DISTRIBUTIONAL EFFECTS OF "NEEDS-BASED" DRUG SUBSIDIES: REGIONAL EVIDENCE FROM CANADA

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Abstract. Canadian provincial government drug subsidy programs have recently begun to change the basis of subsidy from age (age 65+) to financial need (defined as high drug costs relative to income, regardless of age), in an attempt to improve the distributive equity of their programs. Little is known about the extent to which these changes are meeting equity objectives. We therefore investigate the effects of these policy changes on prescription drug expenditure burdens experienced by households of varying levels of affluence, residing in different jurisdictions. Specifically, we use data from a national household expenditure survey, conducted periodically from 1969 to 2004, and nonparametric estimation techniques which allow for the estimation of the impact of age, affluence and other covariates on the 75th, 85th and 95th quantile prescription drug budget shares without imposing the functional form restrictions typical of linear regression. Conditional quantile estimation allows us to assess the impact of the policy changes on the drug expenditure burdens of those with particularly high drug budget shares - it is these households who are the intended beneficiaries of the program changes. We find little evidence that the recent reforms have been particularly redistributive.

1. Introduction

Under the terms of the 1966 *Medical Care Act*, and its successor, the 1984 *Canada Health Act*, provincial governments in Canada are obliged to cover the cost of "medically necessary" physician and hospital-based services. Although the provinces are not similarly obliged to finance prescription drugs used outside of hospital, by the early 1970s most provinces had introduced prescription drug subsidies for seniors (those 65+) and the indigent (those receiving social assistance). Public drug subsidies for the non-elderly, non-indigent (hereafter the 'general population') were initially much less generous. Ontario, Quebec and the Atlantic provinces initially provided no coverage for this group. In 1970, Alberta introduced an optional drug plan with 20% coinsurance and premiums geared to income. Saskatchewan introduced reasonably generous drug subsidies to the general population in 1975 (copayments were in the order of $2 per prescription), but replaced these subsidies with catastrophic (high deductible) coverage in 1987. Manitoba and British Columbia introduced catastrophic coverage to the general population in 1975 and 1977, respectively. These catastrophic

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public plans are generally payers of last resort and therefore attract individuals without recourse to comprehensive coverage from employer plans or other forms of group coverage (Grootendorst (2002)).

Since the provincial plans were introduced in the early 1970s, the scope for drugs to manage health problems has expanded greatly, as has total drug spending. Indeed, the prescription drug share of total health care spending increased from 6.3% in 1975 to 13.8% in 2004 (*National Health Expenditure Trends 1975-2004* (2004)). The development of costly bio-pharmaceuticals in recent years, while offering hope to those with rheumatoid arthritis, cystic fibrosis and other diseases, has created the prospect of ruinous drug costs among those without comprehensive insurance. Several provincial governments have responded in the last decade by enhancing coverage for the general population, typically at the expense of coverage provided to higher income seniors, and to a less extent, lower income seniors. The two most populous provinces, Ontario and Quebec, introduced 'universal' catastrophic drug subsidy plans, in April 1995 and January 1997, respectively, while clawing back coverage for seniors (in July 1996 and August 1996, respectively). Manitoba realigned public subsidies in one fell swoop, replacing age-based subsidies with income-based subsidies in April 1996. British Columbia realigned benefits more gradually, beginning with nominal cuts to seniors' drug benefits in 1987 and enhancements to drug subsidies offered to lower income members of the general population in 1994. In May 2003, the gap between subsidies offered to seniors and non-seniors was almost eliminated with the introduction of the "Fair Pharmacare" program. While subsidies to high income seniors in the Atlantic region have steadily eroded, there are no public drug subsidies offered to the general population. Recently, there have been calls for the federal government to subsidize catastrophic drug coverage (Grootendorst & Veall (2005)).

The net effect of these reforms has been to shift partially the basis of drug subsidy from age to financial need. The primary beneficiaries have likely been the non-elderly "near poor" - those with low incomes who do not qualify for social assistance yet are unlikely to be eligible for comprehensive employer or other group coverage. The primary losers are high income seniors. They have seen their public subsidy clawed back, in some cases quite substantially. In this paper we examine how the realignment of public drug subsidies has affected the expenditure burden of households with catastrophic drug costs of various levels of affluence, and residing in different regions of Canada. We focus on the experience of households situated at the upper tail of the prescription drug budget share distribution, to examine the experience of those with the greatest financial burdens. We address these questions using data from a national household expenditure survey, conducted periodically from 1969 to 2004, and we use robust nonparametric estimation techniques which allow for the estimation of the impact of age, affluence and other covariates on the 75th, 85th and 95th quantile prescription drug budget shares without imposing potentially false functional form restrictions that accompany the use of parametric methods.

2. Methods

2.1. **Data.** We use data from the public use versions of the Statistics Canada Family Expenditure Surveys (FAMEX) and the Surveys of Household Spending (SHS), which replaced the FAMEX in 1997. These surveys collect information on annual household level income, spending on various goods and services, including prescription drugs, as well as information on household living arrangements. The surveys are intended to be representative of all persons living in private households and therefore exclude those residing in long-term care facilities, hospitals, aboriginal reserves, military bases and penal institutions. The survey is a stratified multi-stage sample, and lower population regions such as the Atlantic provinces are over-sampled. Face-to-face interviews are conducted in January, February and March to collect expenditure and income information for the previous calendar year (the 2004 data were collected in the first quarter of 2005).

