The Financial Burden of Prescription Drug Expenditures: A Cross-Sectional Analysis of Publicly Provided Plans in Canada

by

Alisha Chicoine

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Supervised by:
Dr. Chris Auld

We accept this extended essay as conforming to the required standard

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Dr.Daniel Rondeau, Honours Co-Supervisor (Department of Economics)

_____

Dr. Herbert Schuetze, Honours Co-Supervisor (Department of Economics)

Alisha Chicoine, 2012

University of Victoria

1. Introduction

Over the past decade drug coverage policies across provinces in Canada have changed to accommodate growing needs for pharmaceuticals. Lichtenberg et al. (2009) demonstrate that the life expectancy of seniors is positively impacted by pharmaceutical innovation. However, as health outcomes are becoming more dependent on pharmaceutical use, the burden of out-of-pocket drug expenditures is increasing for individuals across all levels of eligibility. The Health Council of Canada reported that 6% of Canadians spent over $1000 in 2007 on out-of-pocket drug expenditures, and in 2008 this proportion rose as much as 17% for individuals with a chronic illness such as cancer, diabetes, or arthritis (Health Council of Canada, 2009, p. 9). Out-of-pocket expenditures on pharmaceuticals are significant for those who do not have health care benefits in Canada. What is the financial burden on Canadians for out-of-pocket pharmaceutical expenditures, and how does this burden differ for individuals between provinces, ages, and levels of affluence?

The Canada Health Act provides Canadians with access to physician services and hospital visits, but does not require compensation for pharmaceutical expenditures. It also requires "provincial governments to provide universal first-dollar public coverage for medically necessary hospital and physician services", but prescriptions used outside of hospitals are not covered (Daw & Morgan, 2011). Consequently, provinces have made independent choices about the nature of their publicly funded drug coverage (henceforth referred to as pharmacare policies) and the extent to which they assist certain demographics. Not only have provinces made differing choices about the nature of their coverage policies, but also with regard to the prescription drug formularies that determine compensation eligibility (Morgan, 2009).

Publicly funded drug coverage policies have evolved: by the 1990s provincial governments recognized the potential financial burden for all sectors of the population, resulting

in a countrywide shift to catastrophic drug coverage policies. The Income Tax Act of Canada requires that 3% of income tax revenues must be designated for pharmacare policy funding (Fraser Group, 2006). Anis et al. (2001) states these programs try to do as much as possible with a limited budget, but it is understood that a nationally provided drug coverage plan will not significantly lower drug prices in Canada, making such a plan costly to implement. The result is a "patchwork" of coverage policies that provide at least some form of coverage to those in need, based on age and level of affluence. However, a number of Canadians who do not benefit from social assistance or who are over the age of 65 do not qualify for a provincial plan for extended health benefits that could cover the increasing costs of pharmaceuticals. They spend an increasing proportion of their income on expensive drugs to abate their chronic illness ailments.

There are currently nineteen publically funded drug coverage programs and over 1,000 available private extended health care plans available in Canada. Ten of these public programs are provincial, three are provided for the territories, and six are offered by the federal government. These plans are heterogeneous in terms of eligibility, drug formularies, and mandate different terms of reimbursement and premium requirements. In all ten provinces, catastrophic drug coverage is provided for seniors, except in New Brunswick, which does not offer coverage for seniors with high income. For those individuals on social assistance, each province provides some form of drug coverage policy that may be catastrophic, or some form of copayment or coinsurance. The story is different for those in the general population; individuals who are under the age of 65 and do not qualify for social assistance are not offered a pharmacare policy in New Brunswick and Prince Edward Island. Furthermore, Newfoundland and New Brunswick have only recently (in October 2007 and October 2008 respectively) implemented public coverage for the general population.

An appropriate policy response would be to ensure that no Canadian is left behind with regard to comprehensive coverage of necessary prescription medicines. Prescriptions for chronic illnesses such as cancer, renal difficulties, or HIV/AIDS are generally not covered by provincial pharmacare policies. These costs are covered by agencies such as the BC Cancer Agency, the BC Renal Agency and the BC Centre for Excellence in HIV/AIDS if applications for funding are accepted (Ministry of Health Services, 2012).

With significant interprovincial variation in government prescription drug coverage programs, research has been dedicated to analyzing the difference in access to prescription drugs. Specific prescription drugs may not be covered by pharmacare policies, as each province determines its own list, or formulary, of drugs it reimburses. One facet of research in this area is simulation studies. These simulate the level of access individuals have to certain drugs on a formulary list given differing levels of coverage that are unique to each province. Research of this nature determine that the level of access to the same drugs differs significantly across provinces with respect to prescription drugs (Anis et al., 2001; Morgan et al., 2009; Grégoire et al., 2001; Demers et al., 2008). Other studies of this type also identify that public access to prescription drugs differ across ages and levels of income.

McLeod et al. (2011) suggest that simulation studies of this type that determine this significant interprovincial variation have their limitations: they do not reflect the out of pocket expenditures made by Canadians in the face of insurance and illness. McLeod et al. (2011) employ a semi-parametric estimation method similar to that specified by Alan et al. (2005) to estimate an Engel curve relationship between a household's income and it's drug budget share. The Engel curve estimation is relevant in this context because its estimated slope will tell us whether a drug policy will be progressive or regressive. The most notable advantage of this approach over simulation studies is the empirical aspect of determining real impacts of drug

formularies on households rather than potential impacts. McLeod et al. (2011) analyze the financial burden of prescription drugs on households across provinces and levels of eligibility for pharmacare policies by focusing on the impact of permanent income on drug budget share[1]. They look at households at the median and 95th percentile using semiparametric regression methods. They find that most households experience very little financial burden and that this impact does not substantially differ across provinces.

I follow McLeod et al.'s (2011) methodology using newer data and explore other variables that potentially impact drug budget share such as level of education, or the presence of a disability. I find results that are comparable to previous findings in the literature with regard to distributive impacts of pharmacare policies across Canada. Across provinces and levels of affluence, the financial burden of prescription drug expenditures is relatively low. For most households a pharmacare policy is found to be progressive for Canadians. Unlike previous studies observations with no out-of-pocket prescription drug expenditures were omitted, and found to correct the observed inverse-U relationship between drug budget share and permanent income.

2. Background

2.1 History of Pharmacare Policies in Canada

Daw & Morgan (2011) review pharmacare policy changes between 2000 and 2010, giving a snapshot of major changes in policies across provinces in Canada. As of 2010, All Canadians are eligible for a pharmacare policy, except for households that are not on social assistance or over the age of 65 (henceforth referred to as households in the general population) that reside in New Brunswick or Prince Edward Island. The nature of these policies and the extent to which they provide drug coverage vary by level of user fees in the form of deductibles

[1] Drug budget share is defined as the percentage of the household budget, or permanent income in my specification, that is spent on prescription medicines.

and co-payments or co-insurance rates depending on province. Some provinces apply a "means test" or an "ability to pay" criteria before establishing a form of pharmacare policy.

