

Pass-through of subsidies to prices under limited competition: Evidence from Canada's Nutrition North program

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Abstract

We study the pass-through of Canada's Nutrition North food subsidy in remote, mainly Indigenous communities with limited competition. Reforms to the program in 2016 and 2019 provide exogenous changes in retailer marginal costs and we show that on average, retail prices were lowered by 67 cents for every additional dollar of subsidy, well below the full pass-through expected under perfect competition. We can precisely characterize the competitive environment for each community, which is typically a retail monopoly or duopoly, and find that the low average pass-through is mostly driven by monopoly communities. Our findings show that resources intended for marginalized communities can be partly captured by local firms with market power.

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1. Introduction

Understanding the relationship between competition and pass-through is important for tax and subsidy policies that target firms, but empirical analysis of this relationship is challenging for several reasons. Measuring and identifying exogenous changes in marginal costs is difficult in general. Even when we observe a marginal cost shock that is independent of shocks to consumer demand, the change in an observed component of a firm's marginal cost may be correlated with unobserved components of its marginal cost through scale effects (Ritz, 2022) and/or with the marginal costs of competitors (Muehlegger and Sweeney, 2022), complicating interpretation. The relationship between pass-through and competition is also sensitive to the shape of the demand curve (Weyl and Fabinger, 2012) and how competition is measured across space and products.

In this paper, we examine pass-through and competition in the context of Canada's Nutrition North Program. The program pays retailers a subsidy based on the weight of nutritious food shipped by air to remote communities in Northern Canada that lack surface access for most of the year and rely heavily on air freight (Government of Canada, 2022). The mainly Indigenous inhabitants of these communities face a dual burden of poverty and high food prices, leading to the highest food insecurity rates in Canada and reaching 57% in Nunavut vs. a national average of 12.7% in 2017-2018 (Leblanc-Laurendeau, 2020). Given their small scale, these communities also have very limited retail competition – most communities receiving the subsidy are served by a retail monopoly or duopoly and it is expensive or infeasible for individuals to arbitrage across markets through personal mail or travel (Burnett et al., 2017). While retail food prices are often a target for tax and subsidy policies like Nutrition North, the effects of limited competition and monopoly on pass-through in this industry are less well understood than in more homogeneous industries like concrete and energy where recent research has leveraged detailed geographic and firm-level data to measure competition (Miller et al., 2017; Muehlegger and Sweeney, 2022; Genakos and Pagliero, 2022). Our unique setting helps address the challenge of defining the relevant geographic and product scope for competition.

Our analysis focuses on policy reforms in October 2016 and January 2019 that increased subsidy rates for select items and communities affected by the program, generating plausibly exogenous changes in marginal cost for retailers across communities. We estimate pass-through by quantifying changes in the subsidy content of a

food basket whose price was also collected for subsidized retailers. We find that a one dollar decrease in the retailer's marginal cost due to subsidy expansion lowers the retail price by 67 cents on average. This is well below full the pass-through (100 cents on the dollar) that would occur with perfect competition and implies substantial leakage of program funds into retailer profits. We can reject full pass-through at the 1% significance level for the full sample. We also find that pass-through is 18 to 69 cents lower (per dollar of subsidy) in communities with a retail monopoly compared to communities with two or more retailers. This pass-through differential is significantly different than zero in most specifications and in some cases the magnitudes imply that the low average pass-through we estimate is entirely driven by communities with retail monopoly, e.g. we cannot reject full pass-through for non-monopolies and monopolies have pass-through closer to zero. Our findings are not driven by pre-trends in prices correlated with subsidy changes, scale economies in shipping, or observable community characteristics correlated with retail competition, and provide rare evidence on pass-through rates for a retail monopolist in the grocery sector, though caution is required in extrapolating from the unique setting and context of this program.

Beyond contributing to the literature on pass-through and competition, our findings have implications for programs that transfer resources to households and rely on markets. The idea that monopolistic retailers may "capture" a large share of the resources intended for vulnerable populations has been raised repeatedly in evaluations of the Nutrition North program (Galloway, 2014; Burnett et al., 2015; Galloway, 2017).¹ Numerous studies have considered the effects of cash or cash-like (e.g. SNAP) transfers on prices in developed (Hastings and Washington, 2010; Goldin et al., 2022; Jones and Marinescu, 2022) and developing countries (Angelucci and Giorgi, 2009; Cunha et al., 2019; Filmer et al., 2022; Egger et al., 2022; Li, 2023) but generally find zero or small average price effects. However, studies that measure remoteness consistently find larger price effects in remote locations that are suggestively related to retail competition (Cunha et al., 2019). We consider communities that are even more remote and find that retailers with market power can capture a substantial part of

¹Our setting recalls the critique of the "company store" in remote mining towns (Fishback, 1986) where employers supposedly made additional profits by operating retail monopolies or forcing employees to buy from their store. The dominant retailer in the region we study – the North West Company – is the successor of the Hudson Bay Company that at one time provided most of the income in these communities through the fur trade, although it has been largely replaced by the government as a source of employment and cash income.

government funds intended to help vulnerable households in spite of accountability measures detailed later.

Two previous studies examined subsidy pass-through in remote communities in Northern Canada. Glacken and Hill (2009) compare prices before and after a pilot program changed shipping costs for three communities under an earlier “Food Mail” program and Indigenous and Northern Affairs Canada (2009) summarizes the average pass-through from this analysis as approximately 62 cents on the dollar. Naylor et al. (2020) use cross-sectional product-level data for 25 Nunavut communities in 2017 to estimate pass-through of Nutrition North subsidies. Their average pass-through estimate is 91 cents on the dollar with standard errors large enough to include pass-through above one or as low as 64 cents, but identification requires the assumption that relative prices across products in Ottawa provide a valid counter-factual for relative prices across products in Nunavut despite a vastly different retail and distribution environment. Our analysis is the first to leverage two subsidy reform episodes that provide more plausibly exogenous variation in subsidies and a control group.² We also use a much larger sample of communities, leading to more precise estimates of average pass-through and more variation in community characteristics to identify pass-through heterogeneity, e.g. none of the monopoly communities in our sample are in Nunavut.