We estimate models separately for four of the five regions identified in all the public use surveys: British Columbia, Ontario, Quebec and the Atlantic region (comprising the provinces of New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland). The remaining region, which consists of the Prairie provinces (Alberta, Saskatchewan and Manitoba), was excluded given that the provincial drug subsidies for senior and non-senior residents of these provinces were too heterogeneous to allow for meaningful conclusions. For each model we use data from the surveys conducted in five different years, 1969, 1982, 1992, 1998, and 2004, to examine the effects of subsidy changes. There have been substantial changes in drug subsidies over this 36 year period. As Table 1 indicates, the provincial plans for seniors were introduced in 1969 and subsidy levels reached the peak of their generosity in 1982. Subsidies for seniors declined gradually over the next decade. The period 1992-1998 saw some of the largest cuts to seniors' drug plans and the introduction of universal catastrophic plans in Ontario and Quebec. In May 2003, BC introduced its Fair Pharmacare program.

2.2. **Models.** We estimate models of the form:

$$\text{RxShare}_i = f(\text{budget}_i, x_i) + u_i \tag{1}$$

where

(1) RxShare_i = prescription drug share of household i's budget
(2) budget_i = the log of household i's budget excluding outlays on large durables (cars and recreational vehicles)
(3) x_i = a set of characteristics of household i including the age, sex, and marital status of the household head and (log) household size
(4) u_i = combined effect of all other factors besides budget_i and x_i on RxShare_i. Such other factors might include the presence of various diseases in household i that can be treated with expensive drugs. All expenditures are deflated using the national all-item consumer price index (1992=100).

Separate models are estimated for each combination of year (1969, 1982, 1992, 1998, and 2004) and region (British Columbia, Ontario, Quebec, and Atlantic) so as to assess the influence of the region-specific changes in public drug subsidy policies on the Engel curve, i.e., the relationship between budget and RxShare. We do so using Li & Racine's (forthcoming) nonparametric conditional quantile estimator. This estimator allows us to assess the impact of budget and other covariates on the 75th, 85th and 95th quantile prescription drug budget shares without imposing the functional form restrictions typical of linear regression. We compare the nonparametric quantile Engel curve estimates to those obtained from the conventional quantile regression estimator to determine if the functional form restrictions implicit in the standard approach are satisfied.

Irrespective of the need to estimate the Engel curves nonparametrically, it is clear that a quantile approach is required. Given that household drug spending is right skewed, with the healthy and/or well-insured incurring zero or small expenditures but the sick, noninsured incurring particularly large expenditures, it is unclear if the expected RxShare - the drug budget share of the "average household" - describes the experience of any household particularly well. Moreover, the extension of catastrophic coverage to the general population has targeted primarily households with large drug costs relative to income - i.e. those households with particularly large values of u_i.

2.3. **Description of the Nonparametric Quantile Estimator.** Li & Racine (forthcoming) propose a fully nonparametric method for estimating conditional quantile functions that admits the mix of categorical (i.e., nominal and ordinal) and continuous datatypes often encountered in applied settings. Their approach is based upon direct estimation of a conditional distribution function. They use a data-driven method of bandwidth selection that has a number of desirable features, and the approach admits a mix of categorical and continuous data by exploiting the properties of "generalized product kernels." We briefly describe the conditional distribution function estimator, list its properties, and then discuss the conditional quantile function estimator and list its properties. For a more detailed discussion of the estimators and their properties, we direct the interested reader to Li & Racine's (forthcoming) paper.

Let Y be a continuous random variable having conditional distribution $F(y|x)$, where X is a vector of covariates that may include a mix of categorical and continuous data. Li & Racine (forthcoming) propose estimating $F(y|x)$ by

$$\hat{F}(y|x) = \frac{n^{-1}\sum_{i=1}^{n} G\left(\frac{y-Y_i}{h_0}\right) K_\gamma(X_i, x)}{\hat{\mu}(x)},$$

where $\hat{\mu}(x) = n^{-1}\sum_{i=1}^{n} K_\gamma(X_i, x)$ is the kernel estimator of $\mu(x)$ (the marginal distribution of the covariates), $K_\gamma(X_i, x) = W_h(X_i^c, x^c)L_\lambda(X_i^d, x^d)$ is a generalized product kernel having components $W_h(X_i^c, x^c) = \prod_{s=1}^{q} h_s^{-1} w((X_{is} - x_s)h_s)$ and $L_\lambda(X_i^d, x^d) = \prod_{s=1}^{r} l(X_{is}^d, x_s^d, \lambda_s)$, while $G(v) = \int_{-\infty}^{v} w(u)du$ is the kernel distribution function derived from the kernel density function $w(\cdot)$. Note that h_0 is the bandwidth associated with Y, while h and λ are the vectors of bandwidths associated with the continuous and categorical covariates, respectively.

