Effect of the Quebec Advertising Ban on Junk Food Expenditure[1]

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Abstract

With growing concern about childhood obesity and associated health risks, several countries are considering banning food advertising directed to children. In 1980, the Canadian province of Quebec imposed a ban on advertising to children under the age of 13. In this paper, we look at whether the advertising ban affected consumer food choice in Quebec. To the best of our knowledge this will be the first study to explore the effect of the Quebec ban on consumption.

Using data from the Canadian household expenditure survey and Canada Foodex surveys from 1984 to 1992, we ask whether expenditure on fast food is lower in those groups affected by the ban compared to those who are not. Following Goldberg (1990) we control for mother tongue as native english speakers have access to more sources of media from outside the province. Unlike Goldberg, we use a difference-in-difference methodology across several dimensions, holding family characteristics such as income, education and immigrant status constant. First, we test whether expenditure on fast food by French-speaking families with kids in Quebec differs more markedly than expenditure by English-speaking families in Quebec compared to their English and French-speaking counterparts in Ontario. We also compare consumption of those families whose first language is neither French nor English to Anglophones in the two provinces. Further, given the ban is directed to children, we estimate the effect of the ban by testing the difference in expenditure between households with children and those without in Quebec versus Ontario.

Our second approach is to estimate the treatment effect by matching households with similar characteristics across Ontario and Quebec. Using both methodologies, we find that for fast food, the primary effect of the ban is to reduce the probability of purchasing fast food as opposed to affecting the amount spent when the family was already in the restaurant. Although we cannot test the effect of the ban directly, we find a miriad of evidence that indicates that the ban had an effect on the number of fast food meals purchased.

1 Introduction

Increasing concern about child obesity has led a number of countries to propose sweeping restrictions on food advertising directed to kids. Several studies have linked childhood obesity to television viewing, and TV advertisements have been targeted as a prime suspect[1]. In response, the UK is considering an outright ban on food advertisements to kids, Australia recently rejected such a measure, and in 2004, United States Senator Tom Harkin introduced a bill to increase FCC restrictions on all advertising directed towards children. Groups on both sides of the debate have noted that bans already exist in some jurisdictions, such as the province of Quebec. Advertising lobby groups state that even with the ban, children in Quebec are no less obese than children in other parts of Canada (The Times, May 31, 2004), whereas proponents note studies showing that 'kidfluence' can affect household consumption, and child advertising is effective in altering consumption choices.

Although the Quebec law is widely referenced by both opponents and proponents of advertising bans, very few academic papers study the effect of the ban in Quebec. Goldberg (1990) notes the fact that English-speaking (Anglophone) children in Quebec have more access than their French-speaking (Francophone) counterparts to media from outside of Quebec, and he uses this insight to find that the ban has affected children's recognition of brand names, but his study does not look at expenditures. One criticism of his approach may be that Francophones are culturally different than Anglophones, having distinct preferences which are translated to

[1] e.g. Crespo et al. 2001; Dietz and Gortmaker, 1985; Gortmaker et al. 1996; Boynton-Jarrett et al.; Giammattei et al. 2003; Halford et al. 2004 and You and Nayga, 2005.

children's brand awareness, and therefore we use a difference-in-difference approach, comparing Francophones and Anglophones in Quebec to their neighbours in Ontario. Further, we also consider families whose mother tongue is neither French or English (called Allophones) assuming that they too would have less access to outside media if they reside in Quebec, but not if they live elsewhere in Canada. Last, we also specifically test the difference-in-difference for families with and without kids in Quebec and Ontario, given that the ban is expected to primarily affect families in Quebec with children.

The objective of this paper is to analyze the effect of the advertising ban on consumption expenditures in Quebec. We explore changes in demand for goods such as fast food, comparing changes in Quebec to changes in Ontario. To test the effect of the ban, we test the difference in expenditure across several groups and second, we match households of similar characteristics in Quebec and Ontario. To the best of our knowledge, this is the first formal econometric study to explore the impact of the Quebec law on household expenditure.

In 1980, the Quebec Consumer Protection Act banned advertising directed to children under the age of 13. Products and programs are rated according to their appeal to children, and products such as toys and children's food products cannot be advertised during children's programs. Adult advertising and public service announcements are allowed, but are highly regulated. The result is that child television advertising is banned on Saturday and Sunday morning, and during the weekdays after school. As with the current proposed bans, the Quebec law was not without controversy. In one of the most famous free speech cases in Canada, the law was

challenged by Irwin Toys, resulting in the Supreme Court of Canada upholding the ban in 1989. Recently, in the August 15th, 2005 issue of *Marketing Magazine,* an article titled "Time to End It?" discusses the perceived drawbacks of the ban on Quebec TV programming. These concerns were echoed at Canadian Federal Standing Committee hearings in the Senate earlier in 2005, resulting in calls for the law to be revised or reversed.

Literature on the effect of advertisements on demand using behavioral marketing methodology and child psychology is already well developed (for a good review see Hastings et al., 2003). It generally finds strong evidence that product promotion to children has an effect, and that advertising tends to encourage the consumption of unhealthy food. Goldberg (1990) is the only study that has looked at the effect of the Quebec ban using a quasi- experimental setup. He finds that Anglophone children had stronger brand recognition than Francophones, and that those children who watched a greater amount of television emanating from the United States had a stronger awareness of toys and a larger number of children's cereals in their homes. Goldberg concludes that the law was successful in reducing children's exposure to cereals and toys and therefore in reducing the pressure from children on their parents to buy them. However, he did not look at the effect of the ban on consumption patterns per se.

