Borders, varieties and distribution costs: Evidence from a US-Canada retail chain

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Abstract. Using data from a large retailer operating in Canada and the United States, I examine how market size and retailer size at the local and regional level shape the variety of products available to consumers at a given store. The average Canadian store carries many fewer varieties and I show that this has a potentially large (negative) effect on consumer welfare for Canadian (versus American) shoppers. I propose a novel method to quantify the international difference in retail distribution costs and find evidence that they are much higher in Canada. Exploiting intra-national variation in market and retailer characteristics, I find that up to a quarter of the international variety gap can be explained by observed local and regional market characteristics that lead to larger retail scale in the United States. I also show that retailer scale has independent effects on product variety, conditional on market characteristics, and that manufacturer size and retailer size are substitutes in distribution.

Résumé.

JEL classification: F14, F15, L81, R12

1. Introduction

Large retailers help distribute tens of thousands of products manufactured by other firms to consumers. Technological advances – the introduction of barcodes and scanners (Messinger and Narasimhan (1995), Holmes (2001), Basker (2015)) and more recently complementary innovations in logistics (Holmes (2011), Holmes and Singer (2018)) and information technology –

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have led to growing dominance in distribution by large retailers. This has been accompanied by increasing retail concentration in the United States (Autor et al. (2017)) and a recent wave of retail acquisitions in Canada (Lobwlaw's, Sobey's and Metro). With the notable exception of e-commerce giant Amazon, these retailers are large at both the outlet level, with large stores carrying tens of thousands of products across many product categories, and the chain level, with many stores per chain organized into multiple regional clusters (Ellickson (2007), Bronnenberg and Ellickson (2015)). Despite the important role played by these large retailers in the provision of variety to consumers, the literature on large retailers has mainly focused on the effects of entry on wages, prices, and overall consumer welfare (e.g. Hausman and Leibtag (2007) and Atkin et al. (2018) on the effects of Wal-Mart entry). The literature on geographic differences in product variety has abstracted from the internal organization of large retailers, instead focusing on variety pooled across multiple retailers (Handbury and Weinstein (2015), Handbury (2013)) or differences in retail competition (Hottman (2017)) across cities. Given the growing dominance of large retailers and their effects on distribution costs, upstream and horizontal competition, and ultimately consumer welfare, understanding their role in the provision of variety across space and international borders is important.

This paper uses a unique data set on store-level product variety for a large retailer operating in Canada and the United States to explore how economic geography and retailer characteristics shape the international and intra-national provision of variety. Although the analysis is confined to a single retail chain, there is substantial variation in product variety across its stores. Panel A of Figure 1 plots the distribution of store-level variety (unique UPCs) sold in 2005 for 308 stores operated by the retailer. The figure shows high dispersion in store-level variety within each country and higher average store-level variety in the US compared to Canada. In addition to being the only product-level retailer data set covering regions of both Canada and the US[1], the data are unique in providing detailed information on retailer organization and characteristics that, when combined with data on the local and regional markets served, provides insights into retail organization and its contribution to product variety. I use the data to make three main contributions: providing the first estimates of Canada-US variety differences and their consumer welfare implications, providing a novel theoretically motivated estimate of Canada-US differences in the cost of distributing varieties, and providing an accounting of

1 To the best of my knowledge, the only scanner data set covering both Canada and the US that has been analyzed previously was used in Broda and Weinstein (2008) for the 2001-2003 period. They combined ACNielsen Homescan data for the US covering 45 US cities with similar data for 15 regions in Canada. Their analysis focuses on regional/city price differences and does not consider retailers. These data are no longer available to researchers and there is unfortunately no current equivalent to the Kilts Center for data dissemination to academics by Nielsen Canada.

the contribution of local, regional, and retail factors to store variety differences within and across countries.

The Canada-US variety differences I identify for the retailer are much larger at the country level than the store level, with considerable overlap in the products offered across Canadian stores and regions but large regional differences in the set of products offered at American stores. But even at the store-level, the average US shopper at this retail chain has access to 40% more varieties than their Canadian counterpart. This difference is not driven by differences in the broad product groups available in each country but by differences in variety within them, particularly for manufactured packaged goods. Over 80% more firms serve the average American store (Figure 1 Panel B), but most of these firms are small and sell varieties that are marginal from a revenue standpoint. Differences in store variety are smaller for large multinational manufacturing firms (Figure 1 Panel C) and for private-label (store-brand) varieties. Using several definitions of "common" goods between Canadian and American stores, I show that the large average variety difference translates into more modest welfare differences in a CES demand framework, but Canadian consumers still have substantially lower welfare than American consumers from restricted variety (1%-6% expenditure equivalent using a conservative elasticity of substitution of 7). These welfare differences, estimated for stores of a particular retailer, are likely to extend to the grocery sector overall because Canadian stores capture a similar local market share as American stores despite featuring higher prices and less variety.

I next turn to a novel estimate of differences in variety distribution costs across countries. The intuition for my measure is that a profit-maximizing retailer will increase store variety up to the point that the increase in variable profits equals the marginal cost of distributing an additional variety. Differences in the profit-variety slope across locations can then be used to estimate differences in variety distribution costs at the margin. Using multiple sources of intra-national variation in store variety, I show that this profit-variety slope is much higher in Canada, consistent with the notion that retail distribution costs are higher in Canada and play an important role in generating the lower level of variety observed in Canada.

In the last part of the paper, I explore the local, regional and retailer-specific factors that can account for international and intra-national differences in store-level product variety. Retailer scale – both at the store level and at a regional/distribution center scale –is much larger in the US and can account for a substantial share of the international variety difference. I show that these differences in scale matter both when they are endogenously related to economic geography and when they are generated by plausibly exogenous factors related to the historic expansion of the retailer. Although Canadian and American stores serve local markets that are fairly similar in terms of population, income, and competition, regional market size is much larger in the US and this is the relevant scale for the organization of store clusters around distribution centers. I also find evidence consistent with an advantage in international and intra-national distribution for the largest multinational firms, whose store variety is less sensitive to the border and also less sensitive to retailer size; retailer and manufacturer size therefore appear to be substitutes in distribution. Retailer scale differences play a more important role for international and intra-national differences in variety for goods that are not manufactured (e.g. meat, seafood, produce) and for varieties manufactured by smaller firms (including private labels), with the largest part of the unexplained Canada-US variety gap driven by small manufacturing firms. Overall, I find that differences in local/regional economic geography and retail organization can account for over a quarter of the store-level differences in variety between Canada and the US.

This paper sits at the intersection of several literatures. The literature on border effects has largely focused on quantifying the magnitude and causes of international price differences, with much of the recent literature (including several papers using the same single retailer data set) focused on Canada-US price differences (Broda and Weinstein (2008), Gopinath et al. (2011), Burstein and Jaimovich (2012) , Senate of Canada (2013), Cavallo et al. (2014)). The implications of international borders for product variety are less explored despite the fact that differences in firm entry/competition are a potential contributor to international price differences (through pricing to market) and also a complicating factor (given differences in retailer and product specifications across countries). The literature on spatial product variety differences has shown that city-level differences in population and income affect the city-level set of varieties available in the US (Handbury and Weinstein (2015), Handbury (2013)) and that the number of retailers matters for consumer welfare through variety and markup effects (Hottman (2017)) but has so far ignored the role of retailer scale.

It is well known that firms like Wal-Mart leverage distribution centers, store network density, superior logistics and international trade to attain a competitive advantage (Holmes (2011), Holmes and Singer (2018)), and that their entry can increase consumer welfare through several mechanisms (Hausman and Leibtag (2007), Atkin et al. (2018)). While the link between retailer size and product variety is widely recognized (Bronnenberg and Ellickson (2015)), there is little direct evidence because detailed data on retailer organization is rarely linked to product data. The most related paper to mine is Ellickson (2007), who uses data on US retailers to show that firms in larger markets operate a larger number of stores that are also physically larger. Ellickson (2007) shows that this is consistent with a model of endogenous fixed costs where firms compete on variety (proxied by store size) and it is optimal for firms to provide higher variety in larger markets. Ellickson (2007)'s focus is on how this feature of retail competition limits the ability of larger markets to support more retail competition, because larger markets require firms to incur higher fixed costs to be competitive. My paper complements the analysis in

Ellickson (2007) by incorporating product-level data to supplement data on market size and retailer organization, allowing me to shed light on how market size, store size, and regional firm size directly correlate with store-level product variety. I am also able to leverage product-level data to estimate international differences in consumer welfare and variety distribution costs.

The paper is organized as follows. Section 2 of the paper provides a simple model to frame and motivate the subsequent analysis of consumer welfare, distribution costs and determinants of store variety. Section 3 discusses the data. Section 4 presents the mean cross-country differences in variety and their implications for welfare. Section 5 estimates distribution cost differences across countries. Section 6 explores the local, regional, and retailer factors associated with store variety, while Section 7 offers concluding comments.

2. Model

Consider a simple partial equilibrium model of retail, with local demand represented by a two-tiered nested CES demand function. The upper-tier aggregates across retail stores in a location, with elasticity of substitution between stores given by ρ and associated cost-of-living index given by $P = \left(\sum_{j\in\Omega} d_j P_j^{1-\rho}\right)^{1/(1-\rho)}$, where j indexes stores, Ω is the set of stores operating in the location and d_j is a demand shifter capturing store amenities. The lower-tier aggregates across varieties within each store, with elasticity of substitution between varieties given by σ and associated store-level price index given by $P_j = \left(\sum_{i\in\Omega_j} d_{ij} p_{ij}^{1-\sigma}\right)^{1/(1-\sigma)}$, where i indexes varieties, Ω_j is the set of varieties offered by store j and d_{ij} is a demand shifter for each variety at the store-level.

