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Exchange Rates, Cross-Border Travel, and Retailers: Theory and Empirics

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Exchange Rates, Cross-Border Travel, and Retailers: Theory and Empirics *†

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Abstract

This paper provides a theoretical and empirical analysis of the effects of nominal exchange rate movements on cross-border travel by consumers and on retail firms' sales. We develop a search-theoretic model of price-setting heterogeneous retailers and traveling consumers who face nominal exchange rate shocks. These exchange rate shocks act as both a supply side shock for retailers though imported input prices and a demand side shock though their effect on the propensity for consumers to cross the border and shop at foreign retail stores. The model provides predictions regarding relationships between firm and regional characteristics and the magnitude of the effects of nominal exchange rate fluctuations and resulting cross-border travel activity on retailers' sales. We use our theoretical framework to motivate an empirical methodology applied to Canadian firm and consumer level data from 1987 to 2007. Our findings indicate that an appreciation of the Canadian dollar substantially increases cross border travel which in turn has a significant negative effect on the sales of Canadian retailers. These effects diminish with the distance of the retailer from the border and with the shopping opportunities available at relevant US destinations. Using counterfactual experiments, we quantify the effects of more restrictive border controls after September 2001 which discouraged cross-border trips and reduced retailer losses from cross-border shopping as well as the effects of increased duty free allowances which raised cross-border trips and reduced retailer sales.

JEL: F10; F14; L81

Keywords: International Price Differences; Firm Dynamics; Exchange Rate Pass-Through; Cross-Border Shopping

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1 Introduction

This paper provides a theoretical and empirical analysis of the effects of nominal exchange rate movements on cross-border travel by consumers and on retail firms' sales. There is substantial evidence that nominal exchange rate fluctuations are related to persistent differences across countries in aggregate and disaggregated goods' prices.[1] For countries with easy-to-access land borders, such as Canada and the United States, some consumers are motivated to shop across the border to take advantage of these price differences (and perhaps superior shopping opportunities), thereby decreasing market segmentation to some degree. An open theoretical and empirical question is how this activity by consumers affects retailers' choices and performance measures. This paper addresses these questions by developing a search-theoretic model of the effects of nominal exchange rate movements on heterogeneous retailers and on heterogeneous consumers who are able to travel across national borders. We then use consumer- and firm-level data for Canada from 1987 to 2007 to implement an empirical specification motivated by the theoretical model. This unique data set contains information on firm characteristics (including location) and cross-border travel by consumers, making it possible to quantify the impact of local consumers' travel decisions induced by exchange rate movements on retailers' performance. In particular, we estimate the impact of nominal exchange rate fluctuations on trips across the Canada-US border by Canadian residents, quantify the effects of those trips on Canadian retailers' sales, and document how those estimates vary by local and regional characteristics.

We find that aggregate conditions such as nominal exchange rates and tax rates as well as local conditions such as income, distance of a community from the border, and population relative to nearby US shopping destinations are significant determinants of cross-border travel by Canadians. For Canadian retailers, our empirical results indicate that an increase in this cross-border travel significantly decreases their sales, with variation across sub-industries in the magnitude of the effect. For example, we estimate that when the Canadian dollar appreciated by nearly 40% from 2002 to 2006, the crossing rate from a typical Canadian community located 25 kilometers from a substantial US shopping destination increased by approximately 4.6%, resulting in a loss of retail sales for small Canadian apparel retailers of 9%. Our estimates of the analogous numbers for a community located 100 kilometers from a relatively minor shopping destination are 1.1% and 1.9% respectively. Combining these findings leads us to conclude that Canadian retailers are significantly impacted by nominal exchange rate movements and a retailer's

[1] Evidence and theories regarding deviations from absolute and relative purchasing power parity and the law of one price are surveyed in Burstein and Gopinath (2014).

exposure to exchange rate fluctuations depends on aggregate and local conditions, as well as on the type of goods the retailer sells.

Figures 1A and 1B illustrate the relationships between movements in Canada-US nominal exchange rates and cross-border travel by Canadians and Americans that has been documented previously. Earlier empirical studies such as Di Matteo and Di Matteo (1996) and Ferris (2010, 2000) demonstrate that Canadian dollar appreciations are significantly positively correlated with same-day trips by Canadians and that this relationship can be significantly affected by domestic and border policies. Chandra, Head, and Tappata (2014) develop and estimate a model of cross-border shopping decisions by consumers and focus on *real* exchange rate movements and trips of varying length. Their results indicate that the elasticity of cross-border travel depends on the level of the real exchange rate and the distance that consumers must travel to cross the border.

What is much well less understood is the direct and indirect impact (via consumers' cross-border travel) of nominal exchange rate movements on retailers' pricing decisions and sales. There are a handful of papers which use regression analysis to provide evidence. Using firm-level data, Baggs, Beaulieu, Fung, and Lapham (2015) find significant effects of real exchange rate changes on Canadian retailers, with effects that diminish with distance of retailers from the border. The current paper extends that analysis by using a distinct empirical methodology directly motivated by a theoretical model, cross-border travel data, more highly disaggregated industries, and a longer time series that includes larger exchange rate fluctuations and post 9/11 border controls. Campbell and Lapham (2004) use US county-level data to provide evidence of adjustment by retailers to real exchange rate movements on both extensive and intensive margins while Asplund, Friberg, and Wilander (2007) use industry- and region-level data to argue that relative price changes have a significant impact on Swedish alcohol sales.

We contribute to these literatures by developing a search-theoretic model of price-setting heterogeneous retailers who face nominal exchange rate shocks and traveling consumers. We model consumers who can engage in costly cross-border travel as in Chandra, et al. (2014) but assume that consumers do not have full information regarding prices in the spirit of the consumer search model of Burdett and Judd (1983). Retailers set prices above marginal cost due to imperfectly informed consumers and their prices and sales optimally respond to nominal exchange rate movements. In the model, a movement in the nominal exchange rate acts both as a supply side shock for retailers as it affects the cost of imported inputs and as a demand side shock as it affects the number of consumers that choose to shop in the retailer's community. The model allows us to analyze these forces and provides support for an empirical methodology to quantify the effects of nominal exchange rate fluctuations on retailers' sales. Furthermore, given that the model incorporates heterogeneity across retailers with respect to their productivity, location, and industry, we are also able to estimate differential impacts across retailers according to their observable characteristics. In addition, the model makes it possible for us to quantify the impact on Canadian retailers of two important policy changes that have affected cross-border travel decisions: increased border controls following September 2001 and increases in duty-free allowances for overnight trips.

The presence of retail price differences for similar goods between Canada and the US is fundamental to our theoretical and empirical approaches and there are several papers which document the magnitude and persistence of these differences – see Boivin, Clark, and Vincent (2012) and Cavallo, Neiman, and Rigobon (2014) for examples. Similarly, a number of papers, such as Broda and Weinstein (2008), Burstein and Jaimovich (2008), and Gopinath, Gourinchas, Hsieh, and Li (2011), examine exchange rate pass-through and provide evidence that product-level relative prices are highly correlated with the nominal exchange rate between the US and Canada.[2] There is also a large literature which focuses on the role of international borders for segmenting markets and generating price differences including Engel and Rogers (1996), Gorodnichenko and Tesar (2009), Parsley and Wei (2001), and many others. This body of evidence supports our theoretical approach in which price differences across two countries endogenously arise from underlying economic fundamentals; traveling consumers take advantage of those differences but do not arbitrage them away (markets remain segmented); and product-level real exchange rates are highly correlated with nominal exchange rates.

This approach represents a contribution to the theoretical literature which develops micro-founded models designed to analyze the impact of exchange rate movements on the pricing decisions of firms at various levels (border prices, consumer prices, etc.). Much of that research is aimed at providing models for interpreting the empirical observations described above (see Burstein and Gopinath (2014) for a comprehensive discussion of the theoretical literature). There are several modeling approaches in this literature and our work fits into the class of models with variable markups and firms selling in a single market (in contrast to pricing to market models found in Atkeson and Burstein (2008), Corsetti and Dedola (2005), or Dornbusch (1987)). Papers in this literature which are closest to ours in terms of theoretical approach are those which incorporate consumer search in environments with international price differences such as Alessandria (2009, 2004) and Alessandria and Kaboski (2011).

Our focus on *retail* firms and the role of retailers' heterogeneity in their responses to shocks is consistent

[2] See Burstein and Gopinath (2014) for a survey of the evidence for a large number of countries.

with papers by Baldwin and Gu (2008), Foster, Haltiwanger, and Krizen (2006), Kosova and Lafontaine (2010), Eckert and West (2008), and Holmberg and Morgan (2003) who argue that retailers' characteristics can significantly affect firm performance. Furthermore, we contribute to the relatively small literature which examines the impact of international factors on the retail sector. Most papers in this literature focus on the interactions between retailers and manufacturers, examining contracting issues or pass-through of import prices into retail prices (see, for example, Eckel (2009), Hellerstein (2008), and Raff and Schmitt (2012, 2009)). Our contribution explores the theoretical and empirical effects on heterogeneous retailers of two highly correlated international factors: nominal exchange rate movements and cross-border travel.

This focus implies that our work also fits into a general literature which explores the effects of real and nominal exchange rate fluctuations on industries, although most of that research examines manufacturing firms in their role as exporters. Examples of papers which study manufacturing include Baggs, Beaulieu, and Fung (2009), Berman, Martin, and Mayer (2012), and Greenaway, Kneller, and Zhang (2008) while Baggs, Beaulieu, and Fung (2010) examines the effects of exchange rates on firms in service industries. Consistent with our study, many of these papers explore the importance of firm differences and document how heterogeneous firms react differently to exchange rate fluctuations in those industries.

Finally, our research enriches our understanding of how industries respond to demand and supply side shocks more generally and how those responses differ across heterogeneous firms. Our analysis contributes to a growing theoretical and empirical literature focused on firm heterogeneity which uses firm- and plant-level data to provide micro-level analysis of firm and industry dynamics.[3] We expand this further by adding consumer-level data and examining directly the link between consumer decisions to travel across the border and retailer performance. Our results provides insight into the degree of exposure of heterogeneous retail firms to international price fluctuations and provide important quantitative evidence on retail firm dynamics in response to exogenous shocks.

The remainder of the paper is organized as follows. Section 2 presents and analyzes a theoretical model of retailers and cross-border shopping. Section 3 describes the firm, industry, regional, and aggregate data used for the empirical analysis as motivated by the theory. Section 4 discusses the empirical methodology and presents empirical results. Section 5 concludes.

[3]See Bernard, Jensen, Redding, and Schott (2012) for a survey of empirical papers examining firm heterogeneity and trade.

2 Theoretical Framework

2.1 General Description

There are two countries, H and F, and each country has their own currency. The nominal exchange rate, S, is stochastic, exogenous, and denotes units of F currency per unit of H currency.[4] The real exchange rate, Q, is endogenous and is defined as the common currency ratio of the price index in H to the price index in F. Thus an increase in S is an appreciation of H currency and an increase in Q is a real appreciation for country H.

Each country is comprised of multiple regions and each region is comprised of multiple communities. All communities within a region share a common border crossing and this is what defines a region. Let regions be indexed by $r = 1, 2, ..., R$. For now, we focus on Country H and let communities in region r in Country H be indexed by $c = 1, 2, ..., C_r$. Community c in region r is characterized by its distance to the nearest border crossing, D_{cr}, a vector of other community-specific characteristics given by γ_{cr} and a vector of region-specific characteristics given by β_r.

There is a retail sector in each country comprised of multiple retail industries. There are many retailers in each industry, all selling the same good but with heterogeneous production costs. Retailers in each country set prices in units of their local currency and can only sell in their own community. We consider a representative retail industry in the analysis below. We begin by analyzing consumers who make decisions regarding where to shop and then examine the price-setting and entry decisions of retailers.

2.2 Consumers

For now, we focus on consumers in Country H. One element of γ_{cr} is the measure of consumers who reside in community c in region r which we denote as ω_{cr}. Consumers may purchase the good in the community in which they reside or they may engage in costly travel across the nearest border crossing to purchase the good in Country F. We assume that consumers do not purchase from another community within their own country[5] and each consumer in community c in region r allocates $E(\gamma_{cr})$ of their income (denominated in H currency) for expenditure on the good in this industry, regardless of where they purchase the good.

[4]The model is a partial equilibrium model in that it takes the nominal exchange rate and the prices of firm inputs as given. Thus, the model fits into the class of models discussed in Sections 4-6 of Burstein and Gopinath (2014).

[5]Below we demonstrate that the equilibrium average price is the same in all communities within a country so if travel is costly and if price differences are the primary source of benefit from shopping in another location, then consumers would optimally choose to not shop in other communities in their country nor to shop in communities in the other country beyond the one directly across the border.

Thus, if they purchase in their own community, they spend $E(\gamma_{cr})$ units of H currency and if they purchase in the foreign country, they spend $SE(\gamma_{cr})$ units of F currency.

We incorporate features of the consumer search model of Burdett and Judd (1983) by assuming that consumers know the distribution of prices of retailers in their own community and in the community across the border but do not know which firm is charging which price.[6] Based on the average price in each location, a consumer chooses in which country to shop for a good and then they randomly search a subset of the firms selling the good in that location to obtain price quotes. The number of price quotes observed by any one consumer is random and we let q_k denote the probability that an arbitrary consumer will observe k price quotes for $k \in \{1, 2, ..., K\}$ with $\sum_{k=1}^{K} q_k = 1$ (there is zero probability of observing zero quotes). Note that q_k will also be the fraction of buyers in a market who observe k prices. After a consumer has observed his random number of price quotes, he spends all of the income that he has allocated for purchases in that industry and purchases at the lowest observed price using the retailer's currency.

We model the decision of the consumer of where to shop in a similar manner as in Chandra, et al. (2014). Let $T(D_{cr}, \gamma_{cr}, \beta_r)$ denote the utility cost of traveling across the border for any consumer who resides in community c in region r. We assume that $T(\cdot)$ is increasing in distance of the consumer from the border. The community/region-specific vectors, γ_{cr} and β_r, include conditions which may affect the cost of cross-border travel, such as local gasoline prices or the severity of border controls.