We use Statistics Canada's detailed household expenditure data to explore the change in purchases due to the ban. This approach is a distinct departure from the existing advertising studies cited above that are mainly based on cross sectional surveys and experiments. Using data from the annual Canadian household expenditure

survey and Canada Foodex surveys from 1984 to 1992, we ask whether consumption at fast food restaurants and convenience stores has increased or decreased after the ban. We control for expenditure on cable or satellite, and internet. Specifically, we use a difference-in-difference methodology to test whether the level of junk food expenditure is significantly different for Francophone and Anglophone families inside Quebec compared to Francophone and Anglophones in Ontario. We use both a heckman approach to estimate the treatment effect, as well as using matching approach. Unlike other papers on advertising bans, we consider the effect of the ban on both the probability of purchase, and on expenditure. One minor contribution is that we use the matching approach in the presence of censoring.

The paper proceeds as follows: in Section 2 we discuss the background of the legislation. Section 3 describes the database. In Section 4, we outline the model used for the difference-in-difference regression and its results. We present the demand model and its results in Section 5. In section 6, we provide our concluding remarks.

2 Background

On April 30, 1980, the Quebec Consumer Protection Act came into force, banning advertising directed at children under the age of 13. Article 249 of the Act the explains what criteria must be used to determine whether an advertisement is directed at children. These include:

a. The nature and intended purpose of goods advertised. For example, are the products consumed primarily by children?

b. The advertisement itself - does it use fantasy, magic, or children-specific

adventures?

c. The time and place the advertisement is shown.

During television programs where children comprise less than 15 percent of the audience, advertisements that are directed at both children and adults are permitted. During programs where children are less than 5 percent of the viewers, advertisements directed mainly at children may be broadcast. Thus, the law does not formally ban all advertising to children. Stations may still broadcast advertisements during children's programs as long as the ads are not directed exclusively to children. Similarly, ads exclusively to children can still be broadcast, but only during programs that are primarily watched by adults (Caron, 1994). Data on viewing levels and audience composition are compiled by the Bureau of Broadcast Measurement and provided to advertisers. Advertisements must be cleared with l'Office de la Protection du Consommateur (the Consumer Protection Office) before being shown.

The ban is tightly enforced. In 1984, for example, McDonald's proposed a commercial where Ronald McDonald would explain to children the importance of wearing seat belts. This commercial was refused by l'Office de la Protection du Consommateur because it involved a known and well-liked children's character (Government of Canada and Gouvernement du Quebec, 1985). Thus, advertisements during children's programs have to be clearly directed to adults for adult-specific products.

One of the weaknesses with the legislation is that it only applies to signals originating inside Quebec. Thus, it does not apply to signals originating in Ontario and the United States. Although Francophone children are not likely to watch the English programs, Caron notes that Anglophone children do spend a large time watching

these broadcasts that originate largely in the United States. We use this fact to help identify the effect of the ban.

3 Database

To study the effect of the ban, we use household-level expenditure survey data from Statistics Canada. The Canada Foodex survey has detailed information on bi-weekly food purchase behavior of households. The survey has been conducted periodically since 1972 and is large (in 1996 it has household information and detailed food expenditure data for over 5,600 families). In this paper, we specifically focus on expenditure on *meals at fast food restaurants*, as an example of heavily-advertised food. Prices for fast food meals were generated by using the expenditure on restaurant meals (breakfast, lunch and dinner) divided by the number of meals purchased for those observations where fast food was the only type of restaurant visited by a household in a given week. To get a unit price for a fast food meal, we took a weighted average price over the three meals. As with the prices of the other goods, for the observations where no purchase or unique quantity data are observed, we use a provincial median price. In 1982 and 1990, only residents of 15 majour Canadian cities were surveyed (approximately 10,000 households). In contrast, in 1986 and 1992, the survey includes respondents from smaller communities and rural areas. To make use of the variation over time, we restrict ourselves to considering residents of the 15 major Canadian cities, which gives us a total sample of slightly over 40,000 households. We exclude those households with no food expenditure, and, for the fast food regression, we exclude those spending more than $150 per week on fast

food.

The Foodex data include has a number of household characteristics, such as education level, type of home, whether the family owns or rents, income from various sources, and occupation (which we classified as white collar, blue collar or manufacturing and construction, pink collar or service, and other). We also make use of the information on mother tongue, and we create a dummy variable to capture whether both spouses were working.[2] We also create a variable to control for families where both spouses are immigrants. For prices, we used the CPI by expenditure category by province normalized to 1982. The four years of data are stacked, creating a pooled data set. Summary statistics on expenditure are calculated using the probability weights from the survey and are presented in Appendix A by group. As can be seen, our various control groups (Francophone and Allophone families in Ontario, Anglophone families in Quebec and Ontario, and families without children) are similar to the treatment groups (Francophone and Allophone families in Quebec and Quebec families with children) over the various household characteristics.