The paper proceeds by first presenting the economic theory through which we interpret our findings, then describing our data and setting, then our econometric analysis, and then offering some concluding comments.

2. Theory

Profit maximizing firms with market power typically set prices equal to a markup over marginal cost. By defining the price P as the product of a markup μ and marginal cost C the pass-through of a marginal cost shock can be written:

$$\frac{dP}{dC} = \mu + \frac{d\mu}{dC}C \quad (1)$$

²Crown-Indigenous Relations and Northern Affairs Canada (2020) shows that the October 2016 subsidy reform increased quantities shipped to affected communities but does not estimate pass-through.

When markups are constant ($d\mu = 0$), pass-through is also constant and is equal to the markup μ . If markups decrease sufficiently in response to a rise in C , pass-through can be less than or equal to one. In general, both the level of the markup and its responsiveness to marginal cost shocks depend on the nature of local competition, local demand, and the specific pricing strategy of the firm. Genakos et al. (2020) show that if one assumes a firm is a cost-minimizer, takes input prices as given, has linear production costs, and follows a linear supply schedule, firm-level cost pass-through is a sufficient statistic to calculate the impact of a cost shock on an individual firm's profits regardless of the structure of competition and demand (including multiple products) or shocks to other firms.

In a symmetric industry with profit maximizing firms that set marginal revenue equal to a marginal cost that is invariant to quantity, Weyl and Fabinger (2012) show that pass-through of an industry cost shock can be written as:

$$\frac{dP}{dC} = \frac{1}{1 + \frac{\theta}{\epsilon_{ms}}} \quad (2)$$

where the inverse elasticity of marginal consumer surplus is given by $\frac{1}{\epsilon_{ms}} = [1 + \frac{p'q}{p}]$. This term is related to the curvature of demand, and is positive when demand is log concave, in which case pass-through is increasing in a conduct parameter θ which is equal to 1 under monopoly and 0 under perfect competition (leading to full pass-through equal to one). Under symmetric Cournot oligopoly $\theta = 1/N$ and under asymmetric Cournot oligopoly $\theta = q_i/Q$ (quantity market share). These considerations imply that as long as demand is log concave and firms have some market power, pass-through is incomplete (below 1) and increases with more competitive conduct. Under symmetric Cournot, the derivative of pass-through with respect to the number of competitors is given by $\frac{d(dP/dC)}{dN} = \frac{1}{\epsilon_{ms}(N+(1/\epsilon_{ms}))^2}$ which is positive for $\epsilon_{ms} > 0$ but decreasing in N , so each additional competitor raises pass-through by a diminishing amount. For example, with $\epsilon_{ms} = 2$, going from monopoly to duopoly raises pass-through from 0.67 to 0.8 but going from duopoly to three firms only raises pass-through from 0.8 to 0.86. This implies that it may be difficult to estimate the effect of differences in competition on pass-through when comparing across more competitive markets.

The Weyl and Fabinger (2012) formula applies to a single-product setting but may also apply to multi-product firms. Alexandrov and Spulber (2017) show that under

relatively weak conditions (continuity of profit and consumer surplus functions and strict quasi-concavity of profit functions) one can reduce high dimensional multi-product firm decisions to a single “sufficient decision” for profits – “transactions” can serve this purpose, and equilibrium in oligopoly and monopoly markets can be analyzed using the formula above by replacing price and cost with average revenue and marginal cost per transaction. Armstrong and Vickers (2017) show that for multi-product Cournot oligopoly, the analysis of own and cross-product cost pass-through can be greatly simplified when consumer surplus is homothetic. Under conditions satisfied by many demand systems used in applied work (e.g. CES utility and quadratic utility/linear demand) there is no “cross-cost” pass-through in prices (despite potentially large cross-price effects in the demand system) and price for each product depends only on its own marginal cost; in this case the pass-through analysis above applies product by product and not just for the “black-box” of transactions analyzed by Alexandrov and Spulber (2017).

Note that even when a tax, subsidy, or other marginal cost shock affecting firms can be precisely quantified, empirical analysis presents several challenges. Observed changes in costs may be correlated with unobserved changes in demand in general, or through specific mechanisms identified in the literature such as correlated changes in competitor’s costs (Muehlegger and Sweeney, 2022) or (unobserved) changes in own marginal cost due to scale effects (Ritz, 2022). The formula above highlights that both the magnitude and sign of the relationship between competitive conduct and pass-through depend on the shape of demand curves. The conduct parameter can be derived from a valid pass-through estimate that satisfies the conditions of the above formula, but the empirical relevance of market structure for competitive conduct is not always clear. Oligopolies may exhibit more competitive conduct than monopolies but there could be collusion, and monopolies may not maximize short-run profits for a variety of reasons including entry-deterrence and evasion of regulatory scrutiny (which is potentially relevant in our context). Moreover, measuring the number or size of competitors requires defining markets in physical and product space. Prior studies focus on products like energy and concrete that are more homogeneous and have more easily defined markets, which is harder in the retail food sector where previous studies typically make ad hoc assumptions to measure variation in competition (Hong and Li, 2017; Campos-Vazquez and Medina-Cortina, 2019) and a monopoly benchmark is rare. Our data and setting help us address these challenges.

3. Data and context

Nutrition North Canada is a Federal government program administered by Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) that provides subsidies to retailers for shipping food to communities that lack year-round surface (road/rail/marine) transport and depend heavily on air freight (Government of Canada, 2022). We restrict our sample to communities that have price data and are eligible for the subsidy year round. Table 1 presents summary statistics for sample communities that we collected from the Canadian census and other sources. The average community has about 1,000 residents and relies heavily on government transfers (25% of average income). Communities are remote, with an average flight distance of over 1,000km to the nearest service hub (often itself a remote community like Yellowknife) and an average latitude around 60 degrees. Communities typically have seasonal access to a summer sealift (typically a few months in the late summer) or a winter road (typically January to March) during which heavy and non-perishable items can be shipped, with a few communities having access to both and one having access to neither. Local airports have small runways and multiple flights per week for passengers and freight.