Consumers in a community share a common benefit from crossing the border to purchase the good, $B(S, \gamma_{cr}, \beta_r)$. This common benefit depends on the nominal exchange rate through its effect on the real exchange rate between Country H and F (which is endogenous as described below). The underlying assumption is that the higher is the ratio of the price index in H to the price index in F expressed in a common currency, the larger is the benefit to H consumers from crossing the border. In addition, we assume that the common benefit function depends on community and region-specific characteristics such as income and shopping opportunities directly across the border from the region.

As in Chandra, et al. (2014), we incorporate an individual-specific benefit from cross-border travel. We denote this by ζ_i for consumer i and assume it has distribution $K(\zeta)$ with support $[\underline{\zeta}, \bar{\zeta}]$. This distribution is the same across all communities.

Letting the vector of characteristics in community c in region r be denoted by $\theta_{cr} \equiv (D_{cr}, \gamma_{cr}, \beta_r)$

[6] A desirable feature of consumer search environments is that they are tractable models of variable markups and have been used in a wide variety of applications studying price dynamics in papers such as Alessandria (2009), Herrenbrueck (2015), and Kaplan and Menzio (forthcoming).

allows us to write the net benefits of cross-border travel for consumer i who resides in that community as:

$$W(\zeta_i, S, \theta_{cr}) \equiv B(S, \gamma_{cr}, \beta_r) - T(D_{cr}, \gamma_{cr}, \beta_r) + \zeta_i. \tag{1}$$

We assume that $W(\underline{\zeta}, S, \theta_{cr}) < 0 \ \forall S$ to ensure that some consumers (those with relatively low ζ) will optimally choose to not travel across the border.

The cutoff ζ for traveling across the border from community c in region r is denoted $\zeta^*(S, \theta_{cr})$ and it satisfies $W(\zeta^*, S, \theta_{cr}) = 0$:

$$\zeta^*(S, \theta_{cr}) \equiv T(D_{cr}, \gamma_{cr}, \beta_r) - B(S, \gamma_{cr}, \beta_r). \tag{2}$$

Hence, consumers with $\zeta > \zeta^*(S, \theta_{cr})$ will travel and cross-border shop and we label these consumers travelers while those with $\zeta \leq \zeta^*(S, \theta_{cr})$ will not travel and will buy from retailers in their own community and we label them stayers.

Recalling that the measure of consumers who reside in community c in region r equals ω_{cr}, then the measure of stayers in that community equals

$$\lambda(S, \theta_{cr}) = \omega_{cr} K\Big(\zeta^*(S, \theta_{cr})\Big). \tag{3}$$

Let $\epsilon^x(\cdot)$ denote the elasticity of variable x with respect to the nominal exchange rate. The elasticity of the measure of stayers for community c in region r in Country H with respect to the exchange rate is given by:

$$\epsilon^\lambda(S, \theta_{cr}) = \left[\frac{K'(\zeta^*(S, \theta_{cr}))}{K(\zeta^*(S, \theta_{cr}))}\right] \left[-B(S, \gamma_{cr}, \beta_r)\epsilon^B(S, \gamma_{cr}, \beta_r)\right]. \tag{4}$$

Now the sign of the elasticity of the common benefit function with respect to the exchange rate determines the sign of the above expression. For example, if an H currency nominal appreciation is associated with a H currency real appreciation, then $\epsilon^B(\cdot) > 0$ and $\epsilon^\lambda(\cdot) < 0$. This is because the real appreciation means the ratio of the average price in F to that in H has fallen and this increases the common benefit of cross-border travel for H consumers. As a result, more H consumers will travel and the measure of buyers purchasing from an H retailer will fall.

We assume that $\frac{K'(\zeta)}{K(\zeta)}$ is decreasing in ζ (as is the case for many distributions). Since $T(D_{cr}, \gamma_{cr}, \beta_r)$ is increasing in D_{cr}, then $\zeta^*(S, \theta_{cr})$ is increasing in D_{cr}, and we have

$$\frac{\partial \left|\epsilon^\lambda(S, \theta_{cr})\right|}{\partial D_{cr}} < 0. \tag{5}$$

This implies that the model predicts that the fraction of consumers who become travelers when the H currency appreciates is smaller for communities located farther away from the border. The relationships between the elasticity of the measure of stayers with respect to the exchange rate and other characteristics of the community and region depend on the properties of the travel cost function and the common benefit function.

Consumers located in a community in Country F face a similar problem but we assume that their common benefit from crossing falls with an increase in the real exchange rate. Henceforth, let $\lambda_j(S, \theta_{cr})$ denote the measure of stayers in community c in region r in Country j. Then if an increase in S is associated with a real H currency appreciation, the above analysis implies the following:

$$\epsilon^{\lambda_H}(S, \theta_{cr}) < 0 \qquad \epsilon^{\lambda_F}(S, \theta_{cr}) > 0 \qquad \frac{\partial \left|\epsilon^{\lambda_j}(S, \theta_{cr})\right|}{\partial D_{cr}} < 0;\ j \in \{H, F\}. \tag{6}$$

We now analyze retailer behavior and the relationship between nominal and real exchange rates.

2.3 Retailers

The representative retail industry in each country is modeled using an industry structure similar to that described in Burdett and Judd (1983) but with firms which differ in their productivity. Retailers can only sell in their own community and set prices in their own currency.

One of the elements of the community-region specific vector, γ_{cr}, is the fixed measure of *potential* retailers, M_{cr}. Potential retailers in Country j have individual technology (or cost) parameters drawn from a common distribution given by $J_j(a)$ with support $[0, \infty]$. The constant-returns-to-scale technology for a retailer with technology parameter a in Country j is given by

$$y_j(a) = \left(\frac{1}{a}\right) F_j(l, m), \tag{7}$$

where $y_j(a)$ is output, l is the quantity of a domestic input, and m is the quantity of an imported input. The price of the domestic input in Country j, w_{lj}, is denominated in domestic currency and the price of the imported input, $\breve{w}_{mj}$, is denominated in the other country's currency. We do not model the production of inputs and we treat their prices as fixed and common across all communities within a country.

Associated with these technologies are minimum unit cost functions for a firm with cost parameter a denominated in the relevant domestic currency: $a\phi_H(w_{lH}, \breve{w}_{mH}/S)$ and $a\phi_F(w_{lF}, S\breve{w}_{mF})$. For now, we suppress the prices of the inputs in the common cost component and write $\phi_j(S)$. Note that $\phi_H(S)$ is decreasing in S as an H currency appreciation lowers the H currency price of imported inputs facing retailers in H. Similarly, $\phi_F(S)$ is increasing in S.

Each period, incumbents and new retailers observe the nominal exchange rate and choose a price to post. The (endogenous) equilibrium distribution of posted prices in Country j is denoted $G_j(p;S)$ with support $(\underline{p}_j(S),\, \tilde{p}_j)$, where $\tilde{p}_j$ is the exogenous maximum price a retailer is allowed to charge by regulation.[7] Hence $G_j(p;S)$ denotes the fraction of firms in Country j in a representative retail industry which charge a price no greater than p. The price distribution depends on the nominal exchange rate because S affects the unit cost of retailers. A price quotation received by a consumer shopping from retailers in Country j is a random draw from $G_j(p;S)$.

Firms which have marginal cost above the maximum allowable price will not operate so the maximum cost parameter for operation in Country j is given by $\tilde{a}_j(S) = \frac{\tilde{p}_j}{\phi_j(S)}$. For convenience, we define the cost parameter distribution conditional on producing in Country j:

$$\tilde{J}_j(a;S) = \frac{J_j(a)}{J_j(\tilde{a}_j(S))} \tag{8}$$

Although the measure of potential retailers is fixed, the equilibrium measure of active retailers in a community can vary with the exchange rate and is given by:

$$N_{cr}(S) = J_j(\tilde{a}_j(S))M_{cr}. \tag{9}$$

Thus, we assume that retailers enter and exit in response to movements in the exchange rate but the measure of potential retailers is constant.

Now we turn to the determination of the equilibrium price distribution in Country j in a representative retail industry. We will see below that all communities will have the same equilibrium price distribution. This is because all retailers within a country draw from the same cost distribution, face the same prices of intermediates and the same maximum allowable price, and the average search behavior of consumers is the same across communities and those are the only variables that affect the equilibrium price distribution.

We begin by focusing on retailers located in community c in region r in Country H in an equilibrium with no inflow of consumers from Country F, i.e. where the measure of buyers is less than or equal to the population of the community, $\lambda_H(S,\theta_{cr}) < \omega_{cr}$. The expected measure of buyers who observe $k \geq 1$ prices

[7] Alternatively, $\tilde{p}_j$ could be interpreted as a common reservation price for all consumers for purchases in Country j and we assume that the $\tilde{p}_j$ are invariant to changes in S. This allows us to focus on the effects of nominal exchange rate movements on prices only through their effects on the costs of inputs.

and buy from a retailer located in community c in region r in Country H posting price p in H currency equals $\left[\frac{\lambda_H(S,\theta_{cr})kq_k}{N_{cr}(S)}\right]\left[(1-G_H(p;S))^{k-1}\right]$. The first term in this expression is the fraction of total quotes received by all consumers who observe k prices which are from this retailer and the second term is the probability that the price posted by the retailer, p, is the lowest price they observe. Hence, the total expected measure of buyers in community c in region r in Country H who will purchase at price p is given by

$$\left(\frac{\lambda_H(S,\theta_{cr})}{N_{cr}(S)}\right)\sum_{k=1}^{K} kq_k(1-G_H(p;S))^{k-1} = \left(\frac{\lambda_H(S,\theta_{cr})}{N_{cr}(S)}\right)A(G_H(p;S)), \tag{10}$$

where $A(G_H(p;S)) \equiv \sum_{k=1}^{K} kq_k(1-G_H(p;S))^{k-1}$.

Recall that all consumers who purchase from such a retailer will spend the same amount, $E(\gamma_{cr})$. Thus, the expected output of an H retailer posting price p located in community c in region r with measure $N_{cr}(S)$ of retailers, and only selling to local consumers is given by

$$y_H(p;S,\theta_{cr}) = \left(\frac{E(\gamma_{cr})}{p}\right)\left(\frac{\lambda_H(S,\theta_{cr})A(G_H(p;S))}{N_{cr}(S)}\right). \tag{11}$$

Revenue (or sales) for such a firm is given by

$$R_H(p;S,\theta_{cr}) = E(\gamma_{cr})\lambda_H(S,\theta_{cr})\left(\frac{A(G_H(p;S))}{N_{cr}(S)}\right). \tag{12}$$

We now derive the equilibrium pricing functions in a representative community so we drop the γ_{cr} arguments and the c and r subscripts. To minimize notation, we drop the explicit dependence on the exchange rate for now. An H retailer with productivity parameter a chooses p to maximize profits given by

$$\pi(p;a) = (p-a\phi_H)\left(\frac{E}{p}\right)\left(\frac{\lambda_H A(G_H(p))}{N}\right). \tag{13}$$

Letting $p_H(a)$ denote the profit maximizing price of an H retailer with productivity parameter a, we have the following first-order condition:

$$\left(1-\frac{a\phi_H}{p_H(a)}\right)A'(G_H(p_H(a)))G'_H(p_H(a)) + \left(\frac{a\phi_H}{p_H(a)^2}\right)A(G_H(p_H(a))) = 0. \tag{14}$$

Now note that assuming that $J_H(a)$ is differentiable and conjecturing that the equilibrium price distribution $G_H(p)$ and the equilibrium pricing function $p_H(a)$ are differentiable, we know that $G_H(p(a)) = \tilde{J}_H(a)$

and $G'_H(p_H(a))p'_H(a) = \tilde{J}'_H(a)$. Hence, we can rewrite the first-order condition above as

$$p'_H(a) = \left(\frac{A'(\tilde{J}_H(a))\tilde{J}'_H(a)p_H(a)}{A(\tilde{J}_H(a))} \right) \left(1 - \frac{p_H(a)}{a\phi_H} \right). \tag{15}$$

where $A'(\tilde{J}) = -\sum_{k=2}^{K} k(k-1)q_k(1-\tilde{J})^{k-2} < 0$.

Now this is a Bernoulli equation and can be solved to derive the equilibrium pricing function for H retailers where we again make the dependence on S explicit:

$$p_H(a;S) = \frac{A(\tilde{J}_H(a;S))\tilde{p}_H}{q_1 - \left(\frac{\tilde{p}_H}{\phi_H(S)} \right) \int_a^{\tilde{a}_H(S)} \left(\frac{A'(\tilde{J}_H(x;S))\tilde{J}'_H(x;S)}{x} \right) dx}. \tag{16}$$

Recall that $\tilde{a}_H(S) = \frac{\tilde{p}_H}{\phi_H(S)}$ and $\tilde{J}_H(a;S) = \frac{J_H(a)}{J_H(\tilde{a}_H(S))}$. Hence, the pricing equation above implies that all firms in the same industry will follow the same pricing rule, regardless of their location, and that those prices will depend on S only through its effect on $\phi_H(S)$. Thus, this model has the feature that the "size" of the local market (i.e. the measure of buyers and the measure of sellers) does not affect the price distribution nor the average posted price. This is a very convenient feature for the empirical implementation we follow below and it implies that all communities in a country will have the same average posted price.

Similarly, the equilibrium pricing function for retailers located in Country F is given by

$$p_F(a;S) = \frac{A(\tilde{J}_F(a;S))\tilde{p}_F}{q_1 - \left(\frac{\tilde{p}_F}{\phi_F(S)} \right) \int_a^{\tilde{a}_F(S)} \left(\frac{A'(\tilde{J}_F(x;S))\tilde{J}'_F(x;S)}{x} \right) dx}, \tag{17}$$

where $\tilde{a}_F(S) = \frac{\tilde{p}_F}{\phi_F(S)}$ and $\tilde{J}_F(a;S) = \frac{J_F(a)}{J_F(\tilde{a}_F(S))}$.

The average price in Country j expressed in units of that country's currency is given by

$$\bar{p}_j(S) = \int_0^{\tilde{a}_j(S)} p_j(a;S) d\tilde{J}_j(a;S). \tag{18}$$

Now the effect of a change in the nominal exchange rate on firm-level and average prices is unclear. Consider an increase in S (a H currency appreciation). The increase in S lowers the costs of all incumbent H firms by decreasing the H currency price of imported inputs ($\phi_H(S)$ falls). From equation (16), it is clear that this will decrease the price charged by an incumbent, holding the measure of retailers constant (i.e. holding $\tilde{a}_H(S)$ constant). We refer to this effect as an intensive margin effect of exchange rate changes on firm-level prices. Note that along this margin, pass-through of the exchange rate to costs will be incomplete (due to constant-returns-to-scale) and the resulting pass-through of costs to prices will be incomplete (due to the market power of firms in the presence of incomplete price information by consumers).