If one assumes that (i) d_j is the same within a retail chain, (ii) d_{ij} is the same for a given set of (possibly identical) varieties across stores, and (iii) σ is common across locations, the Feenstra (1994) index provides a simple way to estimate differences in store price indexes. I calculate this object in section 4. With the data available I only observe differences in variety and expenditures within stores of the retail chain. This only captures the cost-of-living differences across locations for a hypothetical consumer that exclusively shops at stores of this chain, ignoring differences in the attractiveness of outside options. Although I lack data to compare outside options across countries, the demand framework above implies that differences in outside options should be reflected in store revenue and market share. Where store market shares are higher, because P is higher relative to P_j, the outside options are worse. Thus to supplement my within-retailer estimates of store price index differences across countries I provide suggestive evidence that these are a lower bound – Canadian stores of the retail chain have similar or higher revenues conditional on the (estimated) measures of local market size despite having fewer varieties and higher prices.

Given the consumer demand specified above, retailers can always lower their store price index and increase market share, revenues, and profits by adding varieties. Adding more varieties entails a cannibalization effect because some of their consumption comes at the expense of other varieties sold by the store, but the retailer still increases its market share relative to others and this effect dominates. Given potentially unlimited demand for variety by consumers, a simple and realistic way to bound the retailer's demand for variety is to assume that adding more varieties is costly.[2] These costs range from the obvious – selling more varieties requires more shelf space – to more subtle costs related to inventory management and distribution. Holmes (2001) and Basker (2015) show that the latter are important in the history of retail in North America, as the development of barcodes and scanner technology led to physically larger stores that could stock more varieties and larger retail chains that could take advantage of economies of scale and density in distribution. The presence of variety costs highlights a general first-order condition faced by retailers in their variety optimization decision:

$$\underbrace{\frac{\partial \pi(n,Z)}{\partial n}}_{Marginal\ benefit\ of\ variety} = \underbrace{\frac{\partial F(n)}{\partial n}}_{Marginal\ cost\ of\ variety} \tag{1}$$

where $\pi(n, Z)$ is the variable profit of the retailer that depends on both variety n and other factors Z (which include prices and consumer demand). $F(n)$ is a general variety cost function with $F' > 0$. Variable profits for the retailer may be a constant fraction of revenues, in which case one can substitute variable profit for revenue times a constant in the equation above. For example, the CES demand function above features constant retail markups over marginal cost and hence constant variable profits as a function of revenue ($\pi = Rev/\rho$) if retailers are monopolistic competitors. Many retailers appear to implement uniform pricing across stores that ignores local demand and competition (Dellavigna and Gentzkow (2019)) and this chain can be characterized as engaging in near-uniform pricing within regions (Eichenbuam et al. (2011), Burstein and Jaimovich (2012)).

The first-order condition above implies that the relationship between revenue or variable profit and store variety is potentially informative about differences in the cost of distributing more variety, even under demand systems with complex spillovers across varieties and product categories within stores. Intuitively, if differences in variety across stores are driven by differences in

2 More generally, the demand for variety by the retailer could be bounded with different assumptions about consumer demand, but differences in the cost of providing variety are likely to still play an important role for explaining differences in store variety across locations.

distribution costs, a larger difference in revenues/profits associated with a given difference in variety implies that providing that variety must be more costly. In section 5 I use this insight to provide evidence that the distribution costs of variety is (on average) higher in Canada than the US for this retailer. I do this by analyzing the relationship between revenue and store variety *within* each country using variation in n that is plausibly orthogonal to Z.

To see how both demand factors and distribution costs together shape the equilibrium variety choice for each store, consider a simple parametrization of the store price index and the variety cost function as exponential functions of variety n (a retailer analogue of the consumer analyzed in Li (Forthcoming)). The store price index is represented by $P_j = pn^{-\psi}$ where p is a common price shifter and ψ parametrizes the marginal benefit of variety and depends on both the elasticity of substitution across varieties (σ) and the degree to which marginal varieties are less valuable to consumers than infra-marginal varieties due to price or quality/taste differences across markets.[3] The variety cost index is given by $F(n) = Fn^{\epsilon}$, where $\epsilon = 1$ would imply that the marginal cost of adding variety is constant. The retailer's optimization problem (assuming variable profits are a constant fraction of revenues) is:

$$\max_{n_j} \frac{Y_i}{\rho} \left(\frac{d_j [p_j n_j^{-\psi_j}]}{P} \right)^{1-\rho} - F_j n_j^{\epsilon_j} \tag{2}$$

with first-order condition:

$$\frac{1}{\rho} P^{\rho-1} Y(\rho - 1)\psi_j p_j d_j n^{\psi\rho-\psi-1} = F_j \epsilon_j n_j^{\epsilon_j - 1} \tag{3}$$

Profit maximization yields the following solution for n:

$$n_j = \left[\frac{P^{\rho-1} Y(\rho-1)\psi_j p_j d_j}{F_j \epsilon_j} \right]^{\frac{1}{\epsilon_j + \psi_j - \psi_j \rho}} \tag{4}$$

The solution highlights the different factors that could drive differences in store-level variety: differences in total market demand/expenditures (Y), local retail competition ($P^{1-\rho}$), local taste for variety (ψ_j) and variety prices (p_j, ψ_j), local taste for the retailer's amenities (d_j), and differences in the store-level distribution cost parameters (F_j, ϵ_j) that could be further decomposed into local, regional, and national aspects of distribution by retailers and manufacturers.

In section 6 of the paper, I examine the extent to which local, regional, and retailer characteristics predict store variety differences within and across

3 With symmetric varieties $\psi = 1/(\sigma - 1)$, where σ is the elasticity of substitution across varieties, but more generally marginal varieties could be more expensive or less valuable to consumers for other reasons, leading to an elasticity of the store price index with respect to variety of less than $1/(\sigma - 1)$, see Li (Forthcoming).

countries. Within country variation in these characteristics allows me to assess how much of the average Canada-US difference in variety is due to observable differences in local and regional market size, retail competition, and retailer characteristics. Note that in the long-run, retailer characteristics are themselves endogenous with respect to market size and competition when the retailer can open, close and remodel stores and distribution centers. Similarly, population, taste for variety, retail competition, and manufacturer activity are all potentially endogenous with respect to retailer characteristics. While my analysis in section 6 is thus largely based on the strength of different conditional correlations, I provide evidence that larger retailer size causes more store variety by leveraging the historical expansion of the retailer to generate plausibly exogenous variation.

3. Data

The retailer data come from one of North America's largest retail chains, a chain that has been studied extensively in terms of international and intra-national pricing (see Gopinath et al. (2011), Eichenbuam et al. (2011), Burstein and Jaimovich (2012), **?**,and Hong and Li (2017)). The chain focuses on groceries but also sells other household goods, and carries a large range of branded goods manufactured externally, in-store produced items (e.g. bakery and prepared foods), and private label (store brand) goods. The retailer owns and operates many distribution centers through which it receives the majority of its products, and these products are then shipped to stores by the retailer's trucks. It also receives direct-store-delivery products from manufacturers and distributors. The agreement with the retailer precludes disclosure of the retailer's identity but given the characteristics above it can be characterized as representative of the "conventional" grocery chains operating in the 2000s, distinct from emerging giants with larger scale and/or completely different distribution features (e.g. Wal-Mart and Amazon) or specialty high-end (e.g. Whole Foods, Trader Joe's) or low-end (e.g. Dollar Tree) focused chains.[4] It is unique mainly in being one of the few grocery retail chains with operations in both Canada and the US, and the combination of international and intra-national variation across diverse regions of each country is critical

4 Note that although the importance of "conventional" grocery stores has diminished in the last few decades, they are still the dominant source for "fast moving consumer packaged goods." According to Nielsen in 2018 these are responsible for about half of all shopping trips and expenditures (vs. discount stores, mass-merchandisers, convenience stores, drug stores, specialty stores, etc.) for Canada (https://www.nielsen.com/ca/en/insights/article/2018/purchasing-behaviour-characteristics-across-canada/) and the United States (https://www.nielsen.com/wp-content/uploads/sites/3/2019/04/december-2018-total-consumer-report.pdf). On-line purchases are still rare for these types of goods in both countries.

to identifying the importance of local and regional (versus national) factors affecting store variety.

The retailer scanner data set records weekly UPC-level revenue, quantities, and costs for all products sold in 250 stores in the US and 75 stores in Canada between January 2004 and May 2007. The retailer operates many more stores in both countries (over 1700) and there is complete data on store characteristics such as the address, year opened/closed, and store size (total building area and total selling area in square feet). Retail stores are grouped into 13 "operating areas" in the data (10 for the US and 3 for Canada) and the scanner data represent 25 randomly chosen stores from each of the 10 American and 3 Canadian "operating areas" for the retailer. I supplement this with information on the location and size (in square feet) of the 15 mainland distribution centers operated by the retailer taken from corporate reports. These are typically located on the outskirts of the largest city in the region. Three of the operating areas have two distribution centers, with one for each of the largest cities, and two operating areas share a distribution center. Appendix Figure A.1 presents a map of the retailer's store and distribution center locations. For the rest of the analysis what I call regions and "operating areas" correspond to the 15 distribution centers.

From this initial scanner sample, I exclude several small stores that carry only a small set of product groups. I also exclude stores outside the continental US, as there are only a few such stores and they are likely subject to different distribution issues. For most of the analysis I present results for the year 2005 and exclude stores that were only open for part of the year (e.g. due to renovations or store opening/closing part way through the year). This leaves a core sample of 308 stores (236 in the US and 72 in Canada) for the analysis based on product-level scanner data, and a larger set of 1689 stores that satisfy the same selection criteria for the analysis of retailer characteristics.

I supplement the retailer data with data on the characteristics of the local and regional markets served by the retailer. I use the most disaggregated data available, typically zipcode for the US and census subdivision for Canada, although for some variables the data are only available at the county-level for the US and population for Canada is available at the more disaggregated designated area level. From the population census I get population and median household income (converted to 2005 US dollars) for 2000-2001, and from the economic census I get the number of grocery stores (NAICS code 445110) and the number of food manufacturing plants (NAICS code 311) for 2005. I report results defining "local" characteristics as within 5km of a store's geocoded address and "regional" characteristics as within 300km of a distribution area's geocoded address. Specifically, I estimate the proportion of each census geographic unit within a given radius of the store or distribution center address, and then assign this fraction of the unit's total mass to the address. I choose these distances both because they provide the best fit (highest R^2) for predicting store product variety, but also because they correspond to typical consumer shopping patterns and regional retail organization. The average US household travels 6km to their primary grocery store (Ploeg et al. (2015)) and most stores are located within 300km of a distribution center (for the US the average distribution center is 330km from its most distant store). The results I present are robust to choosing different "local" and "regional" distances as they tend to be highly correlated within a reasonable range; the 5km local store measure has a correlation above 0.93 for all variables within a 2km to 10km radius, and the 300km regional distribution center measure has a correlation over 0.88 with all variables within a 20km to 500km radius.[5] I also collect data on housing prices from Zillow and the Canada Mortgage and Housing Corporation (converted to 2005 US dollars) for the closest zipcode or census subdivision with available data.