To capture access to media from outside the province, we want to control for access to cable television. The biannual Canadian household expenditure survey provides detailed yearly purchases of items like toys, clothing, and expenditure on cable and satellite TV. The Canadian household expenditure survey (also called the Famex) is large, with a sample size that ranges between 10,000 (1996, 1992, 1986 and 1982) and 4,500 (1990 and 1984). Since the Foodex and Famex surveys are conducted on different samples, we cannot directly infer cable consumption by the

[2]Mother tongue is recorded in all surveys except the two from 1996, so we cannot use that year for our analysis.

households in the Foodex data. Thus, by year and by province, we use a probit to predict whether a family had cable as a function of their characteristics, and use the estimated coefficients to predicted the probability of a Foodex household having cable. The results of the probit are in appendix A. For 1990, we predict both the cable expenditure and the non-cable entertainment expenditure given no cable consumption. Using these predictions, for the other years we predicted both the probability of expenditure on entertainment given the Famex data from 1984 and 1986 and the probability of expenditure on non-cable expenditure given no cable from the 1990 Famex data. We subtract these two results to get an estimate of the probability of households having cable.

4 Difference-in-Difference Model

Using difference-in-difference to estimate the average effect of treatment has a long history in the labour and development literature. (for example, see Ashenfelter and Card 1985; Lalonde 1986; .Card and Krueger 1996). The concept is quite simple; one measures the effect of a policy by comparing changes in behaviour or outcome in the treated group before and after the policy, to that of a control group before and after the policy was implemented. As long as the control group is representative of the individuals or households in the treatment group, the control group captures any average effect of changing outcome over time, isolating the effect of the treatment. In its simplest form, one estimates the effect of the treatment from the coefficient on the interaction term for the treatment group after the policy. See equation (1).

$$y_i = z_i'\beta_z + \beta_g g_i + \beta_p p_i + \delta g_i p_i + v_i \quad (1)$$

where y is the outcome for individual i, z is a vector of individual characteristics, g is a dummy variable for the treatment group which equals 0 for the control group and 1 for the treatment group, p is a dummy variable for the policy, equal to 0 before the policy is implemented, and 1 after. The vector of coefficients β_z represent the effect of the individual characteristics, the coefficient β_g represents the effect of other differences between the treatment and control groups, β_p represents the average effect on both treatment and control groups of the introduction of the policy, for example capturing spillover effects or the effect of unobserved variables whose change coincided with the introduction of the policy. The coefficient on the interaction term, δ, represents the average effect of the policy on the treatment group. The last term, ν_i is an error term.

Our formulation is slightly different in that we do not have data from before the ban. However, we can control for the effect of the ban by considering groups that would have been affected differently by the ban, and comparing those treated groups to their counterparts in our control region. Thus, for our regression, the variable p in equation (1) does not represent the time the ban was introduced, but the groups directly affected by the ban, such as Francophones and Allophones and families with children inside Quebec.

Concerns with the approach include the endogeneity of the treatment group (Imbens and Angrist 1994, Angrist, Imbens and Rubin 1996, Heckman 1997, 2001 and Abadie 2002). That might be of concern in our data if Quebec had imposed the

ad ban either in response to province-specific child health concerns. However, in 1980, the ban was directed at all children's products, not just junk food. The other concern is that our treatment group may have been able to impose the ban due to cultural differences which may also affect food expenditure. We control for this concern in two ways: by comparing Francophones inside to Quebec to those outside, and by comparing Francophone families in Quebec with children to those without under the assumption that cultural effects should persist across families before and after they have children.[3]

We estimate household expenditure on fast food, breakfast cereal and soda. Expenditure is assumed to be a function of income, number of family members, price and proxy variables for preferences over quality. We also control for various household characteristics such as age, education, occupation, and whether the families are recent immigrants. One might anticipate that people are less likely to consume junk food as they get older, and the more educated they are. Since we are already controlling for income and education, occupation may act as a proxy for time constraints. Those families with more demanding jobs may eat out more.

The variables of particular interest in our study are dummies for the province, dummies for mother tongue, the number of children in the household under the age of 16, and the interaction terms (capturing families with children in Quebec and Ontario and who are Anglophone, Francophone and Allophone). We can then test whether the difference in expenditure of Francophones and Anglophones families with children in Quebec is larger than the difference between these two groups in

[3]One may hypothesize that in the later years of our sample, some adults may have grown up with the ban. Testing this hypothesis is work we hope to complete in the future

Ontario, which controlling for other demographic differences. We also test whether families with children behave more differently in Quebec than Ontario than their counterparts without children.

Other variables of interest are the probability that a family with children has cable, to capture the effect of exposure to advertising. We also interact this variable with the Quebec dummy, to check for a specific effect of access to cable for Quebec families with children.

One difficulty with developing a model of expenditure is unobservable quality differences in the data. To control for these differences, we control for the type of store at which the item is purchased. Specifically, to capture quality, we generate variables that capture the number of times each family went to each type of store in a week. We also use total family food expenditure to capture whether the family prefers high-quality or high-expenditure food.

We estimate the difference-in-difference two ways: using a Heckman approach and using matching. Each of these will be discussed in turn below.