In addition, the increase in S lowers the costs of potential retailers in H and this raises the threshold cost parameter for operation, $\tilde{a}_H(S)$, and increases the measure of active retailers. The entry of these relatively high cost competitors tends to increase the price of incumbents. We refer to this effect as an extensive margin effect on firm-level prices. As the intensive and extensive margin effects work in opposite directions, the overall effect on firm-level prices is ambiguous, although we expect the intensive margin effect to dominate.

Turning to the average price, the entry of high-cost/high-price retailers in response to an increase in S tends to increase the average price, an additional extensive margin effect on average prices. Thus, if the intensive margin effect on individual prices dominates the two extensive margin effects, the average price in H will fall in response to a rise in S but clearly pass-through of the exchange rate movement to the average price will be incomplete. Similarly, if the extensive margin effects dominate the intensive margin response, the average price in H will rise in response to a rise in S.

Given that an increase in S raises costs for F firms, the forces above would all be reversed and the overall effects on firm-level prices and the average price in F are also ambiguous. If the intensive margin effect dominates, the average price in F will increase in response to a rise in S and the opposite will occur if the extensive margin effects dominate.

2.4 Real Exchange Rates

The analysis above focused on a representative retail industry. Suppose there there are multiple retail industries indexed by $z \in [0, \bar{z}]$. Denote the average price in sector z in Country j denominated in that country's currency as $\bar{p}_j(z; S)$ as determined by equations (16)-(18). These average prices will differ across industries according to variations in maximum allowable prices, differences in probability distributions over price quotes, and technology differences across industries.

We assume that all consumers have the same optimal expenditure shares and we denote that share in sector z as $\sigma(z)$ with $\int_0^{\bar{z}} \sigma(z) dz = 1$. Under this assumption we can construct a consumer-based price index in each country as follows:

$$P_j(S) \equiv \int_0^{\bar{z}} \sigma(z) \bar{p}_j(z; S) dz. \tag{19}$$

Finally, we define the real exchange rate as follows:

$$Q(S) \equiv S\left(\frac{P_H(S)}{P_F(S)}\right). \tag{20}$$

Recalling the discussion above, it is unclear how a change in S will affect the ratio of the price indexes across countries. If extensive margin effects dominate, then an increase in S raises average prices in Country H and lowers average prices in Country F and the real exchange rate will increase. If the intensive margin effect dominates, an increase in S will lower the ratio of the price index in H to the price index in F. However, recalling that exchange rate pass-through to average prices is incomplete, we expect that the increase in S will dominate the fall in the price index ratio, and the real exchange rate will rise. Thus, we expect that the nominal and real exchange rate will be positively correlated, consistent with the data (see Burstein and Gopinath (2014)).

We close this section by noting that given the assumption that the benefit to consumers in H from cross-border shopping is increasing in the real exchange rate, then the above discussion implies that we expect the common benefit function for H consumers, $B(S, \gamma_{cr}, \beta_r)$, will be increasing in S. Similarly, the common benefit function for F consumers is expected to be decreasing in S. Hence, given equilibrium retailer pricing behavior, the results in equation (6) should hold.

2.5 Numerical Simulations

In this section we impose functional forms on the theoretical economy described above and provide results from numerical simulations designed to clarify the properties of the model before moving on to an empirical analysis below. For simplicity, we assume there is a single retail industry and a representative region in H and only H consumers travel. We examine the qualitative responses of equilibrium variables in communities in the region to exogenous movements in the nominal exchange rate. We begin by describing how we define communities and the functional forms that we use in this exercise.

Following the population distribution data in Chandra, et al. (2014), we assume that each region is comprised of 35 communities and that the maximum distance of a community from the border is 300 kms. The distance of community c for $c \in \{1, 2, ..., 35\}$ is then given by $D_{cr} = c\left(\frac{300}{35}\right) \approx 18.57c$. We use the Canadian population distribution data by distance from the border given in Chandra, et al. (2014) and an arbitrary value for the region population, Ω_r, to calculate the population values for each community within the region, ω_{cr}.

In the interest of simplicity, we choose parsimonious specifications for the cost and benefit functions associated with travel. We let the travel cost be specified as a log-linear function of distance and another community/region-specific variable, such as the local price of gasoline and let the common travel benefit function be specified as a log-linear function of the nominal exchange rate and a region-specific variable, such as some measure of relative shopping opportunities directly across the border:

$$T(D_{cr}, \gamma_{cr}, \beta_r) = \tau_0 + \tau_1 \ln(D_{cr}) + \tau_2 \ln(\gamma_{cr}) \qquad B(S, \gamma_{cr}, \beta_r) = \rho_0 + \rho_1 \ln(S) + \rho_2 \ln(\beta_r), \tag{21}$$

where constants and coefficients are positive. We let the distribution for the individual-specific component of travel benefit, $K(\zeta)$, be given by a normal distribution with mean μ_ζ and variance σ_ζ^2.

We assume that the probability distribution over the number of price quotes received by a searching consumer is a Poisson distribution with

$$q_k = \frac{e^{-\eta}\eta^k}{(1-e^{-\eta})k!}, \tag{22}$$

where $\eta > 0$ is the exogenous arrival rate.[8] The expected number of price quotes for a consumer with this distribution is $\frac{\eta}{1-e^{-\eta}}$ and we have $A(\tilde{J}) = \frac{\eta e^{-\eta \tilde{J}}}{1-e^{-\eta}}$.

We let the production technologies be Cobb-Douglas:

$$y_j(a) = \left(\frac{Z_j}{a}\right)(l)^{1-\alpha}(m)^\alpha, \qquad 0 < \alpha < 1. \tag{23}$$

The distribution of retailer cost parameters, $J(a)$ is the same across countries and is log-normal, following Head, Meyer, and Thoenig (2014) with mean μ_a and variance σ_a^2.

The values we use for all exogenous economy parameters are given in Appendix A but here we briefly discuss our choices for particularly relevant parameters. The parameters for the travel cost and common benefit functions are broadly consistent with our estimates of those parameters presented in the next section of the paper. These parameters affect the level of crossing rates and the response of those rates to changes in nominal exchange rates. We set the expenditure share on imported inputs equal to $\alpha = .12$ which is consistent with the average share of imported intermediates based on input-output tables from the World Input-Output Database. We choose $\eta = 4.2$ implying that the average number of price quotes observed by a consumer is approximately 4.25 and the average markup of price over marginal

[8]This specification is used in Mortensen (2005) and (2003).

cost is approximately 1.40, which is generally consistent with retail markup estimates (see Faig and Jerez (2005), for example). Those two parameters are important for determining the degree of exchange rate pass-through to prices. We set $\beta_r = 1.0$ initially and then choose γ_{cr} in the travel cost function so that the average fraction of traveling consumers from the region is approximately 0.95% to be consistent with the evidence presented in the next section.

To illustrate the basic properties of the model, we input actual quarterly nominal exchange rates between Canada and the U.S. from 1985-2014 (treating Canada as Country H) and simulate economy responses to movements in this nominal exchange rate. Figure 2 plots the (exogenous) nominal exchange rate from the data and the simulated economy's average price ratio and real exchange rate. The figure clearly shows the high correlation between the real and nominal exchange rate, consistent with the evidence presented in Burstein and Gopinath (2014). Average pass-through of nominal exchange rate movements over the 120 quarters to the common cost component equals -0.120 and 0.120 in H and F respectively. The resulting average exchange rate pass-through to the average price in H and the average price in F are -0.039 and 0.055 respectively, implying pass-through rates of 0.016 and -0.017 to the respective average mark-ups. Exchange rate pass-through to the ratio of average prices between H and F is -0.094, implying an average pass-through level of 0.906 to the real exchange rate. The model's ability to generate low levels of pass-through of nominal exchange rates to prices and markups but a high degree of pass-through to the real exchange rate are broadly consistent with the evidence discussed in Burstein and Gopinath (2014).

Figure 3 graphs the nominal exchange rate and the model's crossing rate for the entire region and demonstrates the high positive correlation between these variables. Figure 4 plots firm revenue averaged across firms within a community relative to its level at the beginning of the series for the community closest to the border and the community 100km from the border. The graph depicts the model's prediction of a negative correlation between firm revenues and the nominal exchange rate and shows that the community farther from the border is less affected by nominal exchange rate movements. Finally, Figure 5 plots the average (across firms and across periods) elasticity of firm revenues with respect to nominal exchange rates as a function of community distance for different values of other community and region characteristics, γ_{cr} and β_r. We include this figure to demonstrate the model's prediction that local conditions can significantly affect the impact of exchange rate movements on retailers' performance.

While these results from the theoretical model are dependent on the particular specifications for cost and benefit distributions, they are instructive. As well, they suggest that empirical specifications should include a role for variables in addition to retailer distance from the border as influencing the elasticities of firm performance levels with respect to exchange rate movements. We now turn to empirical specifications directly motivated by the theoretical model which seek to estimate the impact of nominal exchange rate movements on cross-border travel and Canadian retailers' revenues.

3 Data

Our firm-level data comes from the Canadian T2LEAP database. This data is created by linking two data sources: corporate income tax data (T2) and the longitudinal employment analysis program (LEAP), which is derived from T4 payroll information. The T2 data includes firm variables such as sales (revenue), assets, debt, and location identified by province and postal code. The LEAP data contains information on employment, payroll, firm age and industry classification.[9] The T2 file covers all incorporated firms in Canada and the LEAP file contains all firms that hire employees, resulting in a comprehensive data set of both private and public firms. The inclusion of small, privately-held firms is particularly advantageous for our study of retailers. We use an unbalanced annual panel of firms from 1987 to 2007 for a set of retail trade industries, food services, and accommodations.[10]

We use 69 Canada-US land and ferry border crossing posts along the southern Canadian border to define *regions* in our empirical analysis.[11] We use a firm's postal code to calculate driving distance between each firm and the closest border post. Each firm resides in one of approximately 290 Canadian census divisions. We define a *community* as an area such that all firms within that area reside in the same census division *and* share the same closest border post. There are approximately 600 such communities in our data. We use the median distance to the closest border post across firms in a community as a measure of the *border post distance* of a community. We also measure the *shopping distance* of a community as the driving distance from the relevant border post to the closest US shopping destination, defined by the closest US city with population greater than ten thousand or the closest large shopping center. We use these distance measures separately as well as their sum, *effective distance*, with the latter as a proxy for the distance that residents in a community must travel to cross border shop, D_{cr}.

We now describe the variables that comprise the vector of community-specific characteristics, γ_{cr},

[9] We use the 1980 Standard Industry Classification-Enterprise, (SIC-E) and 2007 North American Industry Classification (NAICS). Employment is measured by average labour units (ALU) which is defined as payroll divided by the average wage in the same province, industry, and size category.

[10] The T2LEAP data actually covers 1984 to 2008 but the first and last years are partial years and 1985 and 1986 are used for lagged variables (some variables are not available in 1985). See Appendix B for details on industry coverage and the data cleaning process.

[11] There are 114 actual posts but some are combined due to data limitations-see Appendix B.

and region-specific characteristics, β_r. We use median nominal income for the relevant census division in 1986, 1991, 1996, 2001, and 2006 as our measure of community income. We estimate the population of a community by multiplying the population of the relevant census division by the fraction of firms in the census division which are located in the community.[12] We combine this with US city population measures to calculate the relative population of a community to the closest US shopping city. We use data on the price of gasoline in the center of the largest Canadian city either within or closest to a community.[13] We construct measures of community Canadian tax rates using the sum of the federal sales tax rate (GST) and the provincial sales tax rate (PST) for the province in which the community resides. The only region-specific variable is the tax rate for the US state directly across the border from a region's border post. The upper portion of the first column of Table 1 reports means for these variables over the entire panel of communities from 1987 to 2007.

In the following empirical analysis, we estimate relationships between these community- and region-specific variables and the rates at which community residents cross the border. We use data from the 69 border posts from 1985 to 2007 obtained from the Tourism and the Centre for Education Statistics Division at Statistics Canada to determine the number of Canadian residents from each community returning from the US by automobile for same-day trips and for overnight trips.[14] To identify the community of origin of cross-border travelers from Canada, we use methods similar to Chandra, et al. (2014) and employ the International Traveler Survey (ITS) data from Statistics Canada. This database contains information beginning in 1990 from a sub-sample of Canadian travelers including the census division where they reside and the length of their stay. We use this data to portion total cross-border trips by Canadians through a border post to different communities of origin.[15] We then divide this estimated number of community-level cross-border trips by the number of potential trips (365 days multiplied by the community population) to compute crossing rates. We use this method to estimate same-day, overnight, and combined crossing rates by community.[16] The final three rows of column 1 of Table 1 reports estimated mean crossing rates for Canadian residents for varying lengths of stay.

Table 2 reports estimated combined median crossing rates for communities located at varying distances

[12]For median income and population, we use the observation in the census year reported for that year and the two years preceding and following the observation.

[13]We deflate the price of gasoline by the relevant provincial consumer price index to generate a real gasoline price series.

[14]Overnight trips are the sum of one night and two or more night trips. We focus on travel by Canadian residents and do not use US residents' travel data because we do not have a data source which allows us to identify their origin location and because, as Figures 1A-1B show, Americans' cross-border travel patterns are much less highly correlated with exchange rate movements.

[15]We apply the 1990 portion to traveler data prior to 1990.

[16]See Appendix C for details.

Table 1: Descriptive Statistics: Community and Region Variables

	Means of Full Sample	Means of Communities Within 100 km from the Border
Observations	12604	4288
Number of	600.2488	204.2659
Communities	(5.9769)	(3.9468)
Border Post	297.6280	50.6699
Distance	(358.6948)	(29.4720)
Shopping	109.4495	101.9395
Distance	(86.6332)	(78.0752)
Effective	407.0776	152.6094
Distance (D)	(372.7968)	(83.4143)
Real Gasoline	71.8685	72.3029
Price ($Pgas$)	(4.7901)	(4.3766)
Median	18584.1500	19190.2300
Income (I)	(4377.6530)	(4329.8770)
Relative	0.8304	0.6599
Population ($Rpop$)	(2.7849)	(1.7282)
Cdn Sales	0.1301	0.1303
Tax Rate ($Ctax$)	(0.0338)	(0.0314)
US Sales	0.0446	0.0456
Tax Rate ($Utax$)	(0.0199)	(0.0176)
Sameday	0.77%	2.13%
Crossing Rate	(3.32)	(5.40)
Overnight	0.16%	0.35%
Crossing Rate	(0.52)	(0.82)
Combined	0.93%	2.48%
Crossing Rate	(3.58)	(5.78)

Notes: (1) Numbers in parentheses are standard deviations. (2) Median income is in dollars and the gasoline price is in cents per liter.