Li & Racine (forthcoming) propose a data-driven cross-validated method for bandwidth selection, and demonstrate that

$$\begin{aligned} MSE[\hat{F}(y|x)] &= \left[\sum_{s=0}^{q} h_s^2 B_{1s}(y|x) + \sum_{s=1}^{r} \lambda_s B_{2s}(y|x)\right]^2 \\ &\quad + \frac{V(y|x) - h_0\Omega(y|x)}{nh_1 \dots h_q} + o(\eta_{4n}) + o(\eta_{5n}), \end{aligned}$$

and that

$$\begin{aligned} (nh_1 \dots h_q)^{1/2} &\left[\hat{F}(y|x) - F(y|x) - \sum_{s=1}^{q} h_s^2 B_{1s}(y|x) - \sum_{s=1}^{r} \lambda_s B_{2s}(y|x)\right] \\ &\to N(0, V(y|x)) \end{aligned}$$

when the bandwidths are chosen by the proposed cross-validation method.

A conditional αth quantile of a conditional distribution function $F(\cdot|x)$ is defined by $(\alpha \in (0,1))$

$$q_\alpha(x) = \inf\{y: \ F(y|x) \geq \alpha\} = F^{-1}(\alpha|x).$$

Or equivalently, $F(q_\alpha(x)|x) = \alpha$. We can estimate the conditional quantile function $q_\alpha(x)$ by inverting the estimated conditional CDF function, i.e.,

$$\hat{q}_\alpha(x) = \inf\{y: \ \hat{F}(y|x) \geq \alpha\} \equiv \hat{F}^{-1}(\alpha|x).$$

Li & Racine (forthcoming) demonstrate the following result. Define $B_{n,\alpha}(x) = B_n(q_\alpha(x)|x)/f(q_\alpha(x)|x)$, where

$$B_n(y|x) = \left[\sum_{s=0}^{q} h_s^2 B_{1s}(y|x) + \sum_{s=1}^{r} \lambda_s B_{2s}(y|x)\right]$$

is the leading bias term of $\hat{F}(y|x)$ $(y = q_\alpha(x))$ Then it can be shown that $\hat{q}_\alpha(x) \to q_\alpha(x)$ in probability and that

$$(nh_1 \dots h_q)^{1/2} \left[\hat{q}_\alpha(x) - q_\alpha(x) - B_{n,\alpha}(x)\right] \to N(0, V_\alpha(x))$$

in distribution.

There are a number of potential benefits that arise from the use of this robust nonparametric quantile estimator. The most obvious is that the estimator is robust to functional form misspecification, which leads to inconsistent estimates in parametric settings. We use the R (R Development Core Team (2006)) package `np` to generate the nonparametric results presented in the appendix.

3. Results

We focus our discussion on the results of the region- and year-specific nonparametric Engel curve estimates, displayed in Figures 1 to 12. Estimates from the conventional linear quantile regression estimator, displayed in Figures 13 to 24, are roughly similar, suggesting that in this application, the linear index restriction is approximately satisfied.

Several patterns emerge from the results. The first is that, with several exceptions, the curves are negatively sloped, implying that the drug budget share declines as budget (affluence) grows. The exceptions all occurred in 1992 - the τ=0.75 and 0.85 curves in Ontario (they increased slightly at low budget levels) and the τ=0.75 curve in BC (it increased slightly between budget values of $20,000 to $40,000). The other 1992 curves in BC, Ontario and Quebec, although negatively sloped, were quite shallow.

The second pertains to the inter-regional differences in the heights of the curves: Drug budget shares are generally highest in the Atlantic region, and lowest in BC and Ontario. This perhaps reflects superior public and private insurance coverage in BC and Ontario, which are the two most prosperous regions of the four that we consider here.

The third pattern pertains to the direction of curve shifts over the years: All Engel curves decreased between 1969, the year prior to the introduction of the public plans, and 1982. While some of this decline undoubtedly reflects the expansion of employee benefit plans during this period, especially for more affluent households, the introduction of the public drug plans likely played an important role as well. In some cases, such as for the least affluent BC and Ontario households in the top 5% of drug budget shares (who were perhaps less likely than other households to qualify for privately provided group coverage), the savings exceeded one percent of household budgets. In Quebec, the savings to such households exceeded four percent of their budgets. In BC, Ontario and Quebec, the τ=0.75 and 0.85 curves decreased again between 1982 and 1992, whereas Engel curves for Atlantic households had already bottomed out by 1982. Between 1992, the height of the economic slowdown, and 1998, Engel curves gradually rose for each quantile in each province. In the Atlantic region, the curves for less affluent households approached, and for less affluent households at the 95th quantile, actually exceeded 1969 levels. In the other provinces, 1998 curves were generally well below 1969 levels. With a couple of exceptions, drug budget shares increased again between 1998 and 2004, although there was considerable variation in the extent of the increase, as we discuss below.