4.1 Heckman Model and Results

Due to the prevalence of zeros in the weekly expenditure data, we use a Heckman two-stage approach (Gronou 1974, Lewis 1974, Heckman 1976). The approach assumes that there is a latent variable, y_i^* that is a function of the right-hand variables, but that y_i^* is not always observed. Specifically, the decision, d_i of whether y_i^* is observed is a function of various characteristics, z_i, called the selection equation.

$$
\begin{aligned}
y_i^* &= x_i\beta + v_i \\
y_i &= y_i^* \text{ if } d_i = z_i\gamma + u_i > 0 \qquad (2)\\
&= 0 \quad \text{if } d_i = z_i\gamma + u_i \leq 0 \qquad (3)\\
&\text{where } (u,v)\tilde{}n(0,0,\sigma_u,\sigma_v,\rho) \qquad (4)\\
&\text{Note that } v|u\tilde{}n(\rho\sigma_v u, \sigma_v^2(1-\rho^2)) \qquad (5)
\end{aligned}
$$

The linear estimation is generally not independent of the selection process. The error terms are assumed to have a normal joint distribution, with means of 0 and correlation of ρ. Thus, the expectation of the error term in the linear regression conditional on y being observed is not mean zero, and therefore standard regression ignoring selection would produce biased estimates. To correct for this problem, the selection equation is used to generate an inverse mills ratio, which represents the expected value of the error term given y is observed for each individual, to correct for the selection bias in the linear regression.

$$
\begin{aligned}
E(y_i|u_i &> -z_i\gamma) = x_i'\beta + \rho\sigma_v E(u_i|u_i > -z_i\gamma) \qquad (6)\\
E(y_i|u_i &> -z_i\gamma) = x_i'\beta + \rho\sigma_v \frac{\phi(-z_i\gamma)}{\Phi(z_i\gamma)} \qquad (7)
\end{aligned}
$$

where Φ and ϕ are the CDF and PDF, respectively, associated with the probability of observing a censored outcome. In the Heckman approach, we use maximum likelihood to estimate a probit on whether people purchase or not and the amount of expenditure when they do purchase. The results of the probit are used to generate

the inverse mills ratio, represented as the last term in the above equation to control for the selection bias when estimating of the amount of expenditure. Effectively, the IMR represents the omitted variables from the selection that also affect the amount of expenditure (Heckman 1979). To not rely on the functional form for identification, we use several exclusion variables that affect selection but do not affect the choice of expenditure after the decision to purchase has been made. Specifically, we use a dummy for whether both spouses are recent immigrants, under the assumption that recent immigrants are less likely to purchase fast food or junk foods purely due to different preferences. Second, we use income and income squared as income determines whether one eats fast food, but when one decides to purchase fast food, it does not change the amount one spends. Last, we use the education of the male head of household, since higher educated males were more likely to purchase fast food, but their education did not affect the amount spent once in the restaurant. In all three cases these variables did significantly affect the choice to purchase fast food, but had no significant effect on the expenditure on fast food once the expenditure had been made. Our treatment and control variables are included in both the selection and linear regressions. Because the log of non-zero expenditure data closely approximates a normal distribution, we estimate the natural log of expenditure.

Results in all cases show that the error terms in the selection and linear regressions are not independent, and therefore the inverse mills ratio needs to be included. Note that the variables included in both selection and linear regression often have different (and significant) signs, implying that a tobit specification would be too restrictive in this case.

We test the hypothesis that the difference-in-difference is significant for both the decision to purchase and the expenditure on advertised fast food and junk food and not for other food products. Second, we test whether the increase in consumption of fast food and junk food for families with children depends on the probability of cable (as an indicator of exposure to advertising). The difference-in-diference results on fast food expenditure are presented in table 1. We present the marginal effects for the probit selection equation, defined as:

$$\frac{\partial E(d_i)}{\partial z_{ik}} = \gamma_k \phi \left(z_i^{'} \gamma \right) \tag{8}$$

The difference-in-difference results are significant for the determination of whether households consume fast food across all comparisons: French to English families with children in Quebec versus Ontario, other mother tongue to English in Quebec versus Ontario, and families with children to families without children in Quebec versus Ontario. These same difference-in-difference results do not significantly determine the log of expenditure after the decision to purchase has been made.

Table 1: Difference-in-difference results comparing famlies with kids in Quebec and Ontario

	Selection		**Log of Expenditure**	
Families with kids Quebec vs. Ontario	marginal effect	std. err.	coefficient	std. err.
French	-0.193^c	0.063	-0.385^a	0.210
English	-0.098	0.064	-0.349^a	0.198
Other mother tongue	-0.186^c	0.064	-0.424^b	0.217
Difference-in-Difference				
French vs. English	-0.095^b	0.045	-0.022	0.154
Other vs. English	-0.088^b	0.045	-0.057	0.162
Kids vs. no kids	-0.034^b	0.017	-0.024	0.058

a indicates signifcantly different from 0 at the 10% confidence level, b at the 5% level and c at the 1% level.

As can be seen, French-speaking families with children living in Quebec were 19 percent less likely to consume fast food that their Ontario counterparts. They also spent 46% less. English-speaking families in Quebec were not significantly less likely to consume fast food than their Ontario neighbours, although they did spend significantly less (44%). Families whose native language was neither French nor English were also significantly less likely to purchase fast food, and purchased significantly less.

For all three difference-in-difference results, there is a significant difference in the choice of purchase. The difference of the probability of purchase for Francophones in Ontario versus Quebec was 9.5% larger than the difference between Anglophones in the two provinces. Given that the average amount spent per household when the household consumed was \$11.40 per week, this would be an expected increase of \$56. 316 per year per household. Assuming that the 78 percent (or .49 million households per year) of Francophone households with kids in (urban) Quebec currently not consuming fast food increase their probability of consumption by this percent, that would lead to an expected increase of \$27. 6 million in fast food sales in Quebec per year without the ad ban. For Allophones, the ban decreased the probability of consumption by 8.8 percent, which translates into an expected decrease of \$52. 17 per household per year. If all 75% of the Allophone families with kids increased their probability of consumption by this amount, that would translate into a loss of \$3. 668 2 million in sales. Added together, the ban is estimated to have decreased

sales by $31.27 per year.

