THREE ESSAYS ON DRUG INSURANCE AND THE WELL-BEING OF CHILDREN AND THEIR FAMILIES

by

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To my husband, Dmitry, and our daughters, Sasha and Anya.

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Abstract

In Canada, prescription drugs and dental care have traditionally been excluded from the universally covered health services. In the absence of universal drug (and dental) insurance, low-income children have faced a higher risk of not receiving necessary treatment and their families faced the risk of high medical spending. This thesis studies the effects of free drug and dental insurance for children on different facets of family well-being. In Chapter 2, I study the effects of the Quebec universal drug insurance on household spending. I estimate a small reduction in household drug spending among middle-income families but no effect for low-income families. Instead, I find larger offsetting increases in spending on health premiums for all income groups. This finding is alarming since it suggests an increasing financial burden from a drug insurance program instead of a benefit. In Chapter 3, I analyze the impact of free coverage of prescription drugs and dental services for children in low-income families introduced in Saskatchewan in 1998. I find that total drug and dental out-of-pocket spending of households declined on average by 30 percent or more. In addition, I uncover that the reduction in the top part of the drug spending distribution was much larger, likely owing to parents becoming covered for drug costs. These findings suggest that dental insurance for children is as important as drug insurance at reducing the risk of out-of-pocket spending and that the risk of very high costs is truly reduced when both children's and parents' costs are covered. Finally, in Chapter 4, I examine the effect of free drug coverage for children on medication utilization and health outcomes. I uncover heterogeneous effects on medication use, with larger increases in the use of more controversial medications such as Ritalin. Focusing on improved access to asthma medications, I find improvements in child health outcomes and parental depression among lower-income families. These findings suggest that providing free drug insurance to children in low-income families improves the well-being of both the child and the parents, and the design of public drug programs for children should take into account these broader benefits.

List of Abbreviations and Symbols Used

ACHB	Alberta Child Health Benefit
ADHD	attention-deficit/hyperactivity disorder
CRVE	cluster-robust variance estimator
FAMEX	Family Expenditures Survey
NCB	National Child Benefit
NLSCY	National Longitudinal Survey of Children and Youth
PMK	person most knowledgeable
RMSPE	root mean squared prediction error
SCHIP	State Children's Health Insurance Program
SFHB	Saskatchewan Family Health Benefit
SHS	Survey of Household Spending
WCB	wild cluster bootstrap

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Chapter 1

Introduction

It is now widely accepted that health constitutes a form of human capital, and health during childhood has enduring effects into the future, influencing both health-related and non-health outcomes (Currie, 2009, 2020; Goodman-Bacon, 2021). Hence, ensuring children have free access to necessary health care is a crucial investment. While children's healthcare utilization and costs are low relative to other demographic groups, it is generally agreed that children's access to health services should be prioritized. This is reflected in opinion polls (Children's Healthcare Canada & Abacus Data, 2023) and public policies, such as health insurance expansions for children in the US, and the expansions in coverage of uninsured health services in Canada, e.g., the Ontario universal drug insurance plan for children (OHIP+) introduced in 2018.

In Canada, where hospital and physician services have long been publicly and universally covered, the universal coverage for other health care services, in particular prescription drugs, has long been debated. According to official statistics (Cortes & Smith, 2022), in 2021, about one-fifth of Canadians (21 percent) did not have (enough) insurance to cover their prescription drug costs, and a little less than one-fifth (18 percent) spent $500 or more out-of-pocket annually on prescription medications. There is a general agreement that the costs of such services as prescription drugs and dental care, when they are not insured, present a serious barrier to many families, both low- and middle-income households (Kolhatkar et al., 2018; Ramraj et al., 2013). As a result, children in low-income families are at higher risk of either not accessing the necessary health care when it is not insured, or experiencing deprivations due to the high financial demands of the uninsured health services.

The recent announcement of the new universal public dental program and the anticipated introduction of a universal pharmacare program are expected to remove the

financial barriers to accessing the necessary medications and dental care for families of all income levels. However, the effects of the new programs will depend on the program's design and are yet to be seen. In my thesis, I study the effects of providing copayment-free insurance for drugs and dental services for children using historical data on two programs that were implemented in two Canadian provinces in the late 1990s. My study demonstrates that the effects of providing free access to these services for children are multifaceted and that savings may be just a small part of the overall benefits.