In 2002, the Fraser Group study released a study regarding the extent to which Canadians were covered by public or private, and sometimes both, insurance for prescription drug expenditures. The study postulates that as few as 5 or 6 out of 100,000 Canadians would require more than $5000 per year for prescription drugs, and that this proportion is rising and is expected to continue to rise in the coming years. In 2002, as few at 2% of Canadians were left uninsured by either a public or private plan.

Fraser (2006) presents a comprehensive breakdown of pharmacare policy reach in Canada. As of 2000, the 2% of uninsured Canadians reside in Atlantic Canada, where 25% of the population do not have any form of coverage, public or private (Fraser Group, 2006). However, the nature of pharmacare policy in Atlantic Canada has changed significantly since the year 2000. Atlantic Provinces in Canada have begun to stitch the gaps of pharmacare policy (Daw & Morgan, 2011).

In 2009, the Social Affairs Division of Canadian parliament released a review of catastrophic drug coverage in Canada in response to changes made in provincial pharmacare policies across provinces in Canada. Phillips (2009) suggests that moving forward, pharmacare policy design must provide federal fundings in order to expand reach of provincial programs, and that Canada should move towards creating a nationally provided catastrophic drug coverage plan.

The extent to which pharmacare policy is funded, much less whether or not it is universal coverage, is a policy concern. According to the Income Tax Act of Canada, 3% of income tax revenue must be spent on providing funding for public pharmacare policies to Canadians (Fraser Group, 2002). The policy question of providing more funding to reduce financial burden is

overshadowed by the fact that some households in Canada still lack any form of public drug insurance coverage.

Since 2000, provinces in Canada are moving towards providing catastrophic coverage as a way for stitching the gaps in the "patchwork" of Canadian pharmacare policies. Most notably, in 2003 British Columbia augmented its BC PharmaCare program from age-based to income-based coverage. Pharmacare policies can be generally categorized by groups of beneficiaries: social assistance, seniors and the general population. Quebec and the Atlantic provinces provide pharmacare coverage to seniors based on beneficiaries of the government income supplement, or GIS, whereas other provinces provide coverage that is based on income gradients that are means-tested.

2.2 Review of Relevant Literature

The extent to which a prescription drug is covered by a pharmacare policy depends on formularies that are determined on a provincial basis (Morgan et al., 2009; Anis et al., 2001). In this regard, simulation studies can provide insight into the variability of financial burden of prescription drug expenditures on households in different provinces and different groups of pharmacare policy eligibility. Anis et al. (2001) suggest compiling a national formulary as a proposal for creating a National PharmaCare program for Canada.

An updated simulation study by Demers et al. (2009) compiles formularies in 10 provinces for the year of 2006. They calculate the impact of cost-sharing strategies across provinces for different levels of income and different disease categories. They report that personal financial burden was as high as $1332 in a year for a patient with congestive heart failure.

Morgan et al. (2009) study formulary lists for December 2006 for pharmacare policies across most Canadian provinces and determine that “[w]hen formulary listings were weighted by

national retail sales, the measure of formulary coverage exceeded 86% ... however, drugs that were listed on all nine provincial formularies studied accounted for 77% of total retail spending in Canada". In general, Canadian provinces, save Quebec, have been operating under an implicit national formulary. Previous studies of dramatic interprovincial variation in drug insurance coverage are misreported.

Alan et al. (2005) study the financial burden and distributional consequences of pharmacare policy changes over time using FAMEX microdata, the Statistics Canada family expenditure survey which has since been renamed as the Survey of Household Spending. Using semi-parametric estimation methods, difference-in-difference analysis, and quantile regression methods they assert that a drug subsidy for general population households is more redistributive than a proportional income transfer.

McLeod et al. (2011) further analyze the adequacy of pharmacare policies across provinces in Canada by using Statistic Canada's public use Survey of Household Spending 2006 data. Using a semiparametric quantile regression method, they determine that the financial burden of prescription drugs appears to be somewhat small and does not differ across provinces substantially. However, the small percentage of households that spend 10% or more of their budget on prescription drugs is concentrated in beneficiary groups that are likely to benefit the most from a public pharmacare policy.

This study employs the methodology of McLeod et al. (2011) and Alan et al. (2005) using Survey of Household Spending data for 2009. Instead of looking at households that spent more than 10% of their household budget on prescription drugs, I investigate the impacts of zero usage on semiparametric estimations of Engel curve relationships. Furthermore, I explore the nature of financial burden for households in New Brunswick and Prince Edward Island.

3. Methodology

The distribution of the drug budget share across levels of permanent income can give insight to policy implications across Canada. The economic motivation for estimation of this relationship is the Engel curve. The slope of the curve reveals the nature of out-of-pocket drug expenditures as income rises, and gives insight to the redistributive nature of a drug insurance policy. If the curve is upward sloping, the policy will be regressive: someone with a lower level of income will prefer a lump-sum transfer to the policy in question. If the curve is downward sloping, the policy will be progressive: the household will prefer the policy to a lump-sum transfer.

3.1 Model Specification

In order to model the impact of permanent income on drug budget share the following baseline regression specification is used to estimate Engel curves.

$$\omega_h = f(x_h) + \beta z_h + \varepsilon_h \quad (1)$$

where ω_h is the drug budget share for household h, x_h is the permanent income for household h and z_h are dummy variables for household characteristics such as gender, marital status, level of education, province, and disability.

I take two approaches to analyzing this relationship for each household type: senior, social assistance and the general population. First, a linear relationship is estimated between permanent income and drug budget share controlling for household characteristics. I restrict the functional form of permanent income to be the natural log of permanent income and the natural log of permanent income squared. This gives rise to understanding the variation of drug insurance plans across the three household types. Should this relationship be negative, it suggests

that the financial burden of out-of-pocket prescription medicines is higher for those with lower levels of income. The converse is true if the relationship is positive.

Furthermore, a semi-parametric estimation regression is estimated. The advantage of this approach is to allow the data to determine the non-linear nature of permanent income in the regression, thereby not restricting the relationship between permanent income and drug budget share to take a particular form. I generate Engel curves using the semi-parametric estimator constructed by Robinson which is √N-consistent and asymptotically efficient (Robinson, 1988). Rewriting (1) and conditioning z and ω on x it can be shown that:

$$\omega_h - E(\omega_h|x_h) = E(z_h|x_h)\beta_k - f(x_h) = [z_h - E(z_h|x_h)]\beta_k + \varepsilon_h \quad (2)$$

Kernel estimates are made for $E(\omega_h|x_h)$ and $E(z_h|x_h)$ and substituted into (2), then least squares will produce a consistent estimate for β. Unlike ordinary least squares, the estimates of the conditional means will not be linear, but take on some functional form that is determined by the data.