Table 2: Distance and Combined Crossing Rates

Distance from Community to Border Post (kms)	Observations	Median Combined Crossing Rate	Distance from Post to Shopping (kms)	Observations	Median Combined Crossing Rate
≤ 25	1157	2.46%	≤25	198	3.70%
			25-50	301	2.71%
			50-100	224	2.02%
			100+	434	2.11%
25-50	905	0.75%	≤ 25	44	1.28%
			25-50	158	1.26%
			50-100	199	0.44%
			100+	504	0.74%
50-100	2441	0.17%	≤ 25	247	0.17%
			25-50	720	0.14%
			50-100	370	0.12%
			100+	1104	0.20%
100+	8719	0.02%	25	1575	0.06%
			25-50	1253	0.06%
			50-100	1237	0.02%
			100+	4654	0.01%

from border posts and nearest shopping destinations. Consistent with the findings in Chandra, et al. (2014), crossing rates decline with distance from the border post. The table also demonstrates that crossing rates generally decrease with shopping distance, suggesting that measures of the proximity of a community to shopping opportunities should be included in our empirical analysis. We also note that crossing rates are close to zero for communities located more than 100km from the closest border post. Because of this, we focus on communities that are within 100km of a border post in our empirical analysis below. The second column of Table 1 reports means of our variables of interest across that sub-sample of communities.

Returning to the firm-level data, we note that the T2LEAP data is actually at the *enterprise* level. However, because we seek to focus on the impact of exchange rate movements and cross border shopping on retail *stores* where consumers actually make their purchases, we examine sub-samples of small retailers, those with twenty or fewer employees, as those observations are more likely to be retail stores rather than headquarters. As discussed above, because cross-border travelers are primarily from communities relatively near the border, we further narrow our focus to retailers located within 100km from the border. Table 3 summarizes the distribution of distance from the nearest border post of small retailers. Approximately 38% of Canadian small retailers are located within 100km of the border and 70% within 200km

Table 3: Distribution of Firms by Distance

Distance (kms)	Percentage of Firms	Cumulative Percentage
1-25	7.30	7.30
25-50	9.08	16.38
50-100	21.52	37.90
100-150	22.89	60.79
150-200	8.45	69.24
200-250	6.52	75.76
250-300	3.51	79.27
300-350	1.96	81.23
350-400	1.38	82.61
400+	17.39	100.00

from the border.

Table 4 reports descriptive statistics for the firm-level data. In our empirical analysis below, the primary firm performance measure of interest is real sales and we control for firm characteristics by including age, leverage (debt to asset ratio), and size as measured by real assets.[17] The table also includes summary statistics for the industry controls we use in our estimation. In particular, we account for industry characteristics by including industry real sales[18] and the Herfindahl-Hirschman Index of firm concentration. Finally, the last set of rows of the table contains statistics for other variables we include in our firm-level regressions as motivated by the theory, as will be discussed in the empirical implementation section below. Column 1 of Table 4 reports statistics for these variables for the entire sample while column 2 summarizes variables for firms with less than twenty employees located within 100km from the border. Columns 3-8 show statistics for the latter set of firms by industry sub-samples.

4 Empirical Analysis

4.1 Cross-Border Travel

We begin our empirical implementation of the model by estimating the parameters of the cost and common benefit functions of cross-border travel using a similar approach to that of Chandra, et al. (2014). We assume that the distribution of the individual-specific benefit from travel, $K(\zeta)$, follows a normal distribution with mean μ and variance σ^2. Then equations (2) and (3) imply that the fraction of

[17] Real firm-level variables are obtained by deflating nominal variables by industry and province specific consumer price indexes.

[18] We exclude the firm itself from the construction of industry real sales to prevent endogeneity.

Table 4: Descriptive Statistics-Firm and Industry Level Variables

	All Retailers	Small Retailers	Grocery Stores	Gasoline Stations	Apparel and General Retail	Appliance Stores	Food Services	Accommo-dation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Observations	2410875	695080	70009	32362	51884	66958	143588	22536
Number of	117807.900	34085.560	3372.670	1596.426	2476.573	3218.768	7506.274	1084.782
Firms	(18056.740)	(5627.689)	(356.888)	(284.428)	(120.599)	(308.882)	(2073.867)	(107.892)
Number of	18.554	4.733	4.723	6.307	3.876	3.969	6.292	4.381
Employees	(384.319)	(3.831)	(3.646)	(3.971)	(3.286)	(3.456)	(4.317)	(3.947)
Real Sales	3075.890	615.916	7486.478	1161.159	4737.529	663.048	329.748	358.091
	(126000.000)	(963.185)	(742.715)	(1450.054)	(498.619)	(784.294)	(314.979)	(546.709)
Leverage	0.974	1.042	0.977	0.884	1.019	0.973	1.431	0.893
	(1.105)	(1.215)	(1.027)	(0.922)	(1.162)	(1.146)	(1.674)	(0.819)
Real Assets	3721.836							
	(711000.000)							
Firm Age	8.333	7.804	7.403	7.671	7.469	8.320	6.409	8.299
	(5.786)	(5.610)	(5.415)	(5.503)	(5.478)	(5.721)	(4.956)	(5.659)
Distance	229.577	57.740	59.836	61.147	58.507	55.518	58.400	63.276
from Post	(299.199)	(40.759)	(33.369)	(45.069)	(39.274)	(32.945)	(38.511)	(90.192)
H-H Index	0.034	0.033	0.111	0.061	0.055	0.033	0.006	0.026
	(0.063)	(0.054)	(0.048)	(0.068)	(0.060)	(0.033)	(0.013)	(0.031)
Industry	24.100	22.700	85.000	15.600	19.100	66.100	24.100	7.030
Sales	(26.600)	(26.300)	(31.700)	(2.460)	(14.300)	(3.750)	(10.300)	(4.080)
Real Wage	21.545	21.211	16.634	17.273	19.472	26.218	13.191	18.954
	(19.290)	(11.830)	(6.168)	(6.904)	(5.967)	(8.887)	(6.826)	(9.441)
Import Price	127.777	128.220	121.463	145.420	141.074	121.294		
Index	(20.456)	(20.362)	(11.534)	(45.707)	(20.957)	(16.786)		
Community	532.941	510.142	543.336	369.341	587.796	516.932	603.007	242.283
Population	(675.958)	(543.646)	(571.074)	(472.383)	(584.184)	(536.041)	(569.940)	(391.522)
Real Community	22.765	22.977	22.696	22.343	22.141	22.663	23.615	21.462
Median Income	(4.068)	(3.897)	(3.537)	(4.243)	(4.019)	(4.118)	(3.739)	(3.306)

Notes: (1) Numbers in the parentheses are standard deviations. (2) Real sales and real assets are in thousands of Canadian dollars. Industry sales are in millions of Canadian dollars. Population is in thousands. (3) Real assets for small firms are suppressed due to confidentiality. (4) Firm age is truncated at 25 years. (5) Import price indexes are not available for Food Services and Accommodations.

consumers from community c in region r who travel (the crossing rate) is given by

$$\frac{\omega_{cr} - \lambda(S, \theta_{cr})}{\omega_{cr}} \equiv x(S, \theta_{cr}) = \Phi\left(\frac{B(S, \gamma_{cr}, \beta_r) - T(D_{cr}, \gamma_{cr}, \beta_r) + \mu}{\sigma}\right), \tag{24}$$

where $\Phi()$ denotes the standard normal CDF.

We assume the travel cost function is log-linear in the relevant community variables given in Table 1 and we allow for a shift in this function with the change in border controls following September 11, 2001:

$$T(D_{cr}, \gamma_{cr}, \beta_r) = \tau_0 + \tau_1 \ln D_{cr} + \tau_2 \ln Pgas_{cr} + \tau_3 \text{Post911}, \tag{25}$$

where Post911 equals 0 for years prior to 2001 and equals 1 for 2001 and beyond. We assume that the common benefit function is log-linear in the nominal exchange rate and in the relevant community and region variables listed in Table 1:

$$B(S, \gamma_{cr}, \beta_r) = \rho_0 + \rho_1 \ln S + \rho_2 \ln I_{cr} + \rho_3 \ln Rpop_{cr} + \rho_4 \ln Ctax_{cr} + \rho_5 \ln Utax_r, \tag{26}$$

where S is the nominal exchange rate expressed as U.S. dollars per Canadian dollar.[19] Substituting these into (24), adding time subscripts, and letting $x_{crt} \equiv x(S_t, \theta_{crt})$ gives

$$x_{crt} = \Phi\big(\theta_0 + \theta_1 \ln S_t + \theta_2 \ln I_{crt} + \theta_3 \ln Rpop_{crt} + \theta_4 \ln Ctax_{crt} + \theta_5 \ln Utax_{rt} + \theta_6 \ln D_{cr} + \theta_7 \ln Pgas_{crt} + \theta_8 \text{Post 911}\big), \tag{27}$$

where Table 5 shows the mapping between these coefficients and economy parameters and their expected signs from the theoretical model.[20] The crossing rates, x_{crt}, are calculated as described in the data section above, where we consider both same-day and overnight crossing rates.

The empirical crossing equation given by (27) is similar in form, though with some differences in explanatory variables, to that specified by Chandra, et al. (2014) and we follow their methodology by using a fractional probit model for estimation (Papke and Wooldridge, 1996). We refer the reader to Chandra, et al. (2014) for a discussion on the details of taking equation (27) to the data. We also include provincial fixed effects to control for time invariant differences across provinces and a time trend to control

[19]The nominal exchange rate had a mean of 0.766 with a standard deviation of 0.082 over this time period.

[20]The model does not provide strong priors on the sign of θ_2, the coefficient on real income. Economic intuition suggests that higher income households should have lower marginal benefit from cross-border purchases but may be more likely to take extended cross-border trips (see footnote 21). While the model predicts that the coefficient on the price of gasoline, θ_7, should be negative as it increases the cost of cross-border travel, if gasoline is one of the purchased goods, a rise in its local price may increase travel so as to purchase cheaper gas across the border.

Table 5: Interpretation of Coefficients and Expected Signs

Coefficient	Variable	Parameter	Expected Sign
θ_0	Constant	$\frac{\rho_0-\tau_0+\mu}{\sigma}$	?
θ_1	$\ln S_t$	$\frac{\rho_1}{\sigma}$	+
θ_2	$\ln I_{crt}$	$\frac{\rho_2}{\sigma}$	?
θ_3	$\ln Rpop_{crt}$	$\frac{\rho_3}{\sigma}$	-
θ_4	$\ln Ctax_{crt}$	$\frac{\rho_4}{\sigma}$	+
θ_5	$\ln Utax_{rt}$	$\frac{\rho_5}{\sigma}$	-
θ_6	$\ln D_{cr}$	$\frac{-\tau_1}{\sigma}$	-
θ_7	$\ln Pgas_{crt}$	$\frac{-\tau_2}{\sigma}$	-
θ_8	$Post911$	$\frac{-\tau_3}{\sigma}$	-

Table 6: Crossing Rates Estimation Results

Variable	Same-day (1)	Overnight (2)	Combined (3)
θ_0: $Constant$	1.706	-3.832	1.436
	(4.479)	(2.430)	(4.008)
θ_1: $\ln S_t$	1.103**	0.624**	1.071**
	(0.186)	(0.109)	(0.167)
θ_2: $\ln I_{crt}$	-0.789**	0.210	-0.639*
	(0.300)	(0.181)	(0.267)
θ_3: $\ln Rpop_{crt}$	-0.160**	-0.101**	-0.156**
	(0.038)	(0.025)	(0.034)
θ_4: $\ln Ctax_{crt}$	2.451**	1.777**	2.647**
	(0.747)	(0.451)	(0.657)
θ_5: $\ln Utax_{rt}$	12.785*	0.241	9.634^{+}
	(6.243)	(1.884)	(5.000)
θ_6: $\ln D_{cr}$	-0.235*	-0.016	-0.211*
	(0.116)	(0.050)	(0.108)
θ_7: $\ln Pgas_{crt}$	1.050	-0.176	0.817
	(0.993)	(0.338)	(0.887)
θ_8: $Post911$	-0.239**	-0.037	-0.206**
	(0.058)	(0.030)	(0.052)
Observations	4,284	4,284	4,284
Log-Likelihood	-297.835	-80.967	-343.782

Notes: (1) Results are for the sub-sample of communities within 100km from the border. (2) Robust standard errors (adjusted for clustering at the border post level) are in parentheses. (3) Regressions include a time trend and province fixed effects. (4) Significance indicated by ** at the 1% level; * at the 5% level; and $^{+}$ at the 10% level.

for macroeconomic factors.

Table 6 reports the results of that estimation using the approximately 200 communities within 100km from the border over the time period 1986-2007. Column 1 presents results for same-day crossing rates. The first five rows are coefficient estimates for variables which affect the benefit of cross-border travel. As expected, the nominal exchange rate and the Canadian sales tax rate have positive effects while median income and relative population has a negative effect on cross-border travel. The US tax rate surprisingly has a positive effect. Turning to variables which affect the cost of travel, we see that distance and the post September 2001 indicator have negative effects on the propensity to cross, as expected, while the effect of the real gasoline price is insignificant. Relative to the findings in Chandra, et al. (2014), we find similar effects for cost variables and income. Those authors find that a real appreciation of the Canadian dollar is associated with an increase in trips and we find similar results for a nominal exchange rate appreciation. Our results also indicate other significant determinants of cross-border travel that were not measured by Chandra, et al. (2014) including tax rates and relative economic activity between Canadian communities and nearby US communities (as captured by relative population).

Column 2 summarizes the results for overnight crossing rates. We observe that the magnitude of coefficient estimates for the nominal exchange rate, Canadian sales tax, and relative population are significant but smaller than for same-day trips. Interestingly, coefficient estimates for income and all travel cost variables are all insignificant for overnight trips. This may suggest that a longer length of stay makes increased distance and border waiting time relatively less costly per trip when compared to same-day trips. Alternately, it may suggest that travelers respond to longer border waits by taking fewer, but longer, trips.[21] Column 3 summarizes the results for the combined crossing rate, which are strongly driven by the same-day crossing rate.