If we instead assume that without the ban, families with children in Quebec behave like their counterparts in Ontario, they would increase their probability of purchasing fast food in any week by 3.5%. The average expenditure for families with kids when they purchase is $12.85 per week. The increase in expected expenditure without the ban is then $23.4 per household per year. If one assumes that the 0.59 million families with kids in Quebec that are currently not consuming fast food in a week consume fast food 3.5% more often, that translates to an increase of $13.730 million in fast food expenditure in Quebec per year. Using these two difference-in-difference results as endpoints, we can estimate that the ban decreased expenditure on fast food in Quebec between $13.73 and $31.27 million per year in the 1980s and early 1990s. At an average cost of $3.88 per meal, that means that the ban decreased the number of fast food meals in Quebec by between 3.5 and 8.1 million per year.

However, there is no significant effect of the ban on the log of expenditure itself. Thus, the ban appeared to affect the decision of whether to go to a fast food restaurant, it did not appear to affect the decision of how much to spend when there. Even though families with kids living in Quebec do spend significantly less on fast food than their counterparts in Ontario, we cannot attribute that effect to the ban. The full results of the selection and expenditure regression are presented in table 2.

Table 2: Results of Selection Probit Equation and Regression of Log of Expenditure on Fast Food

	Selection		log of Expenditure	
	marginal effect	std. err.	coefficient	std. err.
Quebec* (rest of country as base)	-0.073^c	0.016	0.012	0.046
Ontario* dummy	0.013	0.009	-0.031	0.027
French* (English as base)	-0.063^c	0.014	0.037	0.044
Other mother tongue*	-0.024^b	0.010	0.024	0.030
Number of Children (age 0 to 16)	-0.037^c	0.007	0.092^c	0.020
French Families with Kids in Quebec*	-0.125^c	0.046	-0.419^b	0.178
English Families with Kids in Quebec*	-0.049	0.060	-0.338^a	0.198
Families with Other Mother Tongue with Kids in Quebec*	-0.127^b	0.052	-0.455^b	0.211
French Families with Kids in Ontario*	-0.018	0.037	-0.010	0.123
English Families with Kids in Ontario*	-0.037^c	0.014	0.054	0.045
Families with Other Mother Tongue with Kids in Ontario*	-0.027	0.021	0.013	0.071
Probability of Cable TV	0.111^c	0.029	0.128	0.076
Probability of Cable TV with Kids	0.040^b	0.017	-0.048	0.052
Probability of Cable TV with Kids in Quebec	0.127^a	0.071	0.541^a	0.223
Unit Price of Fast Food	-3.111^c	0.189	0.365^c	0.028
(Unit Price of Fast Food)^2	38.628^c	2.273	-0.009^c	0.002
Number of Household Members	0.003^b	0.002	0.026^c	0.005
Blue Collar Male Occupation (White Collar as base)**	-0.032^c	0.010	0.048	0.034
Pink Collar Male Occupation**	-0.031^c	0.009	0.042	0.028
No Male Occupation**	-0.030^c	0.009	0.048^a	0.027
Blue Collar Female Occupation**	-0.062^c	0.020	0.142	0.090
Pink Collar Female Occupation**	0.015^a	0.008	0.041^a	0.024
No Female Occupation**	-0.026^c	0.008	0.081^c	0.025
Home Owner*	0.012	0.008	-0.051^b	0.026
Recipient of Social Assistance*	-0.067^c	0.012	-0.073	0.046
Male Education***	0.014^c	0.002		
Female Education***			-0.048^c	0.007
Age of respondent	-0.006^c	0.000	-0.003^c	0.001
Double-Income Household*	-0.011	0.008	0.069^c	0.024
Both Spouses Immigrants*	-0.067^c	0.010		
Total Food Expenditure	0.001^c	0.000	0.002^c	0.000
Income	0.087^c	0.034		
(Income)^2	-0.040^a	0.021		

a indicates signifcantly different from 0 at the 10% level, b at the 5% level and c at the 1% level.

* Denotes dummy variable

** Dummy variables, where White collar is defined as managerial, professional or teaching; Blue collar is defined as Farming, Fishing, Forestry, Mining, Processing, Manufacturing or Construction. Pink collar is defined as Clerical, Sales or Service.

*** The education variable is defined as follows: 1 = less than 9 years; 2 = some secondary; 3 = some post-secondary; 4 = post-secondary certificate; 5 = university degree. Those with missing education were dropped.

The constant and year dummies were all positive, significant and increasing over time, for both the probability of purchase and the amount spent.

In general the probability of having cable TV increased the probability of purchasing fast food for all households by about 11 percent. If the household had children, the probability of purchasing fast food increased another 4 percent. However, that increase was even greater for families with children in Quebec, where the probability of cable increased the probability of purchasing fast food by a further 13 percent. This result is consistent with our difference-in-difference results, showing greater access to media from outside the province increases the probability of purchasing fast food.

Other results of interest in the selection equation are that men and women with while collar jobs were more likely to purchase fast food (the one exception being women with pink collar jobs who were more likely than their white-collar counterparts to purchase fast food). However, one having decided to purchase fast food,

households with white collar women spent less. We see a similar result with education, where male education increases the probability to purchase, and female education decreases the expenditure. Households where both spouses are working full-time were slightly less likely to purchase fast food, but spent more when they did. Higher income increased the probability of purchase, but at a decreasing rate. Last, households tended to spend less, less often as the age of the respondent increased.