However, because this estimator requires calculation of kernel estimates of the covariates against the dependent variable, the greater the number of covariates the more arduous the computation becomes. Yatchew (1997) suggests an alternative estimator that does not require kernel estimates to be made for each covariate against the dependent variable, thus gaining computational efficiency. Yatchew's partially linear regression model is only two thirds as efficient as Robinson's (1988) estimator, but if higher order differences are taken when rewriting (1), the estimator gains more efficiency (Yatchew, 1998). After comparing estimates from each estimator, the differences are not substantially different. However, the properties of Robinson's estimator are preferred to that of Yatchew's. Therefore, I report estimates obtained from the Robinson (1988) estimator.

Previous studies ignore the implications of using drug budget share as a dependent variable. Ordinary least squares and semi-parametric regressions assume disturbances that are normally distributed. Assuming normally distributed error terms is an erroneous assumption due to the non-negative nature of the dependent variable in my specification. This is something that previous studies ignore. In this paper, I report ordinary least squares estimates and semiparametric estimates with and without zero drug budget shares as a comparison of methodologies.

4. Data

Data for this cross-sectional analysis is obtained from Statistics Canada's Survey of Household Spending (SHS) for the year 2009. The SHS is a two-stage, stratified sample of residential homes in 10 provinces as well as the Northwest Territories, Yukon and Nunavut. Those living on Indian reserves, crown lands, religious, and communal colonies, official representatives of foreign countries residing in Canada, members of the Canadian Forces residing in military camps or people living in full time institutions such as prisons or nursing homes are excluded from eligibility of this survey.

Surveys were administered between January and March 2010 for individuals that joined the household in 2009 or 2010, irrespective of whether the household existed or the persons were living alone prior. Survey questions required the household to represent household characteristics as well as detailed fiscal accounts of expenses incurred in the year 2009. Care is taken to ensure respondents accurately reported expenditure totals.

Of 16,758 households eligible for the survey 10,811 responded resulting in an overall response rate of 64.5%. In the final cross-sectional dataset 405 observations are removed for households with more than one economic family[2], 941 observations are removed for respondents

[2] An economic family is defined as a family who is related by common law, marriage, blood or adoption.

who did not report their province or those residing in the Yukon, Northwest Territories, or Nunavut, and one observation is deleted for an individual who reported negative total household income. The final sample size is 9464 observations.

I closely follow the data specifications and method used by McLeod et al. (2011) and Alan et al. (2005). I specify permanent income as the household's total expenditures on goods and services, excluding large durables such as vehicles. A household's drug budget share is then defined as the percentage of permanent income spent on out-of-pocket prescription medicines.

The nature of publicly provided drug insurance plans differs across demographics and can be generally categorized by three household types: social assistance, senior and general population. Households that are categorized as social assistance are defined as non-senior households in which the majority[3] of household income is from government subsidies. Households in which the reference person is over the age of 65 are categorized as senior households. Households that are not categorized as senior or social assistance fall under the general population.

Public drug insurance plans are provided for seniors and those on social assistance across all provinces. Households in the general population typically rely on private drug insurance plans, but publicly provided plans are offered by most provinces except for New Brunswick and Prince Edward Island. These plans are often not very comprehensive. For instance, in British Columbia the co-insurance rate is 30% for those in the general population, compared to no cost-sharing for those on social assistance.

The drug budget share is defined as the percentage of a household's permanent income spent on out-of-pocket prescription pharmaceutical expenditures. Permanent income is defined as total consumption less expenditures on large durable goods. Since a household's annual

[3] Social assistance status is determined by government transfers that exceed 50% of the household's total income.

earnings reflects the impacts of saving and borrowing, annual consumption is a better measure as it reflects permanent changes in income rather than transitive changes in income. The drug budget share may be determined by the magnitude of the household's permanent income, as a household may be more willing to spend on prescription medicines if the household budget is higher. For instance, a household with a higher budget may be more willing to spend on prescription medicines as it requires a smaller percentage of its budget to be spent on basic necessities such as shelter and food. Observations in which a household may have paid for a portion, but not all, of the pharmaceutical expense will show up as a non-zero drug budget share. For some households, there is no cost-sharing and will show up as zero drug budget shares. Often, this leads to zero-inflated data for drug budget shares across households and beneficiary levels.

Table 1 summarizes descriptive statistics of permanent income, prescription drug expenditures and drug budget shares across beneficiary groups and provinces in Canada. Along with means of these variables, means conditional on the 90th percentile of the sample are also shown. These statistics are comparable to those represented in McLeod et al. (2011). The conditional means on the 90th percentile demonstrate the higher financial burden on households for prescription drug expenditures. Drug budget shares are much higher for senior households than for general population and social assistance households in Canada. Furthermore, on average social assistance households have higher drug budget shares than general population households.

Provinces such as New Brunswick and Prince Edward Island tend to have higher drug budget shares than other provinces in the general population. Perhaps most surprising is that Manitoba consistently exhibits higher drug budget shares across all beneficiary groups than other provinces. Ontario and British Columbia have much lower drug budget shares, which may be attributable to the higher average incomes in these two provinces.

Household characteristics are determined by the status of the reference person of the household as collected by SHS 2009. Gender, marital status, disability status, and province of residence are characteristic dummies. The level of education variable is defined as a discrete measure of the highest level of education obtained by the reference person that ranges from zero to eight. For example, if the individual has not obtained any degree, diploma or certificate the variable takes on a value of one, whereas if the reference person has obtained a bachelor's degree the variable takes on a value of 6, and non-responses are measured as zeros. Household size is a discrete variable that is defined as the number of individuals living in the household, including the spouse and children. Following Alan et al. (2005) and McLeod et al. (2011), the natural log of household size and the natural log of household size squared are used in household characteristics.