To summarize, our results are broadly consistent with the model's predictions and with the findings of Chandra, et al. (2014) for same-day trips. We now use these estimates to turn to the primary empirical exercise in the paper: estimating the impact of nominal exchange rate movements, in the context of cross border travel, on Canadian retailers using an empirical approach motivated by the theory.

[21] Similar to the findings of Chandra, et al. (2014), the sign of the coefficient on median income switches from negative to positive between the same-day and overnight results. As overnight trips may be primarily for the purposes of vacation and visiting relatives, cost saving from shopping in the US become less important, and higher income households may be more likely to bear the cost of these trips.

4.2 Retailer Performance

We focus on firm-level revenue (or sales) as our primary measure of retailers' performance. The equations for the equilibrium measure of firms and firm-level output in the theoretical model, (9) and (12), imply the following revenue function for a Canadian retailer with cost parameter a located in community c in region r:

$$R(a;S,\theta_{cr}) = \lambda(S,\theta_{cr})E(\gamma_{cr})\left[\frac{A(\tilde{J}(a;S))}{J(\tilde{a}(S))M_{cr}}\right]. \tag{28}$$

The corresponding variable in our firm-level data is nominal sales. If we divide both sides of this equation by a common deflator and take logs, we can write the log of real sales for a firm as

$$\ln \mathbb{r}(a;S,\theta_{cr}) = \ln \nu(S,\theta_{cr}) + \ln \omega_{cr} + \ln \mathbb{e}(\gamma_{cr}) + \ln\left(\frac{A(\tilde{J}(a;S))}{J(\tilde{a}(S))M_{cr}}\right), \tag{29}$$

where $\nu(S,\theta_{cr}) = \frac{\lambda(S,\theta_{cr})}{\omega_{cr}} = 1 - x(S,\theta_{cr})$ is the staying rate and $\mathbb{e}(\gamma_{cr})$ is real expenditure. Recall that in the model, movements in S affect a Canadian retailer's sales through two channels as illustrated by this equation: (i.) $\nu(S,\theta_{cr})$: a change in S affects the real exchange rate, both directly and through its effect on average prices in each country, and this affects the measure of consumers who shop in the community and (ii.) $\frac{A(\tilde{J}(a;S))}{J(\tilde{a}(S))M_{cr}}$: a change in S affects the Canadian dollar price of imported inputs which affects the cutoff cost parameter for operation and the measure of firms in the community.

To estimate equation (29) using our firm-, industry-, community-, and province-level data, we proceed as follows. With a slight abuse of our notation, we now let $c \in \{1,...,200\}$ index the 200 communities in our data which are within 100km of the border, and we let f index firms and i index industries. We deflate firm-level nominal sales by the relevant industry-province specific CPI to construct firm-level real sales at time t, $\mathbb{r}_{fict}$. We assume that real expenditure on goods in an industry is a constant share of real income (as in the theoretical model) and replace real expenditure by real income, I_{ict}, measured as nominal community income deflated by the appropriate industry-province specific CPI. We calculate predicted values for crossing rates from equation (27) and use those to construct estimated combined staying rates for each community in each year, $\hat{\nu}_{ct}$.

All that remains is our specification for the last term in equation (29). We allow differences across industries in production technologies and input prices giving rise to an industry-specific common cost function $\phi_i(w_{l_i}, w_{m_i})$, where w_{l_i} and $w_{m_i} \equiv \breve{w}_{m_i}/S$ are the domestic currency prices of the domestic input and imported inputs respectively for industry i. We also allow industry differences in the distribution for firm-specific cost terms, $J_i(a)$, and the measure of entrepreneurs in a community, M_{ci}. There may also be differences in consumer search probabilities and maximum allowable prices across industries. These assumptions imply industry-specific cutoffs for the firm-level cost parameter given by $\tilde{a}_i(S) \equiv \frac{\tilde{p}_i}{\phi_i(w_{l_i}, w_{m_i})}$. Given these assumptions, we can explicitly write the last term in equation (29) for a firm with cost parameter a_f in industry i as follows:

$$\ln\left(\frac{\sum_{k=1}^{K} kq_{ki}\left(1 - \frac{J_i(a_f)}{J_i\left(\frac{\tilde{p}_i}{\phi_i(w_{l_i}, w_{m_i})}\right)}\right)^{k-1}}{J_i\left(\frac{\tilde{p}_i}{\phi_i(w_{l_i}, w_{m_i})}\right) M_{ci}}\right). \tag{30}$$

Given the complexity of this expression, in our regression equation, we approximate this term with a log-linear function of a vector of lagged firm-level characteristics (reflecting differences in a_f across firms), lagged measures of the prices of domestic and imported inputs, and a vector of lagged industry controls (reflecting differences in production technologies, $J_i()$, M_{ci}, q_{ki}, and $\tilde{p}_i$ across industries). We lag these variables to control for endogeneity.

These assumptions lead to the following estimating equation for firm-level real sales given by equation (29):

$$\ln \mathbb{r}_{fict} = \beta_0 + \beta_1 \ln \hat{\nu}_{ct} + \beta_2 \ln \omega_{ct} + \beta_3 \ln I_{ict} + \beta_4 \ln w_{l_{fit-1}} + \beta_5 \ln w_{m_{it-1}} + \eta x_{ft-1} + \mu Y_{it-1} + \psi t + \epsilon_{fict}. \tag{31}$$

Our measure of the price of the domestic inputs, $w_{l_{fit}}$, is the average real wage in the firm's industry, province and size category and it is calculated from the firm-level data. We use industry-specific import price indexes reported by Statistics Canada as our measure of the price of imported inputs, $w_{m_{it}}$.[22] These indexes are constructed using both unit values from customs data and foreign price indexes. Importantly, the import price indexes reflect underlying movements in nominal exchange rates as well as changes in foreign prices. The vector of firm-level controls, x_{ft-1}, includes age, assets, and leverage (debt to asset ratios), and the vector of industry controls, Y_{it-1}, includes the industry Herfindahl-Hirschman Index (HHI) and industry sales. We also include a time trend to capture macroeconomic conditions and firm and provincial fixed effects.

Before reporting the results of the estimation, we note that the theoretical model predicts $\beta_1 > 0$:

[22]As noted previously, import price indexes are not available for Food Services and Accommodations so we do not include a measure of imported input prices for the regressions for those two industries.

an increase in the staying rate of a community increases the number of shoppers in a community and, therefore, increases the sales of a retailer located in that community. It also predicts positive values for β_2 and β_3: retailers located in more highly populated areas with higher levels of expenditure have higher revenue. The predicted signs for β_4 and β_5 from the model are ambiguous because an increase in the Canadian dollar cost of either input raises costs for all firms, causing relatively high cost firms to exit. This has two opposite effects on a firm's expected revenue. First it decreases the probability that a firm's price will be the lowest price observed by an arbitrary consumer because the fraction of firms charging a lower price than the firm increases–this decreases the firm's expected revenue (a fall in the numerator in equation (30)). The second effect is that since there are fewer firms operating, the probability that a firm's price will be observed by an arbitrary consumer rises–this increases a firm's expected revenue (a fall in the denominator in equation (30)).

Table 7 reports results from using panel fixed effects methods for estimating equation (31) for small retailers located in communities with an effective distance of 100km or less. The coefficient estimate for the staying rate is positive and significant, as predicted by the model, for all such retailers and for four of the six sub-industries. We also find that community income is positively correlated with real retail sales for all industries, also consistent with the model. The coefficient estimates for the import price index are negative and significant for three of the four industries where this variable is included, whereas the coefficient estimates for wages tend to be positive. As discussed above, the predictions of the model are ambiguous for these coefficients. The coefficient estimates for community population are negative and small which is not consistent with the model's predictions. Looking across the columns, we see that the estimated coefficients on staying rates are largest for gasoline stations, apparel and general retail, appliances and food services. This is possibly because these products have been documented as popular goods among cross-border shoppers (see Ford (1992)).

4.3 Robustness

To examine the robustness of our finding that staying rates are significantly positively correlated with retailers' sales, we also estimate equation (31) with different firm size and distance to border post cut-offs. Columns 1 to 7 of Table 8 report results for retailers of all sizes that locate within 100 kilometers from the border. Overall, the estimated effects of staying consumers on retailers in all sizes are smaller than those using our preferred sub-sample of retailers with twenty or fewer employees (Table 7). As discussed in Section 3, the T2LEAP data used here is at the enterprise level, and the location of multi-store large

Table 7: Firm Sales Regression Results

	(1) All Industries	(2) Grocery Stores	(3) Gasoline Stations	(4) Apparel and General Retail	(5) Appliance Stores	(6) Food Services	(7) Accommodation
β_0 : Constant	1.678**	13.524**	12.705**	-1.082	2.567**	-1.488+	3.545+
	(0.563)	(1.735)	(1.716)	(0.750)	(0.874)	(0.848)	(1.817)
$\beta_1 : \ln \hat{\nu}_{ct}$	1.247**	0.764	2.668**	1.786**	1.187*	-1.026**	1.455*
	(0.201)	(0.654)	(0.923)	(0.531)	(0.490)	(0.303)	(0.587)
$\beta_2 : \ln \omega_{ct}$	-0.018**	-0.010	-0.010	-0.019**	-0.019*	-0.014*	-0.055**
	(0.003)	(0.008)	(0.016)	(0.007)	(0.008)	(0.006)	(0.016)
$\beta_3 : \ln I_{cit}$	0.381**	0.140**	0.275**	0.553**	0.323**	0.426**	0.302**
	(0.014)	(0.034)	(0.096)	(0.038)	(0.039)	(0.025)	(0.068)
$\beta_4 : \ln w_{l_{fit-1}}$	0.073**	-0.001	0.113**	0.047+	0.082**	0.160**	-0.067*
	(0.008)	(0.023)	(0.028)	(0.027)	(0.019)	(0.018)	(0.033)
$\beta_5 : \ln w_{m_{it-1}}$	-0.113**	-0.071	-0.174*	-0.239**	-0.132**		
	(0.015)	(0.068)	(0.069)	(0.040)	(0.043)		
R-squared	0.131	0.081	0.107	0.160	0.190	0.081	0.076
Observations	478224	61026	28998	45025	60805	122189	20435

Notes: (1) Results are from the sub-sample of small retailers located within 100 km from the border. (2) Time trend, firm and province fixed effects are included. Firm and industry controls include firm age, size, leverage, industry HHI, and industry sales. Coefficient estimates for control variables are reported in Table D.1 in Appendix D. (3) Standard errors (in parentheses) are bootstrapped using 99 replications. (4) Significance indicated by $**$ at the 1% level, $*$ at the 5% level, and $^+$ at the 10% level.

enterprises may not reflect the location of actual stores. For this reason, it is expected that consumer staying rates in communities where large enterprises locate may have little effect on their overall sales and this can make the average effect across small and larger enterprises smaller than the effect among small ones. Columns 8 to 14 summarize the results for the sub-sample of very small retailers with ten employees or less. Comparing to the benchmark results in Table 7, the estimated effects for very small retailers are qualitatively similar. These results suggest that our findings of positive and significant effects of consumer staying rates on sales among small retailers in certain industries are robust to different samples of retailers.

Because consumers who reside more than 100 kilometers from the border may still shop abroad, we expand the distance cut-off to 150 and 200 kilometers while the firm size cut-off is held at twenty employees. Columns 1 to 7 of Table 9 summarizes the results of estimating equation (31) for small retailers located within 150 kilometers from the border while columns 8 to 14 present the results for small retailers located within 200 kilometers from the border. The coefficient estimates here are qualitatively similar to the ones presented in Table 7, suggesting that our results are robust to different choices of distance cut-offs.

As a final robustness exercise, we estimate the effect of consumer staying rates on retailers' *profits*. We use a similar empirical approach as for sales as in equation (31) but with minor differences as discussed in Appendix D. The results indicate that as with sales, consumer staying rates have positive and significant effects on firm profits for many of the sub-industries, in line with predictions from the theoretical model. Given space consideration, those results are presented at Appendix D.

4.4 Distance, Shopping Opportunities, and Border Controls

The regression results in the previous sections indicate that nominal exchange rate fluctuations are significantly correlated with border crossing rates which, in turn, are correlated with retailers' sales. In this section, we use the estimates from these regressions to quantify the impact on these variables of the observed 27.03% Canadian dollar depreciation from 1991 to 2002 and the subsequent appreciation of 38.45% from 2002 to 2006.[23]

We begin by using the results from column 3 of Table 6 to compute predicted crossing rates at nominal exchange rates for 1991, 2002 and 2006 for hypothetical communities located 8, 25, 50 and 100 kilometers from the closest shopping destination with relative population at the minimum, medium, and maximum. The 1991 crossing rate was calculated with the post 9/11 dummy set at 0, the 2006 rate with the dummy set at 1, and the 2002 rates for both levels of the dummy variable. All other variables are set at their means. We then use those crossing rates and the results from Table 7 to calculate predicted sales of a median firm in our industry sub-samples in different communities for each of the three years. Finally we calculate percentage changes in the predicted values of the variables of interest between 1991 and 2002 without post 9/11 border controls and changes between 2002 and 2006 in the presence of those controls.

Section A of Table 10 reports changes in the predicted crossing rates for the two time periods of interest. The results suggest that these historical periods of substantial nominal exchange rate movements were associated with significant changes in cross-border travel but with effects that diminish fairly rapidly with distance of a community from a US shopping destination. In addition to distance, the impact of nominal exchange rate changes on cross border travel is also strongly affected by the size of a community relative to the nearest US shopping destination. For example, when the relative population is at its maximum (representing a large Canadian city facing a small US shopping destination), the impact of the exchange rate on crossing rates is approximately one third as compared to the effect when the relative population is at the median.

Section B of Table 10 reports the predicted change in sales for all retailers and for one of the most affected industries, apparel and general retail, through changes in the staying rate (corresponding to changes in the crossing rate).[24] The predicted gains in revenues in the early period and losses in the

[23]The average nominal exchange rates were $S_{1991} = .873$, $S_{2002} = .634$, and $S_{2006} = .882$.