Sample communities are split evenly between Inuit-majority communities in the Northwest Territories, Nunavut, Northern Quebec and Labrador, and First Nations communities (mostly in Ontario and Manitoba). Most of these communities are co-located with a historic outpost of the Hudson Bay Company through which Indigenous peoples traded furs for imported retail goods. The North West Company was created when investors purchased the northern retail division of the Hudson Bay Company in 1987 and it is the dominant retailer in our data, with a store in 94% of sample communities. The largest competitors in the region are two retail chains with roots in the Inuit co-op movement, Arctic Co-operatives Ltd. (which operates 33 stores) and Fédération des Coopératives du Nouveau-Québec (which operates 14 stores). The remaining stores in the sample are independent stores or local co-ops. 42% of the sample communities are retail monopolies (30 out of 35 of these for the North West Company) while 47% of communities have a co-op store. Most (86%) of the stores in the sample, including all of the big players, receive the Nutrition North subsidy, but a few local stores do not for reasons that are unclear but may include costs of bureaucratic compliance and a focus on selling items not covered by the subsidy. Only seven communities have more than 2 stores, and the majority (about 80%)

of our sample can be characterized as a monopoly or a duopoly where all retailers receive subsidies. Shopping in other communities is expensive due to extreme distances and lack of surface/marine transportation, such that our population and local retail variables are likely to capture the relevant market within which consumers shop for food and retailers compete.

What explains the variation in retail competition in our sample? Columns 6 and 7 of Table 1 present means for communities grouped by monopoly status, with column 8 providing the p-value for a test of equality of means. Monopoly communities are typically smaller and have lower average income although government income and trend growth in population and income are similar. They are less remote, with lower latitude and hub distance, and are more likely to have access to a winter road and less likely to have access to a summer sealift. Inuit communities are much less likely to be monopolies because most feature an outlet of one of the two co-op chains; these chains grew thanks to early government support for the Inuit co-op movement (Mitchell, 1996) perhaps aided by community support for alternative retail options where they exist. There was only one store opening and closing during our sample period – a North West Company store that closed and was quickly replaced by an Arctic Co-op run store in 2015. Our econometric analysis will quantify heterogeneous pass-through for monopoly versus non-monopoly communities while also accounting for these observable differences.

Data on prices and the subsidy come directly from the Nutrition North website and are summarized in Table 1. The website reports the price of the Revised Northern Food Basket (RNFB), a fixed weight 67 item food basket that reflects a nutritionally adequate but locally relevant diet sufficient to feed a family of four for two weeks. The basket weighs 51.8KG in total and includes 29 items deemed non-perishable (25% of the basket weight) and 38 items deemed perishable by CIRNAC. To receive the subsidy in a given community, retailers must report the prices of these items to the government which are then aggregated at the community level – in many cases data come from a single retailer but otherwise they represent the (unweighted) average price of a consistent set of retailers receiving the subsidy.³ The community-level

³One of the major retailers (Arctic Co-op, Ltd.) now provides data for Nunavut and the Northwest Territories but it is deliberately excluded from RNFB calculations to preserve comparability with earlier years when their data were deemed not usable. Most of the price data come from the North West Company and Fédération des Coopératives du Nouveau-Québec, with some data from Big Land Groceries, Rampart, and Stanton.

RNFB price is reported for March, June, September, and December of each year since the program's inception in April 2011 although some communities start or stop reporting because they gained or lost access to the subsidy.

To measure the subsidy content of the RNFB, we apply the community-level subsidy rate applicable to each item in the basket based on its fixed basket weight and add these up. Subsidy rates vary based on the category of the good and the community – goods that are more nutritious and perishable receive a higher subsidy level as do communities with higher shipping costs. Our RNFB subsidy measure is the dollar amount the retailer receives for shipping one unit of the (51.8KG) RNFB to a given community in a given month. RNFB prices are similar on average between monopoly and non-monopoly communities but RNFB subsidies are significantly higher in the non-monopoly communities as these are more remote on average. The Nutrition North website also reports the weight of subsidized goods shipped at the community-quarter level which we use to assess scale economies. The per capita quantity of subsidized goods shipped is similar for monopoly and non-monopoly communities despite the difference in average income. Changes in RNFB prices and the weight of subsidized goods shipped per capita are similar for monopoly and non-monopoly communities in the period leading up to the October 2016 reform.

Our empirical strategy leverages the reforms to the subsidy program that occurred in October 2016 and January 2019. The October 2016 reform, which followed a recent election where the winning Liberal party performed well with Indigenous communities, expanded eligibility to 37 communities that had no access to the program or only received a nominal (5 cents per kilogram) subsidy. Of the 11 affected communities for which we have before and after RNFB price data, 10 are retail monopolies, and the average increase in RNFB subsidy was \$54.38.⁴ The 2019 reform, which occurred 10 months before another Federal election, changed the subsidy rates for specific items (e.g. the number of subsidy eligible items in the RNFB rose from 44 to 46) and increased subsidy rates for all communities.⁵ The RNFB subsidy increased by \$20.62 on average but this varied across communities, with a \$17.81 increase at the

⁴Note that more sample communities were part of this reform but they do not report price data for the before period. Several communities affected by this reform also lost eligibility one year after due to the completion of all-season roads.

⁵This reform also introduced a flat \$1/KG surface transport subsidy for subsidized goods during seasonal sealift/winter road periods, but usage of this part of the subsidy is very low (below 1% of subsidy expenditure or weight of subsidized goods shipped) during our sample period.

25th percentile and a \$25.57 increase at the 75th percentile. The reason for these differences is unclear but fairness may have been a consideration as the reform somewhat equalized the RNFB subsidy across communities (Figure 1).

Figure 1 presents the time-series of our price and subsidy data. Panel A presents the mean RNFB prices and subsidies for the 65 communities that consistently report price data during our entire sample period (March 2012 to December 2019) along with an estimate of Ottawa prices for a comparable basket.⁶ The average RNFB price falls around the time of the reform episodes but there appear to be some confounding changes in average Canadian food prices. Panels B and C present the RNFB prices and subsidies for the communities most and least affected by the October 2016 and January 2019 reforms in the eight quarters before and four quarters after, and it is these relative changes in subsidies across communities that we use for identification.