4.2 Matching Approach and Results

The treatment effect for a single unit, τ_i is defined as the difference between the outcome of a family that was in the treatment group less the outcome if that same family was untreated $y_i(1) - y_i(0)$. In our case, the treatment effect is the difference in fast food expenditure between a Quebec family affected by the ban and that same family if it were in Ontario. If we could observe the treatment and non-treatment outcome for the same household - i.e. both $y_i(1)$ and $y_i(0)$, then the effect of the treatment on household i would simply be the difference. The problem is that for each household, we only observe either the outcome of treatment or not. Thus, following Imbens et al's notation:

$$y_i = y_i(T_i) = \begin{cases} y_i(0) & \text{if } T_i = 0 \\ y_i(1) & \text{if } T_i = 1 \end{cases}$$

where T_i represents whether treatment is received by household i ($T_i = 1$) or not ($T_i = 0$).

We are specifically interested in the population average treatment effect: $\delta = E\{y(1) - y(0)\}$

Intuitively, if the treated and control units systematically differ in their characteristics, then in observing only for the control group we do not correctly estimate for the treated group. Such bias is of paramount concern in non-experimental studies. As illustrated above in the summary statistics of our data, the characteristics of the treated and untreated households overlap significantly. Second, because we have a large data-set, we do not have to rely on small-sample properties of the estimator. We use the unbiased matching estimator as developed by Abadie and Imbens (2006).

In our data, we assume that treatment is truly exogenous - that people do not choose to live in Quebec or to be Francophone as a result of the ban on advertising. Similarly, we assume that prior to the ban, characteristics of the treated and untreated groups are similar. Thus, we avoid one of the primary difficulties using either difference-in-difference or matching estimators. However, we are faced by another (hopefully less complex) problem in that we have censored data.

Assume we have a latent variable, y_i^* that is desired expenditure on fast food by household i, where $y_i^* = x_i'\beta + \delta T_i + \varepsilon_i$

and we want to estimate the effect of treatment on that latent variable, δ. However, we only observe y_i^* if the household chooses to buy fast food, or if $d_i = z_i'\alpha + \gamma T_i + \nu_i > 0$. Note that the decision to purchase fast food is also a function of treatment. What we observe is $y_i = \begin{cases} 0 \text{ if } d_i \leq 0 \\ y_i^* \text{ if } d_i > 0 \end{cases}$

Now, when we take the difference in outcomes between treated and untreated, we see one of four possible outcomes: both households have no expenditure, the treated household has no expenditure while the treated household purchases, the treated household purchases while the untreated household has no expenditure, where both

households have positive expenditure. Thus,

$$y_i(1) - y_i(0) = \begin{cases} 0 \text{ if } d_i(0) \leq 0,\ d_i(1) \leq 0 \\ y_i(1) \text{ if } d_i(0) \leq 0,\ d_i(1) > 0 \\ -y_i(0) \text{ if } d_i(0) > 0,\ d_i(1) \leq 0 \\ y_i(1) - y_i(0) \text{ if } d_i(0) > 0,\ d_i(1) > 0 \end{cases}$$

If the error terms of the probabilities of the two groups are independent, i.e. $E(v_i(1)v_i(0)) = 0$, then the joint probability is just the multiplication of the two individual probabilities. Thus, the above can be simplified to:

$$E(y_i(1) - y_i(0)) = E(y_i(1)|d_i(1) > 0) \times P(d_i(1) > 0) - E(y_i(0)|d_i(0) > 0) \times P(d_i(0) > 0)$$

Thus, estimating a straight difference of the observed outcomes gives us a mix of the difference in the latent variable and a difference in the probability. To address the fact that we do not see both treated and untreated for the same household, we match households in the treated subpopulation to untreated households by their characteristics, so that $x_i \approx x_j$. If we want to determine the effect of treatment on the latent variable, we want to take into account the selection bias, and set it equal across our two households. In other words, we want to account for the omitted variables that affect selection that also affect the amount of purchase. Just as in the Heckman approach discussed above, we can use a probit to generate the inverse mills ratio, and then match households over this measure of selection bias, controlling for the effect of treatment on the selection, and allowing us to isolate the effect of treatment on the amount spent. Second, we can also compare the (estimated) probability of purchase for the treatment and control groups, to see if treatment affected whether households purchased or not. To generate the estimated probabilities, we split our sample into Quebec and the rest of Canada, and estimated

the probability of purchase over each sample using a probit.

For our matching variables, we use a similar specification as in the Heckman above. We match households by number of family members, income, education, total food expenditure, age of the respondent, probability of having cable television, price of pop and match exactly over the year, occupation dummy, whether the family owns its house, whether the family is on social assistance, and a dummy for double-income household. Matching results are presented in table 3. For the comparisons over language group, we restrict our sample to families with children, since they are the groups we would expect to be affected by the ban. We find results similar to that from the Heckman: that French-speaking families in Quebec are less likely to purchase fast food than their counterparts in Ontario. They also purchase less, but the effect is not significantly different than zero. As one might anticipate, there were no difference in consumption - either the probability of purchase or the quantity purchased - between English-speaking families in Quebec versus Ontario. Thus, there is some evidence that the ban, even if it may have changed behaviour of some households, did not affect Quebec Anglophones. Families that have neither English nor French as their mother tongue also were less likely to purchase fast food in Quebec than in Ontario.