Table 1: Summary statistics for a household's permanent income, pharmaceutical expenditures and drug budget share as collected by Survey of Household Spending, 2009 (9464 eligible sample size)

		Median Value			90th Percentile		
Province and beneficiary level*	**N**	**Permanent Income ($CAD)**	**Pharmaceutical Expenditures ($CAD)**	**Drug Budget Share (%)**	**Permanent Income ($CAD)**	**Pharmaceutical Expenditures ($CAD)**	**Drug Budget Share (%)**
Senior (age 65)							
Newfoundland and Labrador	232	23685	634	2.92%	37769	1800	8.37%
Prince Edward Island	138	24980	733	3.34%	41550	1800	8.71%
Nova Scotia	231	25449	612	2.42%	42062	1440	5.48%
New Brunswick	228	25717	586	2.35%	42375	1500	5.67%
Quebec	310	26719	723	2.96%	43289	1619	6.17%
Ontario	332	31884	265	0.94%	55167	607	2.20%
Manitoba	188	28424	1058	4.14%	47448	2400	9.94%
Saskatchewan	224	25351	920	4.04%	41996	2000	9.41%
Alberta	158	28980	668	2.25%	49761	1200	4.64%
British Columbia	258	30029	648	2.38%	52110	1622	5.91%
Total	**2,299**	**27360**	**658**	**2.66%**	**45440**	**1600**	**6.68%**
General Population							
Newfoundland and Labrador	560	44504	335	0.90%	70985	1000	2.44%
Prince Edward Island	295	43148	322	0.73%	64770	900	2.01%
Nova Scotia	559	44941	206	0.53%	72213	500	1.43%
New Brunswick	573	45186	317	0.80%	73640	671	2.01%
Quebec	803	44106	275	0.68%	70601	775	2.01%
Ontario	988	54737	255	0.52%	88019	600	1.30%
Manitoba	574	45597	342	0.80%	75082	900	2.27%
Saskatchewan	637	47902	301	0.75%	78606	900	2.40%
Alberta	676	54373	222	0.47%	89230	600	1.26%
British Columbia	674	54349	283	0.56%	91169	600	1.41%
Total	**6,339**	**48625**	**281**	**0.66%**	**79193**	**720**	**1.76%**
Social Assistance							
Newfoundland and Labrador	162	21579	340	1.36%	38322	1200	4.99%
Prince Edward Island	44	25035	440	1.50%	39959	1398	5.00%
Nova Scotia	80	21145	303	1.41%	35892	860	3.24%
New Brunswick	95	22281	333	1.48%	40938	1044	4.02%
Quebec	117	21963	194	0.78%	41049	720	2.85%
Ontario	129	24831	244	0.99%	43757	960	2.81%
Manitoba	43	22008	270	1.09%	35016	1000	4.12%
Saskatchewan	40	21059	338	1.32%	40434	1450	4.64%
Alberta	35	23895	288	1.00%	36000	400	1.65%
British Columbia	81	27876	288	1.07%	51420	1000	3.06%
Total	**826**	**23077**	**294**	**1.19%**	**40829**	**1000**	**3.85%**

* Beneficiary level determined by status of reference person, the individual responsible for chief financial decisions of the household including paying expenses such as rent and utility bills.

5. Results

The ordinary least squares case, the quantile ordinary least squares case, semiparametric, and augmentation of regressions when accounting for zero percentage drug budget shares are represented in this section. It can be shown that by accounting for the zero percentage drug budget shares in the data, semiparametric methods of estimation need not be necessary to evaluate the financial burden on prescription medicines on households.

5.1 Ordinary Least Squares Regression

As stated in Section 3, ordinary least squares regressions will give a precursory understanding of the nature of permanent household income on drug budget share. Specifying the form that permanent income takes in this relationship is restrictive but informative. Table 2 shows the coefficient estimates for a baseline regression for each pharmacare policy beneficiary level. The interpretation of marginal effects for these coefficients should not be confused to be elasticities, as drug budget share is specified as percentage points. Therefore, a percentage point increase in the drug budget share should be interpreted as a ten percent increase in permanent income, when permanent income is specified as the natural log of permanent income in this regression specification.

5.1.1 Ordinary Least Squares Regression with Zero Drug Budget Shares

Table 2 summarizes ordinary least squares coefficient estimates and corresponding significance levels for a baseline regression specification while including zero drug budget shares. The natural log of permanent income and the natural log of permanent income squared are significant for only social assistance households, but are jointly significant across all beneficiary groups. For senior households the Ontario, Manitoba, and Saskatchewan province dummies are significant, for general population households the Newfoundland dummy is

significant, and for social assistance households no provincial dummies are significant at any reasonable level. Being married is highly statistically significant for all beneficiary levels, but disability status is only significant for senior and general population households. Education is also significant for all beneficiary groups.

Table 2: Coefficients from ordinary least squares regression with drug budget share as dependent variable for each beneficiary level.

	Beneficiary level		
Drug Budget Share	**Senior**	**General Population**	**Social Assistance**
ln (Permanent Income)	0.058	0.008	0.077**
	(-1.494)	(-0.990)	(2.612)
ln (Permanent Income) squared	-0.003	-0.001	-0.004*
	(-1.747)	(-1.39)	(-2.371)
Female (=1 if female)	(-0.002)	-0.001***	-0.003
	(-0.963)	(-3.453)	(-1.594)
Married (=1 if married)	0.013***	0.003***	0.011***
	(4.545)	(4.740)	(4.467)
Disability (=1 if disability status)	0.006***	0.006***	0.002
	(3.771)	-6.987	(0.967)
Level of education	-0.001**	-0.000***	-0.001**
	(-3.149)	(-5.177)	(-2.056)
ln(Household Size)	-0.002	0.003*	-0.006
	(-0.321)	(-2.207)	(-1.273)
ln(Household Size) Squared	0.001	-0.002**	-0.003
	(0.117)	(-3.044)	(-1.311)
Constant	-0.224	-0.401**	-0.401**
	(-1.133)	(-2.737)	(-2.737)
Number of observations	2299	6339	826
R-squared	0.095	0.047	0.055

Note: t-statistics are reported in parentheses. Significance at 10%, 5%, and 1% are denoted by ***, **, and * respectively. Coefficient estimates of province dummies are omitted from this table. Household characteristic dummies are determined by status of the reference person in the survey.

5.1.2 Ordinary Least Squares Regression with Zero Drug Budget Shares

Table 3 reports coefficient estimates and corresponding significance levels for the baseline regression specified in Table 2 but omitting zero drug budget shares. If zero drug budget shares are omitted from the regression specification, the estimated signs of the coefficients of the

natural log of permanent income and the natural log of permanent income squared are reversed. These variables are only significant at the 10% level but are not jointly significant for social assistance households. These two variables are jointly significant for senior and general population households. For general population households, Newfoundland is no longer a significant provincial dummy variable, but Nova Scotia and Saskatchewan become significant.

Table 3: Coefficients from ordinary least squares regression with non-zero drug budget share as dependent variable for each beneficiary level.

