production.

We focus the following discussion on Alberta although in our robustness checks we allow for a demand shift in Saskatchewan as well. Our specific proxy makes use of the high endowment of oil in Alberta relative to the rest of Canada and hence the differential impact of the oil price on its consumers' income. Intuitively, for Albertans, the increase in the oil

price translates into higher consumer prices (gas in particular) and additional income. For residents of other provinces, higher oil prices translate into an increase in consumer prices only. The difference between the two is a proxy for a change in consumer income in Alberta resulting from a shift in oil prices.

To take the this logic to the data, we estimate:

$$p_{tsm} = \beta AB_s \times p_t^{oil} + \alpha_{r(s)} + \gamma_{tm} + \varepsilon_{tsm} \tag{6}$$

where AB_s indicates whether store s is in the province of Alberta and p_t^{oil} is the median crude price of oil in calendar month t. Monthly crude oil prices are obtained from West Texas Intermediary (Cushing, Oklahoma) and are measured in Canadian dollars. We standardize p_t^{oil} by its full sample mean and standard deviation. Note that time dummies, γ_{tm}, capture p_t^{oil} in our fixed effects specifications. We also estimate an alternative specification that abstracts from time dummies, γ_{tm}, but includes instead the oil price p_t^{oil}.

The parameter of interest is β. It measures the effect of the oil price on base and warranty prices in Alberta, relative to the rest of Canada. Based on our argument above, we expect $\beta > 0$ for all prices.

Estimates are found in Table 3. The warranty price estimates in Column (1) are from a simple difference-in-difference specification with no fixed effects but with AB_s and p_t^{oil}. The estimates in Column (2) are based on a specification with fixed effects for the EI region and year-month. The estimates in Column (3) are based on the specification described by Equation (6). This specification includes fixed effects for the EI region and year-month-model. A comparison of Columns (1), (2), and (3) supports a causal interpretation for our estimates. The analogue estimates for base good prices are found in Columns (4)-(6). We will focus the discussion on the estimates in Columns (3) and (6).

Column (3) shows a one standard deviation increase in the median crude oil price increases the warranty price by \$7.98 in Alberta, relative to the rest of Canada. The estimate amounts to a 9.9% increase over the mean warranty price. Column (4) shows a relative increase of \$3.96 in the base good price, though the estimate is statistically insignificant at the 5% level. The estimates are qualitatively similar to our baseline results of price responses to the unemployment rate, reported in Table 2. In Figure OA.6.4(left) we show that the difference-in-difference estimates by product category are also qualitatively similar to their analogues in Figure 4. Again the median crude oil price has the largest effect on warranty prices for the TV category in Alberta, for example.

Our interpretation of the effect of world oil prices on base and warranty prices is based

Table 3: Pricing and oil price shock (oil prices in CAD$)

	Warranty price			Base price			Warranty discount		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Alberta × World oil price	7.315***	7.952***	7.983***	3.958	3.082	3.639	-4.838**	-5.893***	-6.226***
	(2.181)	(2.183)	(1.819)	(5.863)	(5.250)	(1.819)	(1.909)	(1.496)	(1.694)
World oil price (in CAD $)	0.086			0.469***			0.673***		
	(0.045)			(0.107)			(0.054)		
Alberta (0/1)	6.073			-6.039			-5.127		
	(4.602)			(20.053)			(3.352)		
Constant	80.228***	85.441***	86.118***	665.331***	686.871***	675.914***	12.394**	42.401***	42.582***
	(1.246)	(0.028)	(0.021)	(19.769)	(0.021)	(0.010)	(1.320)	(0.021)	(0.021)
Controls									
EI Region Fixed Effects	N	Y	Y	N	Y	Y	N	Y	Y
Year-Month Fixed Effects	N	Y	N	N	Y	N	N	Y	N
Year-Month-Model Fixed Effects	N	N	Y	N	N	Y	N	N	Y
Observations	1452881	1452881	1355930	2730533	2730532	2605751	1459504	1459503	1360460
R^2	0.004	0.037	0.547	0.001	0.008	0.982	0.052	0.082	0.487

Notes: Unit of observation is year, month, store, and model. Model identifiers are specific to the manufacturer. Warranty price discount equals the maximum of 0 and the suggested price less the warranty price. Standard errors clustered on EI region and in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5% levels.

on two primary assumptions. The first assumption is that the consumer gas prices follow common trends across provinces. The second is that estimated β predominantly reflects a demand shock. Supporting evidence for both assumptions are provided in Online Appendix Section OA.3.

Several other robustness checks can be found in the online appendix. The results are robust to using the natural logarithm of prices in Table OA.6.4, to expanding our definition of oil producing provinces to include Saskatchewan in Table OA.6.5, and to replacing the interaction term $AB_s \times p_t^{oil}$ with the provincial monthly average gas prices in Table OA.6.6.

6 Discounts, Demand, and the Great Recession

Figure 2 suggests local stores may be "throwing in" extended warranties during the Great Recession. Figure OA.6.3 in Online Appendix shows further that a disproportionate share of warranties is sold for a price close to zero. These patterns arise outside of advertised promotions on warranties, which are rare, comprising approximately 0.1% of all transactions.

Why would stores give away extended warranties during recessions? Recall the price elasticity of base-good demand derived in Section 4.3: $\varepsilon^D = -\overline{\alpha}c + 2 - w$. We expect more price elastic base-good demand during recessions, because the average marginal utility of income $\overline{\alpha}$ tends to increase during recessions. The interaction term in the elasticity $-\overline{\alpha}c$ suggests that a firm can mitigate increases in the marginal utility of income by reducing the marginal cost c of producing the base good.

Marginal cost reductions can arise naturally during recessions if the increased prospect of unemployment increases effort by individual sales agents [Shapiro and Stiglitz, 1984]. The extra effort implies higher productivity and lower marginal cost. Alternatively, the increased prospect of unemployment generates more effort for a given commission rate. This effective reduction in the commission rate reduces the marginal cost c.

Motivated by the above arguments, we construct a measure of sales agent effort that is based on the warranty price discount relative to the headquarter suggested price. We first show that these warranty discounts indeed reflect the sales agents efforts. We then investigate the role of the discounts in shaping the base-good demand. We find that the increased effort from sales agents lowered the base-good price elasticity during the Great Recession.

6.1. Warranty discounts. [Hastings et al., 2017] show that exposure to sales agents lowers

price sensitivity, leading to inelastic demand and high equilibrium prices. In our context, increased effort by sales agents reduces marginal cost, c, lowering price sensitivity. To measure these efforts, we define:

$$d_{tsm} = \max\{0, swp_{tsm} - wp_{tsm}\}$$

where $|\cdot|$ denotes the absolute value, wp_{tsm} is the median warranty price, and swp_{tsm} is the median suggested price in year-month, t, store, s, model m. Note that $d_{tsm} = swp_{tsm} - wp_{tsm}$ in 96.5 % of cases because $swp_{tsm} > wp_{tsm}$ in 96.5 % of all transactions. The distribution for d_{tsm} exhibits left skewness, with a large mass around 0, nonnegligible mass spread between discounts of 0 and 200, and a small number of very large discounts. See Figure OA.6.6 in Online Appendix for a visualization.

If the proposed discounts, d_{tsm}, proxy sales effort per transaction, then we would expect transaction volume to decrease warranty discounts. This intuition gives us a basis for testing the suitability of our proxy. In particular, we estimate

$$\bar{d}_{ts} = \alpha_s + \beta v_{ts} + \gamma_t + \epsilon_{ts}$$

where $\bar{d}_{ts}$ is the average discount at store s on year-month-day t, v_{ts} is the transaction volume (number of transactions) on that day, α_s and γ_t are fixed effects for the store and calendar date, and ϵ_{ts} is an idiosyncratic error term. Given the aforementioned intuition, we expect $\beta < 0$. To facilitate a causal interpretation, we instrument for v_{ts} using the average transaction volume for other stores in the same province on the same calendar date. Estimates can be found in Table 4.

Column 1 shows a positive correlation between transaction volume and the warranty discount. The estimate is statistically insignificant. Column 2 implies that 100 additional transactions decreases the average warranty discount by approximately \$15. Column 3 shows that the estimate decreases to -0.34 if we eliminate potential outlier volumes from the sample. The estimates in Columns 2 and 3 suggest that discounts are proxying for sales effort.

Next, we document the cyclicality of d_{tsm} in the rightmost panel of Table 2 and the response to oil price shocks in the rightmost panel of Table 3. Both tables show small differences in the effects on warranty prices and warranty discounts, suggesting that most of the warranty price movements are driven by discounts and not by suggested prices. Because deviations from suggested warranty prices are discretionary decisions, the estimates suggest that the discounts are a suitable proxy for sales agent effort. We cannot however completely rule out alternative explanations. For example, larger discounts can reflect the broader price

Table 4: Do discounts proxy for sales effort?

	Warranty discount		
	(1)	(2)	(3)
Transaction volume	0.019	-0.152***	-0.340***
	(0.016)	(0.047)	(0.114)
Constant	44.213***		
	(0.331)		
Estimand	OLS	IV	IV
Kleibergen-Paap Wald F	-	30.61	24.79
Observations	311112	309037	305201
R^2	0.268	-0.002	-0.005

Notes: Unit of observation is store and calendar date (year-month-day). Regressions include fixed effects for store and calendar date. Instrumental variable is the average transaction volume of other stores in the same province on the same calendar date. Column 3 trims the top 1 percentile of volumes from the sample. Standard errors are clustered at the level of the store and are in parentheses. *** and ** denote statistical significance at the 1 and 5% levels.

discrimination strategies of stores rather than the effort of individual workers. Stores throw in the warranty because there are more consumers on the margin between buying and not buying the base good, and because free warranties persuade these consumers to buy the base good.

To simplify the exposition, we refer to the discounts as proxies for sales agent effort. We note however that "sales agents" include individual workers and the broader sales team at a store. "Effort" captures actual efforts to work hard by individuals salespersons as well as intensified price discrimination strategies that target base-good sales by the team as a whole.

6.2. Price elasticity in the Great Recession. We assume that base-good demand is generated according to:

$$q_{tsm} = \beta_{tsm0} + \beta_{tsm1} p_{tsm} + \alpha_{r(s)} + \gamma_{tm} + \varepsilon_{tsm} \tag{7}$$

where q_{tsm} is the natural logarithm of the total base-good m quantity sold in store s at time t. The total base-good sales include those with and without the extended warranties. The fixed effects $\alpha_{r(s)}$ reflect income effects at the level of the EI region.[10] γ_{tm} reflect differential obsolescence rates, inventories, shifting consumer demand across manufacturers, models, quality levels, centralization in price dynamics, as well as movements in the national business cycle. p_{tsm} is the natural logarithm of the sum of median prices for the base good and warranty. We add 1 to this variable to facilitate an elasticity interpretation for β_{tsm1}. The intercept β_{tsm0} reflects the valuation of the highest value consumer for base good m sold in store s at time t. In a general discrete choice framework, β_{tsm1} reflects the fraction of consumers on the margin of buying at price p_{tsm}, relative to the fraction of consumers who are already buying at p_{tsm}. In this general framework, demand is more elastic when the pool of marginal consumers is large.

Our specification interprets discounts as a determinant of consumer demand rather than as a determinant of supply. This may seem odd because seller behavior is not a primitive in traditional consumer choice problems and thus not a direct factor in the relationship between consumer demand and prices. It is important to note, however, that typical consumer choice problems do not allow for the complexity of direct interactions (communication, negotation, etc.) between buyers and sellers. In these more complex interactions, sellers can alter the relationship between consumer demand and prices via information provision, persuasion, or simply by exploiting psychological or cognitive biases. Our specification allows for such

[10]Including census income explicitly has no real effect on the coefficient estimates.

possibilities.

Identification of Equation (7) relies on the assumption that there is no unobserved variable that correlates with warranty discounts and prices and that tracks variation across months, stores, and models. The assumption may not hold if local stores encourage sales staff to push a particular set of goods in a given month, for example, because of excess inventory or the activities of local rivals. OLS estimates of the demand system (Online Appendix Table OA.6.8) suggest that the identifying assumption fails, as it yields a positive price elasticity of demand.

To address this identification concern, we use an instrumental variables (IV) strategy with three primary instruments: (i) the sum of headquarter suggested prices and the costs of base goods to stores; (ii) lagged warranty discounts; (iii) the interaction of (i) and (ii). We exclude expected warranty costs from the instrument set because it has no predictive power for warranty prices.

Our benchmark specifications let the slopes differ depending on the Great Recession: $\beta_{tsm0} = \beta_{t0}$ and $\beta_{tsm1} = \beta_{t1}$.[11] Benchmark estimates can be found in specification A of Table 5. A 13.5% increase in the transaction price, equivalent to the mean warranty price, decreases base good sales by 2.3% pre-recession and 7.0% thereafter. Only the latter is statistically significant. The results indicate that consumers were more price sensitive after the onset of the Great Recession, consistent with a general increase in the marginal utility of income.

6.3. Sales agent effort and price elasticity of base-good demand. We now evaluate the impact of warranty discounts on the magnitude of price elasticities, before and after the onset of the Great Recession. We let $\beta_{tsm0} = \beta_0 + \beta_1 d_{tsm}$ and $\beta_{tsm1} = \beta_2 + \beta_3 d_{tsm}$. β_1 then measures the influence of a 100% warranty price discount on the valuation of the highest value consumer. β_2 measures the transaction price elasticity of demand when there is no discount. β_3 measures the influence of the discount on this price elasticity. We add 1 to d_{tsm} and express it in natural logarithms. The logarithmic transformation facilitates an elasticity interpretation for warranty discounts while at the same time minimizes the effects of skewness and extreme discounts on the results (see Online Appendix Figure OA.6.6). Additionally, we demean the transaction price in the interaction $p_{tsm}d_{tsm}$ because it lets us interpret β_1 as the marginal effect of the warranty price discount at the mean transaction

[11] Average effects for the entire sample and the associated first stage estimates can be found in Online Appendix Tables OA.6.9 and OA.6.10. A discussion of the estimates and other issues can be found in Online Appendix Section OA.5.

Table 5: Warranty discounts and consumer demand IV estimates before and after onset of Great Recession

	Base good quantities	
	Before onset	After onset
	(1)	(2)
	SPECIFICATION A.	
Transaction price	-0.172	-0.518***
	(0.194)	(0.199)
Kleibergen-Paap Wald F	114.956	24.268
Year-month-model combinations	42845	16558
Observations	349319	173211
	SPECIFICATION B.	
Transaction price	-0.079	-0.781***
	(0.145)	(0.219)
Warranty price discount	0.032**	-0.021
	(0.015)	(0.019)
Transaction price × discount	0.049***	0.130***
	(0.013)	(0.023)
Kleibergen-Paap Wald F	27.72	8.66
Year-month-model combinations	42806	16556
Observations	347787	172913

Notes: Unit of observation is year-month, store, and model. Sample is restricted to year-month-store-model combinations where at least one extended warranty was sold. Reported dependent and independent variables are in natural logarithms. Regressions include fixed effects for the year-month-model combination and EI region. Standard errors are clustered at the level of the EI region and are in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5% levels.

price.

Estimates can be found in SPECIFICATION B of Table 5. Column (1) shows that the no discount price elasticity was -0.079 in the pre-recession period. The no discount elasticity implies that a 13.5% increase in the transaction price decreases base good quantities by 1.1%. The estimate is statistically insignificant but the sign is as expected. A 100% warranty price discount at the mean base good price increases base good quantities by 3.2% ($p < 0.01$). A warranty price discount of 100% decreases the elasticity magnitude by 0.049, from 0.079 to 0.030 ($p < 0.01$), suggesting warranty discounting lowers price sensitivity among base good consumers.

Column (2) of the same panel shows a stark change in the elasticity and the influence of the warranty price discount during the recession. The no discount elasticity during the Great Recession is 10 times higher than its pre-recession counterpart. It implies that, before the recession, a 13.5% increase in the transaction price decreases base good quantities by 10.5% ($p < 0.01$). The third row of the panel shows the impact of the warranty discount on price elasticity. A 100% warranty price discount reduces the elasticity by 0.130, from 0.781 to 0.651 ($p < 0.01$). The results favor the hypothesis that, during the recession, the efforts of sales agents were mitigating increases in the sensitivity of consumers to prices.