The fourth pattern relates to the extent of the recent shifts of the Engel curves for affluent and less affluent households. Recall that during the period 1992 to 2004, three of the regions -BC (in 2003), Ontario (1995) and Quebec (1997) - realigned to varying degrees public drug subsidies from affluent seniors to less affluent non-seniors. The Atlantic region cut benefits to higher income seniors but did not offer catastrophic coverage to the general population; this region might therefore be a useful comparator to the other provinces. In the Atlantic region, the increase in drug budget shares between 1992 and 2004 was felt equally among households of all levels of affluence, at least for those in the highest 5% of the drug budget share distribution. Somewhat surprisingly, the upwards shift in the Engel curves in BC between 1998 and 2004 occurred almost entirely among less affluent households; indeed, the τ=0.75, 0.85 curves for more affluent households dropped slightly. A similar pattern was observed in for Quebec households situated at the 95th quantile. In Ontario, the increase in drug budget shares between 1992 and 2004 has been felt more equally across the range of incomes, and indeed for households situated at the 85th quantile, the increase was limited to more affluent households (with budgets in excess of $20,000).

4. Discussion

On the face of it, the evidence is that the recent 'needs based' drug subsidies in Canada might not have had their intended redistributive effects. Our results are seemingly at odds with Alan, Crossley, Grootendorst & Veall (2002) who found that the introduction of catastrophic public drug plans for the general population in the western provinces in the 1970s and 1980s was mildly progressive. This could have been because these programs typically do not attract those who already have comprehensive private group coverage and do attract those without such coverage.

There is evidence that the probability of holding private prescription drug insurance coverage in Canada is strongly positively associated with income (Grootendorst & Levine (2001)), so that the introduction of such plans may have benefited primarily the less affluent.

The drug subsidy policies analyzed in this paper, however, are somewhat different than those analyzed by Alan et al. (2002). The Fair Pharmacare policy introduced by the BC provincial government in 2003, for instance, was designed to at once redirect subsidies on the basis of need, not age, and also reduce the amount of government drug subsidy overall. In other words, the objective was to allocate a smaller subsidy pie more equitably. The reforms to the Quebec drug plan in 1997 were similarly redistributive and were also designed to constrain overall public subsidy. The catastrophic general population drug plans introduced earlier, by contrast, were on the whole expansionary. Similarly, the introduction of catastrophic coverage in Ontario in 1995 probably overwhelmed the small cuts to seniors' drug benefits in 1996.

One possible explanation for the observed findings, consistent with the results of Alan et al. (2002), is that the more affluent senior households were able to cushion the impact of the subsidy cuts by relying more heavily on retirement drug plans or perhaps overcoming non-price barriers to public subsidy of higher priced drugs. Since the early 1990s public drug plans - and BC Pharmacare especially - has relied more heavily on "special authority" restrictions in which physicians are required to justify why more expensive therapies are required as a pre-requisite for public subsidy. It could be the case that affluent seniors are better able than other seniors to have physicians petition on their behalf.

Table 1. Cost sharing requirements of provincial drug plans for seniors and non-indigent non-seniors, by province/region and year

Province/ Region	Year	Prescription drug cost sharing for seniors	Prescription drug cost sharing for non-indigent non-seniors
BC	1969	No public coverage	No public coverage
BC	1982	Full public coverage	$125 deductible, then 20% coinsurance
BC	1992	75% of dispensing fee up to $125 annual maximum	$400 deductible, then 20% coinsurance up to $2,000 total payment per household
BC	1998	100% of dispensing fee up to $200 annual maximum	Lower income: $600 deductible; higher income: $800 deductible then 30% coinsurance up to $2,000 total payment per household
BC	2004	Income contingent deductibles (0%, 1% and 2% of adjusted household incomes for those with adjusted household incomes of less than $33K, between $33K-$50K, and over $50K, respectively), then 25% coinsurance up to income contingent maximum total payments (1.25%, 2%, 3% of adjusted household incomes)	Income contingent deductibles (0%, 2% and 3% of adjusted household incomes for those with adjusted household incomes of less than $15K, between $15K-$30K, and over $30K, respectively), then 30% coinsurance up to income contingent maximum total payments (2%, 3%, 4% of adjusted household incomes)
Ontario	1969	No public coverage	No public coverage
Ontario	1982	Full public coverage	No public coverage
Ontario	1992	Full public coverage	No public coverage
Ontario	1998	$100 deductible then $6.11/prescription; $2/prescription for lower income seniors	Family size and income contingent deductible ($150 lowest possible deductible, $4,089 for single with income of $100,000) then $2 per prescription
Ontario	2004	$100 deductible then $6.11/prescription; $2/prescription for lower income seniors	Family size and income contingent deductible ($150 lowest possible deductible, $4,089 for single with income of $100,000) then $2 per prescription
Quebec	1969	No public coverage	No public coverage
Quebec	1982	Full public coverage	No public coverage
Quebec	1992	$2/prescription up to $100 annual maximum; full coverage for lower income seniors	No public coverage
Quebec	1998	Income contingent annual premium ($0-$175) with $8.33 monthly deductible then 25% coinsurance up to income contingent monthly total out of pocket maximum ($17-$62.50)	Income contingent annual premium ($0-$175) with $8.33 monthly deductible then 25% coinsurance up to monthly total out of pocket maximum of $62.50
Quebec	2004	Income contingent annual premium ($0, $0-$460 & $0-$460) with ($8.33, $9.60 & $9.60) monthly deductible then (25%, 28% & 28%) coinsurance up to income contingent monthly total out of pocket maximum ($16.66, $46.17 & $69.92)	Income contingent annual premium ($0-$460) with $9.60 monthly deductible then 28% coinsurance up to monthly total out of pocket maximum of $69.9