The program's accountability measures are important for our analysis, which was made possible by the mandatory reporting of RNFB prices to the government and the availability of data on RNFB basket prices and subsidy rates on the public website. In interpreting our findings, it is important to note that retailers receiving the subsidy must promise to fully pass-on the subsidy to consumers and are subject to periodic compliance audits. This raises questions about whether our analysis may be biased against finding incomplete pass-through related to market power. We view these retailer promises as unlikely to bind for two reasons. First, the audit reports (available on the government website) are mostly focused on other aspects of program compliance such as clearly posting the pre and post subsidy prices for consumers on shelves and receipts, ensuring that freight quantities and eligibility are accurate, requesting better record keeping and processes to reduce reporting errors, and implementing processes to prevent purchases from ineligible clients (e.g. certain businesses like mining camps). Where pricing is mentioned, we only observe a request to "develop a policy, process and procedure for assessing profit margins on an ongoing basis." We see no evidence that an economic or econometric methodology is used to formulate counter-factual prices or profit margins, nor is there language in the retailer agreements that establishes how these could or should be measured. Ultimately auditors face the same challenges as researchers – how to formulate counter-factual prices in

⁶Specifically we match 44 items with Canadian average monthly price data reported by Statscan Table 18-10-0245-01 to items in the RNFB and use RNFB weights to aggregate, and then scale the price of this basket by a constant factor to match the Ottawa RNFB price observed in March 2010 (the latest available outside of our sample communities).

the absence of a subsidy – and before January 2019 would at best be limited to cross-sectional comparisons of products or markets, similar to Naylor et al. (2020). Second, the website states that if the retailer “continues to be non-compliant, the funding agreement can be terminated. This is a last resort option, and CIRNAC will work with the [retailer] to fix issues where possible to allow Northerners as much choice as possible.” To date there have been no terminations for non-compliance and auditors have only issued recommendations. Given that termination of subsidies would harm the program’s intended recipients, the credibility of this potential punishment for non-compliance is questionable. While we acknowledge that this aspect of the program could affect subsidy pass-through, we view retailers as having considerable latitude to set prices and our findings on incomplete pass-through and competition support this view; they could therefore be interpreted as a lower bound relative to unconditional subsidies in this environment.

4. Econometric Analysis

Our identification of changes in retailer marginal cost uses the community-level *changes* in subsidies that took place in October 2016 and January 2019. We therefore control for time-invariant community-level factors that may be correlated with the community’s initial subsidy level, ranging from differences in freight costs and local operational costs to differences in local demand and competition. We also control for quarter-year fixed effects that capture any common factors, such as national energy and food prices, that are likely to affect the price of the RNFB in these communities. Our specification for estimating average pass-through is the following OLS regression equation (for community i and period t):

$$RNFBprice_{it} = \gamma_i + \eta_t + \beta RNFBsubsidy_{it} + \epsilon_{it} \quad (3)$$

Intuitively, we use the change in price of communities that experience a zero or small subsidy increase to construct the counter-factual change in price for communities that experience a larger increase, inferring pass-through from the differential trajectory of prices in these communities. We report standard errors clustered by community.

Table 2 presents our results on average pass-through. Column 1 considers the simplest specification and estimates a pass-through of -0.67 or 67 cents on the dollar, and

we can reject full pass-through at the 1% level. Column 2 adds a control for the logarithm of the weight of subsidized goods shipped and the pass-through coefficient remains similar. The effect of scale on RNFB prices is small – a 1% increase in the weight of goods shipped corresponds to a 3.4 cent reduction in the price of the RNFB – and accounting for the “scale” effects brought about by the reform does little to change estimated pass-through. Column 3 considers the RNFB subsidy measure for only perishable goods, i.e. goods that should experience an instantaneous full marginal cost reduction when subsidy rates change. Pass-through is similar. Columns 4 and 5 break up our sample to include only the period around the October 2016 (column 4) and January 2019 (column 5) reform episodes. In both cases we can reject both zero and full pass-through at the 1% significance level. Recall that the notion of pass-through here includes both shocks to the costs of firms reporting RNFB prices but also (in most non-monopoly communities) shocks to competitor prices, so average pass-through of idiosyncratic cost shocks is expected to be lower on average. Note also that the pass-through estimated here is for the price and marginal cost of the RNFB bundle and may not apply on a product by product basis to the products in the RNFB bundle.

To assess the effect of competition on pass-through in this setting, we interact our subsidy variable with an indicator for monopoly in the community:

$$PriceRNFB_{it} = \gamma_i + \eta_t + \beta_1 RNFBsub_{it} + \beta_2 RNFBsub_{it} Monopoly_i + \epsilon_{it}. \quad (4)$$

Table 3 column 1 reports coefficients from this specification and shows that monopoly communities have substantially lower (less negative) pass-through. These pass-through estimates are for a bundle of goods such that the Weyl and Fabinger (2012) formula may not apply exactly, but they are consistent with $\theta/\epsilon_{ms} \approx 0.5$ for monopoly and $\theta \approx 0$ for non-monopolies (with $\epsilon_{ms} \approx 2$ under the additional assumption that $\theta \approx 1$ for monopolies). While all monopoly communities in our sample are subsidized, some non-monopoly communities have a non-subsidized competitor and/or more than 2 stores. Column 2 includes subsidy interactions that capture “subsidy competition” (the presence of at least two subsidized retailers) and/or three or more retailers. The coefficients are consistent with greater pass-through in these cases but are not precisely estimated, and restricting the sample to communities with monopoly or two subsidized retailers (about 80% of our sample) yields virtually identical estimates to column 1. We therefore focus on the monopoly interaction and account for other fac-

tors that may differ between monopoly and non-monopoly communities. Columns 3 through 5 sequentially add interactions of subsidy rates with community-level variables from Table 1. Column 3 adds population and average income in 2015. Column 4 adds remoteness (hub distance and latitude), surface transit mode (summer sealift and/or winter road) and indigenous characteristics (share indigenous and Inuit majority). Column 5 adds time by monopoly fixed effects and interactions with the level and five year trends of RNFB prices and per capita weight of goods shipped shipped in December 2016. Monopoly coefficient remains large and positive. Columns 6 and 7 restrict the sample to windows around the two specific reform episodes and show that both reforms feature lower subsidy pass-through for monopoly communities. These estimates indicate that pass-through for monopolies from the January 2019 subsidy changes was particularly low; the average pass-through for monopolies over the entire sample period is substantially higher because the largest subsidy variation used for identification comes from the October 2016 reform which featured higher pass-through for monopolies. For similar reasons, the average pass-through estimate in Table 2 is fairly low due to greater subsidy shocks for monopoly communities; put differently, the reforms we consider generate much more subsidy variation across monopoly versus non-monopoly communities than within each type of community.