7 Aggregate inflation measures

We have shown so far that the warranty prices are more sensitive to the regional unemployment rate fluctuations than are the base-good prices, at the store level. Does this also imply more pronounced business cycle fluctuation of prices in aggregate? To answer this question, we construct two aggregate price measures. Ideally, we would like to build an aggregate price index and resulting inflation measures, including all CPI components.[12] The restricted set of product categories and add ons covered by our retailer makes construction of an ideal aggregate price index impossible. We instead construct a price index for our retailer and compare its dynamics to the official Canadian durable goods index.

7.1. Construction of durable goods indexes. The construction of our fixed weights indexes follows the methodology used by STATSCAN to compute the measure of core inflation based on the trimmed mean (CPI-trim).[13] Details on sample construction for this exercise

[12]We investigate a different set of add ons in the US Airline industry in Section OA.4.

[13]Detailed description of the methodology behind the preferred measure of CPI can be found here: `https://www.statcan.gc.ca/en/statistical-programs/document/2301_D64_T9_V2` We base ourselves on the

can be found in Online Appendix OA.8.

Our baseline durable goods price inflation measure is the weighted arithmetic average of monthly inflation rates for N product categories in our data:

$$\pi_t^a = \sum_{i=1}^{N} \omega_i^a \pi_{it}^a. \tag{8}$$

where i denotes the product category and t the month. Year-on-year add-on adjusted inflation rates per category π_{it}^a are computed as follows:

$$\pi_{it}^a = ln(p_{it}^a/p_{i0}^a) - ln(p_{it-12}^a/p_{i0}^a). \tag{9}$$

where $p_{it}^a = J_{it}^{-1}(\sum_{j=1}^{J_{it}} p_{jit}^a)$ is an arithmetic average of the J_{it} products that belong to category i at time t, p_{jit}^a are arithmetic averages across all transaction prices of product j at time t, inclusive of transactions with and without an extended warranty. $\omega_i^a = \frac{p_{i0}^a q_{i0}^a}{\sum_{i=1}^{N} p_{i0}^a q_{i0}^a}$ are expenditure weights of product category i computed at $t = 2000m1$. q_{i0}^a denote corresponding quantities.

Our second fixed weights inflation measure uses base good prices not adjusted for add ons. We use π_t^{na} and π_{it}^{na} to denote the aggregate and product category inflation rates in this case.

Since the adjusted and unadjusted weights ω_i^a and ω_i^{na} are not necessarily equal, we compute a third fixed weights add-on adjusted measure where the weights for each product category equal the base good expenditure weights:

$$\pi_t^{a*} = \sum_{i=1}^{N} \omega_i^{na} \pi_{it}^a. \tag{10}$$

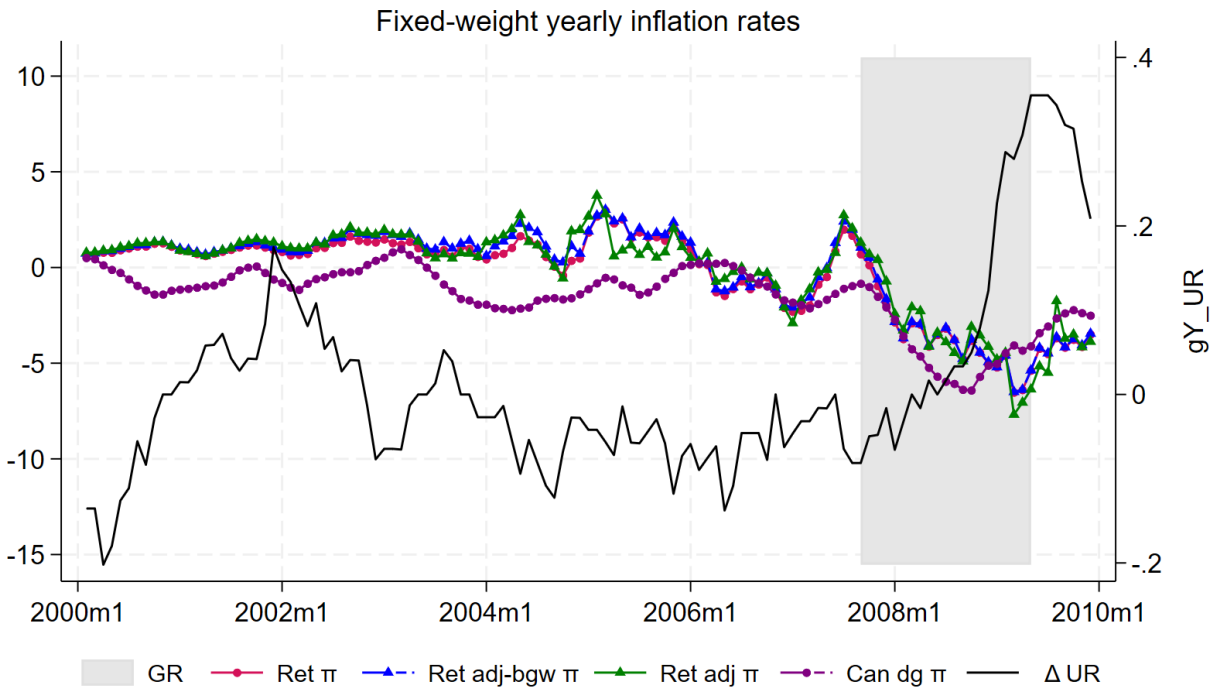
This inflation measure lets us compute bias due to add-on prices while ruling out composition effects.

7.2. Properties of aggregate inflation rates. We start by comparing inflation rates computed for our retailer with official Canadian durable goods inflation rates in Figure 5.

All series imply a negative trend, consistent with decreases in durable goods prices over the last several decades. The three fixed weights measures from our retailer move together closely. The measures track the official rate reasonably well, although the latter is smoother.

first measure described in the document and called CPI-trim.

Figure 5: Durable goods price inflation: retailer and official measure



Notes: Figure plots retailer's inflation rates computed with fixed product category weights. Retailer unadjusted inflation rate is in red. Retailer adjusted rate in blue. Retailer adjusted rate with base good weights in green. Official rate in purple. Black line depicts unemployment rate growth (ΔUR). All series are seasonally adjusted. Grey area marks Great Recession. Great Recession dates are retrieved from `https://fred.stlouisfed.org/series/CANRECM`.

Table 6: Properties of inflation measures.

	π_t^a	π_t^{a*}	π_t^{na}	π_t^{Can}
μ	-0.10	-0.11	-0.30	-1.49
σ	2.31	2.30	2.22	1.67
$\rho_{t,t-1}$	0.94	0.97	0.96	0.98
π_t^a	1			
π_t^{a*}	0.97	1		
π_t^{na}	0.96	0.97	1	
π_t^{Can}	0.77	0.77	0.78	1
Obs	120	120	120	120

Notes: Top panel reports summary statistics of 4 inflation measures. μ stands for the mean in percent, σ for standard deviation, and $\rho_{t,t-1}$ for first order autocorrelation. Bottom panel displays correlation matrix for the 4 measures.

The fixed weights inflation series for our retailer trend above the official series most of the time, suggesting that the prices of products sold by our retailer declined at a slower pace than durable goods prices in general.

Table 6 summarizes the four inflation measures. Our retailer's indices are reported in the first three columns and the last column shows the official measure. The mean (μ) is always negative. Consistent with Figure 5, average inflation rates are higher than the official one. Volatility (σ) magnitudes are comparable to the Canadian inflation series but somewhat higher. All inflation rate series are highly persistent ($\rho_{t,t-1}$ in row 3).

An inflation rate correlation matrix is found in the bottom panel of Table 6. The last row tells us to what extent our indices capture official inflation dynamics. The correlations between the three fixed weights measures and the official rate are between 0.77 and 0.78.

7.3. Cyclicality of aggregate inflation measures. We study the cyclical properties of the four price inflation measures via the following time-series regression: $\pi_t^y = \alpha^y + \beta^y \Delta UR_t + \epsilon_t^y$ where $y = \{a, a*, na, Can\}$ and ΔUR_t is aggregate Canadian year-on-year unemployment growth rate.[14] Because of the possibility of a lagged response of inflation to the unemployment rate, we also estimate the cyclicality coefficient β for lagged unemployment rate growth

[14]We use the growth rate of unemployment rate in the cyclicality regressions because the unemployment rate is non-stationary. Specifically, we cannot reject the null of the presence of a unit root when performing Augmented Dickey–Fuller test.

Table 7: Cyclicality of aggregate inflation measures.

		PANEL A: $\pi_t^y = \alpha^y + \beta^y \Delta UR_{t-j} + \epsilon_t^y$			
		π_t^a	π_t^{a*}	π_t^{na}	π_t^{Can}
Model 1	ΔUR_t	-0.121^{***}	-0.118^{***}	-0.113^{***}	-0.063^{***}
		(0.030)	(0.030)	(0.028)	(0.016)
Model 2	ΔUR_{t-1}	-0.114^{***}	-0.112^{***}	-0.106^{***}	-0.056^{***}
		(0.032)	(0.029)	(0.030)	(0.015)
		PANEL B: $\pi_t^y = \alpha^y + \beta^y \Delta UR_{t-j} + \psi^y t + \epsilon_t^y$			
		π_t^a	π_t^{a*}	π_t^{na}	π_t^{Can}
Model 3	ΔUR_t	-0.071^{**}	-0.079^{**}	-0.068^{**}	-0.031
		(0.021)	(0.020)	(0.015)	(0.019)
	t	-0.037^{***}	-0.038^{***}	-0.038^{***}	-0.027^{**}
		(0.010)	(0.009)	(0.010)	(0.010)
Model 4	ΔUR_{t-1}	-0.069^{***}	-0.066^{***}	-0.061^{***}	-0.023
		(0.018)	(0.018)	(0.017)	(0.020)
	t	-0.039^{***}	-0.040^{***}	-0.040^{***}	-0.028^{**}
		(0.010)	(0.010)	(0.009)	(0.011)
	Obs	119	119	119	119

Notes: Unit of observation is year-month. Table reports the results of the cyclicality regressions of the form: $\pi_t^y = \alpha^y + \beta^y \Delta UR_{t-j} + \epsilon_t^y$ where $y = \{a, a*, na, Can\}$ and $j = \{0, 1\}$. π_t^y refers to different measures of inflation. ΔUR_t is the Canadian unemployment growth rate. Bottom panel reports estimates of specifications with a linear time trend. Regressions use Newey-West standard errors. *** and ** denote statistical significance at the 1 and 5% levels.

ΔUR_{t-1}. The top panel of Table 7 reports results of these regressions. Since all inflation series display a declining pattern, we include a time trend in the cyclicality regressions. Results from these regressions are found in the bottom panel of Table 7.

Panel A indicates the retailer's inflation series are procyclical. The coefficient β is larger for the add-on adjusted measures, consistent with our earlier microeconometric evidence. The estimated coefficients approximately equal 0.12, implying that a 1 pp increase in unemployment rate growth reduces inflation rate by 0.12 pp. A similar picture emerges with lagged unemployment rate growth regressions.

Panel B suggests that the coefficients reported in top panel partially capture downward trend in durable goods inflation. Once we account for the time trend, our retailer's fixed

weights inflation series exhibit smaller business cycle fluctuations but still twice as large as the official measure.

7.4. Inflation bias. Using the aggregate price inflation indexes constructed in the previous section, we now compute the resulting bias and examine its cyclical properties. To isolate inflation bias due to the lack of add-on prices only, we compare indices constructed using (i) the same set of products and (ii) the same weights attributed to those products in each month t. These conditions are satisfied by π_t^{a*} and π_t^{na}.

We compute bias as follows:

$$\varepsilon_t^f = \pi_t^{a*} - \pi_t^{na} \tag{11}$$

$\varepsilon_t^f > 0$ indicates downward bias in the base-good price inflation, π_t^{na}, relative to the add-on adjusted index, π_t^{a*}. The bias ε^f is expected to be larger in expansions, when the retailer can charge higher prices for add ons. During recessions, the bias ε^f should be close to zero because the retailer charges almost nothing for add ons.

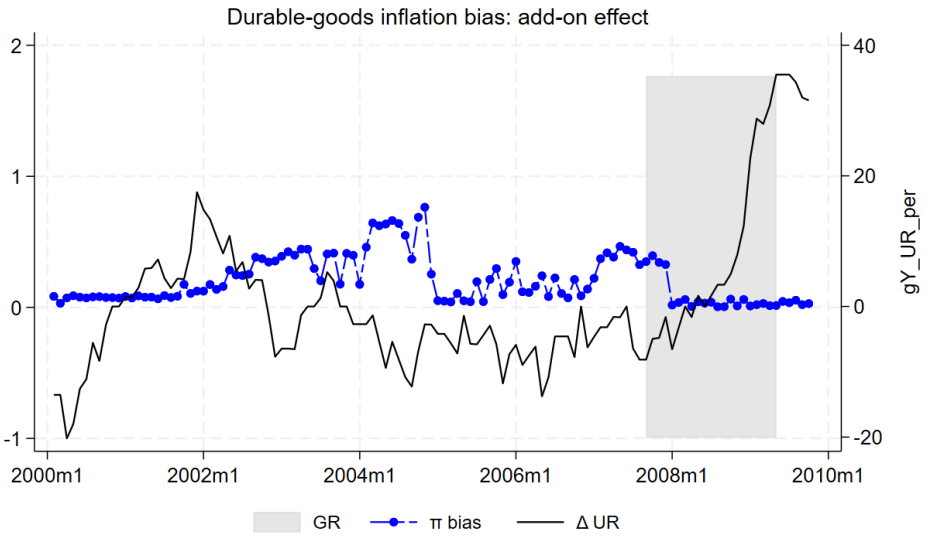
Figure 6 plots ε_t^f, jointly with yearly growth rate of unemployment rate. On average, the bias due to add ons equals 0.20 pp per year. However, as demonstrated in the top panel of Figure 6, it varies with the business cycle. During the Great Recession, the bias is small, $\varepsilon_t^f = 0.08$, while in the expansion before the Great Recession, the bias was equal to 0.30 pp. The results of this exercise suggest that durable-goods inflation has been biased downwards by 0.30 pp during expansion between 2000m1 and 2007m7.

8 Other interpretations

We argue that warranties are a source of price flexibility for stores and they reduce the price sensitivity of base-good demand. We explore several alternative interpretations of our results. First, we consider the interpretation of base-good and add-on pricing as being centralized versus decentralized strategy of the retailer, respectively. Second, we investigate the hypothesis that the warranties are a proxy for quality substitution over the business cycle. Finally, we briefly discuss the possibility that our cyclicality estimates are driven by the store-specific inventory conditions.

8.1. Add-on prices or more decentralized prices? A competing interpretation for our results is that they simply reflect the fact that warranty prices are more decentralized than

Figure 6: Durable-goods inflation bias.



Notes: Figure plots retailer's inflation bias (blue line) computed in equation (11). Black line depicts unemployment rate growth (ΔUR). Grey area marks Great Recession in Canada and the dates are retrieved for the FRED: `https://fred.stlouisfed.org/series/CANRECM`.

base-good prices.[15] Under this interpretation, warranty prices are more responsive to local conditions because they are the primary instrument stores control. We explore the add-on and decentralisation interpretations of our results as follows. First, we evaluate how much discretion the stores have over the base-good prices. We do this directly by contacting 19 existing stores in the retail chain. The interviews support the notion that stores have discretion over base-good prices. Second, we formally investigate the hypothesis of centralised versus decentralised prices by studying price dynamics over time and across stores. While we cannot rule out this hypothesis unequivocally, we find compelling evidence in favor of the add-on pricing interpretation.