	Beneficiary level		
Drug Budget Share	**Senior**	**General Population**	**Social Assistance**
ln (Permanent Income)	-0.048	0.110	-0.040*
	(-0.966)	(-1.551)	(-2.331)
ln (Permanent Income) squared	0.002	-0.006	0.002*
	(-0.69)	(-1.602)	(-2.012)
Female (=1 if female)	-0.001	-0.001	-0.001
	(-0.437)	(-0.225)	(-1.897)
Married (=1 if married)	0.012***	0.012**	0.003***
	(-4.002)	(-3.203)	(-3.618)
Disability (=1 if disability status)	0.006***	0.005	0.008***
	(-3.362)	(-1.438)	(-6.363)
Level of education	0.001***	-0.001	-0.001***
	(-3.482)	(-1.695)	(-5.188)
ln(Household Size)	-0.004	-0.009	0.002
	(-0.547)	(-1.060)	(-1.229)
ln(Household Size) Squared	0.002	-0.003	-0.002*
	(-0.253)	(-0.690)	(-2.350)
Constant	0.34	-0.516	0.255**
	(-1.358)	(-1.417)	(-2.758)
Number of observations	1938	432	4162
R-squared	0.105	0.042	0.073

Note: t-statistics are reported in parantheses. Significance at 10%, 5%, and 1% are denoted by ***, **, and * respectively. Coeffiicient estimates of province dummies are omitted from this table. Household characteristic dummies are determined by status of the reference person in the survey.

In general these results suggest that estimates are sensitive to the inclusion of zero drug budget shares. Following previous studies methodology, I will inspect the nature of coefficient

estimates when conditioning on the 90th percentile, so as to inspect households with higher prescription drug financial burdens.

5.2 Quantile Regression

The quantile regression specification allows us to extend our analysis of financial burdens on households. Whereas ordinary least squares reports estimates for explanatory variables conditioning on the mean value of the dependent variable, quantile regression reports estimates for explanatory variables conditioning on a specific percentile. In this study, the quantile regression is conditioned on the 90th percentile. As Alan et al. (2005) suggests, there are two advantages to conditioning on a higher percentile. First, there are a high proportion of households that report zero pharmaceutical expenditures, which may be indicative of either good health, or the household has universal and comprehensive health care coverage that may be private or public. Second, analysing the 90th percentile allows us to focus on households that are most likely to experience financial burden from lack of comprehensive pharmaceutical coverage.

Table 3 reports estimated coefficients for the same baseline regression specification as in Table 2, but conditioned on the 90th percentile. For senior households the Newfoundland, Prince Edward Island, Ontario, Manitoba, and Saskatchewan province dummies are significant, for general population households the Newfoundland, Quebec, Manitoba, and Saskatchewan dummies are significant, and for social assistance households no provincial dummies are significant at any reasonable level. The natural log of permanent income and the natural log of permanent income squared are significant for only senior and social assistance households, but are jointly significant at the 1% level across all beneficiary groups.

5.3 Semiparametric Regression

As motivated in Section 3, specifying the functional form of permanent income in this regression is restrictive. We can allow the data to determine the functional representation of permanent income while acquiring ordinary least squares estimates of the covariates by implementing a semi-parametric regression method. Here, coefficients are reported across beneficiary groups in Table 4, but the nature of the natural log of permanent income must be represented graphically as it is determined non-parametrically.

Table 4: Coefficient estimates for quantile regression for the 90th percentile.

	Beneficiary level		
Drug Budget Share	**Senior**	**General Population**	**Social Assistance**
ln (Permanent Income)	-0.026	-0.077***	0.071
	(-0.247)	(-3.607)	(0.750)
ln (Permanent Income) squared	0.001	0.003**	-0.003
	-0.096	(3.195)	(-0.601)
Female (=1 if female)	0.001	-0.003***	-0.006
	(0.239)	(-3.976)	(-1.010)
Married (=1 if married)	0.020*	0.004*	0.024***
	(2.478)	(2.391)	(3.355)
Disability (=1 if disability status)	0.010**	0.021***	0.004
	(2.81)	(14.007)	(0.694)
Level of education	(-.001)	-0.001***	-0.001
	(-1.207)	(-5.403)	(-0.805)
ln(Household Size)	-0.003	0.008*	-0.012
	(-0.184)	(2.345)	(-0.770)
ln(Household Size) Squared	0.002	-0.005**	-0.006
	(-.137)	(-2.959)	(-0.647)
Constant	0.262	0.468***	-0.384
	(-0.488)	(4.167)	(-0.826)
Number of observations	2299	6339	826
Pseudo R-squared	0.116	0.082	0.125

Note: t-statistics are reported in parentheses. Significance at 10%, 5%, and 1% are denoted by ***, **, and * respectively. Coefficient estimates of province dummies are omitted from this table. Household characteristic dummies are determined by status of reference person of survey.

Table 5 summarizes coefficients for the semiparametric regression specification. Being married and level of education is statistically significant across beneficiary groups. However, household size is significant only for general population and social assistance households.

Table 5: Coefficients from semiparametric regression with drug budget share as dependant variable and ln(permanent income) as the non-parametric variable.

	Beneficiary level		
Drug Budget Share	**Senior**	**General Population**	**Social Assistance**
Female (=1 if female)	-0.002	-0.001**	-0.003
	(-0.942)	(-3.214)	(-1.364)
Married (=1 if married)	0.013***	0.004***	0.010***
	(6.296)	(7.138)	(4.202)
Disability (=1 if disability status)	0.005**	0.006***	0.003
	(3.068)	(6.756)	(1.598)
Level of Education	-0.001**	-0.000***	-0.001*
	(-2.823)	(-5.452)	(-2.185)
ln(Household Size) Squared	-0.001	-0.001*	-0.007***
	(-0.662)	(-2.558)	(-6.668)
Number of observations	2299	6339	826
R-squared	0.025	0.03	0.05

Note: t-statistics are reported in parentheses. Significance at 10%, 5%, and 1% are denoted by ***, **, and * respectively.

Figure 1, Figure 2, and Figure 3 are the estimated functional forms of the natural log of permanent income with respect to drug budget share with 95% confidence intervals. In these figures it should be noted that a ten percent increase in permanent income results in a one percentage point increase in drug budget share. For senior and general population households, the Engel curve is downward sloping after approximately $15,000. An upward sloping relationship before these income levels is difficult to verify given the confidence intervals. For social assistance households, the Engel curve is upwards sloping until permanent income reaches approximately $22,000 and afterwards is downward sloping.