The graphical evidence presented in Figure 1 suggests that there were no differential pre-trends correlated with future subsidy changes and we see no evidence from the policy context that the reforms were motivated by differential price trends. To investigate this more formally, we estimate the following regression:

$$RNFBprice_{it} = \gamma_i + \sum_{j=k-7}^{k+4} \eta_j d_j + \sum_{j=k-7}^{k+4} \beta_j \Delta RNFBsubsidy_{ik} * d_j + \epsilon_{it} \quad (5)$$

where d_j is a dummy equal to 1 if $t = j$ and $\Delta RNFBsubsidy_{ik}$ is the change in RNFB subsidy for community i at time k . We use eight quarters before and four quarters after each reform for our estimation window and the omitted category is 8 periods before the reform. For this exercise, we exclude three communities that display implausibly large, mean-reverting price swings during the pre-period – in one case we could confirm from the data documentation that this was due to the temporary exclusion of one retailer from the calculation of mean community prices, and we suspect that either this or a one period data entry error explain the other cases.⁷ Figure 2 re-

⁷Note that the regression results described earlier are not sensitive to excluding these communities

ports the β_j coefficients for the two reform episodes. We expect the coefficient β_j to be zero in the pre-reform period and negative in the post-reform period. The figure confirms that there are no price changes correlated with future subsidies change during the pre-period, and that pass-through is quick and relatively stable in the four quarters after each reform. The coefficient for first period after the January 2019 reform hints at delayed pass-through, which would be consistent with normal competitive dynamics of Cournot oligopoly given the LeChatelier-Samuelson principle (Alexandrov and Bedre-Defolie, 2017), but we are unable to say much more about this given the low frequency nature of our data and it could simply be an artifact of the noisiness of the period-by-period estimates.

Figure 2 also reports β_j coefficients estimated separately on monopoly and non-monopoly communities. As the October 2016 reform only affected one non-monopoly community in our sample, the period-by-period specification above generates a perfect fit; while that community shows signs of a price decline two periods before the reform took place, we cannot learn much about dynamics from a single community. For the January 2019 reform, pass-through in the pre-reform periods is not significantly different than zero for either type of community and only non-monopoly communities have pass-through significantly different than zero in the post-reform periods. The confidence intervals for monopoly and non-monopoly communities do not overlap at the 10% significance level for one of the post reform periods, and the analogous estimate pooling pre and post periods in Table 3 column 7 is significant at the 7.1% significance level. For non-monopoly communities, the point estimates are suggestive of some price movements correlated with future subsidy changes in the period immediately before the reform, but the coefficient is not significantly different than zero at conventional levels (p-value 0.198). This slight pre-trend could be interpreted as an anticipation effect as these prices were recorded between the 12th-18th of December of 2018, after the change in subsidy rates was known but potentially less than two weeks before subsidies changed (similar considerations apply to the October 2016 reform whose pre-period prices were recorded between the 12th and 18th of September 2016). Subsidies are applied to shipments, not sales, so the effective marginal cost (replacement cost) from the retailer's viewpoint may have already changed by the time prices were reported in the period(s) immediately before the reform(s). While we do not know whether marginal costs changed from the retailer's

since the price swings are mean reverting and average out in the pre and post period.

perspective at this point, our main regression results are unaffected if we omit the period immediately before a reform or classify it as part of the post-period. Altogether, we view these period-by-period estimates as supportive of a causal interpretation of the main estimates in Tables 2 and 3.

5. Conclusions

We find that pass-through of increases in the Nutrition North Canada subsidy into retail prices is below one and interpret this, together with lower pass-through rates in monopoly communities, as evidence that retailers with market power can capture a substantial share of government funds intended for marginalized populations. Our findings of large “leakage” (on the order of 33 cents per dollar of subsidy) could potentially apply to cash transfers and retail/distribution subsidy programs in similar circumstances. While our setting is extreme in terms of remoteness and market power, the Nutrition North Canada program also includes accountability measures that may lead us to underestimate the (unconstrained) effect of retail market power if these measures have any bite on firm conduct. Given our findings, we view strengthening these accountability measures through timely publication of store and product level price data, or even collection of wholesale prices, shipping costs, and store-level net profits, as worthy goals.

Future work could extend our analysis of Nutrition North subsidy reforms and consider impacts on other outcomes like nutrition, food security, consumer welfare, and inequality. The impact of cash transfers in our setting seems worth exploring as these address the same nutrition and food insecurity problems but may also be subject to similar capture by retailers. Policy interventions that increase competition – whether by increasing take-up of the subsidies by independent stores, subsidizing mail shipments from non-local retailers, or through in-kind transfers or government retail similar to India’s Public Distribution System or Greenland’s state-run stores (Li, 2023; Galloway, 2017) – may also be worth considering. Recent program enhancements requested by these communities are also worth evaluating as they provide more funds for local food harvesting and community food security initiatives that have the potential to enhance competition and buyer market-power.