Dynamics of discretion. To better understand store discretion in price setting, we study the dynamics of store discounts on base goods and warranties. We compute base-good price discounts as the difference between the list and transaction price, where the list price is proxied by the modal price of a model in an EI region in a given quarter. The warranty price discounts are computed as the difference between the headquarter suggested price and the transaction price. The discount frequency across transactions measures the propensity of stores to deviate from headquarter suggestions. The discount amount measures the extent of these deviations. The monthly average frequency and amount of the discounts across all products and all stores can be found in Figure 7.

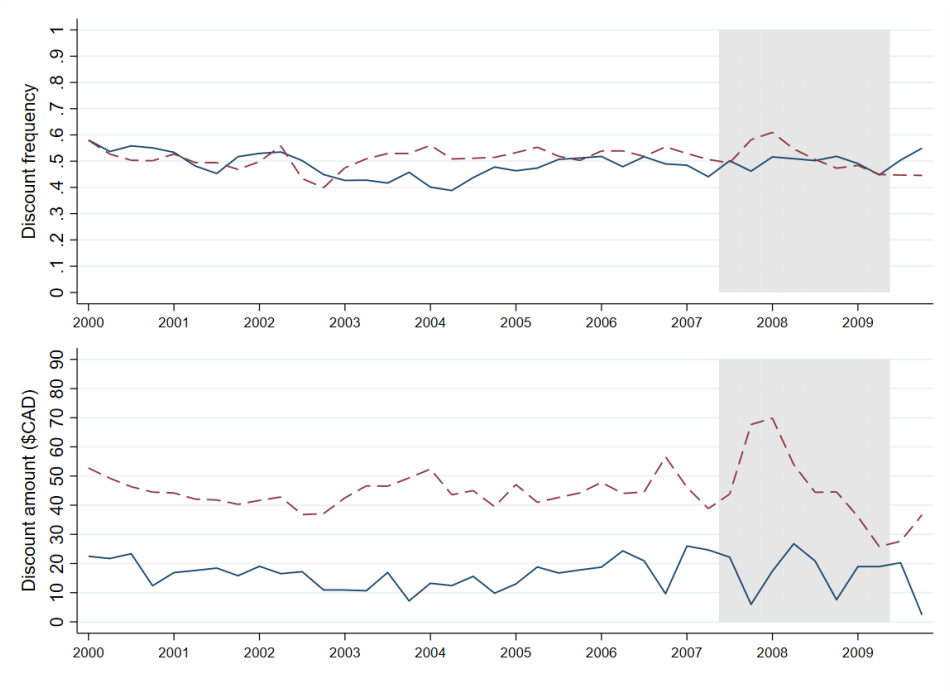
The top panel shows that the stores' propensity to exercise discretion is very similar for both base goods and warranties. While base goods are discounted 49% of the time, warranty prices are discounted 51% of the time, on average, over the sample period.

The bottom panel shows an average discount of $17 on base goods relative to their list prices. The average discount on warranties relative to suggested prices is $45, on average over the sample period. While the stores use equally frequently their discretion to discount the base-good and warranty prices, the extent of these discounts is substantially larger for warranties. This is not surprising given the large profit margins on warranties relative to the base goods (see Table 1).

Warranty discount frequency increases by approximately 10 percentage points around the onset of the Great Recession. Warranty discount amounts exhibit similar dynamics, increasing by approximately $25 initially. We do not observe similar dynamics for base good discounts.

[15] Base-good prices may be more centralized for a variety of reasons, including resale price maintenance, whereby manufacturers impose price constraints on base goods.

Figure 7: Dynamics of base-good and warranty discounts



Notes: Discounts = headquarter suggested price - transaction price. For warranty prices, we observe the suggested price. For base prices, we use the list price of a model (modal price) in an EI region in a given quarter. Left panel plots the discount frequency. Right panel plots the amount of the discount. Discount frequencies and amounts are residualized using a linear trend. Specifically, we estimate and obtain residuals from $y_\tau = \beta_0 + \beta_1 t_\tau + \varepsilon_\tau$, where y_τ is the discount for transaction τ, and t_τ is a linear trend. We then recenter the residual using the sample mean for y_τ. Each point in each series is then the average of the recentered residual across all transactions in a quarter. Base prices are solid blue. Warranty prices are dashed red. Grey area references the Great Recession.

Between store variation in discretion. To further understand store discretion in price setting, we examine the between store variation in prices using an across store price similarity measure from [DellaVigna and Gentzkow, 2019]. We compute these measures for a sample of base goods for which an extended warranty has been purchased at least once in a quarter. For each pair of stores s and s', we calculate absolute difference in the average quarterly price and average this difference across quarters and products:

$$a_{s,s'} = \frac{1}{N_{q,m}} \sum_{q,m} |\overline{p}_{smq} - \overline{p}_{s'mq}| \tag{12}$$

where $\overline{p}_{smq}$ denotes the average price for model m in store s and quarter q, and $N_{q,m}$ is the number of quarters and models. Densities for the $a_{s,s'}$-distribution over all store pairs in the sample can be found in Figure 8. The solid blue line plots the pre-recession distributions for the pairwise differences in prices.

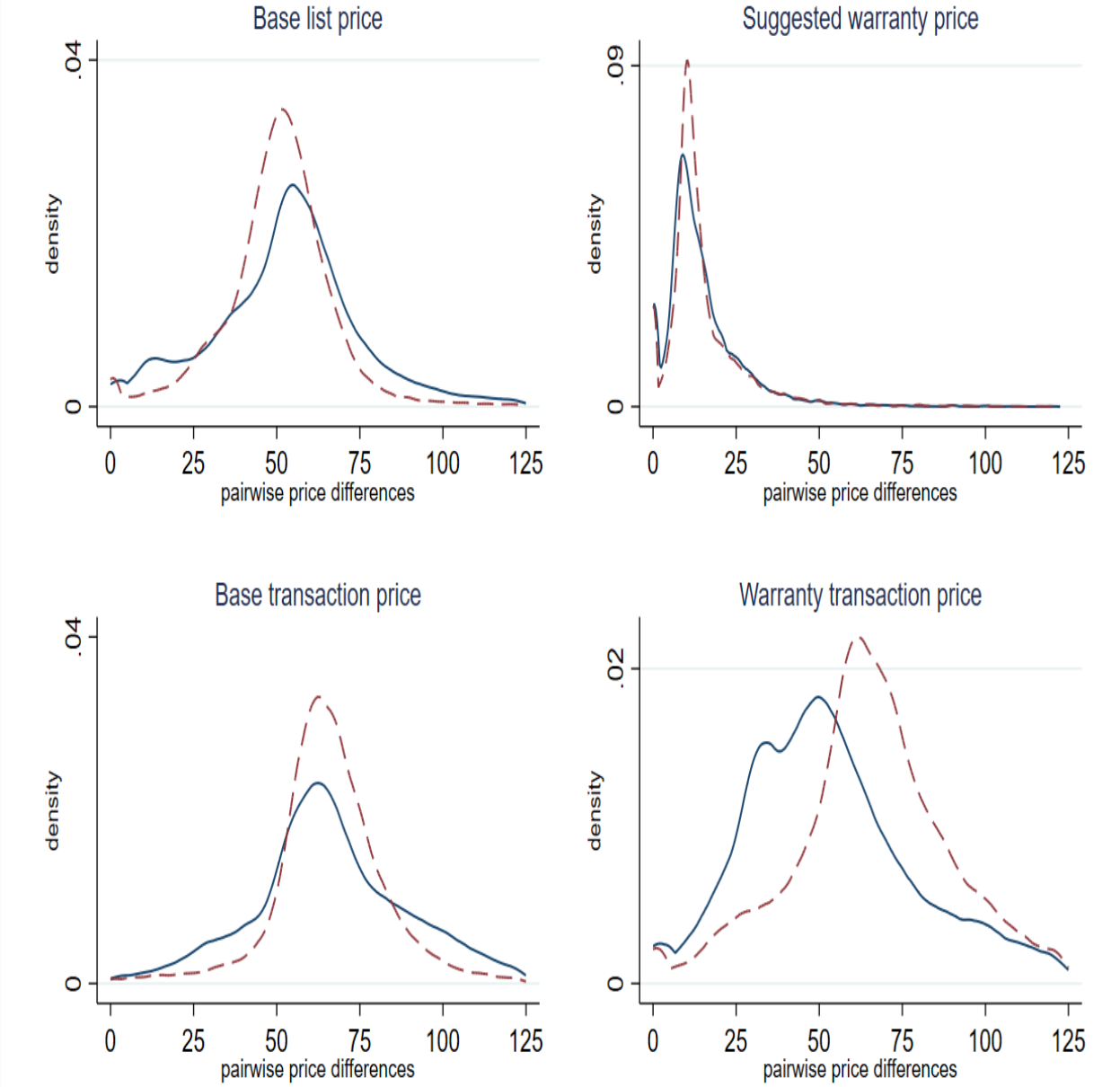
The pre-recession means of the $a_{s,s'}$-distribution for base-good list and transaction prices are \$53 and \$66. They represent 8% and 10% of the mean base-good price. The pre-recession $a_{s,s'}$-mean for warranty prices is \$53, representing more than 50% of the mean warranty price. For suggested prices, the pre-recession mean is \$15, more than 11% of the mean suggested price. The contrast with base good list and transaction prices suggests that base prices are less decentralized than warranty prices.

The dashed red densities in Figure 8 show how pairwise price differences were distributed during the Great Recession. For base-good list prices, we see more uniformity after the onset of the Great Recession. The $a_{s,s'}$ mean for list prices decreases by \$2.25 ($p < 0.01$). For base-good transaction prices, we do not observe a statistical difference in means. For suggested extended warranty prices the difference in mean amounts to 0.42 ($p < 0.01$) and 11.92 ($p < 0.01$) for warranty transaction prices.

8.2. Price flexibility or quality substitution? One could argue that warranties are a vehicle for consumers to substitute across base goods of differing quality over the business cycle. Under this argument, lower warranty prices reflect substitution from the higher quality base good with a warranty to the lower quality base good without a warranty [Bils and Klenow, 2001]. This argument is in sharp contrast with the intuition derived from the add-on pricing model of [Ellison, 2005] and supported by our data analysis.

If warranties are an outlet for quality substitution, and warranties increase base good quality, then we would expect warranty demand to decrease during a recession. As noted

Figure 8: Price similarity across stores before and after onset of Great Recession



Notes: Pairwise price differences calculated as follows. For each store, we average prices for each model and calendar quarter. We then compute differences in average prices relative to every other store. Finally, we average the differences across models and quarters for each store pair. Solid blue density uses pre-recession prices. Dashed red density uses Great Recession prices. The differences in means between the pre-recession and Great Recession are \$-2.25 ($p = 0.000$) for base good list prices, \$0.03 ($p = 0.84$) for base good transaction prices, \$0.42 ($p = 0.000$) for suggested extended warranty prices, and \$11.92 ($p = 0.000$) for warranty transaction prices.

earlier, a recession is associated with increases in the marginal utility of income and higher price sensitivity among consumers. By the utility function in Section 4.1, higher price sensitivity induces consumers to value incremental quality increases less. This puts downward pressure on the demand for extended warranties.

We examine this proposition in Column (1) of Table 8, which reports an estimate of the effect of the unemployment rate on the share of base goods sold with an extended warranty. Column (1) shows a percentage point increase in the unemployment rate increases the warranty share by 1 percentage point, or 2.3% of the mean share of 0.42. The estimate is significant at the 1% level. In the right panel of Figure 4, we show that the warranty share increases for each of the product categories in our data. The finding that the share of upgraded base goods increases in the recession is not surprising given that the large portion of warranties is sold at very low prices.

Our argument can be questioned on grounds that it ignores changes in consumer risk preferences and the inherent nature of extended warranties. Risk averse consumers may be more likely to upgrade during economic contractions because of the additional insurance extended warranties provide. However, in this case, instead of large declines documented in Table 2, we would expect the warranty prices to increase. Our results thus rule out procyclicality in the *ex ante* perceived quality of extended warranties. However, it could be that the *ex post, i.e.* realized quality exhibits business cycle fluctuations. In fact, *ex post* quality only increases in the 9% of transactions where a claim was made at a later date (See Table 1).

We look for changes in *ex post* quality over the business cycle by investigating the link between the unemployment rate and the share of extended warranties where a claim was made at a later date. Column (2) of Table 8 reports estimates of the effect of the unemployment rate on the share of warranties with a claim. The estimates do not reveal any cyclical behaviour in the take-up of *ex post i.e.* realized quality.

8.3. Inventories and price dynamics. [Aguirregabiria, 1999] documents the important role that inventories play in the dynamics of retail prices and frequency of sales promotions. The concerns that our estimates are affected by the store-specific inventory conditions are largely alleviated in our context. All the stores in our sample belong to a retailer with large distribution centers that hold additional inventory and can therefore accommodate inventory fluctuations of local stores. Additionally, our baseline specifications described in Table 2 include fixed effects for each model-calendar-month combination that capture unobserved

Table 8: Warranty purchases and consumer selection

	Extended warranty share (1)	Future claims share (2)
EI region unemployment rate at $t-1$	0.010***	-0.0002
	(0.002)	(0.0013)
Year-month-model combinations	140736	76506
Observations	1939925	686057
R^2	0.276	0.268

Notes: Unit of observation is year, month, store, and model. Model identifiers are specific to the manufacturer. Regressions include fixed effects for year-month-model combination and EI region, as well as lags of dependent variable. Extended warranty share is share of transactions where a warranty was sold with the base good. Future claims share is share of transactions where the consumer eventually made a claim on the extended warranty. Standard errors clustered on EI region and in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5% levels.

fluctuations in inventories.

9 Conclusion

In this paper we investigate the cyclicality of add-on and underlying base-good prices. To do it, we draw on 10 years (1999-2009) of detailed data from a nationwide Canadian retailer of household durables and study the cyclicality of extended warranties, a customary add-on service. We show that changes in the regional unemployment rate are followed by sharp declines in warranty prices. By contrast, base durable prices are rigid over regional business cycles. Since the unemployment rate can measure supply and demand shifts, we exploit differences in oil dependency across provinces to construct a demand shock. We find similar flexibility in warranty prices and rigidity in base-good prices, in response to the income shock.

We study the mechanism underlying the relative flexibility of warranty prices. We estimate a demand system and show that the price elasticity increases from 0.17 pre-recession to 0.52 during the Great Recession. We explain that the difference aligns with a substantial

increase in the marginal utility of income among consumers. We use warranty price discounts to measure the contribution of sales agent efforts towards the price elasticity of base-good demand. We show that warranty discounts help stores mitigate the increased price sensitivity of consumers and that a disproportionate share of extreme warranty discounts takes place during the Great Recession. We also show that the observed cyclicality survives aggregation. Durable-goods price indices and their comparison with official statistics suggest add ons also amplify responses to the national business cycle.

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Add-on pricing over regional business cycles:
Evidence from extended warranties

Online Appendix

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March 9, 2024

OA.1 Model

We calculate the conditions for which the add-on price changes by more than the base good price in the face of increasing marginal utilities of income. Recall the equilibrium base good price

$$p_{iL} = c + \frac{2-w}{2\bar{\alpha}}$$

where $\overline{\alpha} = \frac{\alpha_\ell + \alpha_h}{2}$. The equilibrium add-on price is

$$ap_i = p_{iH} - p_{iL} = \frac{w}{\alpha_h}.$$

We want to the know if

$$\frac{\partial ap_i}{\partial \alpha_h} < \frac{\partial p_{Li}}{\partial \alpha_\ell} + \frac{\partial p_{Li}}{\partial \alpha_h}$$

or equivalently

$$\frac{-w}{\alpha_h^2} < \frac{-2(2-w)}{(\alpha_\ell + \alpha_h)^2}.$$

Letting $r = \alpha_h/\alpha_\ell$, where $0 < r < 1$, the last equation becomes

$$ar^2 + 2r + 1 > 0$$

where $a = \left[1 - \frac{2(2-w)}{w}\right]$. If $a = 0$ or equivalently $w = 4/3$, then this expression is positive if $\alpha_h/\alpha_\ell > -1/2$. The expression is always positive therefore because $\alpha_h/\alpha_\ell > 0$ by definition. In this case, we expect the add-on price to always decrease by more than the base good price during a recession. If $a = \left[1 - \frac{2(2-w)}{w}\right] \neq 0$ or $w \neq 4/3$, solving for the root gives

$$r = \frac{-2 \pm \sqrt{4-4a}}{2a}$$

where $4 - 4a > 0$ or $w < 2$. A root exists for $r = \frac{-2-\sqrt{4-4a}}{2a}$ and $a < 0$ (or $w < 4/3$). The root satisfies $r > 0$ trivially. The root satisfies $r < 1$ if

$$\frac{(-1)(1+\sqrt{1-a})}{a} < 1 \Longleftrightarrow (a+2)a > 0 \Longleftrightarrow w < 4/5.$$

In this case, the add-on price decreases by more than the base good price as long as $w < 4/5$ and w falls within the bounds of Proposition 3 of [Ellison, 2005].