4. International differences in product variety and welfare

4.1. International variety differences

Table 1 presents data on the number of products with distinct barcodes (UPCs) sold in Canada and the US in 2005. Figure 1 shows that there is considerable variation across stores within each country but first I focus on average cross-country differences. I report the number of unique UPCs sold in each country (across all 236 US and 72 Canada sample stores), the number of unique UPCs sold in the average operating area in each country, and the number of unique UPCs sold in the average store in each country. Including all UPCs in the data (first row), the retailer sells over 200% more unique product varieties in the US but only 50% more for the average US operating area or store. This fact indicates that there is considerable overlap in the UPCs available across Canadian regions relative to the overlap across US regions.

One potential explanation for the difference in UPCs across countries is that some types of goods are not sold in Canada. The retailer reports a "product group" identifier for each UPC, with 62 product groups available in the sample stores (see Appendix Table A.1 for a partial list). The most important product group not available in all stores is alcohol, which features many unique UPCs but has different levels of availability in the retailer's stores based on state, province and sometimes county-level regulations. Jurisdictions vary in terms of whether (and if so, which) alcohol products can be sold privately and inside a grocery store. The other product groups that are often missing from the 308 scanner sample stores are automotive/hardware, greeting cards, seasonal/promotional items and specialty organics, although these are much less important than alcohol in terms of revenues or numbers of UPCs.

5 I have also collected data from Simply Analytics for Canada and a subset of locations in the US that contain the precise addresses and geocodes of all NAICS 445110 stores in 2019. Despite the large amount of time that elapsed between the data sets, the correlation with my measure using a 5km radius is 0.9 for the US and 0.83 for Canada.

Altogether, these groups make up about 5% of total sales in the sample, mostly in the US. The gap in UPCs is very similar when I exclude these groups (second row), so I do this for the rest of the analysis to focus on product variety differences within a set of product groups that are common to all sample stores.

Another potential explanation for the difference in UPCs is that the US has higher product churn or more special promotions, leading to the appearance of more UPCs within a given year but really amounting to cycling through more unique UPCs within a year for what is essentially the same product. When I exclude UPCs that are not observed at least once in 2004, 2005 and 2006, the fraction of sales generated by these "consistent" UPCs is slightly reduced and the number of UPCs is significantly reduced, but the Canada-US variety gaps are similar (third row).

The next two rows of Table 1 consider particular groups of goods where we might expect higher trade barriers. Looking only at products that are NAFTA-exempt (i.e. Canadian supply-managed dairy and poultry protected by quotas/prohibitive tariffs) leaves the gap at about 50%. Excluding all goods without fixed weight units, such as produce and most meat and fresh seafood products, also leaves a similar sized gap.

About two thirds of the UPCs in the sample are in product groups that can be classified as "packaged goods" or "manufacturer UPCs," UPCs sold with fixed weights that are manufactured outside the store. Restricting to these groups excludes food service and in-store bakeries as well as floral, meat, seafood, and produce departments. For the packaged goods/manufacturer UPC groups I use manufacturer codes (the first five digits of a UPC) and product descriptions provided by the retailer to identify the firm that manufactured the UPC. For private label (store brand) goods the manufacturer is unknown in most cases so I treat these as a single separate company (Hong and Li (2017)). I use these data to measure the number of firms selling products in the retailer's stores. These "manufacturer UPCs" make up over 58% of total retailer revenue in the sample. They feature a similar US-Canada gap in UPCs, about 200% at the country level and 50% at the store level. The US-Canada gap in the number of unique firms is substantially larger, at over 260% nationally and 80% at the store level. This suggests that the US has many more small firms that sell goods domestically through the retailer but sell fewer UPCs and only serve local/regional markets. This fact is consistent with evidence from Holmes and Stevens (2012) that smaller US plants ship shorter distances domestically. I classify as multinationals the 81 firms that report different manufacturer codes (and hence different UPCs) for each country in the full UPC database provided by the retailer. These are the largest and most well known companies, accounting for almost a third of store revenue and with a presence in most stores.[6] While the multi-national firms tailor their product offerings to different US operating areas there is greater regional overlap. These large firms sell more unique UPCs in the US than in Canada but store-level variety for these firms is only 33% higher in the US, compared to 50% for all products. The number of private label UPC sold by the retailer is somewhat comparable between the two countries, at least at the store level.

The patterns documented in Table 1 are similar for most individual product groups but there are some exceptions. Appendix Table A.1 presents a list of product groups for the packaged/manufactured goods, along with their share of total sales and the average store-level Canada-US UPC gap and firm gap. There are three groups where Canada has higher variety on average (canned seafood, batteries and shelf-stable juice) along with many that feature gaps of more than 100% in favor of the US such as hispanic food, ice cream and frozen prepared foods.

4.2. Consumer welfare implications

Although Table 1 shows that by any measure Canadians shopping at this retailer have access to less variety than their American counterparts, UPC counts are not necessarily informative about consumer welfare. The standard approach to mapping differences in product variety to welfare requires estimating demand curves, using estimates of the price elasticity/substitutability of varieties as well as data on expenditures for common and non-common products (Hausman (2003)). Existing estimates of the elasticity of the cost-of-living with respect to UPC variety in similar scanner data sets differs according to the estimation method and context, ranging from as low as 0.05 (Handbury and Weinstein (2015)) to above 1 (Kroft et al. (2017)).[7] Going from the store price index to overall welfare also requires information on the value of outside options (i.e. competing retailers).

To shed light on the potential welfare implications of international variety differences, I assume the nested CES demand system from the model in Section 2 holds and first consider an application of the Feenstra (1994) CES cost-of-living index across stores. The relative cost-of-living for a shopper at store A relative to store B is given by:

$$COL_{AB} = P_{AB} \left(\frac{X_A^c / X_A}{X_B^c / X_B} \right)^{\frac{1}{\sigma - 1}} \tag{5}$$

6 Note that the reason why only 62 of the 81 firms classified as multinationals have sales in Canada is that the UPC database provided by the retailer covers hundreds of thousands of UPCs that are not observed in the sample.

7 Handbury and Weinstein (2015) estimate an elasticity of willingness to pay for variety to population of -0.015 and an elasticity of variety to population of 0.3 across US MSAs, yielding an overall elasticity of the cost-of-living to the number of varieties of -0.015/0.3=-0.05.

where σ is the elasticity of substitution between varieties within the stores, X_i is total expenditure in store i, X_i^c is total expenditure in store i on a set of varieties common to stores A and B, and P_{AB} is a price index defined over common products. The second part of equation 5 ("variety adjustment" term) quantifies the value of non-common varieties in each location relative to a common bundle available in all locations using the expenditure ratio. When the share of expenditures on common varieties is higher in store A than store B, it implies that the other (non-common) varieties are less valuable which implies higher cost-of-living/lower consumer welfare in store A.

The existence of common goods, and the assumption that consumers value the set of common goods equally across locations, is critical for an unbiased estimate of welfare effects. The price differences for common goods are already analyzed extensively in Gopinath et al. (2011) so I focus on the the variety adjustment term, but they provide a useful benchmark when considering the quantitative importance of variety effects. Gopinath et al. (2011) report a 13% "Canada border effect" on prices in their regression discontinuity estimates and report a median absolute price gap between Canadian and US stores of 15% for the first week of 2005. As reported in Gopinath et al. (2011), the set of varieties with identical UPCs sold in both countries is very small (3%) and concentrated in a few non-representative product categories. Given that there is more product-market competition in the US from other firms, it is possible that the taste for the common varieties in the US has to be higher to make entry profitable.[8]

One feasible alternative is to use firms as a coarse measure of variety. If a firm sells any product in two stores, I can treat those stores as having access to the *same* set of varieties from the firm, such that the formula uses the ratio common firm revenue to total revenue. Using common firms instead of varieties substantially improves the match rate across countries although the assumption that consumers value the set of common goods equally across locations is less reasonable, as most of the firms serving both countries sell more varieties in US stores than Canadian stores. Nevertheless, data limitations mean that in practice "varieties" are often defined as firms, plants or trade categories (e.g. SITC5 or HS10) rather than products with unique barcodes.

A second alternative is to assume that a given set of varieties yields the same welfare in either country even if UPC codes differ. For example, I can assume that the value of the private label goods sold by the retailer is the same across

8 Note that while name/text matching yields a larger set of common varieties (see Burstein and Jaimovich (2012)), varieties with similar names but different UPCs may not be identical in a meaningful sense, e.g. different volumes, different packaging, even different ingredients. For example, prior to 2015 Coca-Cola in Canada had 7% more sugar and 12.5% more calories than in the US (see https://www.cbc.ca/news/health/why-coke-is-lowering-its-sugar-levels-in-canada-1.2961029).

countries even though the typical US store sells a modestly higher number of UPCs and there are few common private label UPCs. A higher private label revenue shares could then be interpreted as evidence for less valuable non-private label offerings and lower welfare from variety. Alternatively, I can take the set of core national brand products – non-private label UPCs sold in all 72 Canadian sample stores (3204 UPCs) or at least 233 out of 236 US stores (3190 UPCs) – and assume that the value of these products is the same across countries. While debatable, these alternative assumptions about "common" goods greatly expand the set of common varieties and cover almost all product groups. Given the low cross-country overlap in UPCs in the data, this could make the valuation of common varieties relative to all varieties less sensitive to idiosyncratic demand patterns.[9]

Table 2 presents estimates of the expenditure and welfare ratios for common/all varieties for the US relative to Canada given these different assumptions. I focus on product groups with "manufactured" goods. Columns 1 through 4 treat common UPCs, common firms, all private label goods, or core national brand products (defined above) as yielding the same welfare across countries, abstracting from the price differences for these "common" goods. I calculate each statistic at the store-level and average across stores in the country. The first row presents the gap in variety counts, replicating the earlier finding that there are 50% more UPCs in the average US store and 86% more firms. The second row shows that set of "common" varieties is small using exact UPC matching, much higher using firm matching, and in-between when treating private label or core national brand products as common. The third row presents the average ratio of expenditures on all varieties to "common" varieties for the US relative to Canada. If all varieties were symmetric and had equal expenditures, this ratio would be identical to the variety ratio, but it is considerably lower which implies that the average variety only available in the US is worth less to consumers than the average variety only available in Canada. The expenditure ratio is much higher for columns 3 and 4 when treating private-label goods and core national brands as common.