Figure 1: Estimated Engel curves for prescription drugs, Seniors(65+)

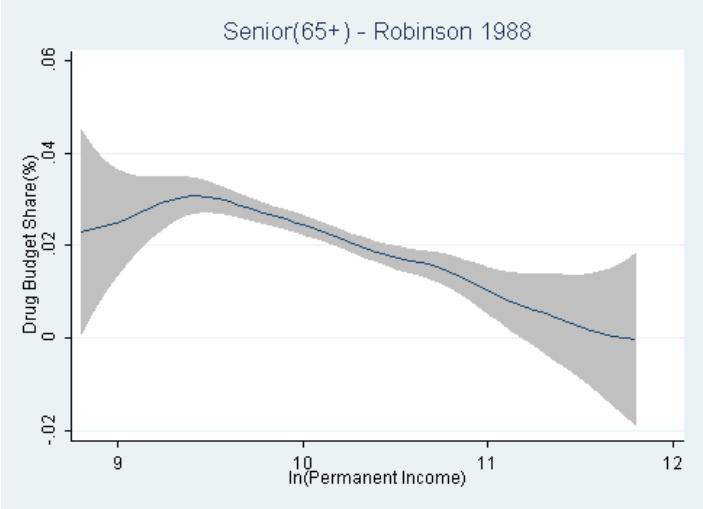


Figure 2: Estimated Engel curves for prescription drugs, General Population (age≤65)

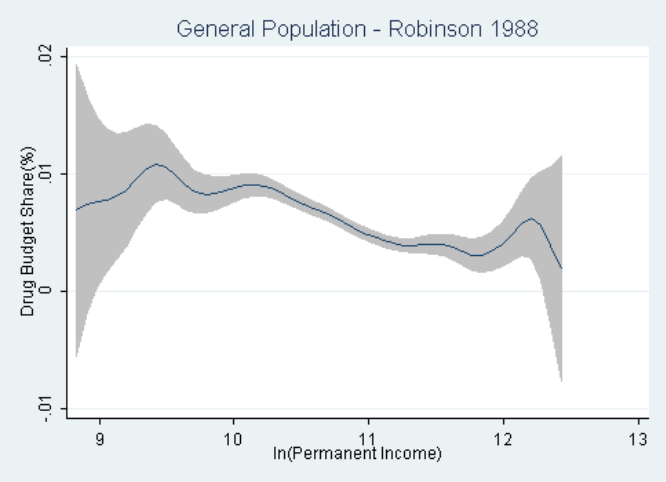
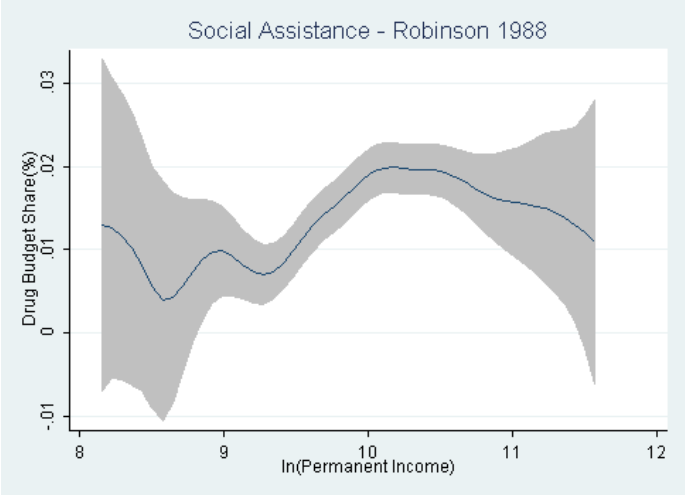


Figure 3: Estimated Engel curves for prescription drugs, Social Assistance (age≤65)



5.4 Semiparametric with non-zero drug budget shares

After generating Engel curve estimates Robinson's (1988) semi-parametric estimator, it can be observed that there is an inverse-U relationship. However, this can be explained not by lower income households spending a lesser proportion of their income than those in the middle class, but by the disproportionate number of zero percentage drug budget shares in the data. Once accounted for, the relationship is strongly downward sloping.

Table 6 summarizes coefficient estimates for the same regression specification as in section 5.3, save that zero percent drug budget shares are excluding from the regression. When compared to estimates shown in Table 4, household size is now highly significant for all beneficiary groups. However, education is not statistically significant for households in the general population. This may be explained by the better health status exhibited by more education individuals, or also by the tendency for more educated individuals to seek out more comprehensive prescription drug coverage.

Table 6: Coefficients from semiparametric regression with non-zero drug budget share as dependant variable and ln(Permanent Income) as the non-parametric variable.

	Beneficiary level		
Drug Budget Share	**Senior**	**General Population**	**Social Assistance**
Female (=1 if female)	-0.001	-0.001	-0.001
	(-0.57)	(-0.147)	(-1.572)
Married (=1 if married)	0.012***	0.010**	0.004***
	(-5.28)	(2.857)	(4.801)
Disability (=1 if disability status)	0.005***	0.006	0.007***
	(-2.83)	(1.611)	(6.213)
Level of Education	0.001***	-0.001	-0.001***
	(-3.17)	(-1.71)	(-5.387)
ln(Household Size) Squared	-0.002***	-0.008***	-0.001***
	(-0.900)	(-4.792)	(-3.488)
Number of observations	1938	432	4162
R-squared	0.022	0.049	0.031

Note: t-statistics are reported in parentheses. Significance at 10%, 5%, and 1% are denoted by ***, **, and * respectively.

Figures 4, 5 and 6 are graphs of the estimated relationships of the natural log of permanent income with respect to drug budget share. Here it is demonstrated that there is no upward sloping portion of the graphs with respect to senior and general population households. For social assistance households, the curve is upward sloping until approximately $8,000. Therefore, in Canada on average the financial burden of prescription medicines rises up until this income level, and then falls. Recall that for most provinces there is no cost sharing for prescription drugs for those on social assistance, but Ontario, Saskatchewan, New Brunswick and Nova Scotia require co-payments of up to $5 per prescription. This is not a significant financial burden, but financial burden slightly increases for those with extremely low levels of income.

Figure 4: Estimated Engel curves for prescription drugs for non-zero percentage drug budget shares, Seniors(65+)

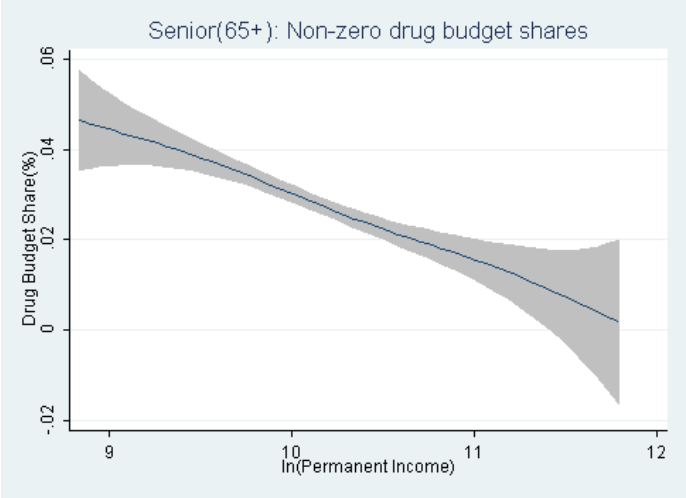


Figure 5: Estimated Engel curves for prescription drugs for non-zero percentage drug budget shares, General Population (age≤65)