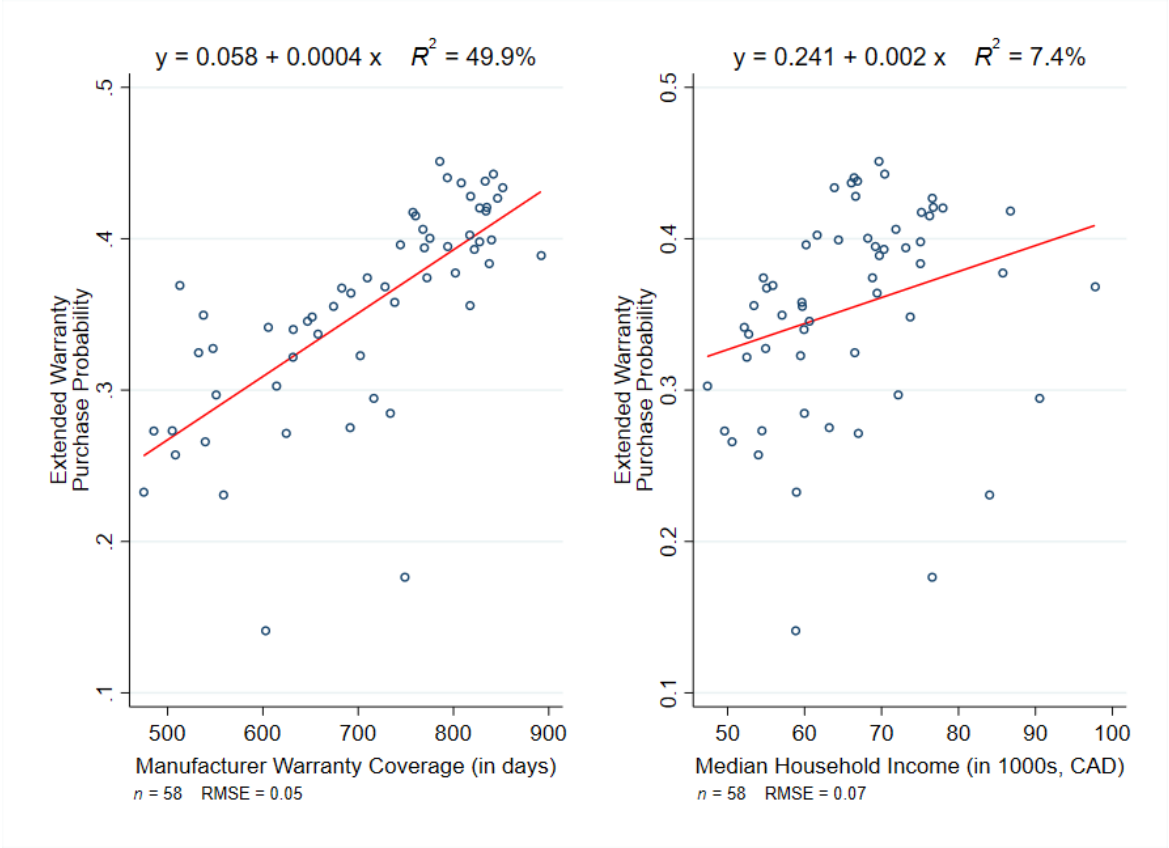
OA.2 Are extended warranties add ons?

The low claim rate in Table 1 raises questions about whether an extended warranty can be interpreted as an add on, as it only improves durable goods quality in a handful of cases. As a check on our interpretation, we investigate whether the relationship between consumer types and extended warranties in our setting mimics the links between consumer types and add ons in the canonical model of add-on pricing by [Ellison, 2005]. In particular, we verify if high type consumers are more likely to purchase the extended warranty for a given warranty price.

We consumer two proxies for consumer type. Our first proxy is the manufacturer's warranty coverage (in days). It proxies for consumer types because high types are more likely to buy higher quality goods and because higher quality goods tend to have longer warranties. Our second proxy for consumer type is median household income in the EI region in the Canadian Census of 2006. Median income proxies for type because low marginal utility of income consumers likely earn more.

We residualize both proxies and the warranty purchase probability by the warranty price. Figure OA.2.1 then shows that for both consumer type proxies, the likelihood of extended warranty purchase increases in type, at a given warranty price.

Figure OA.2.1: Are extended warranties add ons?



Notes:

1 Unit of analysis is Employment Insurance (EI) region.
2 Extended warranty purchase probability is frequency of transactions where an extended warranty was purchased within a region.
3 Manufacturer warranty coverage stands for the number of days that the manufacturer will cover costs for parts. The weights in the average are the frequencies of product transactions in a region.
4 Income statistic is median of the median incomes across all postal codes in a region. Median income is constructed this way because the 2006 Canadian Census only provides summary income statistics at postal code level. CAD = Canadian Dollars.
5 All variables are residualized by the average extended warranty price in the region. Specifically, we estimate and obtain residuals from $y_i = \beta_0 + \beta_1 wp_i + \varepsilon_i$, where y_i is the frequency of extended warranty purchases in EI region i, and wp_i is the warranty price. We then recenter the residual using the sample mean for y_i.

OA.3 Identificaton checks for oil price regressions

Our interpretation of the effect of world oil prices on base and warranty prices is based on two primary assumptions. The first assumption is that the consumer gas prices follow similar trends across provinces. Figure OA.3.1 plots time series of consumer gas prices in Alberta and the rest of Canada. Consumer gas prices are always lower in Alberta, 9 cents less per litre on average relative to the rest of Canada, but the trends are similar with the correlation between the two series of 0.994. Online Appendix Figure OA.6.5 checks this further, showing substantial overlap between the two time series after they are detrended by a second order polynomial in the calendar month.

Figure OA.3.1: Provincial trends in consumer gas prices

Notes:

1 Monthly average retail consumer prices for unleaded gasoline, by province. Dashed blue line denotes Alberta. Solid red line denotes all other Canadian provinces.
2 Overall mean in Alberta is $0.81 per litre with a standard deviation of 0.18. Overall mean in other provinces is $0.90 per litre with a standard deviation of 0.17.
3 Data from Statistics Canada table 18-10-0001-01.

The second assumption relates to whether a positive β predominantly reflects a demand shock. To assess this assumption, we compare the impact of oil prices on wages and employment in Alberta versus the rest of Canada. We estimate:

$$w_{tri} = \beta AB_r \times p_t^{oil} + \phi w_{0ri} \times f(t) + \gamma_t + \alpha_r + \delta_i + \varepsilon_{tri} \tag{13}$$

Table OA.3.1: Do oil prices generate a demand shock in Alberta?

	Full sample (1)	Wholesale and retail trade (2)	Natural resources (3)
	Dependent variable = Annual wages (2020 CAD $)		
Alberta × World oil price	1956***	1925***	2744**
	(255)	(237)	(1123)
Mean annual wage (Alberta)	40554	29789	62794
Mean annual wage (ROC)	34858	24428	48292
Observations	1920	120	120
R^2	0.940	0.981	0.947
	Dependent variable = Employment (persons)		
Alberta × World oil price	6006***	15587***	20630***
	(1836)	(1992)	(5308)
Mean employment (Alberta)	116473	286390	126620
Mean employment (ROC)	99482	252533	20108
Observations	1590	100	100
R^2	0.973	0.999	0.993
Controls			
Province fixed effects	Y	Y	Y
Year fixed effects	Y	Y	Y
Province and industry Specific trend	Y	Y	Y
NAIC fixed effects	Y	N	N

Notes:

[1] Unit of observation is defined by year-month, province, and sector.

[2] Alberta is a binary variable. ROC is an acronym for Rest of Canada.

[3] World Oil Price is price of crude oil in US $ standardized by its mean and standard deviation for full sample.

[4] Retail sample refers to North American Industry Classifications (NAIC) "Wholesale and retail trade [41, 44-45]." Oil & Gas refers to "Forestry, fishing, mining, quarrying, oil and gas [21, 113-114, 1153, 2100]." The numbers are the relevant NAIC codes. The groupings of NAIC codes are determined by Statistics Canada. The annual wage data comes from Statistics Canada table 14-10-0063. The employment data comes from table 14-10-0092.

[5] Robust standard errors in parentheses. *** and ** denote statistical significance at the 1 and 5% levels.

where w_{tri} is either the annual wage in current (as of 2020) Canadian dollars or number of workers employed in industry i of province r at year t. w_{0ri} is the value of the dependent variable in the base year of the sample and $f(t)$ includes linear and quadratic polynomials in t. The $w_{0ri} \times f(t)$ interaction lets us control for a differential trend in p_t^{oil} across provinces. γ_t, α_r, δ_i are fixed effects for the year, province, and industry, respectively and ε_{tri} is an idiosyncratic error term. Estimates based on the sample period for our main data set are found in Table OA.3.1.[1]

Column (1) of Table OA.3.1 shows that a one standard deviation increase in the oil price increases the relative annual wage in Alberta by 1956 dollars and the relative number of employed workers by 6006. The estimates amount to 5.5 and 5.9% increases over their respective means and they support our assumption that the world price of oil shifts consumers' income in Alberta and therefore proxy for a demand shock.

Columns (2) and (3) of Table OA.3.1 investigate the effects of oil prices on wages and employment in two sectors: (i) natural resources (oil and gas) and (ii) the wholesale and retail sector. The estimate in Column (3) shows that oil prices had large and economically substantive effects on wages and employment in natural resources. The estimate in Column (2) shows smaller but still substantial effects on wages and employment in the wholesale and retail sector. It suggests that oil prices have strong spillover effects on retail. These spillover effects can manifest themselves as increased demand from retail workers or as a shift in their supply due for example to better opportunities in other sectors. A comparison of the two columns indicates that a one standard deviation increase in oil prices increases relative wages in the natural resources sector by \$819 more than in wholesale and retail. This result suggests that any shift in retail worker supply will be dominated by the shift in consumer demand in natural resources.

[1]Note that we use robust standard errors because of the small number of provinces and industries and because finite sample adjusted clustered standard errors gave cause for concern. For instance, we were unable to estimate wild two-way clustered bootstrap standard errors for wages because the variance-covariance matrix was not positive definite.

OA.4 Cylicality of add ons in another sector

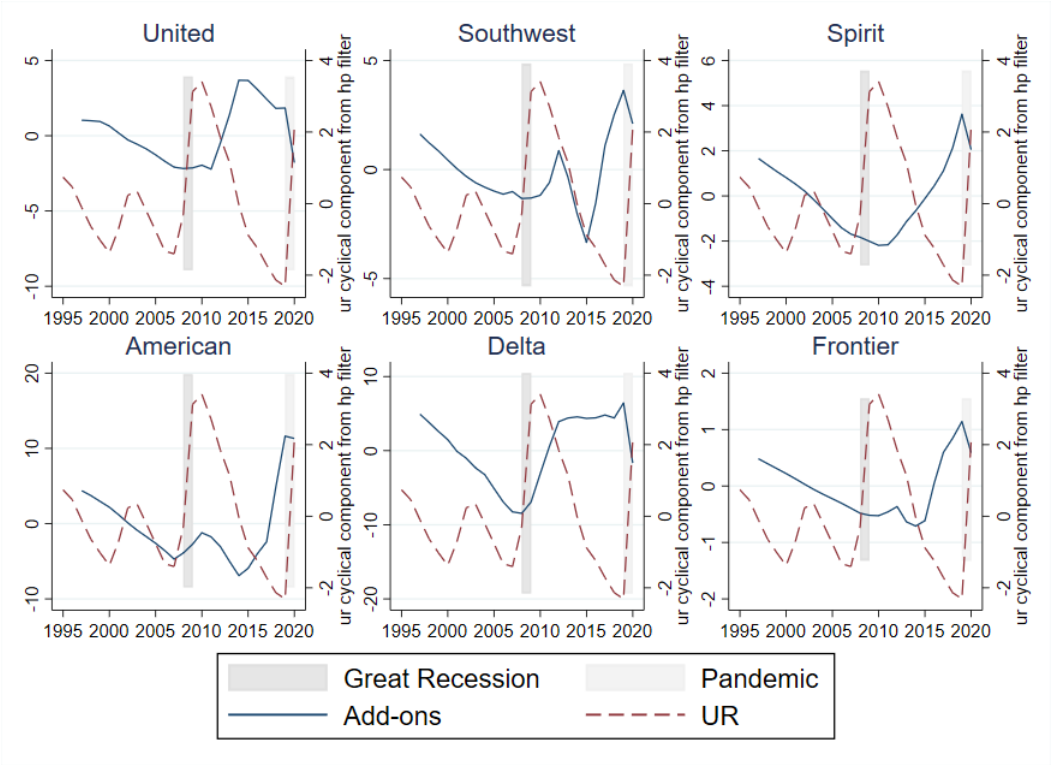
We explore the cyclicality of add ons in another sector, using the next best data we could find. Specifically, we publicly available data obtained from the MIT Airline Data Project to examine the cyclicality of ancillary revenue from several major U.S. airline carriers. Ancillary revenue covers revenue from baggage fees (another classic add on), cancellation fees, and miscellaneous operating revenues (which should include revenue from other add ons such as extra leg room). We cannot examine the cyclicality of prices because there is no information about prices in the dataset. We show that ancillary revenues are highly procyclical, consistent with our data, but subject to the caveat that the cyclicality might reflect the imperfect measurement of add-on revenue as well as the fact ancillary quantities might be changing more than ancillary prices.

The data are annual. They cover 16 carriers between 1995 and 2021.[2] That leaves us with the following 10 airlines: Alaska, American, Delta, Frontier, Hawaiian, Southwest, Spirit, US Airways, United, and JetBlue. Figure OA.4.1 plots the cyclical components of add-on revenues of 6 U.S. airlines (black solid lines) and the U.S. unemployment rate (grey dashed lines), obtained by removing the Hodrick-Prescott trend from the series. The shaded areas cover the Great Recession and beginning of the Pandemic. Figure OA.4.1 shows add-on revenues are highly procyclical for all the airlines in our sample.

We formally test this intuition by estimating the cyclicality coefficient. We pool data from the 10 airlines and regress the cyclical component of add-on revenues on the cyclical component of the U.S. unemployment rate. The coefficient equals -0.41 and is highly significant, indicating that the add-on revenues tend to decline when there is slack in the labour market.

[2]We keep carriers with at least 20 observations. During this period, several airlines went bankrupt or were merged so that for them the number of observations is low.

Figure OA.4.1: Cyclical component of ancillary revenues of US airlines.



Notes:

1 Black solid lines plot the cyclical component of ancillary revenues. Ancillary revenues include revenues from baggage fees (another classic add on), cancellation fees, and miscellaneous operating revenues (which should include revenue from other adds such as extra leg room). Left y-scale is for ancillary revenues.