To translate the common-goods expenditure ratio to welfare in equation 5 I need an estimate of the elasticity of substitution. There is a large range of estimates for this elasticity using scanner data sets, owing to different estimation methodologies – ranging from 2.4 in Handbury (2013) to about 7.7 in Handbury and Weinstein (2015) – so I report results using both a low end

9 A third alternative I have considered is an assumption that the top N UPCs in each store, ranked by revenue, yield the same welfare, with N set to different values (e.g. the top 1000 ranked UPCs, the top 5000 ranked UPCs). This does not require that the "core" set of UPCs is the same across stores, even within a country, but simply imposes a normalization that consumers get the same welfare from the top N ranked products, and then considers relative expenditures on the rest. For N=1000 to N=5000 these estimates lie in-between the estimates using common varieties/firms and those assuming common welfare from private label or "core national brand" products.

and high end value.[10] For the expenditure ratios using common UPCs or firms, these values yield welfare gains (lower cost-of-living) for American consumers ranging from 1% to 5% of expenditures. Welfare gains are substantially higher when treating private-label goods (6% to 31% welfare gain) or core national brands (4% to 21% welfare gain) as common. While the lower end estimates of 1% are not trivial, the higher end estimates are comparable to or larger than the price gaps observed for common products, indicating that international differences in the cost-of-living due to variety could be as large as differences due to prices for common varieties. These differences are also likely to be more persistent and less sensitive to nominal exchange-rate fluctuations in the short-run.

Similarly detailed product-level data for other Canadian retailers do not exist, and even for the US some of the most important retailers like Wal-Mart are not represented in the existing multi-retailer scanner data sets (e.g. Nielsen and Symphony IRI). This makes estimating the overall cost-of-living differences for the grocery sector impossible, and my results comparing store variety within a single retail chain may under or overestimate the differences in overall consumer welfare for households living near sample stores. However, the demand framework outlined earlier suggests that one way to bound this bias and infer the relative value of the outside option in each country is to compare store revenues conditional on total market expenditure; if the market share of a store is higher, ceteris paribus, the value of all other retail options must be lower. As Canadian stores have higher prices for common varieties and a less valuable set of non-common varieties than American stores, if Canadian stores have similar or higher revenues (given estimated market expenditure) this implies that the outside option in Canada is worse and the cost-of-living differences estimated within the retailer are a lower bound on the overall cost-of-living differences. Figure 1 Panel D shows that the distribution of store revenues is similar across countries despite the variety gap. Although I do not have data on total grocery expenditure, I can control for local market size using estimates of the population and median household income in 2005 US dollars, and can also control for the number of competing grocery stores within a given distance. Appendix Table A.2 provides evidence that one cannot reject the hypothesis that Canadian stores of this chain have similar sales (in 2005 USD) as American stores. This suggests that Canadians do not have better outside options in the local markets served by the retailer and that the higher Canadian cost-of-living estimated *within*-retailer is representative of overall differences in the retail environment.

10 Hottman (2017) finds median values ranging from 4.5-7 depending on whether the substitution is across stores, across products within a product group, or across product groups.

5. Distribution costs and variety

To understand why the retailer's US stores sell so many more varieties than its Canadian stores, I first consider the role of distribution costs. Although the cost of distributing more varieties is not observed directly, the first-order condition for optimal retailer variety (equation 1 in general and equation 3 for a specific parametrization of demand) implies that the relationship between variable profit/revenue and variety is informative about the marginal cost of store product variety. Figure 2 plots the relationship between store revenues (in 2005 USD) and store variety for the sample stores. Stores that sell more varieties have higher revenues in either country. Most US stores carry more UPCs than Canadian stores although there is some overlap in the 12,000 to 16,000 UPC range, and within this range Canadian stores have higher revenues.

My main analysis uses store revenues instead of variable profits as they are measured precisely and are equivalent under constant retailer markups (due to monopolistic competition or uniform pricing). Variable profits can be estimated by subtracting retailer reported wholesale costs from average prices and multiplying by the quantity sold for each variety. This corresponds more closely to the relevant theoretical concept, but the cost data provided by the retailer may be a poor measure of average costs (as opposed to the marginal cost/replacement cost of goods) because non-linear pricing and trade promotions are common in this industry. The reported costs for products manufactured/branded by the retailer may also not be allocative ((Grocery Manufacturers Association (2008), Hong and Li (2017)). I report results using the variable profit measure in Appendix Table A.3 and they are qualitatively similar except where noted.

Note that the marginal distribution cost of variety may not be constant in the number of varieties. Figure 2 shows that in the cross-section this relationship is convex, with a higher slope within each country as the number of UPCs increases. This would be consistent with a parametrization of equation 3 with $\epsilon > 1$ and marginal variety distribution costs that increase with variety. A comparison of linear slopes estimated over the entire range of store variety in each country will tend to underestimate the extent to which Canadian distribution costs are higher, as most US stores have higher variety than observed in any Canadian store. I address this issue by considering a subset of stores in each country that have between 12,000 and 16,000 UPCs, and also use panel data to show that the marginal variety distribution costs appear to increase with variety.

Note also that a structural interpretation of the revenue-variety slope as (proportional to) the marginal distribution cost of variety requires that other factors affecting store revenue be held constant, i.e. Z in equation 1 and the parameters capturing market size, competition, and taste for variety in equation 3) must be orthogonal to the identifying variation in store variety.

I address this in part by using only within-country variation in UPCs across stores to identify the slopes. Specifically I estimate equations like:

$$Rev_i = \alpha + \beta_1 n_i + \beta_2 n_i \ * \ CAN_i + \beta_3 CAN_i + u_i \tag{6}$$

where i indexes stores and β_3 controls for other (common) unobserved factors in Canada that may drive average differences in revenue and variety relative to the United States. The slope coefficient β_1 captures the relevant slope for the US and the interaction term β_2 captures the extent to which Canadian marginal variety costs are higher or lower.

Store variety could be correlated with local/store-level differences in demand within each country, although this would only bias the estimate of the difference in distribution costs (β_2) if the correlation were different for each country. I address this concern in three ways. First, I include controls for the local market of each store (population, median income, number of competing stores, number of local food manufacturing plants, housing prices). Second, I estimate the slopes within operating area (controlling for common regional differences in demand within each country) or within-store using panel data for 2004-2006 (controlling for time-invariant store-level differences in demand). Third, I instrument for store variety using the year each store opened. I describe the instrument and discuss its validity in more detail in the next section when discussing retailer characteristics, but the idea is that older stores are smaller and store size is a strong predictor of store variety, with store age being uncorrelated with demand conditional on contemporary local market characteristics.

Table 3 presents the distribution cost estimates. Column 1 presents the OLS estimates from the simple specification in equation 6, analogous to figure 2, which confirms that the slope in Canada is statistically different and almost twice as large as in the US. Column 2 adds controls for local market characteristics (population, median household income, grocery stores, food manufacturing plants, and housing prices) within 5km of the store along with dummies for each operating area. I also include a store price index that captures the price of common goods within each country, interacted with a Canada dummy, since the prices of varieties directly enter equation 3.[11] The coefficients of interest are similar using these controls although the difference in variety distribution costs (slopes) appears to be smaller. In column 3, I restrict the sample to 78 stores with total UPCs in the 12,000 to 16,000 range. These stores may be more similar in terms of unobserved factors affecting revenue, and this specification also helps isolate "local" differences in the fixed

11 Specifically, for each country I use the total national quantity of common goods (sold at all 72 Canadian or at least 233/236 US stores) as weights combined with their annual average store price to construct a cross-sectional store price index for each country. By defining these indexes separately for each country the number of common goods is very large.

distribution cost of variety when this cost varies with the number of products. The larger difference between the Canadian and US slopes suggests that the marginal cost of adding a variety increases with the number of varieties. Using the full sample attenuates this "local" difference in slopes because many US stores have variety above this range and many Canadian stores have variety below this range. Column 4 estimates the same specification as column 2 but uses year of store opening and its interaction with the Canada dummy as instruments for store variety and its interaction with the Canada dummy. The instrument is strong and the results are very similar to the OLS specification in column 2.

Columns 5 and 6 estimate a panel version of equation 6 where each observation is a store by year for the 308 store sample over the 2004-2006 period. The panel is not balanced as some stores are not open throughout every year. I include store fixed effects so the variation in UPCs and revenues used for identification is only within-store over time. I also include year dummies interacted with the Canada dummy to capture any national trends in either country affecting revenues/profits or the number of UPCs, and include the (time-varying) store price index defined earlier as a control. Note that in principle panel variation could be used to estimate store-specific revenue-variety slope, but the number of observations per store (up to 3) is too low so I pool across stores to estimate a common country-level slope comparable to the previous specifications. I estimate the equation by OLS as my instrument does not generate variation in UPCs over time. Compared to the cross-section estimates, the identifying variation is more local and reflects small changes in the number of varieties within each store from year to year, rather than larger differences in variety across stores. To the extent that these variety differences are driven by changes in distribution costs over time, which are plausible given advances in logistics and information technology, this variation is potentially less susceptible to endogeneity from demand shocks that affect store variety decisions, particularly since retailers can only respond to demand shocks with a lag. The results from the panel estimation are reassuringly similar to the cross-section OLS and IV estimates. Column 5 presents results for the whole sample, while column 6 only uses stores with between 12,000 and 16,000 varieties which again imply a larger difference in slopes within a common range of UPCs. Finally, column 7 presents a panel specification where the dependent variable is now the slope (the change in revenue divided by the change in variety for 2004-2005 and 2005-2006). The Canada dummy now reflects the difference in slopes conditional on the number of UPCs, and the number of UPCs is included as a control to capture the fact that the slope is increasing in the the number of UPCs (although not a very high rate).