Province/ Region	Year	Prescription drug cost sharing for seniors	Prescription drug cost sharing for non-indigent non-seniors
Atlantic	1969	No public coverage	No public coverage
Atlantic	1982	NB: full coverage; NS: full coverage; PEI: no coverage; NF: no coverage for higher income seniors; lower income seniors paid dispensing fee.	No public coverage
Atlantic	1992	NB: $7.05/prescription; lower income seniors: $120 annual maximums; higher income: $48 monthly premium; NS: max of 20% or $3 per prescription up to $150 annual maximum; PEI: $11.85/prescription; NF: no coverage for higher income seniors; lower income seniors paid dispensing fee.	No public coverage
Atlantic	1998	NB: $9.05/prescription; lower income seniors: $250 annual maximums; higher income: $58 monthly premium; NS: income contingent premiums from $0-$215, max of 20% or $3 per prescription up to $200 annual maximum; PEI: $14.46/prescription; NF: no coverage for higher income seniors; lower income seniors paid dispensing fee.	No public coverage
Atlantic	2004	NB: lower income seniors: $9.05/prescription up to $250 annual maximum; higher income: $89 monthly premium, $15/prescription; NS: income contingent premiums from $0-$336, max of 33% or $3 per prescription up to $350 annual maximum; PEI: $17.85/prescription; NF: no coverage for higher income seniors; lower income seniors paid dispensing fee.	No public coverage

Source: Grootendorst (2002). Drug plan information for 2004 was obtained directly from the provincial drug plans. Note that other drug-specific remuneration restrictions may increase beneficiary costs. These restrictions include non-coverage of higher cost drugs, and requirements that physicians attempt therapy using lower cost drugs before higher cost drugs are reimbursed.

References

Alan, S., Crossley, T. F., Grootendorst, P. & Veall, M. R. (2002), 'The effects of drug subsidies on out-of-pocket prescription drug expenditures by seniors: Regional evidence from canada', *Journal of Health Economics* **21**(5), 805–26.

Grootendorst, P. (2002), 'Beneficiary cost sharing under provincial prescription drug benefit programs: History and assessment', *Canadian Journal of Clinical Pharmacology* **9**(2), 79–99.

Grootendorst, P. & Levine, M. (2001), Do drug plans matter? effects of drug plan eligibility on drug use among the elderly, social assistance recipients and the general population, Mimeo, University of Toronto.
URL: *http://individual.utoronto.ca/grootendorst/pdf/HTF_Final_Report_Vers_3.pdf*

Grootendorst, P. & Veall, M. R. (2005), 'National catastrophic drug insurance revisited: Who would benefit from Senator Kirby's recommendations?', *Canadian Public Policy* **31**(4), 341–358.

Li, Q. & Racine, J. S. (forthcoming), 'Nonparametric estimation of conditional CDF and quantile functions with mixed categorical and continuous data', *Journal of Business and Economic Statistics* .

National Health Expenditure Trends 1975-2004 (2004), Technical report, Canadian Institute for Health Information.

R Development Core Team (2006), *R: A Language and Environment for Statistical Computing*, R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0.
URL: *http://www.R-project.org*

Appendix A. appendix

We use Roger Koenker's `quantreg` in R (R Development Core Team (2006)) to compute the parametric regression quantiles. For the parametric regression quantiles, for a given year and region the models are specified as follows:

```
library(quantreg)
rqmodel<-rq(rxshare~male+married+hagecat+lhhsize+lrex,
            tau=tau,
            data=data)
```

For the partial quantile plots that follow, we plot the τth quantile ($\tau = 0.75, 0.85, 0.95$) of rxshare versus exp(lrex) for the range of exp(lrex) from its 5th through 95th quantile ($8,502 and $55,408, respectively).

We hold values for all covariates constant at their median values for all years thereby allowing for direct comparison across regions and time. The median values are male (1), married (1), hagecat (2), and lhhsize (1.09).