References

- Alexandrov, A. and D.F. Spulber, "Sufficient Decisions in Multi-Sided and Multiproduct Markets," *Journal of Industrial Economics*, 2017, 65(4), 739–766.
- and O. Bedre-Defolie, "LeChatelier-Samuleson principle in games and pass-through of shocks," *Journal of Economic Theory*, 2017, 168, 44–54.
- Angelucci, M. and G. De Giorgi, "Indirect Effects of an Aid Program: How Do Cash Transfers Affect Ineligibles' Consumption?," *American Economic Review*, 2009, 99, 486–508.
- Armstrong, M. and J. Vickers, "Multiproduct Pricing Made Simple," *Journal of Political Economy*, 2017, 126(4), 1444–1471.
- Burnett, K., K. Skinner, and J. Leblanc, "From Food Mail to Nutrition North Canada: reconsidering federal food subsidy programs for northern Ontario," *Canadian Food Studies*, 2015, 2.
- , —, T. Hay, J. Leblanc, and L. Chambers, "Retail food environments, shopping experiences, First Nations and the provincial Norths," *Health Promotion and Chronic Disease Prevention in Canada*, 2017, 37(10).
- Campos-Vazquez, R. and E. M. Medina-Cortina, "Pass-through and competition: the impact of soft drink taxes as seen through Mexican supermarkets," *Latin American Economic Review*, 2019, 28(3).
- Crown-Indigenous Relations and Northern Affairs Canada, "Horizontal Evaluation of Nutrition North Canada," 2020.
- Cunha, Jesse, Giacomo De Giorgi, and Seema Jayachandran, "The Price Effects of Cash Versus In-Kind Transfers," *Review of Economic Studies*, 2019, 86(1).
- Egger, D., J. Haushofer, E. Miguel, P. Niehaus, and M. Walker, "General Equilibrium Effects of Cash Transfers: Experimental Evidence From Kenya," *Econometrica*, 2022, 90(6), 2603–2643.
- Filmer, D., J. Friedman, E. Kandpal, and J. Onishi, "Cash Transfers, Food Prices, and Nutrition Impacts on Ineligible Children," *Review of Economics and Statistics*, 2022, 105(2), 1–45.

- Fishback, P., "Did Coal Miners "Owe Their Souls to the Company Store"? Theory and Evidence from the Early 1900s," *Journal of Economic History*, 1986, 46(4), 1011–1029.
- Galloway, T., "Is the Nutrition North Canada retail subsidy program meeting the goal of making nutritious and perishable food more accessible and affordable in the North?," *Canada Journal of Public Health*, 2014, 105(5).
- , "Canada's northern food subsidy Nutrition North Canada: a comprehensive program evaluation," *International Journal of Circumpolar Health*, 2017, 76.
- Genakos, C. and M. Pagliero, "Competition and Pass-Through: Evidence from Isolated Markets," *American Economic Journal: Applied*, 2022, 14(4), 35–57.
- , F. Grey, and R. Ritz, "Generalized linear competition: From pass-through to policy," *EPRG Working Paper*, 2020.
- Glacken, J.B. and F. Hill, "The Food Mail Pilot Project: Achievements and Challenges," 2009.
- Goldin, J., T. Homonoff, and K. Meckel, "Issuance and incidence: SNAP benefit cycles and grocery prices," *American Economic Journal: Policy*, 2022, 14, 152–178.
- Government of Canada, "Nutrition North Website," <https://www.nutritionnorthcanada.gc.ca/eng/1415385762263/1415385790537> 2022. Accessed: 2022-12-16.
- Hastings, J. and E. Washington, "The first of the month effect: consumer behavior and store responses," *American Economic Journal: Policy*, 2010, 2, 142–162.
- Hong, G.H. and N. Li, "Market Structure and Cost Pass-Through in Retail," *Review of Economics and Statistics*, 2017, 99(1).
- Indigenous and Northern Affairs Canada, "Food Mail Review – Interim Report," 2009.
- Jones, Damon and Ioana Marinescu, "Universal Cash Transfers and Inflation," *Working Paper*, 2022.
- Leblanc-Laurendeau, O., "Food insecurity in Northern Canada: an Overview," *Library of Parliament Background Paper 2020-47-E*, 2020.

- Li, N., "In-kind transfers, marketization costs and household specialization: Evidence from Indian Farmers," *Journal of Development Economics*, 2023, 164.
- Miller, N. H., M. Osborne, and G. Sheu, "Pass-Through in a Concentrated Industry: Empirical Evidence and Regulatory Implications," *RAND Journal of Economics*, 2017, 48(1), 69–93.
- Mitchell, M., *From Talking Chiefs to a Native Corporate Elite: The Birth of Class and Nationalism among Canadian Inuit*, McGill-Queen's University Press, 1996.
- Muehlegger, E. and R. L. Sweeney, "Pass-Through of Own and Rival Cost Shocks: Evidence from the U.S. Fracking Boom," *Review of Economics and Statistics*, 2022, 104(6), 1361–1369.
- Naylor, J., B.J. Deaton, and A. Ker, "Assessing the effect of food retail subsidies on the price of food in remote Indigenous communities in Canada," *Food Policy*, 2020, 93.
- Ritz, R. A., "Does competition increase pass-through?," *Energy Policy Research Group Working Paper*, 2022, 1929.
- Weyl, E. G. and M. Fabinger, "Pass-Through as an Economic Tool: Principles of Incidence under Imperfect Competition," *Journal of Political Economy*, 2012, 121(3).