Equivalent regressions using estimated variable profits as the dependent variable (Appendix Table A.3) yield qualitatively similar results as the cross-sectional regressions and the panel specification in column 7, consistent with higher marginal variety distribution costs in Canada. The estimates for the

the panel specifications in columns 5 and 6 are noisy and the difference between countries is no longer statistically significant. I have also estimated the revenue-UPC slope at the product group level, although complementarity or substitutability between groups in the store revenue function complicates the interpretation of the slope parameter in this case. I plot the results in Appendix Figure A.2 – the revenue-UPC slope is higher or equal in Canada for almost all groups, with only four exceptions (batteries, refrigerated juice and drinks, household cleaners, and food service).

6. Local, regional and national sources of differences in retail variety

Having documented large gaps in store variety between Canada and the US within a retail chain, gaps that have potentially large effects on consumer welfare and that are driven in part by higher distribution costs in Canada, I now turn to an exploration of the local, regional, and retailer factors correlated with these gaps. My analysis highlights how differences in the size of local and regional markets and retail distribution matter and contribute to the overall national-level differences.

6.1. Cross-country differences in market size and retail organization

Table 4 presents summary statistics for the entire set of 1689 standard format grocery stores operated by the retailer that were open throughout 2005 in Canada and the US (excluding Alaska and Hawaii). I also present the US-Canada ratio for easy reference along with the US-Canada ratio for the 308 sample stores with scanner data.

Panel A reports means at the store level with all monetary figures converted to US dollars using the average annual exchange rate for 2005. The store selling area in the US is 16% larger than in Canada overall and 25% larger for the scanner sample. The differences are similar for building size as Canadian stores use only a slightly smaller fraction of their building area for sales (as opposed to inventory storage, receiving, staff areas, etc.). Canadian stores are about 3 years older on average. While average incomes are clearly higher in the (5km) vicinity of US stores, differences in local population and grocery store competition are more ambiguous, as the means are lower in the US for all stores but higher for the scanner sample. Housing prices near the retailer's stores are about 15% lower in the US on average during this period. Canadian stores are closer to a higher concentration of food manufacturing plants, which partly reflects the greater importance of food manufacturing to the Canadian economy [12] but also reflects the smaller size of Canadian plants and their greater concentration in major urban centers.[13]

Panel B extends the analysis to the 11 US and 4 Canadian distribution centers operated by the retailer. These are typically located on the outskirts of the largest city in a region and are 20-30 times larger than individual stores. The average distribution center services over 100 stores. A large share of the varieties sold in stores are first shipped by manufacturers to distribution centers and then consolidated and shipped to stores by the retailer using its fleet of trucks. The remaining varieties sold in stores are either shipped directly by manufacturers/distributors through direct-store-delivery services (which account for 24% of unit volume according to Grocery Manufacturers Association (2008)) or are manufactured in-store (e.g. bakery and other in-store prepared foods). Distribution centers play an important role in the retailers organization, serving as central distribution hubs that are typically within a day's trucking distance (300-500km) of stores they serve.

Table 4 shows that distribution centers are on average twice as large in the US compared to Canada and serve over two and a half times as many stores. As one would expect, distribution centers are located in areas with lower housing prices than stores, but interestingly US distribution centers are larger despite being located in areas with higher housing prices than Canadian distribution centers. Aggregating across all affiliated stores, total sales area is three times higher for the average US distribution center but the ratio of total sales area to distribution center area is lower. This suggests that physically larger US distribution centers and denser store networks may facilitate inventory management. Population and retail competition are 3-5 times higher within 300km of the average distribution center in the US than in Canada. Thus while Canadian and US stores are fairly similar in terms of the local markets they serve, US regional markets are much larger. This partly reflects the greater sprawl of US cities, the large number of small and medium sized urban agglomerations in US, and the greater concentration of Canada's population in a few large urban areas. It also reflects the geography of the Canada-US border, with 90% of Canada's population lives within 100 miles (161 kilometers) of the US border due to some combination of climate and US market access. This implies that the market size in Canada expands less rapidly in distance along a North-South axis, in part due to direct truncation at the US border but also due to the lack of major US population centers close

12 In 2015 there were about 6,500 Canadian food and beverage manufacturing plants versus 34,000 plants in the US, despite a 1:10 population ratio, and this gap is somewhat smaller in the 2005 data (9,000 vs. 26,000).

13 While there are more NAICS code 311 "Food Manufacturing Plants" in Canada up to a distance of 25km from the retailer's stores, there is more NAICS code 311 employment only up to 10km. I use plants for the analysis since they appear to be more correlated with product variety in the sample but the results are robust to using employment and different distance bins.

to the border in Western Canada.[14] Most of the major cities in the US served by the retailer have markets that expand much more rapidly in distance along the North-South axis. Overall, the mean cross-country differences in market size and retailer characteristics are modest at the local store level and much larger at the regional distribution center level.

Retailer size and market size are also correlated within each country and this intra-national variation helps shed light on the contribution of local, regional, and retailer size variables to the international variety gap. The top two panels of Figure 3 plot store variety against store size and distribution area size for the 308 sample stores, revealing both a positive within-country slope for both retailer variables and the clustering of Canadian stores and distribution centers towards the bottom of the size distribution. Canadian stores still have many less UPCs conditional on store and distribution center size, but the conditional gap is significantly smaller than the unconditional gap.

The bottom two panels of Figure 3 show that the historical pattern of retailer expansion predicts store and distribution area size. As discussed in Holmes (2001) and Basker (2015), the invention and widespread adoption of the UPC and scanner technology beginning in the late 1970s improved inventory control and logistics for retailers and facilitated the growth of larger store formats and "superstores" along with larger retail chains that could take advantage of distribution scale economies. The fact that year of store opening predicts store size today reflects a degree of stickiness and path-dependence in retail distribution, perhaps due to zoning and indivisibilities in real estate as well as the large fixed/capital costs involved in expanding the physical footprint of stores. Older stores routinely undergo remodeling, but instances where the retailer closes and then reopens a store with a larger building size at the same address are relatively infrequent in the data, and there are many stores in the data with opening dates 20-30 years in the past. Retailer expansion also occurs through expansion to new regions, much of which occurs through the acquisition of existing retail chains and their store network. Store opening dates are based on when the current store building was created, not the date of ownership change. Store and distribution area size are correlated with local and regional market sizes in an intuitive way, but because of the frictions mentioned above, the historical expansion pattern of

14 A partial exception is the Vancouver-Seattle region, but even in this case Vancouver lies only 32 miles from the border and Seattle lies 111 miles. Note that while cross-border retail shopping occurs in this context (Campbell and Lapham (2004), Chandra et al. (2014)), the cost of crossing the border is substantial in terms of time, hassle, the need for a passport, etc. More importantly, national retail markets are segmented in that there is no indication that retailers use distribution centers in one country to service retail stores in another country, particularly in the Canada-US context where there are still external tariffs, non-tariff barriers, and NAFTA exemptions for many important grocery products beyond regulatory and hassle costs of clearing customs.

the retailer generates plausibly exogenous variation in retailer characteristics I exploit in the UPC analysis.

Table 5 presents results from a regression of store size on local and regional characteristics for the full set of 1689 standard format grocery stores open throughout 2005 in both countries. These results are largely in line with Ellickson (2007) who shows that large regional markets in the US feature larger stores and within-retailer store networks but add an international dimension. Column 1 includes only a Canada dummy and shows that Canadian stores are 14% smaller on average. Column 2 adds housing prices, which have a large negative correlation with store size; because housing prices are higher in the vicinity of Canadian stores, including housing prices as a control reduces the "unexplained" size gap to 11%. In column 3 I add other local controls for population, mean income, grocery store competition and the number of food manufacturing plants. These variables enter with the expected sign if optimal store size is increasing in the size of the local consumer market – conditional on housing prices, retailers build larger stores where population and income are higher and smaller stores where there is greater competition. Canadian stores are still smaller for unexplained reasons but the Canada-US difference is no longer statistically significant. In column 4 I add distribution center/regional level market characteristics. The Canada dummy now has a positive point estimate but remains insignificantly different than zero, while the significant correlation with local market size variables persists. Regional population and the number of stores serviced by the same distribution center have positive and negative significant correlations with store size respectively. The importance of regional scale factors for store size suggests that the retailer thinks about distribution of varieties at a regional level, since these are unlikely to affect consumer demand at the store-level.

Column 5 adds the year each store opened, which is a highly significant positive predictor of store size conditional on local and regional characteristics and more than doubles the R^2 from a regression including all of the local and regional covariates. Column 6 replicates the specification in column 5 but restricts to only the 308 stores used for UPC analysis. This is the first-stage for the IV analysis in Tables 6 and 7 and confirms the graphical evidence in Figure 3 that year of store opening predicts store size and store size predicts store variety. Conditional on variables capturing local and regional demand for and supply of varieties, the year of opening thus satisfies the relevance condition for instrumenting variety (Table 3) or store size (Tables 6 and 7). While the exclusion restriction is not testable, in Appendix Table A.4 I provide further evidence that the year of store opening has no effect on store revenues conditional on store size, across or within regions. This assuages concerns that stores are opened earlier in locations with systematically higher or lower (unobserved) demand for the retailer. Store opening years are not random – the retailer's stores that opened earlier tend to operate in locations with higher housing prices and more retail competition – but conditional on current market characteristics they provide plausibly exogenous variation in store size that does not affect variety through other channels like demand.