Appendix B. Nonparametric Regression Quantiles by Year: BC

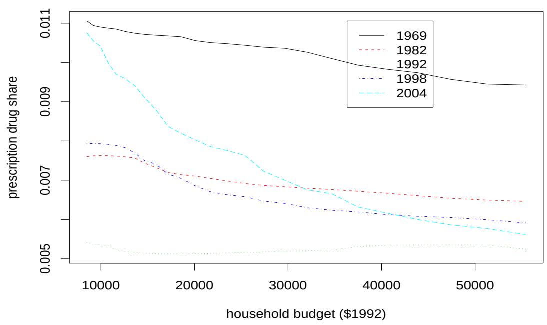

Figure 1. $\tau = 0.75$, BC

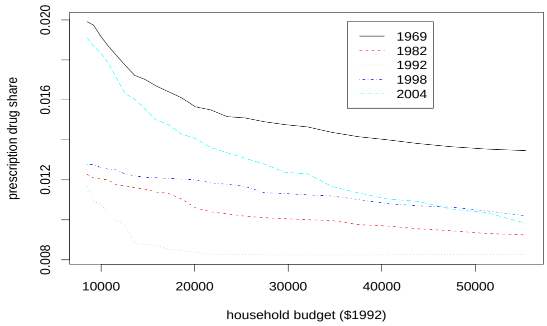

Figure 2. $\tau = 0.85$, BC

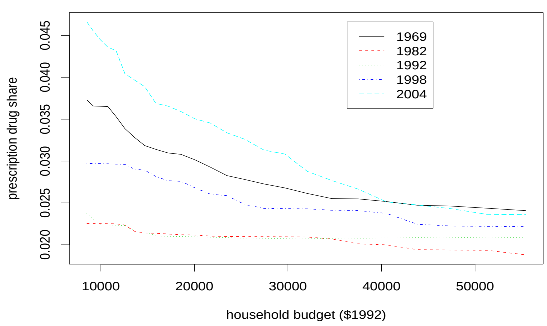

Figure 3. $\tau = 0.95$, BC

Appendix C. Nonparametric Regression Quantiles by Year: Ontario

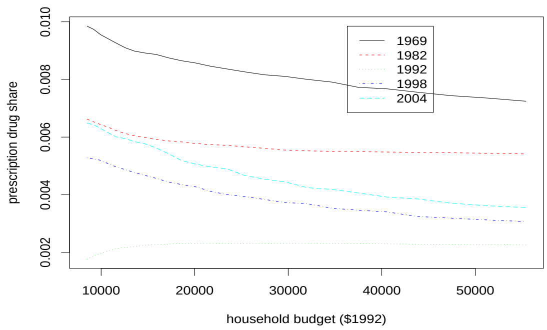

Figure 4. $\tau = 0.75$, Ontario

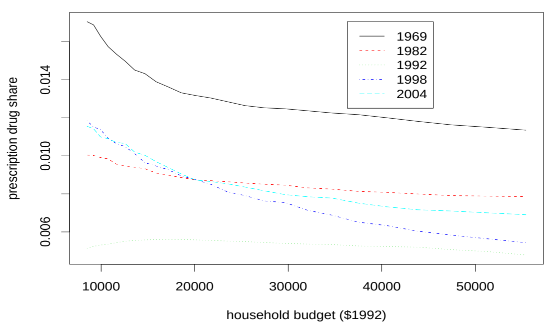

Figure 5. $\tau = 0.85$, Ontario

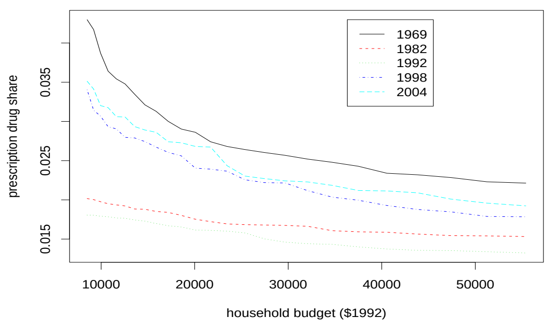

Figure 6. $\tau = 0.95$, Ontario

Appendix D. Nonparametric Regression Quantiles by Year: Quebec

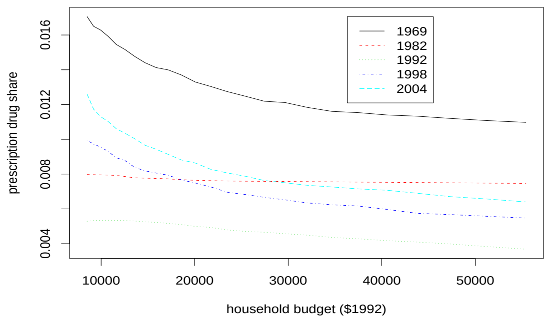

Figure 7. $\tau = 0.75$, Quebec

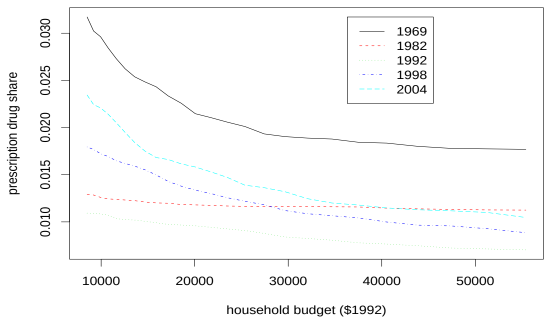

Figure 8. $\tau = 0.85$, Quebec