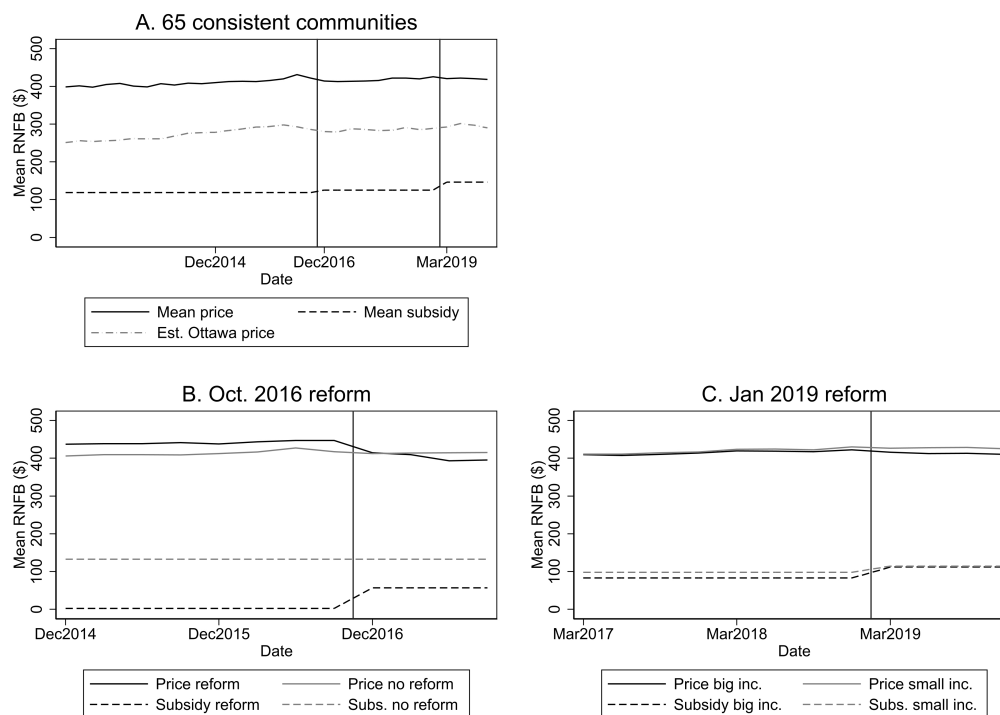


Figure 1: Mean RNFB prices and subsidies over time. Graphs display mean price and subsidy content of RNFB for communities that consistently report data for entire sample period (panel A) or around the October 2016 and January 2019 subsidy reforms (panels B and C). Reform dates are denoted by vertical lines. The estimated Ottawa price is based on all-Canada average price movements for similar items to the RNFB deflated to equal the Ottawa RNFB price in 2010. For the October 2016 reform (panel B), only 11 sample communities (“reform”) experienced an increase in subsidies. For the January 2019 reform (panel C), all communities experienced a subsidy increase – the panel splits communities into those with a “big” (top 25%) and “small” (bottom 25%) subsidy increase.

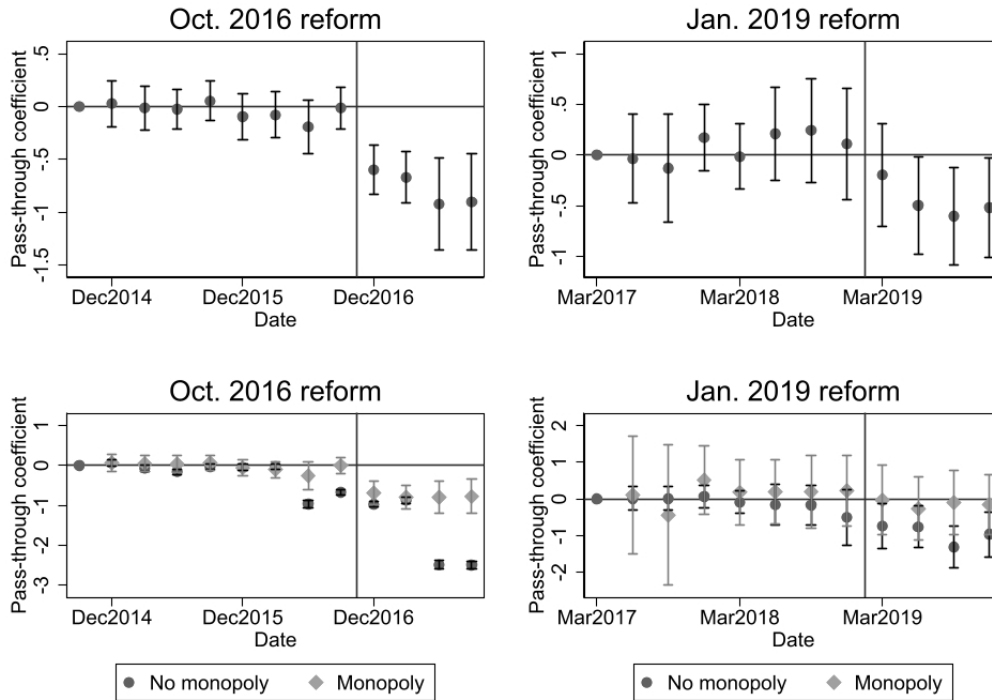


Figure 2: Period by period pass-through estimates. Graph displays the β_j coefficients and 95% confidence intervals from estimating the regression $RNFBprice_{it} = \gamma_i + \sum_{j=k-7}^{k+4} \eta_j d_j + \sum_{j=k-7}^{k+4} \beta_j \Delta RNFBsubsidy_{ik} * d_j + \epsilon_{it}$ where d_j is a dummy equal to 1 when $t = j$. The sample window includes 8 quarters before and four quarters after the reform at time k (denoted by the vertical line), so the omitted category is the period eight quarters before the reform ($k - 8$). There is only one non-monopoly community affected by the October 2016 reform in our sample so standard errors are undefined in this case when splitting sample communities by monopoly status. Note that retailers were aware of future subsidy changes at least one period before each reform such that there may be some anticipatory effects for these periods (see text for further discussion).