Although there is limited variation in distribution center characteristics due to the small number of independent observations, Appendix Figure A.3 shows that the best predictor of the size of a distribution center is the number of stores in the region it serves. Canadian distribution centers do not appear to be larger or smaller than US distribution centers conditional on the number of stores served, but the average US region has many more stores. There is also a positive though somewhat weaker relationship between distribution center area and population or food manufacturing plants within 300km. The retailer's historical expansion pattern involves both expansion to new geographic regions and increases in the number of stores operated within existing regions. Distance of a region from the original corporate headquarters has some predictive power for the number of stores operated and the size of the distribution center, but this correlation is quite weak conditional on regional population and hence this is not a strong instrument. However there appears to be enough variation in number of stores operated, conditional on regional variables, to generate a strong first-stage for distribution center area.

6.2. Retail organization, distribution and product variety

I now turn to a regression analysis of store-level variety motivated by model equation 4, which highlights that local market size, variety characteristics, and distribution costs could affect store variety. I consider distribution cost factors related to retail organization (store and distribution area size, distance), manufacturer characteristics (local and regional density of food manufacturing plants and manufacturer size), and their interaction. Intranational variation in these characteristics helps assess their contribution to the overall international border effect.

Table 6 presents the first set of store results, where the dependent variable is the log total number of UPCs sold in a store in 2005 for the common product groups. Column 1 shows that for the 308 sample stores, Canadian stores have 34% fewer products than their American counterparts. Column 2 show that this gap is reduced to 28% when including store size; store size and the Canada dummy alone generate an R^2 of 0.906. Column 3 adds two additional retailer characteristics – distribution center area, which enter positively, and distance from store to distribution center, which enters negatively. Inclusion of these two variables further reduces the size of the Canada dummy to 25%. Together these three retailer variables account for over a quarter of the difference in store variety between Canada and the US. However, retailer variables also reflect market characteristics that could directly affect variety choice through demand or distribution costs on the manufacturer side (e.g. a greater concentration of local and regional food manufacturing plants). Column 4 omits retailer characteristics and includes only local (within 5km) characteristics of the sample stores. These enter with the predicted signs although some of the variables are highly correlated and lose statistical significance when included together. Local population and income predict more UPCs, local competition predicts less UPCs, more local food manufacturing predicts more UPCs, and higher housing prices predict less UPCs (presumably through their strong effect on store size, although housing prices may also affect consumer demand positively or negatively through wealth/real income channels). These local variables cannot explain much of the Canada-US variety gap though, lowering the Canada dummy coefficient by only 1 percentage point. This is not surprising in light of Table 4, which shows that these local characteristics do not vary much on average across countries for the sample stores; in some cases they have offsetting effects, e.g. higher population and income for US sample stores is counterbalanced by higher competition and less local food manufacturing. Column 5 adds regional (within 300km of the distribution center) characteristics. Population density at the regional level has a large and highly significant correlation with store variety, even conditional on local characteristics, while retail competition at the regional level has an equally strong negative effect. Income and food manufacturing have less significant effects at the regional level, but note that standard errors are clustered at the distribution center level which leaves limited independent variation. Inclusion of regional variables reduces the unexplained Canada variety gap to 21%, which highlights that the regional scale of retail distribution and the greater regional density of the US compared to Canada is an important factor for international differences in store-level variety.

In columns 6 through 8 I include all of the local, regional, and retail variables together, which does little to change the share of the Canada-US store variety gap that is unexplained but highlights the independent importance of retail factors even after controlling for local and regional market characteristics. In column 6 we see that store size is still a highly significant predictor of store variety given the other covariates and explains a lot of the cross-sectional differences in variety. Distribution center area and distance to distribution center are no longer significant. In column 7 I instrument for store size and distribution center area using the year a store opened and the number of stores served by the distribution center; the first-stage F-statistic is very high, and both variables have a sizable and statistically significant effect on store variety that have a causal interpretation. Column 8 replaces distribution center area with number of distribution center stores, since number of stores may violate the exclusion restriction by facilitating distribution of variety through mechanisms other than distribution area size (e.g. more efficient trucking routes).

Although my analysis focuses on retail distribution, the results suggest that the location of food manufacturing plants also matters. Manufacturers may play an important role in determining store variety through their role in distribution, both through direct-store-delivery and through shipments to retailer distribution centers. To shed more light on how manufacturing firm characteristics interact with retailer size and regional scale, Table 7 considers different types of products and firms using the same IV specification as Column 7 of Table 6. Columns 1 and 2 split the UPCs into product groups that are not linked to manufacturers (meat, seafood, produce, floral, and in-store food preparation/manufacture) and the manufacturer UPCs that I link to firm identities. The unexplained Canada-US variety gap is mostly driven by the manufacturer UPCs. Product variety for non-manufactured/in-store manufactured goods is much more correlated with store size and distribution center size than externally manufactured goods, but it is less correlated with regional food manufacturing. Store-level variety for non-manufactured goods is clearly more reliant on retailer characteristics.

Columns 3 through 7 further explore the manufacturer UPCs. Column 3 reports results where the dependent variable is the number of firms selling to a given store. There are many (56%) fewer food manufacturing firms selling to Canadian stores, despite the higher number of local food manufacturing plants in Canada. Firm entry is especially sensitive to income, suggesting that these are often niche/higher-end local firms. Firm entry is as responsive to store size as product variety but more sensitive to distribution center size. Column 4 reports results for firm entry by multinationals. Multinationals are less likely to enter Canadian stores but this effect is much smaller than for firms or UPCs overall. Multinational entry is less sensitive to income, local and regional food manufacturing activity, or the size of stores or distribution centers.

Column 5 reports results for UPCs by multinational firms, which also display lower sensitivity to the Canadian border, local income, local or regional manufacturing plants, store size or distribution center size. Together columns 4 and 5 show that the availability of products from multinational firms is less sensitive to the distribution characteristics of the retailer or to distribution costs imposed by distance or international borders. Columns 6 and 7 consider two types of UPCs manufactured by smaller firms. Column 6 reports results for private label UPCs, which depend more on the retailer for distribution and are often manufactured by smaller firms. Private label UPCs are more likely to be stocked in lower income areas as expected and are more reliant on regional distribution characteristics of the retailer. Column 7 reports results for UPCs manufactured by other (small) firms. These appear to be the most sensitive to local incomes and local manufacturing activity, but are also the more sensitive to store size and border effects.

Altogether the results in Table 7 suggest that both retailer and manufacturer size can lower distribution costs but they act as substitutes. Larger retailers will tend to favor smaller manufacturers who are more reliant on retailers for distribution. The largest manufacturers are better at distribution (e.g. direct-store delivery infrastructure, manufacturer-controlled distribution centers, and in some cases multiple national/international production locations) which makes their product offerings less sensitive to market size or retailer organization at the local, regional and even national level.

Overall, Tables 6 and 7 indicate that over a quarter of the Canada-US gap in store variety can be explained by variation in regional and retailer characteristics, with larger US stores, larger US distribution centers and store networks, and larger US regional markets all playing a quantitatively important role. The smaller average size of Canadian local and especially regional markets contributes to physically smaller stores and distribution centers, a smaller regional network of stores, and lower product variety. The remaining negative variety gap captured by the "Canada" dummy in Tables 6 and 7 has several possible interpretations, including international differences in the taste for variety, international differences in assortment strategy by the retail chain, and differences related to a national market scale effect at the retailer and/or manufacturer level.

There are only two national markets in the data and only a single retailer, making it hard to draw firm conclusions about the precise source of the residual international variety gap. However, two pieces of evidence suggest that national market scale effects are important. First, Section 5 provides evidence that the marginal cost of providing variety in Canada is higher than in the United States and that this cost is, if anything, increasing in the level of variety. If higher US variety were mainly driven by a higher taste for variety by US consumers, this could only generate a low marginal benefit of variety in the United States if the cost of providing marginal variety were decreasing in the level of variety. The variety gap and implied difference in marginal variety costs are present in many different product categories and the retailer offers almost exactly the same product categories in each country with a substantial presence of major MNC brands and private labels within each category. It thus seems unlikely that differences in product assortment strategy related to consumer tastes or positioning strategy can explain such a large variety gap.

Second, Table 7 shows that the residual "Canada" variety gap depends on the type of product or firm, highlghting the role of manufacturers at a national scale. The larger (negative) "Canada" effect for firms than for UPCs, and the larger effect for UPCs manufactured by small firms than large firms, both suggest an important national market scale effects that prevent smaller manufacturers from exporting (or engaging in multinational production) to serve the smaller Canadian national market. Note that these effects are large even controlling for the amount of local and regional food manufacturing activity, so they can be interpreted as arising from national differences in the number of small firms that can serve other regions (or for MNCs, national differences in the product lines they offer through direct production and/or exporting in each country). Interestingly the absence of a large "Canada" effect for non-manufactured UPCs suggests that border effects related to customs and regulations (e.g. language and ingredient labeling, health and safety standards, etc.) are not as important for goods where producers play a smaller role in distribution and marketing.

7. Conclusion

My findings highlight that the growing importance of large retailers is partly linked to their ability to lower variety distribution costs through local and regional scale. Although retail concentration may hurt consumers through higher retail markups, the success of large retailers is also due to lower distribution costs that may be passed on to consumers both through lower prices and greater product variety. My analysis of the Canada-US variety gap provides support for the notion that countries like Canada, with lower regional population density than the US, may require higher degrees of retail concentration to achieve an efficient scale of distribution (Senate of Canada (2013)). Although the evolution of retailer size and competition may be mostly driven by technological and business innovations, the recent approval of major retail mergers in Canada highlights that competition policy still has an important role to play in trading off the benefits of scale economies against the costs of lower competition and increased market power in retail distribution.

An obvious area for future research is to extend this analysis to a multiple retailer context. Although there are widely used scanner data sets with multiple retailers for the United States, identifying these retailers and linking them to their distribution characteristics is challenging. The market research firms that provide scanner data sets are focused on manufacturer competition and require retailer cooperation to do so, which makes them reluctant to allow researchers to use their data to analyze retail cost structures. However, important issues – including the growing importance of small format stores that are part of large chains (Bronnenberg and Ellickson (2015)) and the role of manufacturer-retailer matching frictions – require this type of data to address. In the international context an additional challenge is that most of the scanner data sets used come from single countries, limiting analysis of border effects on distribution and product variety and the ability of large retailers to lower border costs.