Table 3: Results of estimated average treatment effect of Families with Children using matching over Quebec and Ontario

	Probability of purchase		Latent Expenditure	
Families with Kids Quebec vs. Ontario	average treatment	std. err.	average treatment	std. err.
French	-0.053[c]	0.013	-1.347	0.979
English	-0.0004	0.014	1.437	0.966
Other mother tongue	-0.068[c]	0.013	1.130	1.169
Difference-in-Difference				
French vs. English	-0.053[c]	0.019	-2.784[b]	1.375
Other vs. English	-0.068[c]	0.019	-0.307	1.516
Kids vs. no kids	-0.062[c]	-2.706	-2.646[a]	1.354

Thus, using the matching estimation, the ban reduced the probability of expenditure between 5.3 and 6.8 percent. These results indicate a slightly smaller effect by language group than the Heckman method, but a slightly larger effect comparing families with children to those without. The overall results in terms of the decrease in expected expenditure and number of meals is about the same.[4]

5 Concluding Remarks

The consumption of fast food and junk food is on the rise along with the related health concerns. Several countries are responding by considering banning advertisements of unhealthy food to children. One jurisdiction that has experience with such a ban, province of Quebec in Canada, has banned advertisements to children since 1980. In this paper, we study the effect of the ban on fast food expenditure.

Our difference-in-difference regressions and match estimators indicate a difference in the probability of consumption of fast food. Interestingly, once families decide to

[4]When we estimated these effects for each year separately, all years had significant effects (although 1990 was only significant at the 10 percent level) and more importantly, the magnitude of the effects actually increased slightly over time

go to a fast food restaurant, the amount they spend does not vary much. Estimates of the magnitude of the effect range from a decrease of 3.5 to 8.1 million fast food meals per year due to the ban. We found a significant difference in the probability of purchasing fast food comparing Francophone and Anglophone families in Quebec and Ontario. For those who have concerns about comparing Francophone families in Quebec to those in Ontario, we also compare families with neither English or French as their mother tongue, and find that these families are less likely to visit fast food restaurants in Quebec versus Ontario, and that this difference is larger than the difference in English-speaking families. For readers concerned that Allophone families may also not be comparable across the two provinces, we also compare households with kids to those without in Quebec to those in Ontario. We find that the difference in the probability of visiting a fast food restaurant of households with kids compared to those without is significantly larger in Quebec versus Ontario. Thus, cutting the data three separate ways, we consistently find an effect of the ban on the probability of purchasing fast food.

Last, to address concerns that households in these various categories are different in the two provinces, we also match families by their characteristics (number of household members, income, education, occupation, age and immigrant status) and find that our results still hold.

5.1

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Appendix A: Summary Statistics

	Quebec		Ontario		
	Mean	**Std. Err**	**Mean**	**Std. Err**	**T-test**
Households With Kids					
Number of Observations	2363		3235		
Fastfood expenditure ($ per week)	3.90	0.19	4.95	0.19	*-3.96*
Probability of Fastfood purchase in a week	0.29	0.01	0.38	0.01	*-6.70*
Number of Children ages 0 to 16	1.68	0.02	1.72	0.01	*-2.02*
Number of Household members	3.64	0.03	3.66	0.02	*-0.67*
Household Income	0.43	0.01	0.50	0.01	*-9.48*
Dummy for Double-Income Household	0.34	0.01	0.35	0.01	*-1.30*
Dummy for Both Adults Immigrants	0.10	0.01	0.25	0.01	*-14.05*
Total Food Expenditure ($ per week)	133.13	1.76	131.73	1.61	*0.59*
Male Education	2.63	0.03	2.75	0.03	*-2.75*
Female Education	2.66	0.03	2.86	0.02	*-5.64*
Male Occupation - Blue Collar	0.13	0.01	0.14	0.01	*-0.97*
Male Occupation - Service Sector	0.18	0.01	0.18	0.01	*-0.46*
Male Occupation - None	0.15	0.01	0.13	0.01	*2.36*
Female Occupation - Blue Collar	0.04	0.00	0.03	0.00	*1.24*
Female Occupation - Service Sector	0.29	0.01	0.32	0.01	*-2.55*
Female Occupation - None	0.36	0.01	0.31	0.01	*3.58*
Owns home	0.65	0.01	0.67	0.01	*-1.13*
On Social Assistance	0.10	0.01	0.08	0.00	*2.35*
Probability of Cable	0.77	0.00	0.83	0.00	*-15.05*
Households without Kids					
Observations	4856		6028		
Fastfood expenditure ($ per week)	2.56	0.11	3.36	0.11	*-5.05*
Probability of Fastfood purchase in a week	0.22	0.01	0.32	0.01	*-11.27*
Number of Household members	2.44	0.03	2.56	0.03	*-3.18*
Household Income	0.32	0.00	0.42	0.00	*-18.71*
Dummy for Double-Income Household	0.18	0.01	0.21	0.01	*-4.63*
Dummy for Both Adults Immigrants	0.05	0.00	0.13	0.00	*-13.74*
Total Food Expenditure ($ per week)	90.36	0.99	99.32	1.06	*-6.19*
Male Education	1.82	0.03	2.05	0.02	*-6.63*
Female Education	1.93	0.02	2.21	0.02	*-8.80*
Male Occupation - Blue Collar	0.06	0.00	0.07	0.00	*-1.56*
Male Occupation - Service Sector	0.12	0.00	0.10	0.00	*3.54*
Male Occupation - None	0.20	0.01	0.19	0.01	*0.77*
Female Occupation - Blue Collar	0.02	0.00	0.02	0.00	*-0.14*
Female Occupation - Service Sector	0.18	0.01	0.19	0.01	*-1.77*
Female Occupation - None	0.28	0.01	0.25	0.01	*3.77*
Owns home	0.41	0.01	0.54	0.01	*-12.74*
On Social Assistance	0.08	0.00	0.04	0.00	*7.57*
Probability of Cable	0.56	0.00	0.66	0.00	*-26.58*