2 Grey dashed lines plot the cyclical component of US unemployment rate. Right y-scale is for unemployment rate.

3 Cyclical components have been separated using the HP filter.

4 Data is retrieved from MIT Airline Data Project: `http://web.mit.edu/airlinedata/www/default.html`.

OA.5 Demand System

We estimate average effects across our full sample in Table OA.6.10. Our main estimates are found in the bottom panel (SPECIFICATION C) of Table OA.6.10 in Column (1). Table OA.6.10 also includes several benchmark demand system estimates. The top panel (SPECIFICATION A) reports estimates of a constant price elasticity specification. The middle panel (SPECIFICATION B) reports estimates of a specification restricts the elasticity effect of warranty discounts equal to 0. Columns (2) and (3) of Table OA.6.10 report demand system estimates for base goods sold with and without extended warranties.

Note that the estimates are based on a restricted sample where at least one warranty is sold in the year-month-store-model cell. In Table OA.6.11, we report price elasticity estimates for a demand system that excludes warranty discounts from the specification and that in turn uses the full sample for estimation. The estimates are similar to the estimates in (SPECIFICATION A) of Table OA.6.10.[3]

The transaction price elasticity of demand absent a warranty price discount is -0.221. A 13.5% increase in the transaction price, roughly equivalent to the mean warranty price, decreases base good quantities by $100 \times 0.135 \times 0.221$=2.98%. A 100% warranty price discount at the mean base price increases base quantities by 1.9%. The baseline elasticity and discount coefficients are statistically insignificant at the 5% level. A warranty price discount of 100% decreases the elasticity magnitude by 0.058, from 0.221 to 0.163, suggesting warranty discounting reduces price sensitivity among base good consumers. The interaction coefficient is statistically significant at the 1% level.

Column (2) shows that a 100% warranty price discount decreases price sensitivity by 0.063 for consumers who purchase the warranty. Column (3) shows similar albeit less pronounced effects among consumers who do not purchase the warranty, with a 100% discount decreasing price sensitivity by 0.029 points. The estimates are consistent with specific efforts to add on the warranty (Column 2) and general effort to decrease the price sensitivity of consumers and sell more of the base good (Column 3).

[3]Another way to circumvent this, and increase sample coverage, would be to assume 0 discount for warranty prices that are not observed. We would rather not do this because it can lead to nonclassical measurement error. The consumer may not take the warranty even though they were offered a discount. Assuming that there was no discount would lead us to assign the wrong discount value to the transaction. The error frequency may depend on demand and supply conditions.

OA.6 Additional Figures and Tables

Table OA.6.1: Summary statistics for model-year-month combinations where at least one extended warranty was sold

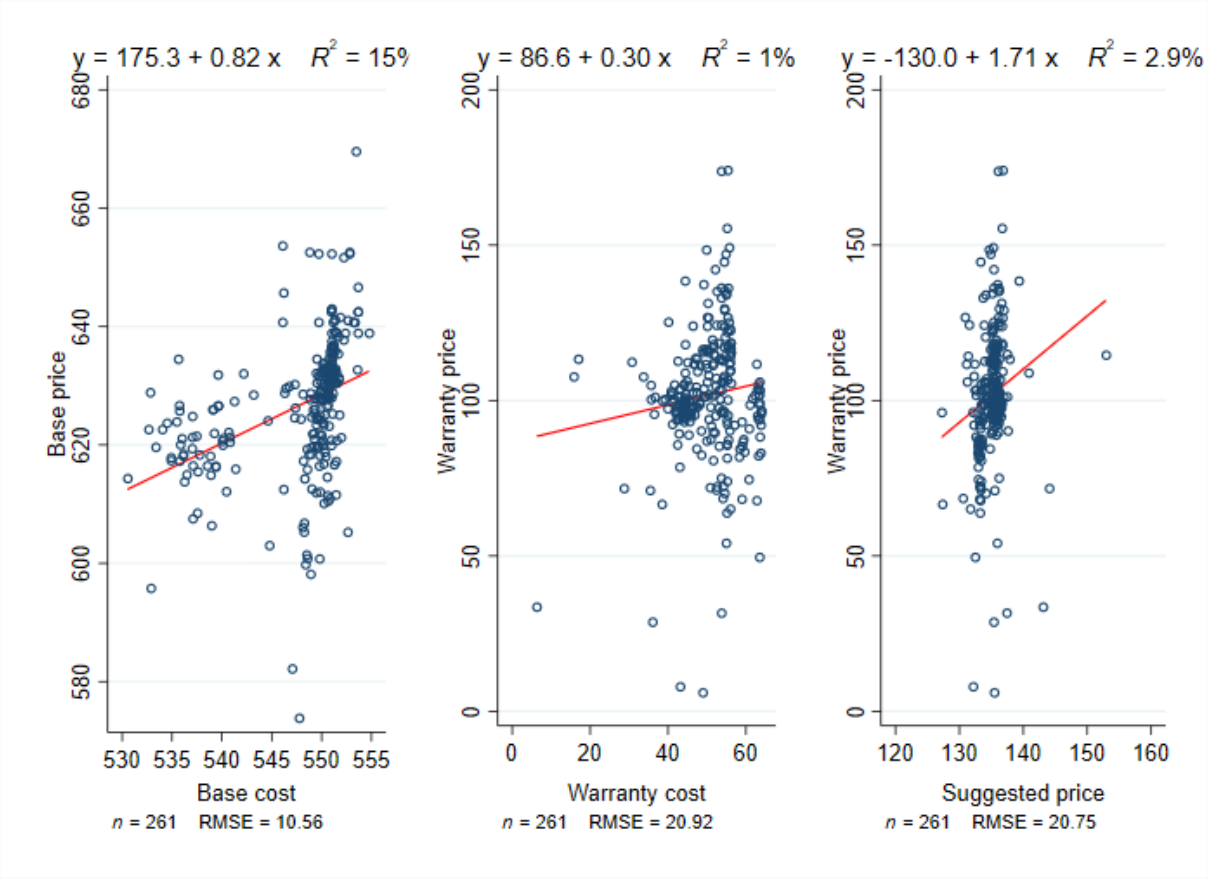
	Base good	
	Price	Average cost
	636.09	555.10
	(614.71)	(528.41)
Observations	6313137	4755584

	Extended warranty			
	Price	Average cost	Suggested price	Take up
	89.41	57.11	134.07	0.41
	(93.62)	(242.36)	(109.13)	(0.49)
Observations	2576246	2576579	2576674	6313137

	Claims on extended warranties	
	Average cost	Claim made
	482.82	0.09
	(526.78)	(0.29)
Observations	239215	2576674

[1] Unit of observation is the transaction.
[2] All prices and costs are in Canadian (CAD) dollars.
[3] Extended warranty cost set to zero in cases where no claim was made. Average cost of extended warranty includes commissions on extended warranty sales, royalties and other fees that are paid to the chain, and the costs from servicing claims on the extended warranty. Average cost for claims is calculated over realized claims.
[4] Claims made is the number of claims made relative to the total number of purchased extended warranties in our sample.
[5] Standard deviations are in parentheses.

Figure OA.6.1: Prices and costs by store



Notes:

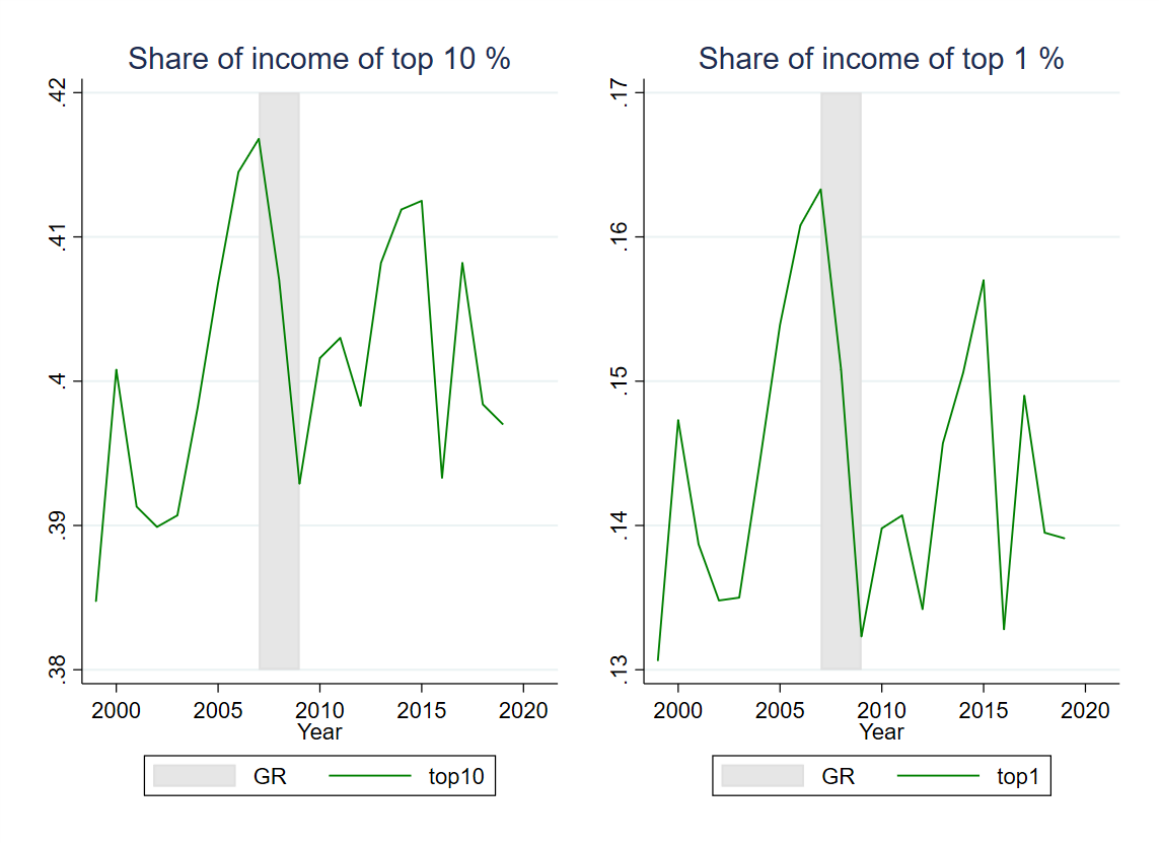
1 Unit of analysis is store.

2 All variables are residualized by model fixed effects and store owner. The distributions are shifted to the right by the overall sample mean of the underlying price or cost variable. Residualization by store owner eliminates cost differences for franchises relative to corporate stores. Outliers are removed from the figures.

3 Base costs are the sum of the transfer/manufacturer price, sales agent commissions for base good sales (4% of base revenue), royalties to the chain if the store is a franchise (4% of base revenue), inventory and marketing and advertisement costs (2.5% of base revenue).

4 Warranty costs include sales commissions (15% of warranty revenue), royalties to the chain (4% of warranty revenue) in the case of franchises, marketing and advertisement costs (2.5% of warranty revenue), and servicing costs discounted to the date of the transaction.

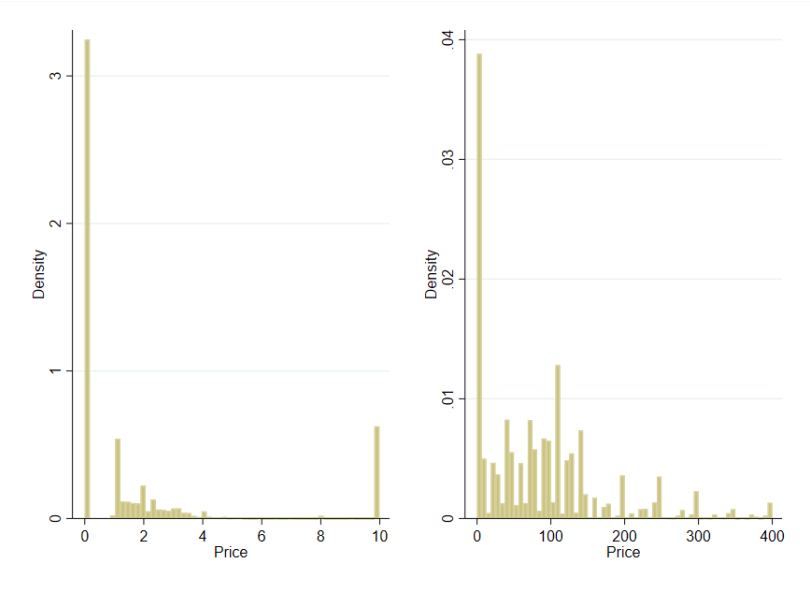
Figure OA.6.2: Income Inequality in Canada



Notes:

1 GR stands for Great Recession.
2 Inequality is measured by the share of income earned by the 10 % (left panel) and 1 % (right panel) richest households in the Canadian economy.
3 Data downloaded from: `https://wid.world/`.

Figure OA.6.3: Distribution of extended warranty prices



Notes:

1 Unit of analysis is transaction.
2 Left panel plots histogram for prices between 0 and 10 dollars. Right panel plots histogram for prices between 0 and 400 dollars, which is essentially the full support, less outliers.
3 Histograms show that a disproportionate share of extended warranties are sold with a price close to zero.

Table OA.6.2: Pricing and local economic activity: transaction-level data

	Warranty Price			Base Good Price			Warranty Price Discount		
	(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		-2.490***			-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	-6.364***	-6.200***	-6.406***	-1.777	-1.635	-1.644**	5.088***	4.851**	4.951***
increase in Lagged UR Rate	(2.033)	(2.040)	(1.851)	(0.926)	(0.903)	(0.790)	(1.831)	(1.855)	(1.694)
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	0.497	0.486	0.482	0.982	0.982	0.981	0.453	0.449	0.447

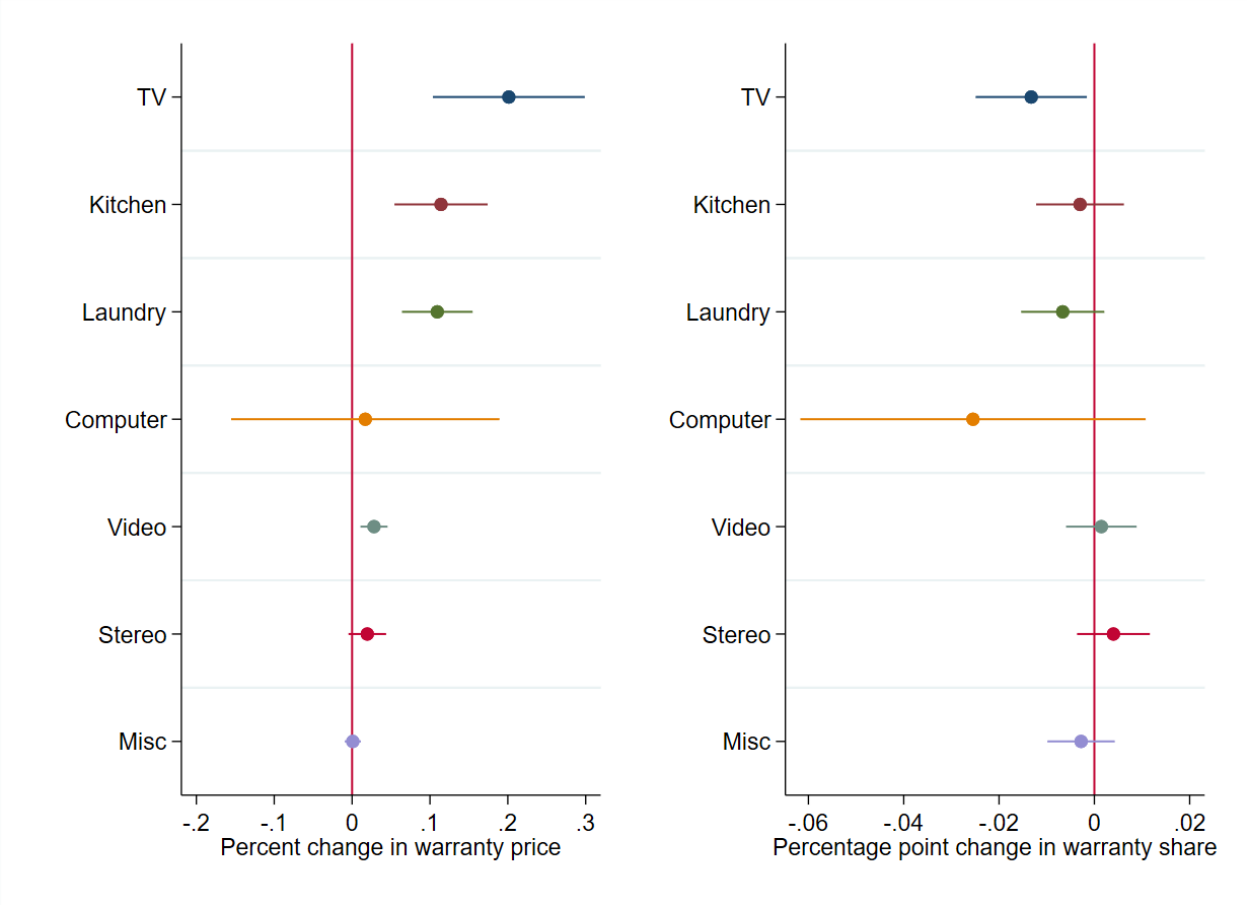
Notes:
[1] Unit of observation is transaction.
[2] Regressions include fixed effects for year-month-model combination and EI region, as well as lags of dependent variable.
[3] Warranty price discount equals the maximum of 0 and the suggested price less the warranty price.
[4] Standard errors clustered on EI region and in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5% levels.