My results also show that retail scale, through its effects on product variety and firm entry, has important vertical effects that are not well understood. Assessing the extent to which larger retailers affect upstream competition, by weakening the distribution advantage of larger manufacturers relative to smaller firms or by directly undertaking a greater share of product development, marketing and distribution (e.g. through private labels, vertical integration and exclusive use of retailer distribution centers) is an important area for future research.

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8. Figures and Tables

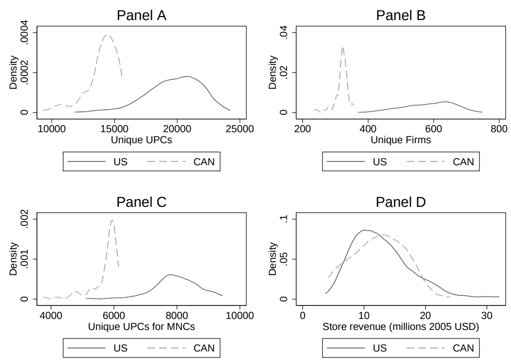

FIGURE 1

Variety gaps. Figures are for the 308 sample stores with scanner data open throughout 2005. Panels B and C are for the subset of product groups linked to manufacturers. Multinationals are defined as the 81 firms with different UPCs in each country in the retailer's UPC database.

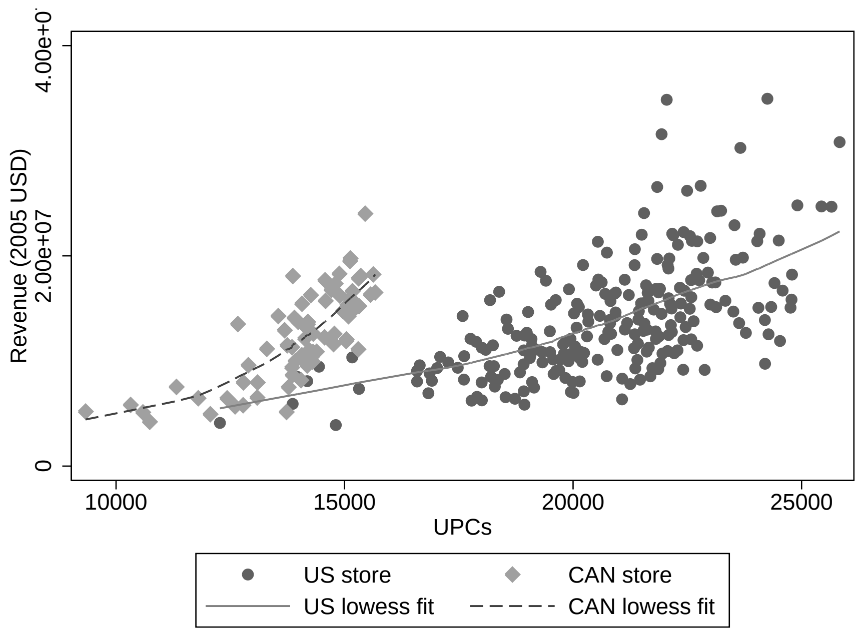

FIGURE 2
Store variety and revenue. Each datapoint represents the number of UPCs and annual store revenue for one of the 308 sample stores open throughout 2005.

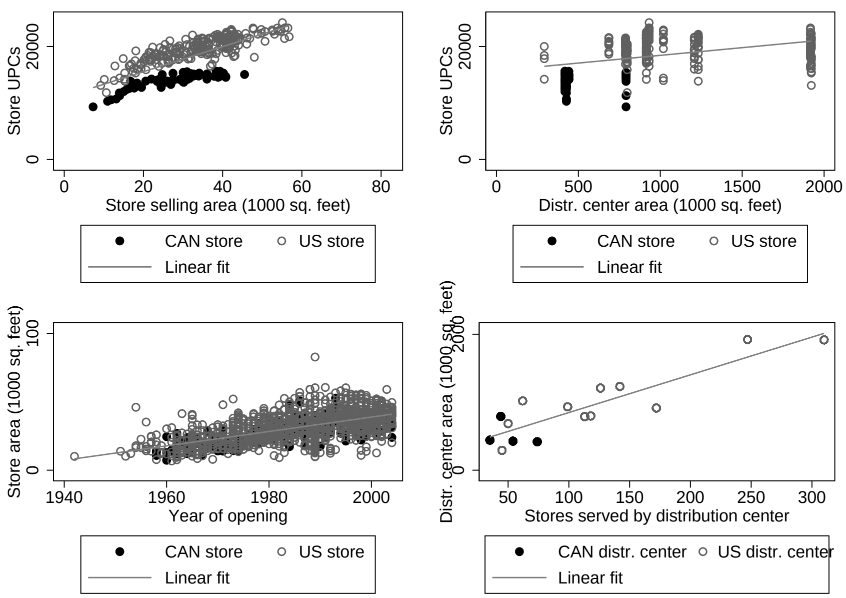

FIGURE 3
Retailer expansion, distribution characteristics and store variety

TABLE 1
Product variety across countries

Country	Both	Canada			United States		
	RevShare	All	Region	Store	All	Region	Store
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All UPCs	1	21,737	18,932	13,995	68,445	29,933	20,752
Same group UPCs	0.946	21,691	18,894	13,970	62,199	27,997	19,731
3-year UPCs	0.937	15,446	13,837	10,978	48,618	23,079	17,030
NAFTA-ex UPCs	0.182	1,827	1,656	1,405	5,725	2,454	2,030
Fix quant. UPCs	0.811	20,018	17,596	13,013	62,780	28,026	19,489
Manufactured UPCs	0.584	13,203	11,997	9,986	41,621	20,023	14,864
Firms	0.584	494	412.3	318.6	1,802	819.5	586.2
Private-label UPCs	0.133	2,130	2,060	1,880	6,301	2,427	2,201
MNC firms	0.315	62	61	58.32	81	70.10	65.91
MNC UPCs	0.315	7,028	6,646	5,716	15,749	9,720	7,970

NOTES: Each row represents a different set of products. Column 1 is the total share of retailer revenue generated by the row's set of products when pooling across all sample stores. "Country" columns report total number of products or firms in the country, while Region and Store are the mean number of products (firms) for regions (=operating areas) or stores in each country. Data for this table is generated by aggregating across all weeks in 2005 for 308 mainland sample stores open throughout the year (236 in the United States and 72 in Canada).

TABLE 2
Welfare implications of cross-country product variety differences (US/CAN)

"Common" goods	Exact match	Firm	Private lab.	Core nat. brands
	(1)	(2)	(3)	(4)
Total variety ratio (count)	1.497	1.862	1.497	1.497
N common varieties	357	35805	2201/1880	3187/3204
Common exp. ratio	1.065	1.071	1.465	1.307
CES variety welfare (low elast.)	1.046	1.050	1.313	1.211
CES variety welfare (high elast.)	1.009	1.010	1.059	1.041

NOTES: The table uses country-level store means for the 308 sample stores to compute variety ratios, expenditure ratios, and the Feenstra (1994) "variety adjustment term" across countries. The common variety expenditure ratio is defined as $(X_{US,all}/X_{US,common})/(X_{CAN,all}/X_{CAN,common})$ where X is total expenditure on all products or a "common" set of products. The columns represent different definitions of "common" based on exact product match, firm match, assuming the total set of private label goods in each country is common, or assuming that the roughly comparable number of non-private label UPCs available in all stores nationally (i.e. in 72 out of 72 in Canada and at least 233 out of 236 in the United States) is common. The CES variety welfare gain raises the common variety expenditure ratio to an exponent $(1/(\sigma-1))$ and I report results using the low elasticity of $\sigma = 2.4$ from Handbury (2013) and higher elasticity of $\sigma = 7.7$ from Handbury and Weinstein (2015) to give a plausible range of welfare gains.

TABLE 3
Estimates of marginal variety distribution costs based on regressing store revenue on store variety (equation 6)

Estimation	OLS (1)	OLS (2)	OLS (3)	IV (4)	Panel (5)	Panel (6)	IV-Panel[a] (7)
Variety	1.4***	1.8***	0.0	1.6***	0.5***	-0.0	0.0001**
	(0.2)	(0.2)	(0.4)	(0.2)	(0.1)	(0.5)	(0.0000)
Variety x Canada	1.2***	0.8**	3.4***	1.0**	1.1***	1.6***	
	(0.3)	(0.3)	(0.6)	(0.3)	(0.3)	(0.6)	
Canada	-9,256.6**	43,146.6	-43,151.7***				11.4996***
	(4,196.8)	(52,099.3)	(8,435.9)				(3.1511)
Pop. < 5km		570.9		561.3			-0.0625*
		(425.8)		(404.6)			(0.0320)
Mean inc. < 5km		-3,363.3**		-2,998.2**			-0.1095
		(1,190.8)		(1,102.6)			(0.0976)
Grocery stores		306.8		180.3			-0.0382
		(496.9)		(491.6)			(0.0320)
Food man. plants		-716.3**		-587.3**			0.0321
		(265.2)		(208.1)			(0.0398)
House prices		1,171.7		946.7			0.2860**
		(940.2)		(981.2)			(0.1006)
Common price		60,324.2**		64,234.5**			-0.9514
		(23,267.7)		(22,634.4)			(1.6223)
Com. price x Can.		-36,635.7		-40,344.7			-7.5897***
		(39,741.2)		(38,862.1)			(2.2459)
Observations	308	308	78	308	918	220	616
Operating area FE	No	Yes	No	Yes	No	No	No
Store FE	No	No	No	No	Yes	Yes	No
Country-year FE	No	No	No	No	Yes	Yes	Yes
Adj R-squared	0.367	0.537	0.620	0.532	0.973	0.970	0.221
First-stage F				15.92			65.48

NOTES: *** p<0.01, ** p<0.05, * p<0.10. Standard errors clustered by operating area in parentheses. All control variables are in logs. Columns 1 through 4 use UPCs and revenue (in thousands 2005 USD) sold in the store during 2005. Columns 4 and 7 use year of store opening (and for column 4, year of store opening x Canada) as instruments, with first-stage Kleibergen-Paap F statistics reported. Columns 5 and 6 use an unbalanced 3 year panel for 2004-2006. *a*: Column 7 uses the annual change in revenue/annual change in UPCs as the dependent variable, so the Canada dummy directly measures differences in the slope and Variety measures changes in the slope with respect to the level of UPCs.