The thesis consists of four chapters where chapters 2, 3 and 4 are stand-alone studies, each investigating the impacts of drug insurance (and, in one instance, dental insurance) on various facets of family life. In each of these three chapters, my focus is on low-income families, who are particularly vulnerable to high healthcare costs when essential services are needed but not covered by insurance.

In chapter 2, I study the effects of a universal drug insurance reform implemented in the province of Quebec in 1997 on household spending. The reform introduced a new public drug plan for all uninsured families, providing free access for eligible children and making prescription drug coverage compulsory in Quebec. While there is evidence documenting a sharp increase in prescription drug coverage and a higher prescription drug utilization among adults (Wang et al., 2015), no thorough evaluations of its effect on lowering out-of-pocket costs and potentially reducing financial risks have been conducted. In this chapter, using two different empirical strategies, I estimate a small reduction in household drug spending among middle-income families but find no evidence of spending reductions among low-income families. Instead, I find larger offsetting increases in spending on health premiums for all income groups, although only statistically significant for the middle-income group.

In chapter 3, I study the impact of introducing coverage for prescription drugs and dental services specifically for children in low-income working families. Using the introduction of the Family Health Benefits program in the province of Saskatchewan as a quasi-natural experiment, I study the effects of both types of insurance simultaneously. Using a combination of several empirical approaches, I find that total drug and dental out-of-pocket spending of households declined on average by 30 percent

or more, and by 50 percent and more - at the 90^{th} percentile. My estimates suggest that dental spending decreased for all levels of spending, while the reduction in drug spending was only noticeable for those with spending above the 90^{th} percentile. Moreover, above the 90^{th} percentile, the decrease in drug spending was considerably larger than that of dental spending, particularly among the top 5^{th} percentile. I attribute the larger effect in the top part of the drug spending distribution to parents becoming covered for drug costs but not for dental costs. These findings suggest that providing dental insurance to children may have a comparable effect on reducing the mean out-of-pocket health costs as providing drug insurance. However, the larger effects on drug spending compared to dental spending at the top of their spending distributions suggest that the risk of very high costs is truly reduced when both children's and parents' costs are covered.

In chapter 4, I explore whether providing comprehensive drug insurance for children leads to improvements in children's health and parental mental health. I use the Quebec universal drug insurance reform introduced in 1997 as an exogenous policy change and the National Longitudinal Survey of Children and Youth as the main data source. Because this survey collects information on the health of both children and parents, I can study their interaction. Exploiting the fact that free access to medication must have a larger effect on families with children requiring maintenance medications compared to families with healthy children, I build the identification strategy on the contrast between these two types of families and estimate a triple difference model. I find an increase in the probability of a child being often in good health and a decrease in the parental depression score for lower-income families. These findings suggest that providing drug insurance to children, particularly children in low-income families, improves the well-being of both the child and the family, and the design of public drug programs for children should take into account these broader benefits.

Chapter 2

Effects of the Quebec universal drug insurance reform on out-of-pocket spending of families with children

2.1 Introduction

Providing health insurance for children has become a priority for many governments. This is reflected, for example, in the high policy profile of health insurance expansions for children in the US (Medicaid and the State Children's Health Insurance Program (SCHIP)). Even though the morbidity and the costs of children's health care are much smaller than those of adults, providing insurance for children is an important investment in their future (Currie, 2009; Goodman-Bacon, 2021). In Canada, where hospital and physician services have long been universally covered, national universal prescription drug coverage is in the early stages of development. In this paper, I study the effects of a universal drug insurance reform that was implemented in the province of Quebec in 1997. The reform introduced a new public drug plan for all uninsured families, provided free access for eligible children, and made prescription drug coverage mandatory in Quebec. The reform was followed by a sharp increase in prescription drug coverage and reportedly higher prescription drug utilization (Wang et al., 2015). While it was assumed to lower out-of-pocket costs (Furzer et al., 2023; Lebihan, 2023) and potentially reduce financial risks, no thorough estimations of these effects have been documented. In this study, using two different empirical strategies, I estimate a small reduction in household drug spending among middle-income families but find no evidence of statistically significant reductions in spending among low-income families. Instead, I find larger offsetting increases in spending on health premiums for all income groups, although only statistically significant effects for the middle-income group.