[24]Note that in this exercise, we are not accounting for the effect of exchange rate movements on retailers' sales that work

Table 8: Alternative Size Cut-offs

	All Sizes						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All Retail Industries	Grocery Stores	Gasoline Stations	Apparel and General Retail	Appliance Stores	Accommodation	Food Services
β_0 : Constant	1.129**	12.339**	11.573**	-1.815**	1.966**	2.533$^+$	-0.551
	(0.329)	(1.390)	(1.449)	(0.701)	(0.678)	(1.392)	(0.518)
$\beta_1 : \ln \hat{\nu}_{ct}$	0.978**	0.098	2.187*	0.774	1.017*	1.194*	-0.218
	(0.165)	(0.597)	(0.909)	(0.491)	(0.411)	(0.509)	(0.253)
$\beta_2 : \ln \omega_{ct}$	-0.009**	-0.003	-0.010	0.002	-0.014$^+$	-0.038**	-0.013**
	(0.003)	(0.006)	(0.014)	(0.007)	(0.007)	(0.014)	(0.004)
$\beta_3 : \ln I_{cit}$	0.365**	0.148**	0.316**	0.483**	0.333**	0.303**	0.415**
	(0.013)	(0.029)	(0.090)	(0.036)	(0.031)	(0.061)	(0.023)
$\beta_4 : \ln w_{l_{fit-1}}$	0.057**	0.002	0.032	0.040	0.078**	-0.079**	0.087**
	(0.007)	(0.023)	(0.030)	(0.026)	(0.014)	(0.029)	(0.017)
$\beta_5 : \ln w_{m_{it-1}}$	-0.088**	-0.092$^+$	-0.180**	-0.230**	-0.065$^+$		
	(0.015)	(0.054)	(0.046)	(0.034)	(0.035)		
R-squared	0.161	0.102	0.113	0.193	0.222	0.103	0.091
Observations	616156	87287	38094	58258	72537	33427	203064
	Below Ten Employees						
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
β_0 : Constant	2.228**	13.903**	14.831**	-0.224	3.218**	2.529	-1.477
	(0.431)	(1.143)	(3.131)	(0.683)	(0.752)	(1.982)	(0.908)
$\beta_1 : \ln \hat{\nu}_{ct}$	1.227**	1.291	2.989**	2.270**	0.959$^+$	1.225$^+$	-0.963$^+$
	(0.227)	(0.983)	(1.022)	(0.673)	(0.497)	(0.655)	(0.509)
$\beta_2 : \ln \omega_{ct}$	-0.019**	-0.019$^+$	-0.011	-0.023**	-0.025*	-0.049*	-0.012$^+$
	(0.003)	(0.011)	(0.019)	(0.008)	(0.010)	(0.023)	(0.006)
$\beta_3 : \ln I_{cit}$	0.374**	0.184**	0.167	0.563**	0.278**	0.306**	0.416**
	(0.018)	(0.050)	(0.174)	(0.032)	(0.038)	(0.083)	(0.041)
$\beta_4 : \ln w_{l_{fit-1}}$	0.100**	0.000	0.222**	0.051*	0.112**	-0.026	0.181**
	(0.009)	(0.034)	(0.034)	(0.023)	(0.016)	(0.037)	(0.025)
$\beta_5 : \ln w_{m_{it-1}}$	-0.109**	0.060	-0.137	-0.263**	-0.170**		
	(0.016)	(0.083)	(0.113)	(0.049)	(0.035)		
R-squared	0.113	0.073	0.101	0.137	0.170	0.093	0.076
Observations	358334	44161	14821	35581	45966	14464	69434

Notes: (1) Results are for the sub-sample of retailers located within 100 km from the border. (2) Time trend, firm and province fixed effects are included. Firm and industry controls include firm age, size, leverage, industry HHI, and industry sales. Coefficient estimates for control variables are reported in Table D.2 in Appendix D. (3) Standard errors (in parentheses) are bootstrapped using 99 replications. (4) Significance indicated by $**$ at the 1% level, $*$ at the 5% level, and $^+$ at the 10% level.

Table 9: Alternative Distance Cut-offs

	Within 150 Kilometers						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All Retail Industries	Grocery Stores	Gasoline Stations	Apparel and General Retail	Appliance Stores	Accommodation	Food Services
β_0 : Constant	2.254**	14.978**	13.368**	-0.047	3.368**	3.990**	-1.687**
	(0.338)	(1.378)	(1.269)	(0.566)	(0.761)	(1.237)	(0.595)
$\beta_1 : \ln \hat{\nu}_{ct}$	1.579**	0.558	3.192**	2.098**	1.761**	1.698**	-0.857*
	(0.171)	(0.519)	(0.859)	(0.499)	(0.461)	(0.582)	(0.366)
$\beta_2 : \ln \omega_{ct}$	-0.018**	-0.015$^+$	-0.017	-0.022**	-0.012$^+$	-0.038**	-0.018**
	(0.003)	(0.008)	(0.013)	(0.008)	(0.007)	(0.014)	(0.005)
$\beta_3 : \ln I_{cit}$	0.344**	0.105**	0.273**	0.517**	0.254**	0.271**	0.386**
	(0.011)	(0.031)	(0.085)	(0.031)	(0.030)	(0.057)	(0.024)
$\beta_4 : \ln w_{l_{fit-1}}$	0.091**	0.006	0.130**	0.024	0.109**	-0.090**	0.186**
	(0.006)	(0.021)	(0.029)	(0.021)	(0.013)	(0.024)	(0.015)
$\beta_5 : \ln w_{m_{it-1}}$	-0.124**	-0.063	-0.141**	-0.324**	-0.140**		
	(0.012)	(0.053)	(0.050)	(0.026)	(0.030)		
R-squared	0.127	0.074	0.113	0.154	0.179	0.071	0.082
Observations	755067	92299	43713	72079	97162	28918	191283
	Within 200 Kilometers						
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
β_0 : Constant	2.265**	16.365**	12.895**	-0.323	3.477**	3.019*	-1.622**
	(0.238)	(0.967)	(1.216)	(0.640)	(0.621)	(1.231)	(0.512)
$\beta_1 : \ln \hat{\nu}_{ct}$	1.635**	0.645	3.263**	2.126**	1.932**	1.447**	-0.658$^+$
	(0.173)	(0.599)	(0.813)	(0.501)	(0.503)	(0.501)	(0.341)
$\beta_2 : \ln \omega_{ct}$	-0.015**	-0.011	-0.032*	-0.016*	-0.011$^+$	-0.021$^+$	-0.018**
	(0.003)	(0.009)	(0.014)	(0.008)	(0.006)	(0.012)	(0.004)
$\beta_3 : \ln I_{cit}$	0.328**	0.087**	0.308**	0.508**	0.209**	0.242**	0.365**
	(0.010)	(0.029)	(0.071)	(0.025)	(0.033)	(0.052)	(0.022)
$\beta_4 : \ln w_{l_{fit-1}}$	0.090**	0.007	0.136**	0.031	0.107**	-0.054**	0.188**
	(0.006)	(0.019)	(0.024)	(0.019)	(0.012)	(0.020)	(0.014)
$\beta_5 : \ln w_{m_{it-1}}$	-0.132**	-0.102$^+$	-0.143**	-0.340**	-0.165**		
	(0.011)	(0.054)	(0.043)	(0.022)	(0.027)		
R-squared	0.127	0.075	0.116	0.152	0.179	0.073	0.079
Observations	854989	104238	50518	81059	110598	35965	214456

Notes: (1) Results are for the sub-sample of retailers located within 100 km from the border. (2) Time trend, firm and province fixed effects are included. Firm and industry controls include firm age, size, leverage, industry HHI, and industry sales. Coefficient estimates for control variables are reported in Table D.2 in Appendix D. (3) Standard errors (in parentheses) are bootstrapped using 99 replications. (4) Significance indicated by $**$ at the 1% level, $*$ at the 5% level, and $^+$ at the 10% level.

Table 10: Estimated Exchange Rate Effects on Crossing Rates and Retailer Sales

	A: Predicted Change in Crossing Rate		B: Predicted Change in Retailer Sales			
			All Small Retailers		Apparel and General Retail	
	1991-2002 (A-1)	2002-2006 (A-2)	1991-2002 (B-1)	2002-2006 (B-2)	1991-2002 (B-3)	2002-2006 (B-4)
Relative Population at the Minimum						
8km	-7.9%	6.5%	11.5%	-9.0%	16.5%	-13.0%
25	-6.0%	4.6%	8.3%	-6.3%	11.8%	-9.0%
50	-4.9%	3.7%	6.6%	-4.9%	9.5%	-7.0%
100	-3.9%	2.9%	5.2%	-3.8%	7.5%	-5.4%
Relative Population at the Median						
8km	-4.1%	3.1%	5.5%	-4.0%	7.9%	-5.7%
25	-2.8%	2.0%	3.6%	-2.5%	5.1%	-3.6%
50	-2.1%	1.4%	2.7%	-1.8%	3.9%	-2.6%
100	-1.6%	1.1%	2.0%	-1.3%	2.9%	-1.9%
Relative Population at the Maximum						
8km	-1.5%	1.0%	1.8%	-1.2%	2.6%	-1.7%
25	-0.8%	0.6%	1.1%	-0.7%	1.5%	-1.0%
50	-0.6%	0.4%	0.8%	-0.5%	1.1%	-0.7%
100	-0.5%	0.3%	0.5%	-0.3%	0.7%	-0.4%

Note: Columns A-1, B-1, and B-3 are computed with Post911=0 while A-2, B-2, and B-4 are computed with Post911=1.

latter period due to a change in the number of shoppers in a firm's community are significant for firms with a high degree of exposure to US shopping opportunities (i.e. firms in communities which are close to a relatively large US shopping destination). These effects diminish with distance and relative population, tracking the behavior of crossing rates. Generally, these results suggest that in addition to distance to shopping destinations, local availability of goods and services can be an important determinant of the impact of cross-border shopping on Canadian retailers. We also see that the nature of the industry matters for the magnitude of the demand-side effect of exchange rate movements on retailers with significantly larger effects for apparel and general retail than for total retail (around 40% larger on average).

Finally, our empirical methodology provides a useful framework for examining how policy changes which influence cross border travel effect retail sales. Here we attempt to quantify the effects of increased border controls following September 11, 2001 and changes in the duty-free allowance for Canadians returning from the US. The results from those experiments are presented in Table (11).

When comparing the crossing rate changes with the Post911 dummy set to zero to the rate when it is set to one we find that increased border controls following September 2001 reduced the crossing rate between 20% and 30%, depending on the community. The retailer's sales results suggests that when the

through the retailer entry channel.

Table 11: Estimated Effects of Border Policies

	A:Post 9/11 Border Controls				B:Change in Duty-Free Allowance		
	Predicted Change in Crossing Rates		Predicted Change in Retailer's Sales All Small Retailers		Predicted Change in Retailer's Sales All Small Retailers		
	2002-2006 Post911=0	2002-2006 Post911=1	2002-2006 Post911=0	2002-2006 Post911=1	Increase Staying Rate Coefficient by 60%	Increase Crossing Rate by 5.5%	Increase Both Staying Rate Coefficient and Crossing Rate
	(A-1)	(A-2)	(A-3)	(A-4)	(B-1)	(B-2)	(B-3)
Relative Population at the Minimum							
8km	8.2%	6.5%	-12.0%	-9.0%	-13.8%	-1.4%	-16.0%
25	6.2%	4.6%	-8.6%	-6.3%	-9.1%	-0.9%	-10.5%
50	5.1%	3.7%	-6.9%	-4.9%	-6.9%	-0.7%	-8.0%
100	4.1%	2.9%	-5.4%	-3.8%	-5.2%	-0.5%	-6.0%
Relative Population at the Median							
8km	4.3%	3.1%	-5.7%	-4.0%	-5.5%	-0.5%	-6.4%
25	2.9%	2.0%	-3.7%	-2.5%	-3.4%	-0.3%	-3.9%
50	2.2%	1.4%	-2.8%	-1.8%	-2.4%	-0.2%	-2.8%
100	1.7%	1.1%	-2.1%	-1.3%	-1.7%	-0.2%	-2.0%
Relative Population at the Maximum							
8km	1.5%	1.0%	-1.9%	-1.2%	-1.6%	-0.1%	-1.8%
25	0.9%	0.6%	-1.1%	-0.7%	-0.9%	-0.1%	-1.0%
50	0.6%	0.4%	-0.8%	-0.5%	-0.6%	-0.1%	-0.7%
100	0.5%	0.3%	-0.5%	-0.3%	-0.4%	-0.0%	-0.4%

Notes: (1) Changes reported in columns A-1 to A-4 are changes when the exchange rate moves from the 2002 level to the 2006 level. (2) Changes reported in columns B-1, B-2 and B-3 are a comparison between predicted sales with changes described in the column title to predicted sales without those changes.

Canadian dollar appreciated from the 2002 to the 2006 level, the loss of retailer sales are predicted to have been 25% to 30% larger had the post-9/11 border controls not been imposed.

Turning to the duty-free allowance policy change, we note that for cross border trips lasting longer than 24 hours, Canadian residents are allowed to bring back a certain amount of goods duty free for personal use. Effective June 1, 2012, these allowances increased. For trips above 24 hours, the allowance increased from $50 to $200, for trips above 48 hours, from $400 to $800, and above 7 days, from $750 to $800. Same-day trips had zero duty free allowance both before and after the policy change. Although this policy change occurred after our sample period making a direct assessment difficult, we are able to use the estimated parameters to estimate the impact on Canadian retailers.

Increases in duty free allowances may affect retailers through two channels: augmenting the impact of each trip and increasing the number of trips. If consumers spend a fixed share of their duty-free allowance, the estimated weighted average increase in expenditure due to the policy shift is 60%.[25] We model this intensive margin effect by a 60% larger coefficient of the staying rate in the sales regressions. Based on monthly statistics on cross-border trips, compared to June 2011, total trips by Canadians increased by approximately 5.5% in June 2012 when the duty allowance increased. We model this extensive margin effect by a 5.5% increase in crossing rates.

In Table 11, we report the estimated effects of these changes on average retail sales in Columns B-1 to B-3. We find substantial impacts of changes in the duty-free allowance along both margins: for firms located in a border community with relative population at the median, an increase in the allowable value of goods brought from the U.S. reduces retailer sales by between 5.5% and 6.4%. At any given distance, retailers in communities with relative population at the minimum encounter a much larger decline in sales than those in more relatively populated communities. Comparing across Columns B-1 to B-3, our results suggest that the intensive margin adjustments dominate extensive margin adjustments in retailers' sales due to a change in the duty-free allowance.