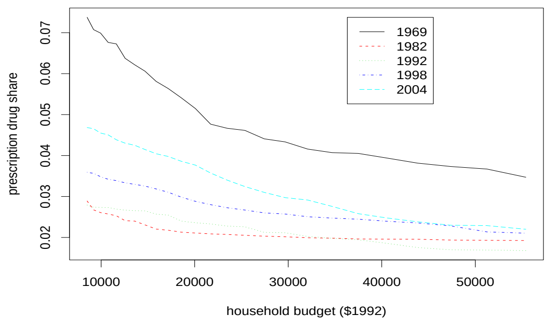

Figure 9. $\tau = 0.95$, Quebec

Appendix E. Nonparametric Regression Quantiles by Year: Atlantic

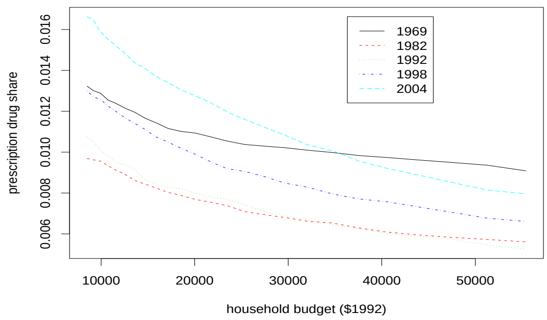

Figure 10. $\tau = 0.75$, Atlantic

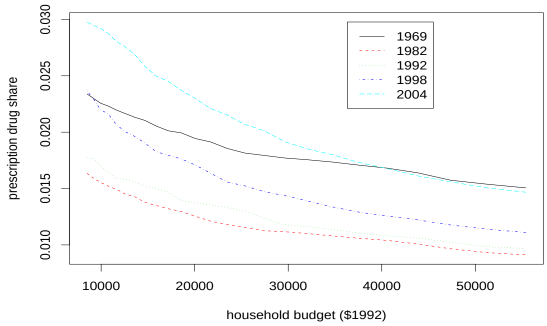

Figure 11. $\tau = 0.85$, Atlantic

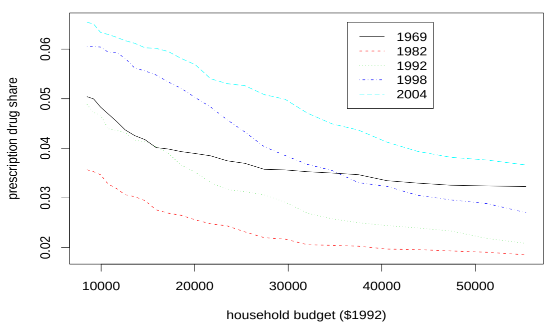

Figure 12. $\tau = 0.95$, Atlantic

Appendix F. Parametric Regression Quantiles by Year: BC

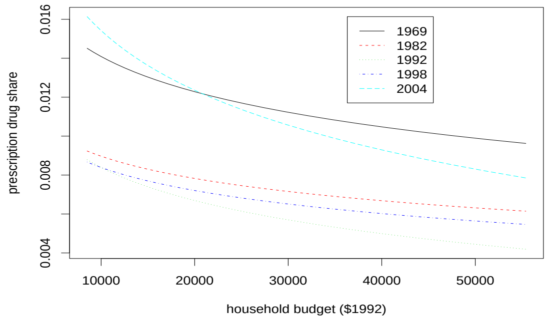

Figure 13. $\tau = 0.75$, BC

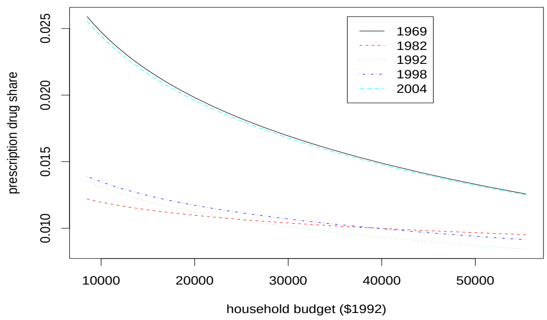

Figure 14. $\tau = 0.85$, BC

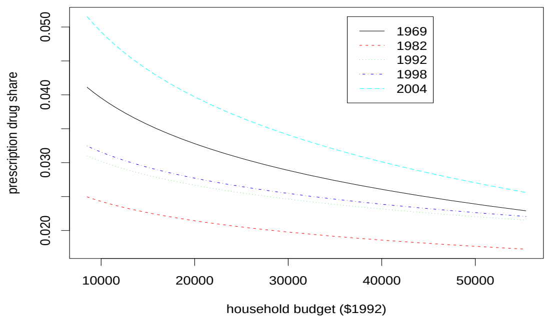

Figure 15. $\tau = 0.95$, BC

Appendix G. Parametric Regression Quantiles by Year: Ontario

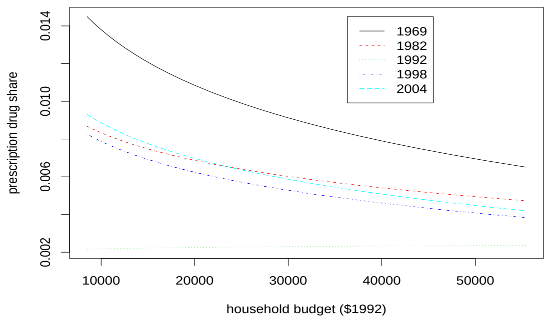

Figure 16. $\tau = 0.75$, Ontario