Table 1: Community-level summary statistics for RNFB sample

Communities	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	Obs.	Mean	St.Dev.	Min	Max	Mean	Mean	P-value
			All			Non-monop.	Monop.	Difference
Population	83	1084	1011	195	7585	1275	823	0.03
Average income	77	32334	14600	13923	100820	38851	23170	0.00
Avg. gov. income	77	7602	1515	3641	10564	7508	7735	0.50
Pop growth 2010-2015	83	0.02	0.17	-0.8	0.44	0.03	0.01	0.63
Inc. growth 2010-2015	61	0.17	0.13	-0.18	0.41	0.16	0.19	0.48
Latitude	83	59.58	6.68	43.01	73.02	62.37	55.74	0.00
Hub distance (km)	83	1018	781	55	3118	1345	571	0.00
Summer sealift	83	0.63	0.49	0	1	0.83	0.34	0.00
Winter road	83	0.53	0.5	0	1	0.31	0.83	0.00
Runway length (m)	83	3893	978	1899	8605	4127	3574	0.00
Flights	58	3478	4073	398	20178	3889	2633	0.21
Share indigenous	83	0.94	0.11	0.26	1	0.91	0.98	0.00
Inuit	83	0.51	0.5	0	1	0.75	0.17	0.00
Hudson Bay Company date	52	1875	69	1679	1950	1901	1815	0.00
Monopoly	83	0.42	0.5	0	1	0	1	.
Northern store	83	0.94	0.24	0	1	1	0.86	0.02
Co-op store	83	0.47	0.5	0	1	0.71	0.14	0.00
Retailers	83	1.69	0.7	1	4	2.19	1	0.00
Registered retailers	83	1.46	0.53	1	3	1.79	1	0.00
Largest retailer size (sq.ft.)	68	10735	7717	1600	47553	11770	8836	0.08
RNFB subsidy	83	113	73	47	364	137	80	0.00
RNFB price	83	417	31	363	517	418	414	0.56
Shipped weight per capita	83	78	30	0	262	81	75	0.34
Δ RNFB price	73	13.68	18.04	-27.63	61.35	11.25	18.08	0.12
Δ weight p.c.	83	0.8	8.6	-25.73	33.86	0.14	1.72	0.42
Δ subs. Oct.2016	83	7.21	18.68	0.00	60.01	1.25	15.38	0.00
Δ subs. Jan.2019	80	22.50	8.03	16.64	77.66	21.72	23.62	0.26

Summary statistics for all communities that report RNFB price data in Dec. 2017. Income, population, and share indigenous come from the 2016 and 2011 censuses. RNFB, subsidy, retail competition, distance, latitude, and sealift/winter road access come from the CIRNAC community profiles posted on the Nutrition North website. Store size, Hudson Bay Company, Inuit identity, and airport characteristics are collected by the authors from Wikipedia and Google Maps. Changes in RNFB price and weight shipped per capita are measured from 2014Q3-2016Q3.

Table 2: Average pass-through of subsidy changes. Dependent variable is the community-level RNFB cost in current dollars.

	(1)	(2)	(3)	(4)	(5)
Period	Full sample (2012Q1-2020Q1)			Oct.2016 reform	Jan.2019 reform
RNFB subsidy value	-0.669 (0.080)	-0.595 (0.068)		-0.733 (0.114)	-0.545 (0.168)
Log(weight shipped)		-3.337 (1.768)	-3.403 (1.780)		
RNFB perishable subsidy value			-0.617 (0.072)		
Community Fixed Effects	Y	Y	Y	Y	Y
Time Fixed Effects	Y	Y	Y	Y	Y
Observations	2,457	2,405	2,405	923	956
Adj R-squared	0.819	0.828	0.827	0.849	0.855

Standard errors clustered by community in parentheses. RNFB subsidy value is calculated by multiplying weight of item in RNFB by the subsidy/weight for that item, community and period using subsidy data provided by CIRNAC. Weight subsidized is the quarterly weight of subsidized goods shipped to the community reported to CIRNAC. Columns 4 and 5 use the eight quarters before and four quarters after each reform.

Table 3: Heterogeneous pass-through of subsidy changes. Dependent variable is the community-level RNFB cost in current dollars.

Period	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Mar2012-Dec2019					Oct.2016 reform	Jan.2019 reform
RNFB subsidy value	-1.132 (0.113)	-1.076 (0.160)	-0.787 (0.304)	0.905 (1.032)	-0.611 (1.010)	-1.471 (0.026)	-0.842 (0.212)
RNFB subsidy X Monopoly	0.461 (0.099)	0.392 (0.148)	0.361 (0.136)	0.181 (0.106)	0.690 (0.252)	0.729 (0.094)	0.581 (0.318)
RNFB subsidy x Subsidy comp.		-0.169 (0.173)					
RNFB subsidy x 3+ stores		-0.016 (0.453)					
RNFB subsidy x Avg. Inc.(000s)			-0.008 (0.008)	-0.016 (0.013)	-0.023 (0.011)		
RNFB subsidy x Pop. (000s)			-0.123 (0.067)	-0.187 (0.094)	-0.188 (0.089)		
RNFB subsidy x Hub dist. (000km)				-0.368 (0.140)	-0.286 (0.139)		
RNFB subsidy x Latitude				0.012 (0.011)	0.027 (0.015)		
RNFB subsidy x Summer sealift				0.131 (0.117)	0.196 (0.097)		
RNFB subsidy x Winter road				-0.536 (0.398)	0.703 (0.306)		
RNFB subsidy x Inuit				-0.411 (0.380)	0.569 (0.271)		
RNFB subsidy x Share indig.				-1.281 (0.673)	-1.687 (0.656)		
RNFB subsidy x Weight p.c.*					0.001 (0.002)		
RNFB subsidy x RNFB price*					-0.002 (0.001)		
RNFB subsidy x Δ weight p.c.*					0.007 (0.003)		
RNFB subsidy x Δ RNFB price*					0.005 (0.006)		
Community Fixed Effects	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y
Time x Monopoly FE	N	N	N	N	Y	Y	Y
Observations	2,457	2,457	2,288	2,254	2,148	923	956
Adj R-squared	0.822	0.822	0.811	0.797	0.812	0.857	0.857

Standard errors clustered by community in parentheses. RNFB subsidy value is calculated by multiplying weight of item in RNFB by the subsidy/weight for that item, community and period using subsidy data provided by CIRNAC. Income, population, and share indigenous come from the 2016 census. RNFB price, subsidy, retail competition, distance, latitude, and sealift/winter road access come from the CIRNAC community profiles posted on the Nutrition North website. Store size, Hudson Bay Company, Inuit identity, and airport characteristics are collected by the authors from Wikipedia and Google Maps. *RNFB price and weight shipped p.c. are measured in 2016Q4 (levels) and 2014Q3-2016Q3 (changes). Columns 6 and 7 use the eight quarters before and four quarters after each reform.