Table OA.6.3: (log) Pricing and local economic activity

	Warranty price			Base price			Warranty discount		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EI region unemployment rate at									
t - 1	-0.046***			-0.000			0.051***		
	(0.014)			(0.001)			(0.017)		
t - 6		-0.045***			-0.001			0.046***	
		(0.015)			(0.001)			(0.019)	
t - 12			-0.045***			-0.001			0.044***
			(0.014)			(0.001)			(0.016)
Year-month-model combinations	64814	61834	58586	142969	137605	131890	78103	74897	71392
Observations	495975	473112	451322	1916799	1854809	1792592	654883	629422	604900
R^2	0.289	0.285	0.282	0.983	0.964	0.963	0.442	0.436	0.432

Notes:
[1] Unit of observation is month-year, store, and model. Model identifiers are specific to the manufacturer.
[2] Dependent variables are in natural logarithms.
[3] Regressions include fixed effects for year-month-model combination and EI region, as well as lags of dependent variable.
[4] Warranty price discount equals natural logarithm of the maximum of 0 and the suggested price less the warranty price, plus 1.
[5] Standard errors clustered on EI region and in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5% levels.

Figure OA.6.4: Pricing and a "pure" demand shock



Notes:

1 Regression estimates of differential effect of oil prices on warranty prices (left) and shares (right) in Alberta. Dots denote coefficient estimates. Lines denote 95% confidence interval.

2 Unit of analysis for regressions is year, month, store, and model. Regressions include one lag of dependent variable and fixed effects for year-month-model combination and EI region. Prices in natural logarithms.

3 Confidence intervals constructed using standard errors that are clustered on EI region.

4 Warranty shares are share of transactions in a year, month, store, model cell that included an extended warranty.

Table OA.6.4: (log) Pricing and a "pure" demand shock

	Warranty price			Base price			Warranty discount		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Alberta × World oil price	0.122***	0.135***	0.126***	-0.004	-0.003	0.004	-0.163***	-0.192***	-0.195***
	(0.038)	(0.037)	(0.031)	(0.010)	(0.009)	(0.003)	(0.051)	(0.037)	(0.039)
World oil price (in US $)	-0.005***			0.001***			0.020***		
	(0.001)			(0.000)			(0.002)		
Alberta (0/1)	0.099			-0.015			-0.194		
	(0.068)			(0.026)			(0.123)		
Constant	4.344***	4.082***	4.085***	6.091***	6.136***	6.125***	0.883***	1.919***	1.920***
	(0.032)	(0.001)	(0.000)	(0.026)	(0.000)	(0.000)	(0.056)	(0.001)	(0.000)
Controls									
EI Region Fixed Effects	N	Y	Y	N	Y	Y	N	Y	Y
Year-Month Fixed Effects	N	Y	N	N	Y	N	N	Y	N
Year-Month-Model Fixed Effects	N	N	Y	N	N	Y	N	N	Y
Observations	1249030	1249030	1158491	2725637	2725636	2601503	1459621	1459620	1360613
R^2	0.010	0.028	0.288	0.001	0.008	0.961	0.056	0.106	0.415

Notes:
[1] Unit of observation is year, month, store, and model. Model identifiers are specific to the manufacturer.
[2] Dependent variables are in natural logarithms.
[3] Warranty price discount equals natural logarithm of the maximum of 0 and the suggested price less the warranty price, plus 1.
[4] Standard errors clustered on EI region and in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5% levels.

Table OA.6.5: Pricing and a "pure" demand shock with an alternative definition for oil producing provinces

	Warranty price			Base price			Warranty discount		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Oil province × World oil price	6.471***	7.242***	7.021***	7.390	4.180	3.657**	-3.406	-4.896***	-5.103***
	(2.093)	(2.036)	(1.840)	(5.659)	(4.439)	(1.625)	(1.974)	(1.590)	(1.690)
World oil price (in US $)	0.087			0.473***			0.720***		
	(0.050)			(0.118)			(0.062)		
Oil province (0/1)	4.756			-21.780			-4.728		
	(4.085)			(20.258)			(3.238)		
Constant	79.619***	85.471***	86.111***	665.572***	686.818***	675.857***	4.786**	42.384***	42.566***
	(1.653)	(0.036)	(0.031)	(19.866)	(0.003)	(0.004)	(1.827)	(0.031)	(0.030)
Controls									
EI Region Fixed Effects	N	Y	Y	N	Y	Y	N	Y	Y
Year-Month Fixed Effects	N	Y	N	N	Y	N	N	Y	N
Year-Month-Model Fixed Effects	N	N	Y	N	N	Y	N	N	Y
Observations	1452995	1452995	1356083	2730753	2730752	2605985	1459621	1459620	1360613
R^2	0.003	0.037	0.547	0.001	0.008	0.982	0.051	0.082	0.486

Notes:
[1] Unit of observation is year, month, store, and model. Model identifiers are specific to the manufacturer.
[2] Oil provinces are Alberta and Saskatchewan.
[3] Warranty price discount equals maximum of 0 and the suggested price less the warranty price.
[4] Standard errors clustered on EI region and in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5% levels.

Table OA.6.6: Pricing and local economic activity using consumer gas prices

	Warranty price	Base price	Warranty discount
	(1)	(2)	(3)
Provincial monthly average retail	0.555**	-0.030	-0.438
prices for gasoline and fuel oil	(0.271)	(0.213)	(0.236)
Constant	36.004	679.823***	82.075***
	(24.329)	(19.472)	(21.203)
Year-month-model combinations	137717	199457	139193
Observations	1348599	2562199	1353129
R^2	0.545	0.982	0.487

Notes:

[1] Unit of observation is year, month, store, and model. Model identifiers are specific to the manufacturer.

[2] Regressions replace Alberta×(World oil price) with monthly average retail gas and fuel prices at the provincial level. Regressions include fixed effects for year-month-model combination and EI region, as well as lags of dependent variable.

[3] Warranty price discount equals maximum of 0 and the suggested price less the warranty price.

[4] Standard errors clustered on EI region and in parentheses. *** and ** denote statistical significance at the 1 and 5% levels.

Table OA.6.7: Warranty purchases and consumer selection under a "pure" demand shock

	Extended warranty share (1)	Future claims share (2)
Alberta × World oil price	-0.0065	0.0002
	(0.0043)	(0.0029)
Year-month-model combinations	200265	139439
Observations	2605985	1360613
R^2	0.273	0.210

Notes:

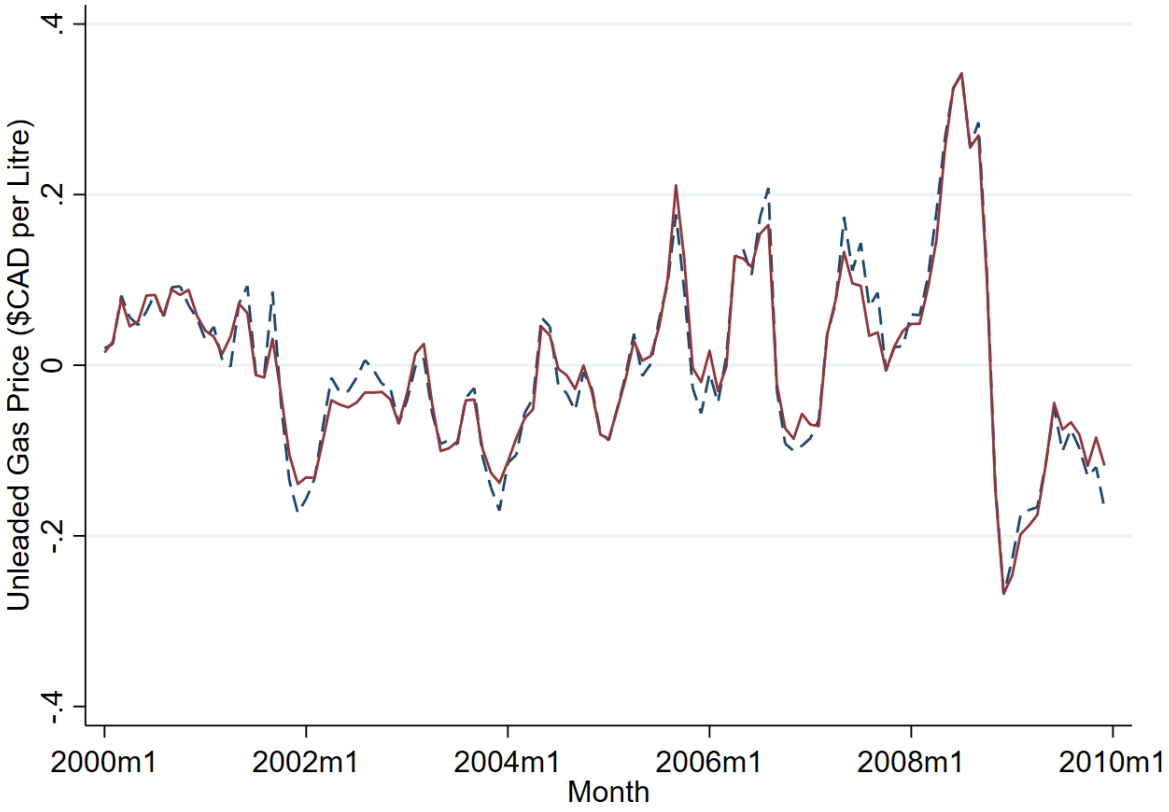
[1] Unit of observation is year, month, store, and model. Model identifiers are specific to the manufacturer.

[2] Regressions include fixed effects for the year-month-model combination and for the EI region, as well as lags of dependent variable.

[3] Warranty price discount equals maximum of 0 and the suggested price less the warranty price.

[4] Standard errors clustered on EI region and in parentheses. $***$, $**$, and $*$ denote statistical significance at the 1, 5, and 10% levels.

Figure OA.6.5: Detrended time series for consumer gas prices



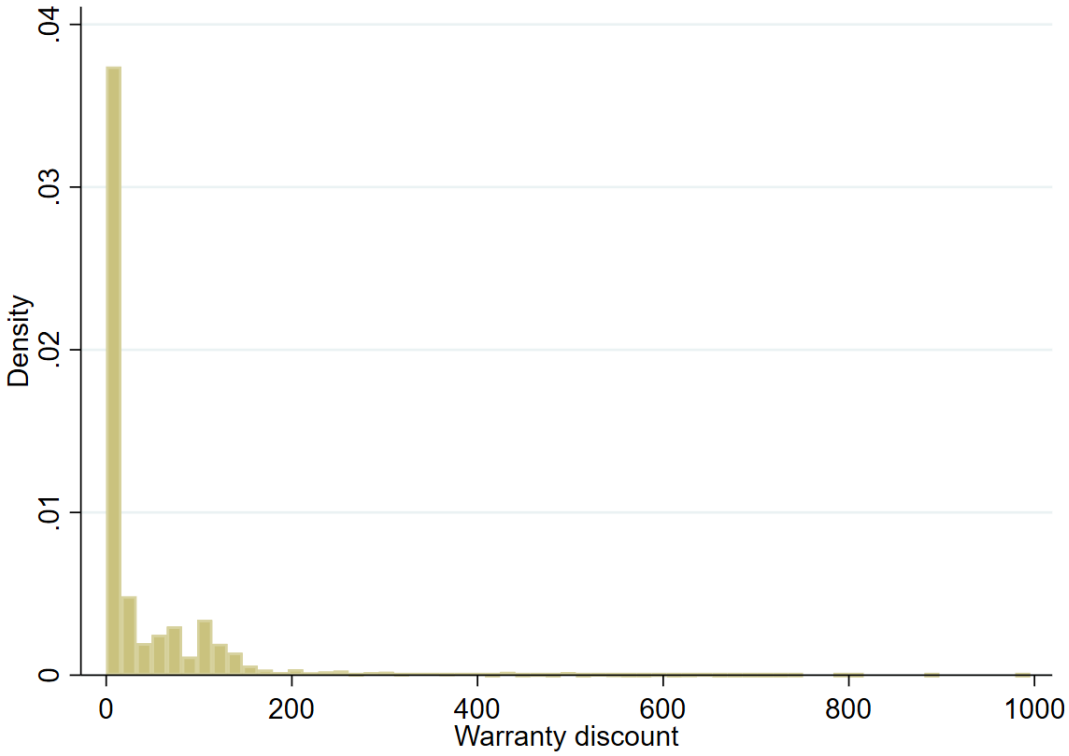
Notes:

1 Unit of analysis is year, month, and province.

2 Dashed blue line denotes average monthly unleaded gas price in Alberta. Solid red line denotes mean of the average monthly unleaded gas price across Canadian provinces. Both series are detrended by a quadratic polynomial trend.

3 Data comes from Statistics Canada table 18-10-0001-01, which reports the monthly average retail consumer prices for gasoline by province.

Figure OA.6.6: Distribution of extended warranty price discounts



Notes:

1 Unit of analysis is year, month, store, model.

2 Histogram illustrates the asymmetry in the distribution of extended warranty price discounts.

Table OA.6.8: Warranty discounts and consumer demand OLS estimates

	Base good quantities		
	All	Sold with extended warranty	Sold without extended warranty
	(1)	(2)	(3)
		SPECIFICATION A.	
Transaction price	0.015	0.015	-0.004
	(0.015)	(0.013)	(0.017)
		SPECIFICATION B.	
Transaction price	0.087***	0.093***	0.019
	(0.017)	(0.014)	(0.017)
Warranty price discount	0.013***	0.014***	0.004*
	(0.002)	(0.002)	(0.002)
		SPECIFICATION C.	
Transaction price	0.057**	0.067***	-0.000
	(0.018)	(0.017)	(0.017)
Warranty price discount	0.011***	0.012***	0.003
	(0.002)	(0.002)	(0.002)
Transaction price × discount	0.007***	0.006***	0.005**
	(0.001)	(0.001)	(0.002)
Year-month-model combinations	59362	59362	59362
Observations	520700	520700	520700

Notes:
[1] Unit of observation is year-month, store, and model.
[2] Sample restricted to year-month-store-model combinations where at least one extended warranty was sold.
[3] Reported dependent and independent variables are in natural logarithms.
[4] Regressions include fixed effects for the year-month-model combination and EI region.
[5] Standard errors are clustered at the level of the EI region and are in parentheses.
[6] $***$ and $**$ denote statistical significance at the 1 and 5% levels.