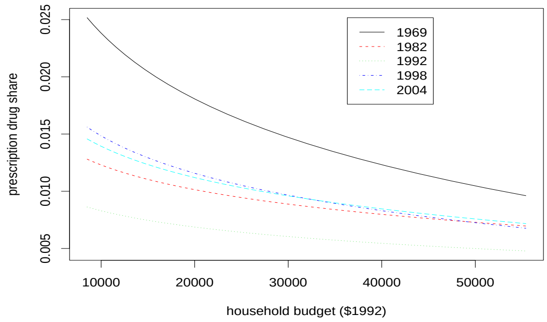

Figure 17. $\tau = 0.85$, Ontario

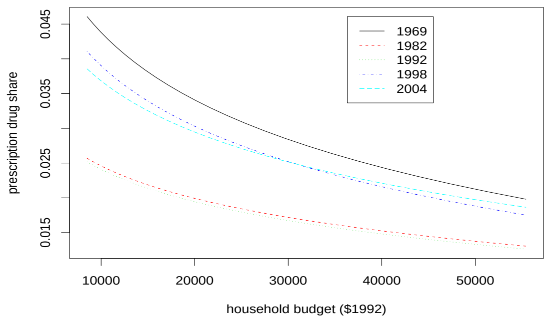

Figure 18. $\tau = 0.95$, Ontario

Appendix H. Parametric Regression Quantiles by Year: Quebec

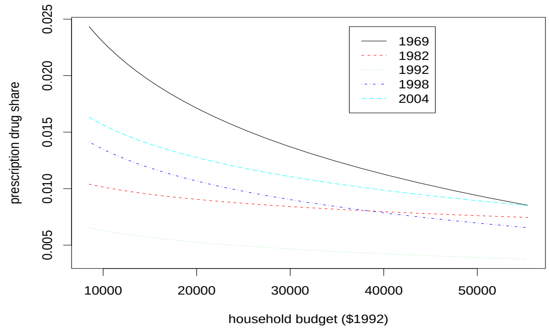

Figure 19. $\tau = 0.75$, Quebec

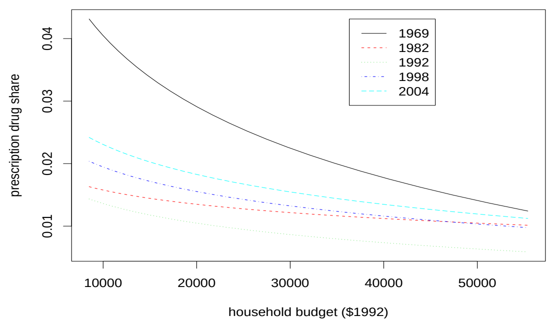

Figure 20. $\tau = 0.85$, Quebec

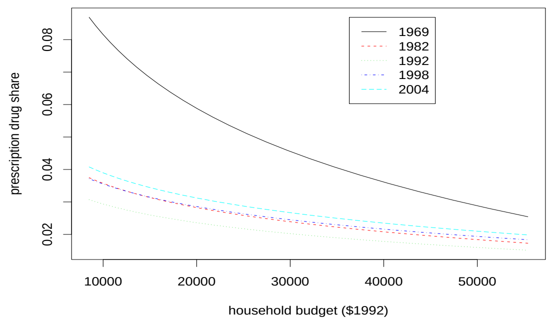

Figure 21. $\tau = 0.95$, Quebec

Appendix I. Parametric Regression Quantiles by Year: Atlantic

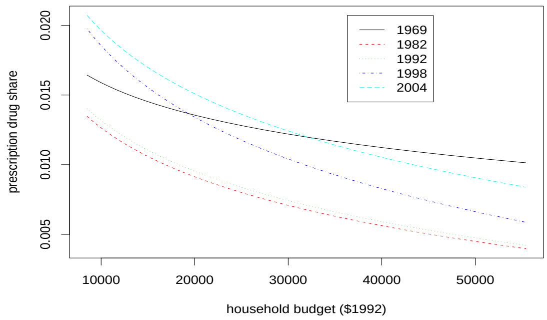

Figure 22. $\tau = 0.75$, Atlantic

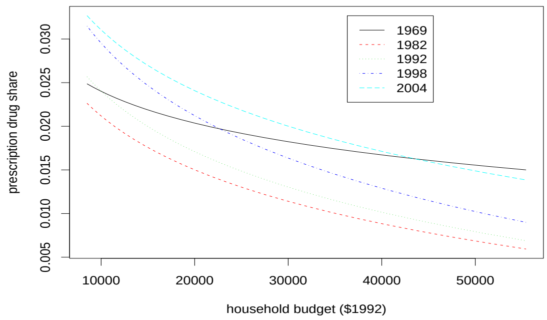

Figure 23. $\tau = 0.85$, Atlantic

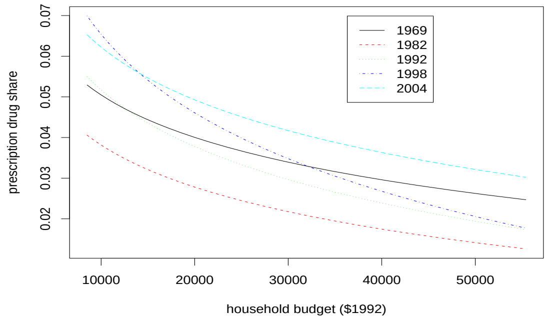

Figure 24. $\tau = 0.95$, Atlantic

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