TABLE 4
Summary statistics on retailer and market characteristics across countries

	CAN mean (1)	USA mean (2)	All US/CAN (3)	Sample US/CAN (4)
Panel A: Stores and local characteristics				
Store selling area (thou. sq. ft.)	28.08	32.48	1.16	1.25
Selling/building area	0.67	0.69	1.03	1.04
Year opened	1984.45	1987.29	1.00	1.00
Pop. < 5km (thou.)	96.14	85.54	0.90	1.11
Mean inc. < 5km (thou. USD)	16.91	20.63	1.22	1.29
Grocery stores < 5km	28.91	20.22	0.70	1.13
Food man. plants < 5km	19.00	7.89	0.42	0.58
House price (thou. USD)	405.89	343.13	0.85	0.84
Observations	205	1,483		
Panel B: Distribution centers and regional characteristics				
Dist. center area (thou. sq. ft.)	519.50	1064.45	2.05	
Distr. center stores	51.75	134.91	2.61	
Total selling area (thou. sq. ft.)	1454.57	4380.86	3.01	
Tot. sell. area/distr. center area	3.04	4.14	1.36	
Mean store distance	130.37	91.36	0.70	
Max store distance	587.17	329.88	0.56	
Pop. < 300km (mill.)	2.40	12.31	5.14	
Mean inc. < 300km (thou. USD)	16.89	17.86	1.06	
Competing grocery stores < 300km	783.00	2423.00	3.09	
Food man. plants < 300km	692.25	1137.36	1.64	
House price (thou. USD)	256.58	294.74	1.15	
Observations	4	11		

Data sources: store size, location, year opened and store network organization are from the retailer data set. Distribution center location and area are from retailer corporate reports. Population, income, and retail (grocery) stores are drawn from the Population and Economic Census of each country from 2000-2001. Food manufacturing plant data is from County Business Patterns/Canada Business Patterns for 2005. House prices from CMHC and Zillow. Store distances are calculated using latitude and longitude of geocoded addresses of stores/distribution centers.

TABLE 5
Variation in store size: dependent variable is log selling area in square feet

	(1)	(2)	(3)	(4)	(5)	(6)
Canada	-0.141**	-0.112**	-0.072	0.016	-0.138	-0.245*
	(0.061)	(0.051)	(0.050)	(0.091)	(0.085)	(0.121)
House price		-0.179***	-0.222***	-0.142**	-0.075*	-0.056
		(0.042)	(0.047)	(0.051)	(0.040)	(0.044)
Pop < 5km			0.127***	0.119***	0.081***	0.102***
			(0.030)	(0.024)	(0.017)	(0.034)
Mean inc. < 5km			0.201**	0.107*	0.084*	0.014
			(0.076)	(0.059)	(0.043)	(0.056)
Grocery stores < 5km			-0.156***	-0.168***	-0.093***	-0.106***
			(0.029)	(0.022)	(0.011)	(0.017)
Food man. plants $< 5km$			0.017	0.024	0.017	0.008
			(0.022)	(0.016)	(0.013)	(0.031)
Pop. < 300km				0.345**	0.153	0.102
				(0.144)	(0.153)	(0.161)
Mean inc. $< 300km$				0.073	0.189	-0.258
				(0.216)	(0.223)	(0.277)
Competing grocery stores < 300km				-0.316	-0.207	-0.202
				(0.186)	(0.197)	(0.180)
Food man. plants < 300km				0.058	0.087	0.164
				(0.131)	(0.130)	(0.122)
Distr. center stores				-0.143**	-0.139**	-0.112**
				(0.058)	(0.058)	(0.043)
Distance store-distr. center				-0.137	0.008	-0.122
				(0.111)	(0.049)	(0.105)
Year opened					0.017***	0.017***
					(0.001)	(0.002)
Observations	1,689	1,689	1,689	1,689	1,689	308
Adj R-squared	0.0157	0.0756	0.202	0.234	0.510	0.497

*** p<0.01, ** p<0.05, * p<0.10. Standard errors in parentheses clustered by operating area. Variables < 300km are calculated relative to distribution center. All variables in logs except Year opened and distance to distribution center.

TABLE 6
Variation in store UPCs: dependent variable is the log number of store UPCs in product groups common to all stores in 2005

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Canada	-0.34***	-0.28***	-0.25***	-0.33***	-0.21***	-0.26***	-0.24***	-0.24***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.05)	(0.03)	(0.03)	(0.02)
Pop < 5km				0.01	0.00	-0.01	-0.01*	-0.01*
				(0.01)	(0.02)	(0.00)	(0.01)	(0.01)
Mean inc.				0.13***	0.12***	0.07***	0.07***	0.08***
				(0.03)	(0.03)	(0.02)	(0.02)	(0.02)
Grocery stores < 5km				-0.03***	-0.03**	0.00	0.00	0.01
				(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Food man. plants				0.03**	0.03**	0.01**	0.01**	0.01**
				(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
House price				-0.04**	-0.05**	0.01	0.00	0.00
				(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Pop. < 300km					0.20***	0.04*	0.03	0.05**
					(0.06)	(0.02)	(0.03)	(0.02)
Mean inc. < 300km					-0.17	-0.05	-0.09	-0.08**
					(0.11)	(0.05)	(0.06)	(0.04)
Comp. stores < 300km					-0.21**	-0.05*	-0.03	-0.07***
					(0.07)	(0.03)	(0.04)	(0.02)
Food man. plants					0.07	0.03*	0.01	0.03***
					(0.04)	(0.01)	(0.02)	(0.01)
Store selling area		0.28***	0.28***			0.27***	0.27***	0.27***
		(0.01)	(0.01)			(0.01)	(0.02)	(0.02)
Distr. center area			0.03*			0.01	0.04**	
			(0.02)			(0.01)	(0.01)	
Dist. store-center			-0.06**			0.03	0.02	0.02
			(0.02)			(0.03)	(0.03)	(0.03)
Distr. center stores								0.02***
								(0.01)
Observations	308	308	308	308	308	308	308	308
Adj R-squared	0.628	0.906	0.910	0.693	0.708	0.927	0.924	0.928
First-stage F							52.63	97.20

NOTES: *** p<0.01, ** p<0.05, * p<0.10. Standard errors clustered by distribution center in parentheses. All variables in logs except distance from store to distr. center. Instruments for store selling area and distribution center area are year store opened and number of stores in the network, with first-stage Kleibergen-Paap F statistics reported.

TABLE 7
Variation in UPCs for different types of firms/UPCs: dependent variable is the log number of UPCs or firms per store

Dep. var.	Non-man. UPCs (1)	Manuf. UPCs (2)	For Manuf. UPCs Firms (3)	MNC firms (4)	MNC UPCs (5)	PL UPCs (6)	Other UPCs (7)
Canada	-0.06	-0.30***	-0.56***	-0.08***	-0.21***	-0.26***	-0.53***
	(0.06)	(0.03)	(0.03)	(0.02)	(0.04)	(0.05)	(0.06)
Pop < 5km	-0.03***	-0.00	-0.02*	-0.00	0.01*	0.00	-0.03*
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
Mean inc.	0.04	0.08***	0.12***	0.03***	0.06***	-0.04***	0.18***
	(0.03)	(0.01)	(0.03)	(0.01)	(0.01)	(0.01)	(0.03)
Grocery stores < 5km	0.00	0.00	0.01	0.00	0.00	-0.01	0.01
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
Food man. plants < 5km	0.03**	0.01**	0.03***	0.00*	-0.00	-0.01	0.03***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
House price	0.08***	-0.02**	-0.02	-0.02***	-0.03***	0.05***	-0.03
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Pop. < 300km	-0.05	0.05	-0.05	-0.01	0.12***	-0.09*	0.01
	(0.06)	(0.04)	(0.05)	(0.04)	(0.05)	(0.05)	(0.10)
Mean inc. < 300km	0.06	-0.15*	-0.19**	0.08	-0.14**	-0.18**	-0.14
	(0.11)	(0.08)	(0.09)	(0.09)	(0.07)	(0.07)	(0.20)
Comp. stores < 300km	0.10	-0.07	0.05	0.05	-0.12*	-0.03	-0.00
	(0.08)	(0.06)	(0.07)	(0.06)	(0.06)	(0.06)	(0.14)
Food plants < 300km	-0.09*	0.05*	0.02	-0.03	0.05	0.07	0.03
	(0.05)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.07)
Store selling area	0.40***	0.23***	0.27***	0.03***	0.18***	0.09***	0.39***
	(0.03)	(0.02)	(0.03)	(0.01)	(0.02)	(0.01)	(0.03)
Distr. center area	0.11***	0.01	0.05**	0.00	-0.02	0.07**	0.04
	(0.03)	(0.01)	(0.02)	(0.01)	(0.02)	(0.03)	(0.04)
Dist. store-center	-0.03	0.03	0.05	0.03	0.04	-0.11*	0.07
	(0.03)	(0.03)	(0.06)	(0.03)	(0.03)	(0.05)	(0.07)
Observations	308	308	308	308	308	308	308
Adj R-squared	0.694	0.944	0.938	0.787	0.938	0.748	0.915
First-stage F	52.63	52.63	52.63	52.63	52.63	52.63	52.63

NOTES: *** p<0.01, ** p<0.05, * p<0.10. Standard errors clustered by distribution center in parentheses. All variables in logs except distance from store to distribution center. Instruments for store selling area and distribution center area are year store opened and number of stores in the network, with first-stage Kleibergen-Paap F statistics reported. Columns 1 and 2 split all UPCs in common groups into those in groups where the manufacturing firm usually cannot be identified or production occurs in-store (food service, in-store bakery, floral, seafood, meat and produce) and groups where manufacturers can be identified (all others). For the latter, columns 3 and 4 report the number of firms selling at least one product in the store (multinationals are defined as firms with separate UPC lines in each country). Columns 5, 6, and 7 split the goods that can be matched to manufacturing firms into multi-nationals (MNC), private labels (PL), and others respectively.