Traditionally, research on health insurance has been concerned with its effects on

utilization and health outcomes (Currie & Gruber, 1996; Currie et al., 2014). More recently, research in the US has looked at the effects of insurance expansions on household spending and medical debt. The findings point to a substantial reduction in financial risk and medical and non-medical debt. These findings hold both in the general population (Finkelstein et al., 2012) and among low-income families with children, who were the main beneficiaries of the early Medicaid expansions (Gross & Notowidigdo, 2011). These results are not surprising considering the high financial risk of having to face costs for all medical care, including physician and hospital services, in the US.

The existing Canadian literature on the burden of prescription drug costs is largely descriptive in nature (Caldbick et al., 2015; McLeod et al., 2011). An exception to this is the study by Alan et al. (2005), who investigate the impacts of introducing public drug plans in Canada that cover extremely high costs, known as "catastrophic"[1] drug plans. Most of these plans were initiated in the 1970s, except for the Ontario Trillium program, which started in 1995. Looking at the budget shares of medication spending and focusing on the re-distribution effects, Alan et al. (2005) found larger reductions in spending for low-income families compared to higher-income families and concluded that these programs were strongly re-distributive.

In this paper, I investigate what effect the introduction of the Quebec public plan with zero copayment for children, and low copayment for parents (100 dollars annual deductible and a 25 percent co-insurance, in the first years of the program) had on out-of-pocket prescription drug expenditures of families with children. Considering that the public plan covered previously uninsured families and that higher-income families were more likely to hold (or be eligible for[2]) private insurance before the reform, I make a special emphasis on analyzing the heterogeneity of the effects by income group. Since the Quebec public drug plan was premium-based, I also analyze the effect of the reform on out-of-pocket spending on health premiums.

Using the fact that Quebec introduced a new mandatory public plan while other

[1]The high-deductible insurance plans which require a deductible on the order of 3-4 (or more) percent of family income.

[2]Anyone eligible for private insurance through their employer had to register for that private insurance rather than the public plan.

provinces did not, I use a quasi-natural experiment framework and compare the spending patterns of the treated (Quebec) and not treated (rest of Canada) families before and after the reform. In addition to the more traditional difference-in-differences method, I also apply the synthetic control method. Instead of relying on common trends assumption, the synthetic control method uses a linear combination of comparison units weighted to best match the pre-reform outcomes of the treatment group. The resulting synthetic control group better approximates the treatment group than any single control unit. In addition, the method provides a reliable inference procedure and a clear graphical exposition.

I study the mean effects of the reform on household annual drug and health premium spending. Using the Statistics Canada Survey of Household Spending (SHS), for the Quebec universal plan, I find a mean reduction in annual drug spending of around $45 (approximately 30 percent) for moderate-income households ($30,000-$50,000) but no effect for the lowest-income households (below $30,000). The estimated mean increase in annual premiums was larger, $110 (approximately 30 percent). As a result, the net effect was an increase in mean combined spending on prescription drugs and health premiums, of about $62 (12 percent). Moreover, due to rising premiums, the net annual effects were increasing over time, reaching an estimated $256 in 2001.

This paper contributes to the existing literature in several ways. First, it provides estimates of the effect of the Quebec drug insurance reform on household drug and health insurance spending, which has not yet been systematically studied. Understanding the scale of spending changes that the Quebec public program has brought about is crucial for shaping universal drug insurance policy design. The results suggest that in the first 5 years following the Quebec reform, mean household out-of-pocket spending on drugs reduced moderately, however, this reduction was more than offset by premium increases. Second, it finds important heterogeneity by income, with only the middle-income group benefiting from the reduction in out-of-pocket spending on drugs. Finally, it makes a methodological contribution. Because in the Canadian context of 10 provinces, the difference-in-differences method has to rely on a limited number of potential controls, the assumption of common trends may not hold. In this

paper, I cross-validate the difference-in-differences results against those of the synthetic control method which requires fewer assumptions. The results suggest that the estimates for prescription drug spending and health premiums for the middle-income group remain robust to the choice of the method. Therefore, there is confidence that the results provide credible estimates of the effects of drug insurance on family spending.

The remainder of the paper is organized as follows. Section 2.2 lays out the details of the drug insurance landscape in the Canadian provinces and the Quebec drug reform. Section 2.3 discusses the data sources and section 2.4 lays out the empirical strategy. The regression results are presented and discussed in Section 2.5. Section 2.6 concludes.