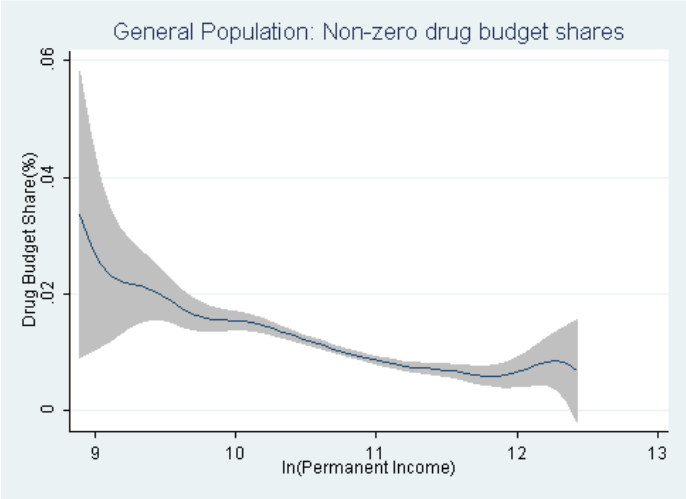
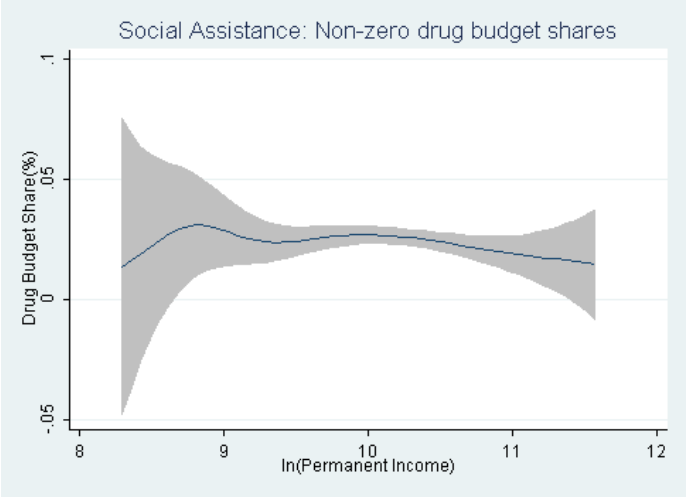


Figure 6: Estimated Engel curves for prescription drugs for non-zero percentage drug budget shares, Social Assistance (age≤65)



5.5 New Brunswick and Prince Edward Island

For the general population in New Brunswick and Prince Edward Island there exists no pharmacare plan that is publicly provided. From a policy point of view this is a gap in pharmacare policy that may be imperative to close. As before, estimates for Engel curve

relationships are estimated for New Brunswick and Prince Edward Island with and without zero percentage drug budget shares.

5.5.1 Semiparametric estimates with zero percentage drug budget shares

Table 7 summarizes coefficient estimates for semiparametric estimates for New Brunswick and Prince Edward Island with zero percentage drug budget shares. Only the level of education is statistically significant for general population households in Prince Edward Island. Figures 7 and 8 represent the functional estimates of the natural log of permanent income with respect to drug budget share. The estimated Engel curve relationship is downward sloping for New Brunswick, but is upward sloping for Prince Edward Island. This appears to suggest that the financial burden of prescription drugs is higher for those with higher incomes in the general population of Prince Edward Island.

Table 7: Coefficients from semiparametric regression with drug budget share as dependant variable and ln(permanent income) as the non-parametric variable for general population households in New Brunswick and Prince Edward Island.

	General Population	
Drug Budget Share	**New Brunswick**	**Prince Edward Island**
Female (=1 if female)	0.001	-0.002
	(-0.619)	(-1.093)
Married (=1 if married)	0.004	0.002
	(-1.835)	(-0.823)
Disability (=1 if disability status)	0.006	0.007
	(-1.736)	(-1.69)
Level of Education	-0.001	-0.001**
	(-1.414)	(-2.858)
ln(Household Size) Squared	0.000	0
	(-0.269)	(-0.121)
Number of observations	573	295
R-squared	0.016	0.05

Note: t-statistics are reported in parentheses. Significance at 10%, 5%, and 1% are denoted by ***, **, and * respectively.

Figure 7: Estimated Engel curves for prescription drugs in New Brunswick, General Population (age≤65)

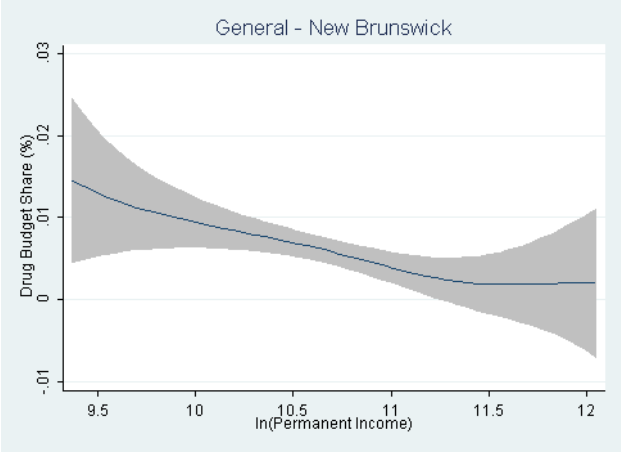
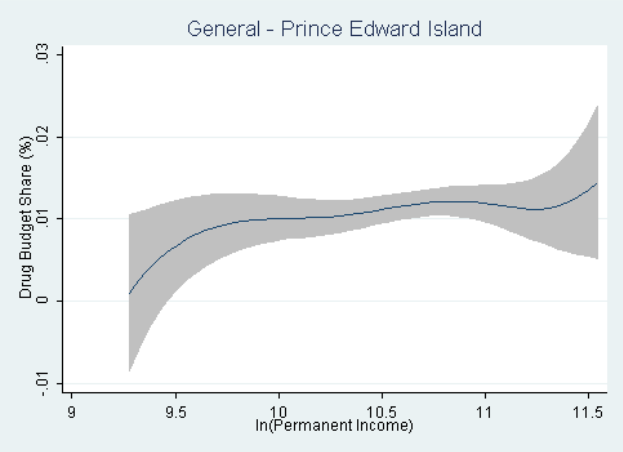


Figure 8: Estimated Engel curves for prescription drugs in Prince Edward Island, General Population (age≤65)



5.5.2 Semiparametric estimates with non-zero percentage drug budget shares

Table 8 summarizes coefficient estimates for a semiparametric regression for New Brunswick and Prince Edward Island in the absence of zero percentage drug budget shares. As in section 5.5.1, only level of education is statistically significant. Figures 9 and 10 are the estimated Engel curve relationships for New Brunswick and Prince Edward Island. The curve is relatively unchanged for New Brunswick, but is drastically different for Prince Edward Island,

which exhibits an upward sloping relationship with zero percentage drug budget shares in the data. Although the sample size is much smaller and the 95%confidence intervals are wide, this suggests that policy intervention in Prince Edward Island may need more investigation before asserting that a public pharmacare policy is necessary.