Table OA.6.9: Warranty discounts and consumer demand first stage estimates

	Transaction price	Transaction price	Warranty price discount	Transaction price	Warranty price discount	Transaction price × discount
	(1)	(2)	(3)	(4)	(5)	(6)
Suggested warranty price	0.483***	0.477***	0.272	0.462***	0.335	-0.553***
+ Base good cost	(0.055)	(0.054)	(0.453)	(0.054)	(0.461)	(0.148)
Warranty price discount $(t-1)$		-0.005***	0.146***	-0.012***	0.180***	-0.019***
		(0.000)	(0.014)	(0.001)	(0.012)	(0.003)
Transaction price IV ×				0.032***	-0.138***	0.228***
$t-1$ discount				(0.002)	(0.015)	(0.021)
F-test of excluded instruments	77.94	117.36	232.36	203.31	209.06	87.83
Sanderson-Windmeijer multivariate F-test	77.94	106.28	659.15	64.74	581.82	88.28
Year-month-model combinations	59362	59362	59362	59362	59362	59362
Observations	520700	520700	520700	520700	520700	520700

Notes:
[1] Unit of observation is year-month, store, and model.
[2] Sample restricted to year-month-store-model combinations where at least one extended warranty was sold.
[3] Column (1) is first stage coefficient for IV SPECIFICATION A in Table OA.6.10. Columns (1) and (2) are first stage coefficients for IV SPECIFICATION B. (3)-(5) are for IV SPECIFICATION C.
[4] Transaction Price IV equals Suggested Warranty Price plus Base Good Cost.
[3] Reported dependent and independent variables are in natural logarithms.
[5] Regressions include fixed effects for the year-month-model combination and EI region.
[6] Standard errors are clustered at the level of the EI region and are in parentheses.
[7] $***$ and $**$ denote statistical significance at the 1 and 5% levels.

Table OA.6.10: Warranty discounts and consumer demand IV estimates

	Base good quantities		
	All	Sold with extended warranty	Sold without extended warranty
	(1)	(2)	(3)
		SPECIFICATION A.	
Transaction price	-0.276	-0.329**	-0.143
	(0.190)	(0.163)	(0.133)
Kleibergen-Paap Wald F	77.94	77.94	77.94
		SPECIFICATION B.	
Transaction price	-0.283	-0.335**	-0.148
	(0.160)	(0.136)	(0.117)
Warranty price discount	0.031***	0.027***	0.021
	(0.010)	(0.006)	(0.011)
Kleibergen-Paap Wald F	52.60	52.60	52.60
		SPECIFICATION C.	
Transaction price	-0.221	-0.268**	-0.117
	(0.154)	(0.132)	(0.110)
Warranty price discount	0.019	0.013	0.014
	(0.013)	(0.008)	(0.012)
Transaction price × discount	0.058***	0.063***	0.029**
	(0.014)	(0.013)	(0.011)
Kleibergen-Paap Wald F	16.89	16.89	16.89
Year-month-model combinations	59362	59362	59362
Observations	520700	520700	520700

Notes:
[1] Unit of observation is year-month, store, and model.
[2] Sample is restricted to year-month-store-model combinations where at least one extended warranty was sold.
[3] Reported dependent and independent variables are in natural logarithms.
[4] Regressions include fixed effects for the year-month-model combination and EI region.
[5] Standard errors are clustered at the level of the EI region and are in parentheses.
[6] $***$ and $**$ denote statistical significance at the 1 and 5% levels.

Table OA.6.11: Warranty discounts and consumer demand IV estimates (unrestricted sample)

	Base good quantities		
	All	Sold with extended warranty	Sold without extended warranty
	(1)	(2)	(3)
		SPECIFICATION A.	
Transaction price	-0.351**	-0.344***	-0.227
	(0.164)	(0.119)	(0.130)
Kleibergen-Paap Wald F	114.08	114.08	114.08
Year-month-model combinations	94115	94115	94115
Observations	957184	957184	957184

Notes:
[1] Unit of observation is year-month, store, and model.
[2] Sample not restricted to year-month-store-model combinations where at least one extended warranty was sold.
[3] Reported dependent and independent variables are in natural logarithms.
[4] Regressions include fixed effects for the year-month-model combination and EI region.
[5] Standard errors are clustered at the level of the EI region and are in parentheses.
[6] $***$ and $**$ denote statistical significance at the 1 and 5% levels.

OA.7 CPI baskets and potential add ons

Table OA.7.1: CPI Basket with examples of base goods/add ons (Canada). Basket items are from STATSCAN document 2301-D59-V4. Basket weights are from STATSCAN table 18-10-0007-01 (release date 2022-06-15). We report weights for 2021 only. Example base goods/add ons are drawn from various internet websites, [Ellison, 2005], and common knowledge. The source list can be obtained from the authors via email. NA indicates not applicable. We used NA when there is no add on potential, when the potential for adding on is unclear, or when we could not find supporting documentation identifying add ons. hh indicates household.

Item category	CPI Weight	Class	Base good example	Add on example
Fresh/frozen beef	0.53	Nondurable	NA	NA
Fresh/frozen pork	0.20	Nondurable	NA	NA
Other fresh/frozen meat	0.08	Nondurable	NA	NA
Fresh/frozen chicken	0.46	Nondurable	NA	NA
Other fresh/frozen poultry	0.08	Nondurable	NA	NA
Ham/bacon	0.12	Nondurable	NA	NA
Other processed meat	0.65	Nondurable	NA	NA
Fresh/frozen fish	0.22	Nondurable	NA	NA
Canned/other preserved fish	0.07	Nondurable	NA	NA
Seafood/other marine products	0.12	Nondurable	NA	NA
Fresh milk	0.31	Nondurable	NA	NA
Butter	0.10	Nondurable	NA	NA
Cheese	0.48	Nondurable	NA	NA
Ice cream/related products	0.10	Nondurable	NA	NA
Other dairy products	0.34	Nondurable	NA	NA
Eggs	0.16	Nondurable	NA	NA
Bread, rolls/buns	0.40	Nondurable	NA	NA
Cookies/crackers	0.19	Nondurable	NA	NA
Other bakery products	0.28	Nondurable	NA	NA
Rice/rice-based mixes	0.08	Nondurable	NA	NA
Breakfast cereal/cereal products	0.32	Nondurable	NA	NA
Pasta products	0.10	Nondurable	NA	NA
Flour/flour-based mixes	0.05	Nondurable	NA	NA
Apples	0.11	Nondurable	NA	NA
Oranges	0.09	Nondurable	NA	NA
Bananas	0.08	Nondurable	NA	NA
Other fresh fruit	0.57	Nondurable	NA	NA
Fruit juices	0.20	Nondurable	NA	NA
Other preserved fruit	0.14	Nondurable	NA	NA
Nuts/seeds	0.15	Nondurable	NA	NA
Potatoes	0.09	Nondurable	NA	NA
Tomatoes	0.09	Nondurable	NA	NA
Lettuce	0.06	Nondurable	NA	NA
Other fresh vegetables	0.79	Nondurable	NA	NA
Frozen/dried vegetables	0.10	Nondurable	NA	NA
Canned vegetables	0.23	Nondurable	NA	NA
Sugar/syrup	0.05	Nondurable	NA	NA
Confectionery	0.35	Nondurable	NA	NA
Margarine	0.02	Nondurable	NA	NA
Other edible fats/oils	0.09	Nondurable	NA	NA
Coffee	0.29	Nondurable	NA	NA
Tea	0.07	Nondurable	NA	NA
Condiments, spices/vinegars	0.38	Nondurable	NA	NA
Soup	0.11	Nondurable	NA	NA

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Table OA.7.1 – continued from previous page

Item category	CPI Weight	Class	Base good example	Add on example
Baby foods	0.04	Nondurable	NA	NA
Frozen food preparations	0.26	Nondurable	NA	NA
All other food preparations	0.54	Nondurable	NA	NA
Non-alcoholic beverages	0.60	Nondurable	NA	NA
Electricity	1.78	Nondurable	NA	NA
Natural gas	0.70	Nondurable	NA	NA
Fuel oil/other fuels	0.22	Nondurable	NA	NA
Detergents/soaps	0.15	Nondurable	NA	NA
Other hh cleaning products	0.26	Nondurable	NA	NA
Paper supplies	0.40	Nondurable	NA	NA
Plastic/aluminum foil supplies	0.11	Nondurable	NA	NA
Pet food/supplies	0.59	Nondurable	NA	NA
Seeds, plants/cut flowers	0.39	Nondurable	NA	NA
Other horticultural goods	0.07	Nondurable	NA	NA
Other hh supplies	0.15	Nondurable	NA	NA
Gasoline	3.47	Nondurable	NA	NA
Prescribed medicines	0.48	Nondurable	NA	NA
Non-prescribed medicines	0.46	Nondurable	NA	NA
Medicinal cannabis	0.04	Nondurable	NA	NA
Other health care goods	0.13	Nondurable	NA	NA
Personal soap	0.15	Nondurable	NA	NA
Toiletry items/cosmetics	0.82	Nondurable	NA	NA
Oral-hygiene products	0.14	Nondurable	NA	NA
Other personal care supplies	0.62	Nondurable	NA	NA
Fuel, parts, accessories for recreational vehicles	0.23	Nondurable	NA	NA
Beer purchased from stores	0.89	Nondurable	NA	NA
Wine purchased from stores	0.73	Nondurable	NA	NA
Liquor purchased from stores	0.57	Nondurable	NA	NA
Other alcoholic beverages purchased in stores	0.03	Nondurable	NA	NA
Cigarettes	1.17	Nondurable	NA	NA
Other tobacco products/smokers' supplies	0.11	Nondurable	NA	NA
Recreational cannabis	0.59	Nondurable	NA	NA
Window coverings	0.07	Semidurable	Window shades	Extended warranty
Bedding/other hh textiles	0.32	Semidurable	Mattress	Extended warranty
Women's clothing	1.46	Semidurable	NA	NA
Men's clothing	0.95	Semidurable	NA	NA
Children's clothing	0.46	Semidurable	NA	NA
Women's footwear (excluding athletic)	0.20	Semidurable	Shoes	Shoe protector spray
Men's footwear (excluding athletic)	0.16	Semidurable	Shoes	Shoe protector spray
Children's footwear (excluding athletic)	0.06	Semidurable	Shoes	Shoe protector spray
Athletic footwear	0.20	Semidurable	NA	NA
Clothing accessories	0.35	Semidurable	NA	NA
Passenger vehicle parts, accessories/supplies	1.56	Semidurable	Transmission	Extended warranty
Eye care goods	0.27	Semidurable	Eye glasses	Extended warranty
Toys, games, hobby supplies	0.69	Semidurable	NA	NA
School textbooks/supplies	0.15	Semidurable	NA	NA
Newspapers	0.05	Semidurable	NA	NA
Magazines/periodicals	0.06	Semidurable	NA	NA
Books/reading material (no textbooks)	0.15	Semidurable	NA	NA
Telephone equipment	0.00	Durable	Phone	Protective equipment
Upholstered furniture	0.76	Durable	Upholstered furniture	Furniture insurance
Wooden furniture	0.47	Durable	Wooden furniture	Furniture insurance
Other furniture	0.48	Durable	Other furniture	Furniture insurance
Cooking appliances	0.20	Durable	Cooking appliances	Extended warranty
Refrigerators/freezers	0.21	Durable	Refrigerators/freezers	Extended warranty
Laundry/dishwashing appliances	0.25	Durable	Laundry machine	Extended warranty
Other hh appliances	0.43	Durable	Other hh appliances	Extended warranty
Non-electric kitchenware	0.25	Durable	NA	NA
hh tools	0.58	Durable	Electric drill	Extended warranty
Other hh equipment	0.52	Durable	Electric equipment	Extended warranty
Other hh furnishings/equipment	0.15	Durable	Electric equipment	Extented warranty

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Table OA.7.1 – continued from previous page

Item category	CPI Weight	Class	Base good example	Add on example
				Furniture insurance
Watches	0.10	Durable	Watch	Extended warranty
Jewellery	0.33	Durable	Jewellery	Extended warranty
Purchase new/used passenger vehicles	5.91	Durable	Car	Extended warranty, Maintenance packages, Car alarms
Exercise equipment	0.53	Durable	Treadmill	Extended warranty
Computer equipment/software	0.41	Durable	Computer	Extended warranty
Multipurpose digital devices	0.23	Durable	Printer	Extended warranty Ink Cartridges
Photographic equipment/supplies	0.06	Durable	Camera	Extended warranty
Other recreational equipment	0.28	Durable	Video game console	Extended warranty
Purchase of recreational vehicles	1.23	Durable	Boat	Extended warranty
Audio equipment	0.09	Durable	Subwoofer	Extended warranty
Video equipment	0.59	Durable	Smart TV	Extended warranty
Purchase of digital media	0.20	Durable	Chromecast	Extended warranty
Food from table-service restaurants	2.70	Services	Basic pasta	Basic pasta with shrimp
Food from fast food/take-out restaurants	1.54	Services	Combination meal	Supersize
Food from cafeterias/other	0.58	Services	Traditional brewed coffee	Diluted espresso
Rent	6.72	Services	NA	NA
Tenants' insurance premiums	0.11	Services	All risk	Mysterious disappearance
Tenants' maintenance/repairs	0.08	Services	NA	NA
Mortgage interest cost	3.11	Services	NA	NA
Homeowners' replacement cost	6.24	Services	NA	NA
Property taxes/special charges	2.59	Services	NA	NA
Homeowners' home/mortgage insurance	1.36	Services	"Named perils"	All risk
Homeowners' maintenance/repairs	1.86	Services	NA	NA
Other owned accommodation expenses	4.16	Services	NA	NA
Water	0.74	Services	NA	NA
Telephone services	1.50	Services	Unlimited local calling	Visual call waiting
Postal services	0.22	Services	Basic mail	Registered mail
Internet access services	1.04	Services	Basic internet	Higher bandwidth
Child care services	0.50	Services	Basic child care	Dry cleaning
Housekeeping services	0.32	Services	Basic housekeeping	Enhanced disinfection
Other hh services	1.57	Services	Weed control/fertilization	Aeration/overseeding, Tree/shrub care
Financial services	2.44	Services	Income tax return	Crypto advice
hh furnishings/equipment services	0.35	Services	Interior wall paint	Wood refinish
Leasing of passenger vehicles	0.53	Services	NA	NA
Rental of passenger vehicles	0.07	Services	Car rental	Insurance, GPS, Satellite radio
Passenger vehicle maintenance/repair	1.02	Services	Engine repair	Vehicle fluid top-up, Air filter replacement, Tire inspection
Passenger vehicle insurance premiums	2.12	Services	NA	NA
Passenger vehicle registration fees	0.18	Services	NA	NA
Drivers' licences	0.05	Services	NA	NA
Parking fees	0.23	Services	NA	NA
Other passenger vehicle operating expenses	0.16	Services	Car wash	Air fresheners, Leather treatment, Tire shine
City bus/subway transportation	0.18	Services	NA	NA
Taxi/local/commuter transport services	0.12	Services	NA	NA
Air transport	0.31	Services	Flight	Extra luggage, Seat choice, Priority boarding, Airport lounge
Inter-city transport (rail, bus, etc.)	0.07	Services	Train ride	Extra luggage, Seat choice, Priority boarding,

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Table OA.7.1 – continued from previous page

Item category	CPI Weight	Class	Base good example	Add on example
				Lounge
Other public transportation	0.18	Services	NA	NA
Eye care services	0.05	Services	Laser vision correction	Custom correction
Dental care services	0.52	Services	All resin dental crown	Platinum dental crown
Other health care services	0.39	Services	Chiropractic treatment	Dry needling
Personal care services	0.66	Services	Spa treatment	Body scrub
Recreational services	0.11	Services	Health club membership	Towel service, Hot yoga, Tanning
Insurance, licences/services for recreational vehicles	0.24	Services	Extended warranty	NA
Rental of digital media	0.01	Services	Film	Ice cream
Other home entertainment equipment, parts, services	0.06	Services	Board game	Extensions
Traveller accommodation	0.54	Services	Hotel room	In-room movies, Minibar items, Drycleaning
Travel tours	0.30	Services	Tour	Food/wine
Spectator entertainment	0.15	Services	Event	Concessions
Video/audio subscription services	0.91	Services	Basic Netflix package	4 devices at a time
Use of recreational facilities/services	0.66	Services	Event facility	DJ
All other cultural/recreational services	0.06	Services	Escape room	Extra clues, Extra time, Photo packages
Tuition fees	1.29	Services	NA	NA
Other lessons, courses/education services	0.23	Services	Course	Individual tutoring
Other reading material (excluding textbooks)	0.01	Services	Kindle book	Audible narration
Beer served in licensed establishments	0.36	Services	Small pint	Large pint
Wine served in licensed establishments	0.14	Services	Half decanter	Full decanter
Liquor served in licensed establishments	0.19	Services	Single shot	Double

Table OA.7.2: CPI Basket with examples of base goods/add ons (United States). Basket items/weights are from BLS Handbook of Methods Chapter 17, updated on 2-14-2018. CPI weights are for urban consumers. Example base goods/add ons are drawn from various internet websites, [Ellison, 2005],/common knowledge. The source list can be obtained from the authors via email. NA indicates not applicable. We used NA when there is no add on potential, when the potential for adding on is unclear, or when we could not find supporting documentation identifying add ons. hh indicates hh.