	Quebec		Ontario		
	Mean	**Std. Err**	**Mean**	**Std. Err**	**T-test**
Francophone families with kids					
Observations	1857		222		
Fastfood expenditure ($ per week)	3.67	0.20	4.47	0.68	*-1.12*
Probability of Fastfood purchase in a week	0.28	0.01	0.35	0.03	*-1.95*
Number of Children ages 0 to 16	1.64	0.02	1.71	0.07	*-0.96*
Number of Household members	3.64	0.03	3.78	0.09	*-1.42*
Household Income	0.43	0.01	0.50	0.03	*-2.31*
Dummy for Double-Income Household	0.33	0.01	0.31	0.03	*0.54*
Dummy for Both Adults Immigrants	0.01	0.00	0.04	0.01	*-1.83*
Total Food Expenditure ($ per week)	131.55	1.99	135.99	6.50	*-0.65*
Male Education	2.57	0.04	2.64	0.11	*-0.53*
Female Education	2.63	0.03	2.57	0.09	*0.57*
Male Occupation - Blue Collar	0.12	0.01	0.14	0.02	*-1.12*
Male Occupation - Service Sector	0.18	0.01	0.20	0.03	*-0.99*
Male Occupation - None	0.15	0.01	0.13	0.02	*1.05*
Female Occupation - Blue Collar	0.02	0.00	0.02	0.01	*-0.08*
Female Occupation - Service Sector	0.31	0.01	0.32	0.03	*-0.36*
Female Occupation - None	0.35	0.01	0.30	0.03	*1.55*
Owns home	0.67	0.01	0.52	0.04	*3.86*
On Social Assistance	0.10	0.01	0.12	0.02	*-0.87*
Probability of Cable	0.76	0.00	0.80	0.01	*-3.98*
Allophone families with kids					
Observations	254		809		
Fastfood expenditure ($ per week)	3.91	0.63	4.14	0.34	*-0.31*
Probability of Fastfood purchase in a week	0.25	0.03	0.33	0.02	*-2.23*
Number of Children ages 0 to 16	1.80	0.05	1.80	0.03	*0.00*
Number of Household members	3.40	0.06	3.61	0.04	*-3.15*
Household Income	0.36	0.01	0.42	0.01	*-3.72*
Dummy for Double-Income Household	0.35	0.03	0.33	0.02	*0.62*
Dummy for Both Adults Immigrants	0.68	0.03	0.67	0.02	*0.25*
Total Food Expenditure ($ per week)	139.38	5.57	130.43	2.86	*1.43*
Male Education	2.67	0.09	2.60	0.06	*0.63*
Female Education	2.43	0.08	2.54	0.05	*-1.22*
Male Occupation - Blue Collar	0.27	0.03	0.17	0.01	*3.03*
Male Occupation - Service Sector	0.20	0.03	0.20	0.01	*0.14*
Male Occupation - None	0.17	0.02	0.15	0.01	*0.78*
Female Occupation - Blue Collar	0.16	0.02	0.07	0.01	*3.91*
Female Occupation - Service Sector	0.23	0.03	0.33	0.02	*-2.97*
Female Occupation - None	0.39	0.03	0.37	0.02	*0.45*
Owns home	0.53	0.03	0.67	0.02	*-3.82*
On Social Assistance	0.10	0.02	0.09	0.01	*0.35*
Probability of Cable	0.79	0.01	0.83	0.00	*-4.28*

	Quebec		Ontario		
	Mean	**Std. Err**	**Mean**	**Std. Err**	**T-test**
Anglophone families with kids					
Observations	230		2204		
Fastfood expenditure ($ per week)	5.61	0.71	5.30	0.23	*0.42*
Probability of Fastfood purchase in a week	0.39	0.03	0.40	0.01	*-0.27*
Number of Children ages 0 to 16	1.85	0.06	1.70	0.02	*2.60*
Number of Household members	3.84	0.11	3.66	0.03	*1.55*
Household Income	0.43	0.02	0.53	0.01	*-4.77*
Dummy for Double-Income Household	0.40	0.03	0.37	0.01	*0.92*
Dummy for Both Adults Immigrants	0.14	0.02	0.11	0.01	*1.14*
Total Food Expenditure ($ per week)	138.05	5.00	131.81	2.02	*1.16*
Male Education	2.96	0.12	2.82	0.04	*1.19*
Female Education	3.14	0.09	3.00	0.03	*1.46*
Male Occupation - Blue Collar	0.13	0.02	0.13	0.01	*-0.12*
Male Occupation - Service Sector	0.16	0.02	0.18	0.01	*-0.75*
Male Occupation - None	0.10	0.02	0.12	0.01	*-0.77*
Female Occupation - Blue Collar	0.02	0.01	0.02	0.00	*-0.12*
Female Occupation - Service Sector	0.22	0.03	0.32	0.01	*-3.32*
Female Occupation - None	0.37	0.03	0.29	0.01	*2.52*
Owns home	0.66	0.03	0.68	0.01	*-0.50*
On Social Assistance	0.11	0.02	0.07	0.01	*1.70*
Probability of Cable	0.77	0.01	0.83	0.00	*-5.99*