Table 8: Coefficients from semiparametric regression with non-zero drug budget share as dependant variable and ln(permanent income) as the non-parametric variable for general population households in New Brunswick and Prince Edward Island.

	General Population	
Drug Budget Share	**New Brunswick**	**Prince Edward Island**
Female (=1 if female)	0.002	-0.002
	(-.753)	(-1.041)
Married (=1 if married)	0.003	0.000
	(-1.103)	(-.136)
Disability (=1 if disability status)	0.006	0.009
	(-1.482)	(-1.931)
Level of Education	-0.001	-0.001**
	(-1.375)	(-2.694)
ln(Household Size) Squared	0.000	0.000
	(-0.181)	(-0.072)
Number of observations	431	228
R-squared	0.012	0.058

Note: t-statistics are reported in parantheses. Significance at 10%, 5%, and 1% are denoted by ***, **, and * respectively.

For New Brunswick, the financial burden of prescription drug expenditures is estimated to be upwards of 2.5% for an individual with income approximately $13,000, but is downward sloping for greater levels of income. This estimate is much lower than the estimates made for the country-wide Engel curve relationship. This may be due to the prevalence of private insurance policies for this beneficiary group. This estimate also does not take into account prescription drugs that are unaffordable and therefore are not purchased by the household.

Figure 9: Estimated Engel curves for prescription drugs for non-zero percentage drug budget shares in New Brunswick, General Population (age≤65)

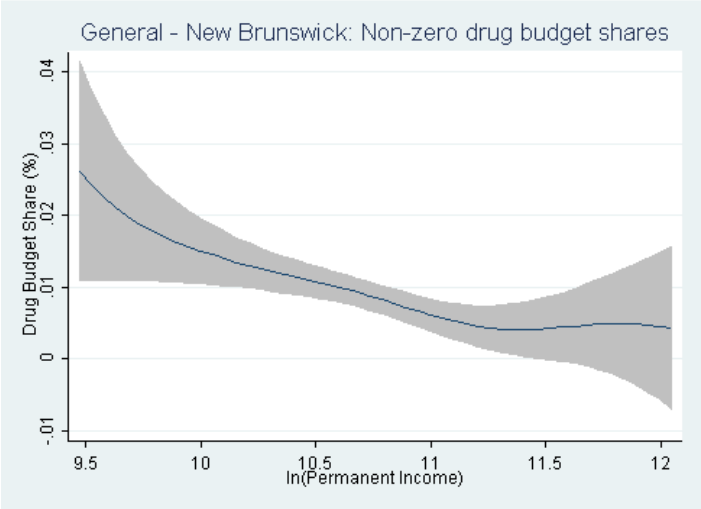
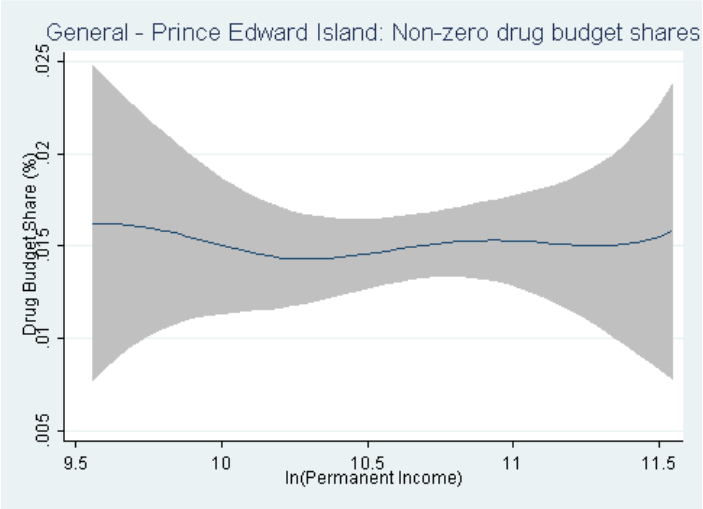


Figure 10: Estimated Engel curves for prescription drugs for non-zero percentage drug budget shares in Prince Edward Island, General Population (age≤65)



6. Conclusion

The focus of this study has been to demonstrate the nature of financial burden of prescription drug expenditures on households in different beneficiary groups across Canada. Understanding the wide variety of public pharmacare policies across beneficiary groups and

across provinces, the focus has been on analyzing the inverse U-relationship that is exhibited in results presented by McLeod et al. (2011).

The dataset used is from the public-use micro dataset of the Survey of Household Spending in the year 2009. Differing public pharmacare policy groups were defined as beneficiary groups for senior, social assistance, and general population households. The evidence suggests that for all beneficiary groups a public pharmacare policy is redistributive, but there exists gaps in the network of pharmacare policy that leaves some individuals behind with substantial prescription drug expenditures that are a financial burden. However, on average the financial burden for individuals is relatively small.

Where previous studies include zero drug usage in their data while using quantile semi-parametric methods, I omit zero drug usage observations in the data and find substantial differences. Results are sensitive to the inclusion of zero drug budget shares. Estimates should be treated with caution given the implications of assuming normally distributed errors when the dependent variable is non-negative and continuous. For ordinary least squares, quantile regression, and semiparametric estimation methods this implication is present.

Even so, some Canadian households are purchasing prescription medicines without compensation from a drug insurance plan. When inspecting general population households in Prince Edward Island and New Brunswick, the two remaining provinces without a public pharmacare policy for the general population, the results tend to be ambiguous. New Brunswick's case seems overwhelming suggestive of instituting a pharmacare policy that would be beneficial for general population households that do not have access to private health insurance policies. However, the case for Prince Edward Island leaves little concrete suggestion for the efficacy of policy for this beneficiary group.

In summary, my paper reports financial burdens for Canadians in the face of prescription drug policies. As prescription medicines grow as a means of abating illness and improving health outcomes, so too does their cost. With some Canadians left out of the patchwork of pharmacare policy and some drugs omitted from provincial formularies for pecuniary reasons, there are obvious impacts on Canadians. Universal drug coverage seems an ideal policy in this regard, but the tradeoffs need to be considered. First and foremost, policy decision makers should keep Prince Edward Island and New Brunswick in mind.

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