5 Conclusions

This paper develops a theoretical model of price setting retailers and traveling consumers who make a border crossing decision. The model provides predictions regarding the relationship between firm and regional characteristics and the magnitude of the effects of nominal exchange rate changes and resulting cross-border travel activity on retailers' sales. We use the theoretical model to guide our empirical

[25] This is the average increase in the duty free allowance weighted by the share of different length of trips in June 2011.

specification and obtain reliable measures of the effects of exchange rate movements on both consumer's propensity to cross-border shop and the sales of heterogeneous retailers.

Our empirical analysis uses Canadian firm and consumer level data from 1987 to 2007. We find that cross-border trips by Canadian travelers are highly responsive to nominal exchange rate changes, consistent with the findings of Chandra, et al. (2014) for real exchange rate movements. This supports the theory that increases in relative prices in Canada motivates some Canadian consumers to engage in cross-border shopping. Our empirical results further suggest that cross-border trips by Canadians have significant adverse effects on Canadian retailers' sales. These effects diminish with the distance of the retailer from the nearest US shopping destination and with the "shopping opportunities" at that destination. Furthermore, the magnitude of these effects varies considerably across the retail industries that we study. Our exercises also show that post 9/11 border control discourages cross-border trips and reduces retailer losses from cross border shopping. Finally, we use our model to predict the effect of the increased duty-free allowance occurred in June, 2012 and find that the effect is larger than that of the large Canadian dollar appreciation between 2002 and 2006.

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Figure 1A: Nominal Exchange Rates and Total Cross-Border Travelers

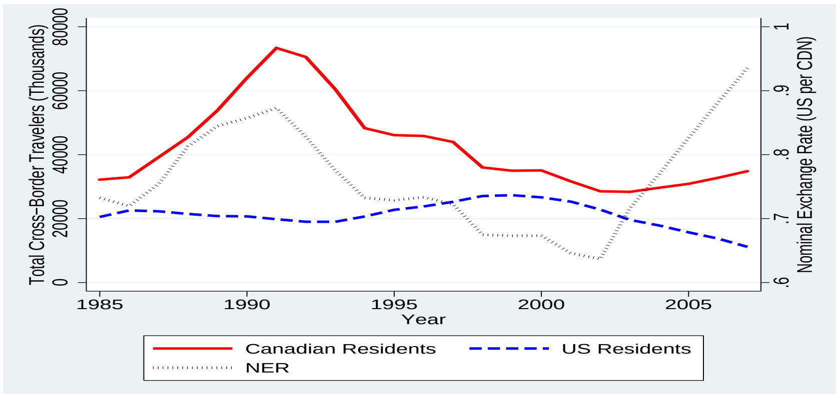


Figure 1B: Nominal Exchange Rates and Sameday Cross-Border Travelers

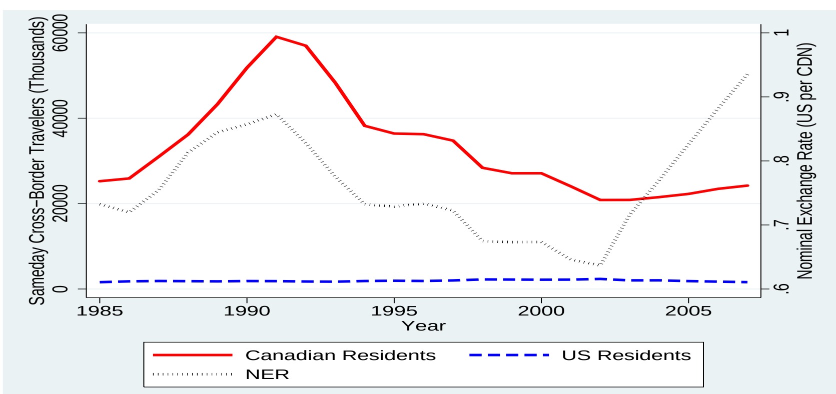


Figure 2: Price Ratios and Real Exchange Rates

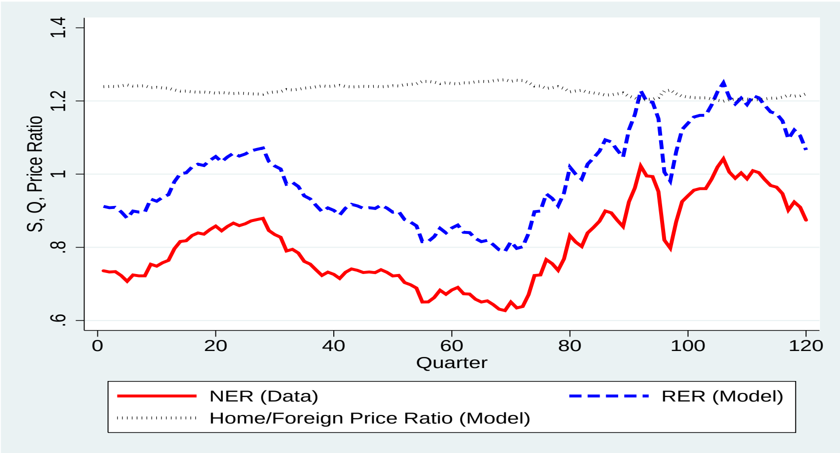


Figure 3: Fraction of Crossers

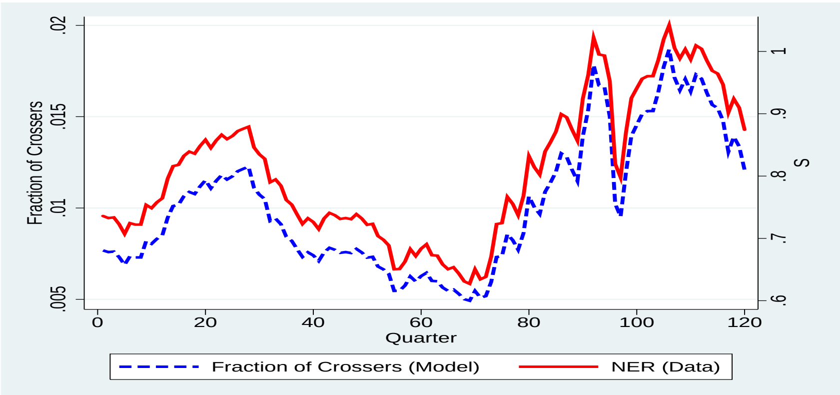


Figure 4: Average Firm Revenues

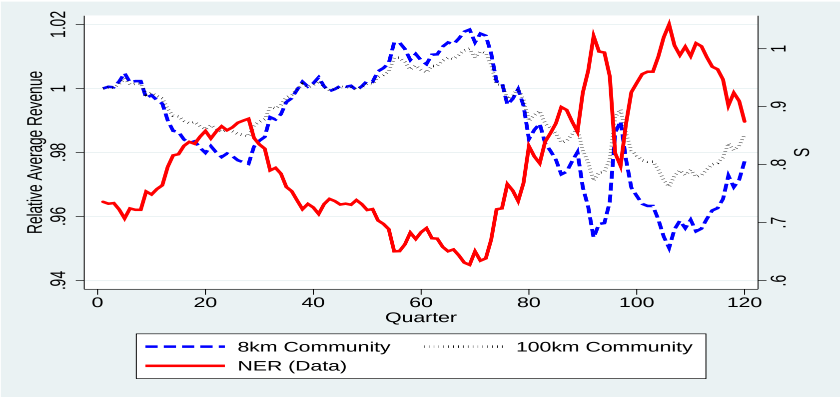
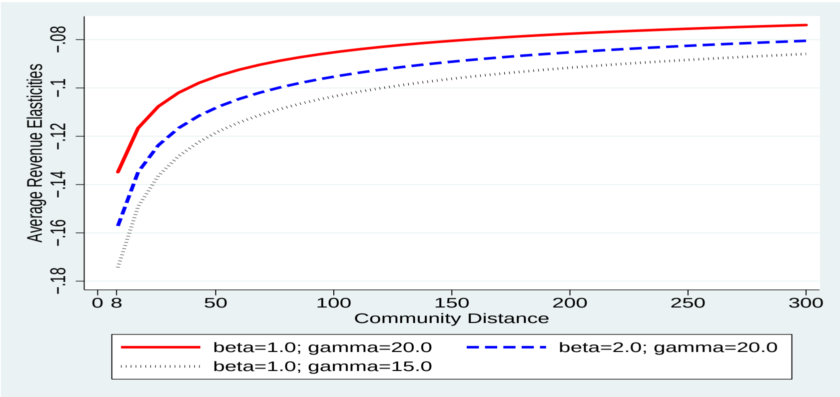


Figure 5: Revenue Elasticities with respect to the Nominal Exchange Rate



Appendix

A Economy Parameters

Table 12: Economy Parameters for Simulation

Consumers		Retailers	
Parameter	Value	Parameter	Value
$\frac{\rho_0-\tau_0}{\sigma}$	1.00	α	0.12
$\frac{\tau_1}{\sigma}$	0.20	w_{lH}	1.00
$\frac{\rho_1}{\sigma}$	1.10	$\breve{w}_{mH}$	1.00
$\frac{\rho_2}{\sigma}$	0.20	w_{lF}	0.75
γ_{rc}	$\in \{15.0, 20.0\}$	$\breve{w}_{mF}$	1.00
β_r	$\in \{1.00, 2.00\}$	Z_H	1.00
Ω_r	$10,000.00$	Z_F	1.25
η	4.20	μ_a	1.00
$\tilde{p}_H = \tilde{p}_F$	1.00	σ_a^2	0.8
μ_ζ	0.00		
σ_ζ^2	1.00		

B Data

B.1 Firm-level Data

Table B.1 lists the industry classifications used in this study from the 1980 SIC-E and 2007 NAICS classifications. To derive a consistent time series, we converted the 1980 SIC-E used in earlier years to 2007 NAICS. Generally speaking, using the 2007 NACIS, the grocery store sub-sample includes industries 4451 and 4452; accommodations is 721; food services is 722; gasoline service stations is 447; apparel & general retail includes 448 and 452; and appliances & furniture includes 442 and 443.

As discussed in Baggs et al. (2009), in the T2LEAP database, a small fraction of firms have some years missing possibly due to late filings and reappeared in later years. In these cases, the missing years were removed from the analysis but the firms are still classified as continuing firms. Also, we remove observations with profit-sales ratio in the top and bottom 0.5 percentile or leverage below the 99^{th} percentile as these are considered extreme values. We also removed observations with negative values in sales or assets.

B.2 Travelers' Data

Travelers' data is from the CANSIM database and from the Tourism and the Centre for Education Statistics Division (TCESD). Some border posts were reported together before 1990. For this reason, we combine the traveler data for the following border post groups: Lacolle Route 15, 221 and 223; Rock Island Rt 55 and 143 (Stanstead); Emerson East and Emerson West Lynne; Armstrong and Ste Aurelie; Windsor Tunnel and Ambassador Bridge; Pacific Highway and Douglas. Also, in regions with a number of border posts close to one another, we merge them into one post. These procedures reduce the number of border posts used in the analysis to 69.

C Crossing Rates

Consumers' crossing rates were constructed using the methods in Chandra, et al. (2014) involving two stages. In the first stage we estimate the number of trips from each census division as follows:

$$\hat{n}_{crt} = \frac{T_{crt}}{\sum_{c \in r} T_{crt}} n_{rt},$$

where $\hat{n}^r_{ct}$ is the estimated number of total trips from community c and T^r_{ct} is the surveyed number of trips from community c based on the International Traveler Survey (ITS), and n^r_t is the actual number of trips through border post r. As the ITS is available only after 1990 while the total trips through a border post is available from 1986, we use the 1990 share of trips to portion cross-border trips data before 1990.

The second stage is to compute the fraction of crossers as the number of trips divided by the number of potential trips. The number of potential trips is the population in community c times 365 days as each resident can potentially take multiple trips in a year and the maximum number of trips a resident can take is 365 trips. That is:

$$x_{crt} = \frac{\hat{n}_{crt}}{365 \times \text{population}_{crt}}.$$

When defining communities and regions, we encounter the case of one census division has firms close to different border posts. In this case, we use the fraction of firms in community c and region r to portion population from a Census Division to different communities. Here, the distance between each community and the closest land border post is the median distance among all firms in this community.