Item category	CPI Weight	Class	Base good example	Add on example
Cereals/cereal products	0,370	Non-durable	NA	NA
Flour/prepared flour mixes	0,048	Non-durable	NA	NA
Breakfast cereal	0,197	Non-durable	NA	NA
Rice, pasta, cornmeal	0,126	Non-durable	NA	NA
Bakery products	0,767	Non-durable	NA	NA
Bread	0,230	Non-durable	NA	NA
Fresh biscuits, rolls, muffins	0,116	Non-durable	NA	NA
Cakes, cupcakes, cookies	0,189	Non-durable	NA	NA
Other bakery products	0,233	Non-durable	NA	NA
Uncooked ground beef	0,238	Non-durable	NA	NA
Uncooked beef roasts	0,085	Non-durable	NA	NA
Uncooked beef steaks	0,207	Non-durable	NA	NA
Uncooked other beef/veal	0,053	Non-durable	NA	NA
Bacon, breakfast sausage, related	0,141	Non-durable	NA	NA
Ham	0,078	Non-durable	NA	NA
Pork chops	0,064	Non-durable	NA	NA
Other pork including roasts/picnics	0,089	Non-durable	NA	NA
Other meats	0,275	Non-durable	NA	NA
Chicken	0,294	Non-durable	NA	NA
Other poultry including turkey	0,066	Non-durable	NA	NA
Fresh fish/seafood	0,148	Non-durable	NA	NA
Processed fish/seafood	0,142	Non-durable	NA	NA
Eggs	0,134	Non-durable	NA	NA
Milk	0,283	Non-durable	NA	NA
Cheese/related products	0,286	Non-durable	NA	NA
Ice cream/related products	0,126	Non-durable	NA	NA
Other dairy/related products	0,204	Non-durable	NA	NA
Apples	0,083	Non-durable	NA	NA
Bananas	0,087	Non-durable	NA	NA
Citrus fruits	0,146	Non-durable	NA	NA
Other fresh fruits	0,259	Non-durable	NA	NA
Potatoes	0,075	Non-durable	NA	NA
Lettuce	0,072	Non-durable	NA	NA
Tomatoes	0,102	Non-durable	NA	NA
Other fresh vegetables	0,251	Non-durable	NA	NA
Canned fruits/vegetables	0,157	Non-durable	NA	NA
Frozen fruits/vegetables	0,088	Non-durable	NA	NA
Other processed fruits/vegetables	0,057	Non-durable	NA	NA
Carbonated drinks	0,285	Non-durable	NA	NA
Frozen noncarbonated juices/drinks	0,014	Non-durable	NA	NA
Nonfrozen noncarbonated juices/drinks	0,400	Non-durable	NA	NA
Coffee	0,158	Non-durable	NA	NA
Other beverage materials including tea	0,099	Non-durable	NA	NA
Sugar/artificial sweeteners	0,054	Non-durable	NA	NA
Candy/chewing gum	0,185	Non-durable	NA	NA
Other sweets	0,060	Non-durable	NA	NA
Butter/margarine	0,077	Non-durable	NA	NA
Salad dressing	0,062	Non-durable	NA	NA
Other fats/oils including peanut butter	0,107	Non-durable	NA	NA
Soups	0,093	Non-durable	NA	NA

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Table OA.7.2 – continued from previous page

Item category	CPI Weight	Class	Base good example	Add on example
Frozen/freeze dried prepared foods	0,285	Non-durable	NA	NA
Snacks	0,330	Non-durable	NA	NA
Spices, seasonings, condiments, sauces	0,292	Non-durable	NA	NA
Baby food	0,055	Non-durable	NA	NA
Other miscellaneous foods	0,444	Non-durable	NA	NA
Full service meals/snacks	2,823	Services	Basic pasta	Basic pasta with shrimp
Limited service meals/snacks	2,413	Services	Combo meal	Supersize
Food at employee sites/schools	0,212	Services	Filter coffee	Diluted espresso
Food from vending machines/mobile vendors	0,064	Services	Basic burger	Burger with bacon
Other food away from home	0,319	Services	NA	NA
Beer, ale, other malt beverages at home	0,274	Non-durable	NA	NA
Distilled spirits at home	0,073	Non-durable	NA	NA
Wine at home	0,250	Non-durable	NA	NA
Alcoholic beverages away from home	0,418	Non-durable	NA	NA
Rent of primary residence	7,159	Services	NA	NA
Housing at school, excluding board	0,172	Services	NA	NA
Hotels, motels, similar lodging	0,666	Services	Hotel room	in-room movies minibar items dry cleaning
Owners' equivalent rent-primary residence	22,918	Services	NA	NA
Owners' equivalent rent-secondary residences	1,421	Services	NA	NA
Tenants'/hh insurance	0,375	Services	All risk	Mysterious disappearance
Fuel oil	0,139	Non-durable	NA	NA
Propane, kerosene,/firewood	0,097	Non-durable	NA	NA
Electricity	2,940	Services	NA	NA
Utility (piped) gas service	0,875	Services	NA	NA
Water/sewerage maintenance	0,945	Services	NA	NA
Garbage/trash collection	0,277	Services	NA	NA
Floor coverings	0,047	Semi-durable	Rugs	Extended warranty
Window coverings	0,053	Semi-durable	Window shades	Extended warranty
Other linens	0,166	Semi-durable	NA	NA
Bedroom furniture	0,268	Durable	Mattress	Extended warranty
Living room, kitchen, dining room furniture	0,363	Durable	Upholstered couch	Furniture insurance
Other furniture	0,128	Durable	Other furniture	Furniture insurance
Unsampled furniture	0,009	Durable	Unsampled furniture	Furniture insurance
Major appliances	0,147	Durable	Major appliances	Extended warranty
Other appliances	0,120	Durable	Other appliances	Extended warranty
Unsampled appliances	0,004	Durable	Unsampled appliances	Extended warranty
Clocks, lamps,/decorator items	0,257	Durable	Lamps	Extended warranty
Indoor plants/flowers	0,107	Non-durable	NA	NA
Dishes/flatware	0,041	Durable	NA	NA
Nonelectric cookware/tableware	0,074	Durable	NA	NA
Tools, hardware/supplies	0,189	Durable	Electric drill	Extended warranty
Outdoor equipment/supplies	0,367	Durable	Lawn mower	Extended warranty
Unsampled tools, hardware, outdoor equipment	0,154	Durable	Unsampled tools	Extended warranty
hh cleaning products	0,337	Non-durable	NA	NA
hh paper products	0,247	Non-durable	NA	NA
Miscellaneous hh products	0,263	Non-durable	NA	NA
Domestic services	0,279	Services	Basic housekeeping	Enhanced disinfection
Gardening/lawncare services	0,279	Services	Weed control, fertilization	Aeration/overseeding Tree/shrub care
Moving, storage, freight expense	0,116	Services	Basic moving expense	Packing
Repair of hh items	0,066	Services	NA	NA
Unsampled hh operations	0,107	Services	NA	NA
Men's suits, sport coats,/outerwear	0,104	Semi-durable	NA	NA
Men's furnishings	0,185	Semi-durable	NA	NA
Men's shirts/sweaters	0,196	Semi-durable	NA	NA
Men's pants/shorts	0,160	Semi-durable	NA	NA
Unsampled men's apparel	0,007	Semi-durable	NA	NA
Boys' apparel	0,181	Semi-durable	NA	NA
Women's outerwear	0,118	Semi-durable	NA	NA

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Table OA.7.2 – continued from previous page

Item category	CPI Weight	Class	Base good example	Add on example
Women's dresses	0,155	Semi-durable	NA	NA
Women's suits/separates	0,550	Semi-durable	NA	NA
Women's underwear, nightwear, sportswear	0,378	Semi-durable	NA	NA
Unsampled women's apparel	0,010	Semi-durable	NA	NA
Girls' apparel	0,229	Semi-durable	NA	NA
Men's footwear	0,218	Semi-durable	NA	NA
Boys'/girls' footwear	0,178	Semi-durable	NA	NA
Women's footwear	0,329	Semi-durable	NA	NA
Infants'/toddlers' apparel	0,135	Semi-durable	NA	NA
Watches	0,046	Durable	Watch	Extended warranty
Jewelry	0,164	Durable	Jewellery	Extended warranty
New/used/leased vehicles	5,539	Durable	Car	Extended warranty
				Protection plans
				Maintenance packages
				Car alarms/trackers
Car/truck rental	0,073	Services	Car/truck rental	Insurance
				GPS
				Satellite radio
Unsampled new/used motor vehicles	0,109	Durable	private plane	Extended warranty
Gasoline (all types)	3,904	Non-durable	NA	NA
Other motor fuels	0,075	Non-durable	NA	NA
Tires	0,285	Semi-durable	Tires	Extended warranty
Vehicle accessories other than tires	0,150	Semi-durable	Hubcaps	Extended warranty
Motor vehicle body work	0,057	Services	Body work	Designer moldings
Motor vehicle maintenance/servicing	0,492	Services	Lube job	Transmission flush
Motor vehicle repair	0,587	Services	Engine repair	Vehicle fluid top-up
				Air filter replacements
				Tire inspection
Unsampled service policies	0,032	Services	NA	NA
Motor vehicle insurance	2,300	Services	NA	NA
State motor vehicle registration/license fees	0,312	Services	NA	NA
Parking/other fees	0,235	Services	NA	NA
Unsampled motor vehicle fees	0,018	Services	NA	NA
Airline fare	0,702	Services	Flight	Extra luggage
				Seat priority
				Priority boarding
				Airport lounge
Other intercity transportation	0,157	Services	Train	Seat priority
				Bed
				Private restroom
				Lounge
Intracity transportation	0,260	Services	NA	NA
Unsampled public transportation	0,004	Services	NA	NA
Prescription drugs	1,345	Non-durable	NA	NA
Nonprescription drugs	0,351	Non-durable	NA	NA
Medical equipment/supplies	0,076	Durable	Defibrilator	Extended warranty
Physicians' services	1,590	Services	Basic service	Colonoscopy screening
Dental services	0,804	Services	All resin dental crown	Platinum dental crown
Eyeglasses/eye care	0,284	Semi-durable	Laser vision correction	Custom laser vision correction
Services by other medical professionals	0,354	Services	Chiropractic treatment	Dry needling
Hospital services	1,853	Services	Basic (shared) room	Hotel-like private room
Nursing homes/adult day services	0,174	Services	NA	NA
Care of invalids/elderly at home	0,132	Services	NA	NA
Health insurance	0,753	Services	Basic plan	Plan with dental coverage
Televisions	0,133	Durable	Smart TV	Extended warranty
Cable/satellite television/radio service	1,468	Services	Basic cable	Additional channels
Other video equipment	0,029	Durable	Chromecast	Extended warranty
Video discs/other media, including rentals	0,090	Services	Film	Ice cream
Audio equipment	0,066	Durable	Subwoofer	Extended warranty
Audio discs, tapes, other media	0,044	Services	NA	NA
Unsampled video/audio	0,016	Durable	NA	NA

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Table OA.7.2 – continued from previous page

Item category	CPI Weight	Class	Base good example	Add on example
Pets/pet products	0,659	Non-durable	NA	NA
Pet services including veterinary	0,399	Services	Basic pet insurance	Physical therapy
Sports vehicles including bicycles	0,181	Durable	Boat	Extended warranty
Sports equipment	0,214	Durable	Treadmill	Extended warranty
Unsampled sporting goods	0,005	Durable	NA	NA
Photographic equipment/supplies	0,058	Durable	Camera	Extended warranty
Photographers/film processing	0,062	Services	Basic photos	Retouching
Unsampled photography	0,001	NA	NA	NA
Toys	0,277	Semi-durable	NA	NA
Sewing machines, fabric/supplies	0,050	Durable	Sewing machine	Extended warranty
Music instruments/accessories	0,042	Durable	Music instrument	Extended warranty
Unsampled recreation commodities	0,011	NA	NA	NA
Club dues/fees for sports/group exercises	0,602	Services	Health club membership	Towel service Hot yoga Tanning
Admissions for recreation services	0,640	Services	Facility	Facility Plus
Fees for recreation lessons or instructions	0,211	Services	Basic lesson	Food/beverage
Unsampled recreation services	0,271	Services	NA	NA
Newspapers/magazines	0,123	Semi-durable	NA	NA
Recreational books	0,094	Semi-durable	NA	NA
Unsampled recreational reading materials	0,002	Semi-durable	NA	NA
College tuition/fees	1,853	Services	NA	NA
Elementary/high school tuition/fees	0,377	Services	NA	NA
Child care/nursery school	0,725	Services	NA	NA
Technical/business school tuition/fees	0,039	Services	NA	NA
Unsampled tuition, other school fees, childcare	0,128	Services	NA	NA
Postage	0,130	Services	Basic mail	Registered mail
Delivery services	0,014	Services	Basic delivery	Liability coverage
Wireless telephone services	1,624	Services	Basic mobile phone service	Additional data
Land-line telephone services	0,837	Services	Unlimited local calling	Call forwarding
Personal computers/peripheral equipment	0,272	Durable	Computer	Extended warranty
Computer software/accessories	0,068	Durable	Stata basic	Stata MP
Internet services/electronic info providers	0,711	Services	Basic package	Higher bandwidth
Telephone hardware, calculators, other	0,068	Durable	Mobile with 128GB	Mobile with 256GB
Unsampled information/ processing	0,012	NA	NA	NA
Cigarettes	0,661	Non-durable	NA	NA
Tobacco products other than cigarettes	0,050	Non-durable	NA	NA
Unsampled tobacco/smoking products	0,006	Non-durable	NA	NA
Hair, dental, shaving, personal care products	0,369	Non-durable	NA	NA
Cosmetics, perfume, bath, nail preparations	0,348	Non-durable	NA	NA
Unsampled personal care products	0,007	Non-durable	NA	NA
Haircuts/other personal care services	0,638	Services	Spa treatment	Body scrub
Legal services	0,316	Services	NA	NA
Funeral expenses	0,173	Services	Basic services	Embalming Premium casket Hearse
Laundry/dry cleaning services	0,276	Services	Basic service	Folding
Apparel services (no laundry/drycleaning)	0,034	Services	NA	NA
Financial services	0,228	Services	Income tax return	Crypto advice
Unsampled items	0,095	NA	NA	NA
Miscellaneous personal goods	0,192	NA	NA	NA

OA.8 Construction of aggregate indices.

We construct fixed weights durable goods inflation index, closely following the procedure implemented by Statistics Canada that can be found here:
`https://www.statcan.gc.ca/en/statistical-programs/document/2301_D64_T9_V2`

We proceed as follows. First, we select only the product categories that are sold by retailer in each month of our sample period. This ensures that (i) all category weights can be fixed at the same base period 2000m1 (ii) and weights are unaffected by introduction or discontinuation of individual products during the sample period. That leaves us with 24 product categories.

Second, within categories, we only keep products that are sold with an add on at least once in a month and that are observed for at least 24 consecutive periods. This gives us 132.2 products per year per category, on average.

Third, we compute inflation rates of each product category and drop the ones with volatility (standard deviation) higher than the 95th percentile. That leaves us with $3,737,533$ observations and 19067 individual products. The time-varying weights inflation rates are computed on the same sample.