D Additional Results

Tables D.1-D.3 report the coefficient estimates for the control variables and they are supplements to Tables 7-9. Table D.4 summarizes the results for estimating the profits equation. The equation estimated is similar to equation (31). The only difference is in firm-level covariates. Here, we remove firm leverage

Table B.1: Industry Classification

1980 SIC-E	Description	2007 NAICS	Description
60	Food, Beverage and Drug, Retail	441	Motor Vehicle and Parts Dealers
61	Shoe, Apparel, Fabric and Yarn, Retail	442	Furniture and Home Furnishings Stores
62	Household Furniture, Appliances and Furnishings, Retail	443	Electronics and Appliance Stores
63	Automotive Vehicles, Parts and Accessories, Sales and Service	444	Building Material and Garden Equipment and Supplies Dealers
64	General Retail Merchandising Industries	445	Food and Beverage Stores
65	Other Retail Store Industries	446	Health and Personal Care Stores
69	Non-Store Retail Industries	447	Gasoline Stations
91	Accommodation Service Industries	448	Clothing and Accessories Stores
92	Food and Beverage Service Industries	451	Sporting Goods, Hobby, Book and Music Stores
		452	General Merchandise Stores
		453	Miscellaneous Store Retailers
		454	Non-Store Retailers
		721	Accommodation Services
		722	Food Services and Drinking Places
		8111	Automotive Repair and Maintenance

Table D.1: Firm Sales Regression Results: Remaining Covariates

	(1) All Retail Industries	(2) Grocery Stores	(3) Gasoline Stations	(4) Apparel and General Retail	(5) Appliance Stores	(6) Food Services	(7) Accommodation
$\eta_1 : \ln age_{ft}$	-0.003	0.028*	0.037	-0.012	-0.055**	0.020**	0.001
	(0.004)	(0.011)	(0.024)	(0.014)	(0.011)	(0.007)	(0.021)
$\eta_2 : \ln assets_{ft-1}$	0.317**	0.236**	0.273**	0.291**	0.387**	0.134**	0.231**
	(0.005)	(0.009)	(0.020)	(0.015)	(0.010)	(0.005)	(0.023)
$\eta_3 : \ln leverage_{ft-1}$	0.077**	0.084**	0.112**	0.058**	0.104**	0.011$^+$	0.096**
	(0.005)	(0.015)	(0.027)	(0.015)	(0.014)	(0.006)	(0.023)
$\mu_1 : \ln HHI_{it-1}$	-0.157*	1.264**	1.611**	-0.898**	-0.518$^+$	-0.418**	-0.750*
	(0.078)	(0.120)	(0.321)	(0.186)	(0.294)	(0.121)	(0.292)
$\mu_2 : \ln IndustrySales_{it-1}$	0.164**	-0.205**	-0.231**	0.261**	0.130**	0.298**	0.251**
	(0.012)	(0.024)	(0.055)	(0.026)	(0.028)	(0.027)	(0.069)
$\psi : Time$	-0.014**	-0.008**	-0.015*	-0.020**	-0.008**	-0.027**	-0.010*
	(0.001)	(0.002)	(0.006)	(0.003)	(0.002)	(0.001)	(0.004)
R-squared	0.131	0.081	0.107	0.160	0.190	0.081	0.076
Observations	478224	61026	28998	45025	60805	122189	20435

Notes: Table reports the remaining results of Table 7. for the sub-sample of small retailers located within 100 km from the border. (2) Time trend, firm and province fixed effects are included. (3) Standard errors (in parentheses) are bootstrapped using 99 replications. (4) Significance indicated by $**$ at the 1% level, $*$ at the 5% level, and $^+$ at the 10% level.

and add labor productivity because Baggs and Brander (2005) discuss that the causality between profit and leverage can be in both directions and both theoretical models and empirical evidence have shown that firms with higher level of productivity tend to have higher profits. Here, labor productivity is measured by sales per employee. The profit measure used here is gross profits from corporate tax form (T2) deflated using province and industry specific CPI. An empirical issue of using taxable profit is that when firms encounter a loss, they may report zero in taxable profits. Under such circumstance, only positive profits are reliable measures, causing a data censoring issue. In the data, only 7.6% of observations have negative or zero profits (and among them only 6% report negative profits while the remaining 94% report zero). As only observations with positive profits are reliable, we set zero and negative values as zeros in estimation. As in Baggs et al (2015), we encountered a trade-off between addressing the data censoring issue and accounting for firm heterogeneity. While a Tobit model can deal with the data censoring issue, incidental parameter problem arises when firm fixed effects are included. Cameron and Trivedi (2005) discuss that when the data is censored from below zero, the OLS slope parameters converge to the fraction of sample with positive values times the true parameters. As the censoring problem is minor here (92.4% of observations have positive profits), the inconsistency caused by using OLS is trivial while firm heterogeneity is an important issue to address, we choose to report the results using panel regressions with fixed effects.[26] Consistent with predictions from the theoretical model, we find that consumers decisions to stay in the community has a positive impact on firm profits (see equation (13)).

[26] Alternatively, we estimated a correlated random effects Tobit model (Wooldridge, 2010) that allows for the random effects to be correlated with independent variables and the results are qualitatively similar.

Table D.2: Alternative Size Cut-offs: Remaining Covariates

				All Sizes			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All Retail Industries	Grocery Stores	Gasoline Stations	Apparel and General Retail	Appliance Stores	Accommodation	Food Services
$\eta_1 : \ln age_{ft}$	-0.017**	0.027**	0.008	-0.034**	-0.066**	0.012	0.028**
	(0.004)	(0.010)	(0.021)	(0.011)	(0.011)	(0.014)	(0.006)
$\eta_2 : \ln assets_{ft-1}$	0.374**	0.301**	0.320**	0.379**	0.434**	0.287**	0.193**
	(0.004)	(0.009)	(0.017)	(0.015)	(0.011)	(0.018)	(0.005)
$\eta_3 : \ln leverage_{ft-1}$	0.102**	0.109**	0.120**	0.086**	0.123**	0.115**	0.024**
	(0.004)	(0.012)	(0.024)	(0.013)	(0.016)	(0.014)	(0.006)
$\mu_1 : \ln HHI_{it-1}$	-0.174**	1.196**	1.189**	-1.214**	-0.478$^+$	-1.007**	-0.349**
	(0.067)	(0.110)	(0.275)	(0.226)	(0.252)	(0.196)	(0.096)
$\mu_2 : \ln IndustrySales_{it-1}$	0.175**	-0.185**	-0.170**	0.273**	0.114**	0.269**	0.285**
	(0.010)	(0.022)	(0.053)	(0.030)	(0.025)	(0.048)	(0.018)
$\psi : Time$	-0.009**	-0.003	-0.012*	-0.012**	-0.003	-0.008**	-0.022**
	(0.001)	(0.002)	(0.005)	(0.002)	(0.002)	(0.003)	(0.001)
R-squared	0.161	0.102	0.113	0.193	0.222	0.103	0.091
Observations	616156	87287	38094	58258	72537	33427	203064
				Below 10 Employees			
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
$\eta_1 : \ln age_{ft}$	-0.003	0.021$^+$	0.042**	-0.009	-0.045**	-0.019	0.014*
	(0.004)	(0.013)	(0.014)	(0.014)	(0.010)	(0.023)	(0.006)
$\eta_2 : \ln assets_{ft-1}$	0.275**	0.201**	0.221**	0.236**	0.348**	0.264**	0.113**
	(0.005)	(0.011)	(0.022)	(0.017)	(0.009)	(0.033)	(0.007)
$\eta_3 : \ln leverage_{ft-1}$	0.060**	0.096**	0.077*	0.044**	0.094**	0.092**	0.008
	(0.005)	(0.019)	(0.032)	(0.013)	(0.015)	(0.023)	(0.010)
$\mu_1 : \ln HHI_{it-1}$	-0.262**	1.233**	1.725**	-0.991**	-0.590*	-0.609$^+$	-0.350**
	(0.089)	(0.142)	(0.383)	(0.269)	(0.295)	(0.334)	(0.134)
$\mu_2 : \ln IndustrySales_{it-1}$	0.160**	-0.199**	-0.273**	0.263**	0.137**	0.268**	0.279**
	(0.015)	(0.029)	(0.059)	(0.030)	(0.036)	(0.074)	(0.028)
$\psi : Time$	-0.017**	-0.012**	-0.022**	-0.022**	-0.012**	-0.006	-0.028**
	(0.001)	(0.003)	(0.005)	(0.003)	(0.002)	(0.004)	(0.002)
R-squared	0.113	0.073	0.101	0.137	0.170	0.093	0.076
Observations	358334	44161	14821	35581	45966	14464	69434

Notes: (1) Table reports the remaining results of Table 8 for the sub-sample of retailers located within 100 km from the border. (2) Time trend, firm and province fixed effects are included. (3) Standard errors (in parentheses) are bootstrapped using 99 replications.(4) Significance indicated by $**$ at the 1% level, $*$ at the 5% level, and $^+$ at the 10% level.

Table D.3: Alternative Distance Cut-offs: Remaining Covariates

	Within 150 km						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All Retail Industries	Grocery Stores	Gasoline Stations	Apparel and General Retail	Appliance Stores	Accommodation	Food Services
$\eta_1 : \ln age_{ft}$	0.000	0.026**	0.041*	-0.008	-0.052**	0.010	0.025**
	(0.003)	(0.009)	(0.019)	(0.010)	(0.008)	(0.018)	(0.005)
$\eta_2 : \ln assets_{ft-1}$	0.313**	0.226**	0.297**	0.291**	0.374**	0.223**	0.129**
	(0.004)	(0.009)	(0.015)	(0.012)	(0.008)	(0.017)	(0.004)
$\eta_3 : \ln leverage_{ft-1}$	0.078**	0.081**	0.125**	0.061**	0.101**	0.102**	0.010*
	(0.004)	(0.012)	(0.023)	(0.011)	(0.011)	(0.019)	(0.005)
$\mu_1 : \ln HHI_{it-1}$	-0.144*	1.509**	1.927**	-0.944**	-0.905**	-0.573*	-0.443**
	(0.065)	(0.102)	(0.288)	(0.223)	(0.214)	(0.231)	(0.105)
$\mu_2 : \ln IndustrySales_{it-1}$	0.164**	-0.254**	-0.291**	0.273**	0.139**	0.246**	0.316**
	(0.010)	(0.020)	(0.048)	(0.025)	(0.022)	(0.043)	(0.020)
$\psi : Time$	-0.014**	-0.005**	-0.013*	-0.018**	-0.007**	-0.013**	-0.029**
	(0.001)	(0.002)	(0.005)	(0.002)	(0.002)	(0.003)	(0.001)
R-squared	0.127	0.074	0.113	0.154	0.179	0.071	0.082
Observations	755067	92299	43713	72079	97162	28918	191283
	Within 200 km						
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
$\eta_1 : \ln age_{ft}$	0.003	0.032**	0.042*	-0.006	-0.051**	0.003	0.029**
	(0.003)	(0.008)	(0.019)	(0.010)	(0.008)	(0.017)	(0.005)
$\eta_2 : \ln assets_{ft-1}$	0.314**	0.226**	0.304**	0.292**	0.375**	0.230**	0.132**
	(0.003)	(0.008)	(0.015)	(0.011)	(0.008)	(0.016)	(0.004)
$\eta_3 : \ln leverage_{ft-1}$	0.080**	0.089**	0.131**	0.059**	0.100**	0.101**	0.018**
	(0.004)	(0.013)	(0.020)	(0.010)	(0.010)	(0.016)	(0.005)
$\mu_1 : \ln HHI_{it-1}$	-0.176**	1.512**	1.945**	-0.930**	-1.013**	-0.600**	-0.431**
	(0.061)	(0.102)	(0.278)	(0.179)	(0.196)	(0.227)	(0.114)
$\mu_2 : \ln IndustrySales_{it-1}$	0.169**	-0.258**	-0.288**	0.274**	0.148**	0.269**	0.321**
	(0.010)	(0.020)	(0.050)	(0.027)	(0.023)	(0.049)	(0.021)
$\psi : Time$	-0.015**	-0.006**	-0.012**	-0.018**	-0.006**	-0.011**	-0.030**
	(0.001)	(0.002)	(0.004)	(0.002)	(0.002)	(0.004)	(0.001)
R-squared	0.127	0.075	0.116	0.152	0.179	0.073	0.079
Observations	854989	104238	50518	81059	110598	35965	214456

Notes: (1) Table reports the remaining results of Table 9 for the sub-sample of small retailers with less than 20 employees. (2) Time trend, firm and province fixed effects are included. (3) Standard errors (in parentheses) are bootstrapped using 99 replications. (4) Significance indicated by $**$ at the 1% level, $*$ at the 5% level, and $^+$ at the 10% level.

Table D.4: Effect of Consumer Staying Rate on Firm Profits

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All Retail Industries	Grocery Stores	Gasoline Stations	Apparel and General Retail	Appliance Stores	Accommodation	Food Services
β_0 : Constant	27.693**	51.808**	51.128**	30.508**	18.738**	-79.518**	17.199**
	(1.837)	(6.352)	(6.990)	(2.553)	(3.952)	(12.802)	(2.546)
$\beta_1 : \ln \hat{\nu}_{ct}$	20.378**	19.721**	13.264**	19.318**	15.492**	38.791**	24.562**
	(0.989)	(2.916)	(4.119)	(2.891)	(2.904)	(5.329)	(2.327)
$\beta_2 : \ln \omega_{ct}$	-0.148**	-0.123**	-0.015	-0.288**	-0.087*	-0.208*	-0.200**
	(0.014)	(0.032)	(0.054)	(0.034)	(0.034)	(0.105)	(0.025)
$\beta_3 : \ln I_{cit}$	-1.572**	-2.377**	-0.330	-1.218**	-1.302**	-0.339	-1.880**
	(0.064)	(0.168)	(0.322)	(0.186)	(0.206)	(0.481)	(0.140)
$\beta_4 : \ln w_{l_{fit-1}}$	-0.234**	-0.348**	-0.057	0.116	0.262*	-0.850**	-0.883**
	(0.039)	(0.114)	(0.113)	(0.138)	(0.107)	(0.206)	(0.119)
$\beta_5 : \ln w_{m_{it-1}}$	1.033**	0.676*	-2.460**	0.282$^+$	2.346**		
	(0.065)	(0.309)	(0.232)	(0.163)	(0.190)		
$\eta_1 : \ln age_{ft}$	0.229**	0.327**	0.263**	0.185**	0.185**	-0.469**	0.094**
	(0.019)	(0.050)	(0.075)	(0.047)	(0.056)	(0.162)	(0.031)
$\eta_2 : \ln assets_{ft-1}$	0.290**	0.164**	0.163**	0.286**	0.412**	0.359**	0.100**
	(0.012)	(0.031)	(0.042)	(0.040)	(0.035)	(0.109)	(0.018)
$\eta_3 : \ln laborproductivity_{ft-1}$	0.287**	0.402**	0.487**	0.209**	0.280**	0.231**	0.111**
	(0.016)	(0.044)	(0.059)	(0.043)	(0.039)	(0.080)	(0.030)
$\mu_1 : \ln HHI_{it-1}$	3.183**	4.273**	7.414**	7.338**	7.519**	-12.097**	0.248
	(0.251)	(0.507)	(1.368)	(0.786)	(0.949)	(2.317)	(0.491)
$\mu_2 : \ln IndustrySales_{it-1}$	-0.452**	-0.931**	-1.462**	-0.537**	-0.632**	4.448**	0.837**
	(0.052)	(0.109)	(0.291)	(0.121)	(0.137)	(0.573)	(0.109)
$\psi : Time$	0.072**	0.049**	0.179**	0.078**	0.075**	0.278**	0.014$^+$
	(0.004)	(0.010)	(0.023)	(0.009)	(0.011)	(0.033)	(0.008)
R-squared	0.067	0.047	0.049	0.049	0.084	0.264	0.035
Observations	478763	61161	29035	45088	60862	20475	122394

Notes: (1) Results for the sub-sample of small retailers located within 100 km from the closest border post. (2) Time trend, firm and province fixed effects are included. (3) Standard errors (in parentheses) are bootstrapped using 99 replications. (4) Significance indicated by $**$ at the 1% level, $*$ at the 5% level, and $^+$ at the 10% level.