2.2 Drug insurance in Canada and the Quebec drug reform

This section provides the background on drug insurance in Canada and the Quebec drug insurance reform.[3]

In Canada, where hospital and physician services have traditionally been universally covered, prescription drugs have not. Instead, according to Hoskins et al. (2019), there have been numerous public plans (over a hundred) as well as a variety of private plans, many of which necessitate a copayment of some kind. Public coverage for medications has traditionally been available to welfare recipients and, with some variation in generosity depending on the province, to Canadian seniors (Grootendorst, 2002). The middle-class Canadians holding full-time jobs with benefits have traditionally been covered by work group plans (Applied Management et al., 2000), but their generosity may also have varied. The group most likely to have gone without coverage for prescription drugs in Canada are those employed without benefits (Angus Reid Institute, 2020; Applied Management et al., 2000; Grootendorst, 2002). As a result, in Canada, many families with children who are neither seniors nor on welfare have been facing the risk of out-of-pocket payments when filling prescriptions. According

[3]It should be noted that at the time of writing, the federal government has announced its commitment to implementing the national universal pharmacare. However, the program is still in the initial stages of implementation. The description below reflects the drug insurance landscape in effect at the time of writing.

to a recent poll (Angus Reid Institute, 2020), between 20 (Ontario) and 37 (Manitoba) percent of respondents paid half or more of the prescription drug costs out-of-pocket. In addition, according to recent Canadian findings, families without adequate drug coverage were reported to reduce spending on food and other necessities (Law et al., 2018), and eventually resort to borrowing (Kolhatkar et al., 2018).

To ensure children do not experience financial barriers to prescription medications, over the last couple of decades, several Canadian provinces have introduced drug benefits for children. First-dollar comprehensive plans began to emerge in the 1990s, starting with the Quebec drug reform in 1997 and several income-targeted programs in the late 90s in Alberta and Saskatchewan. More recently, Ontario introduced a comprehensive drug benefit for all uninsured children, Ontario Health Insurance Plan+ (OHIP+), in January 2018.

The Quebec universal drug plan is probably the oldest established program that has introduced universal drug coverage for children. The Quebec program was implemented in 1997, making drug insurance mandatory for all residents and introducing a compulsory public drug insurance plan for all uninsured residents. The plan charged income-indexed premiums, ranging between 0 and $175, a monthly deductible of $8.33 and a 25 percent copayment. However, the coverage was free for dependent children of enrolled (i.e., premium-paying) adults.

The design of the Quebec public plan is unique in the Canadian context. While there have been long-established universal public programs in several Canadian provinces (e.g., Saskatchewan, Manitoba, British Columbia) for "catastrophic" drug costs, they usually cover only the costs above a certain percentage of family income. Unlike those programs, a comprehensive plan such as the Quebec drug plan for children, removes all financial risks related to prescription drug spending, not only the risk of very high spending.

There were several other initiatives that provided children with new comprehensive drug benefits: Alberta Child Health Benefit (ACHB) (introduced in August 1998), and Saskatchewan Family Health Benefit (SFHB) (August 1998).[4] The programs

[4]In 1999, Prince Edward Island also introduced its Family Health Benefit, which I do not include

were provincial initiatives implemented as part of the National Child Benefit (NCB)[5] re-investments and were narrowly targeted at low-income children. Table B1 in Appendix B summarizes the new public drug plans.

During the same period, Ontario introduced its catastrophic plan in 1995; and in 1996 Manitoba restructured the deductible schedule of its "catastrophic" plan, essentially lowering the out-of-pocket cost for lower-income families and increasing it for higher-income families. A previous study reported little effect of the Ontario reform on drug spending budget shares (Alan et al., 2005).[6] The available evidence for the effects of the Manitoba reform suggests that utilization did not increase for low-income children, while it decreased for higher-income children (Kozyrskyj et al., 2001). Considering that few families gained coverage through the Alberta and Saskatchewan children's drug programs and that the catastrophic drug plans in Manitoba and Ontario were unlikely to have any effect on mean drug spending, I keep these provinces in the main analysis.

2.3 Data

To analyze the effects of drug insurance on household spending, I use the SHS public-use microdata files by Statistics Canada. The SHS is a national cross-sectional survey which collects detailed information on household expenditures. It also contains information on income and its sources, geographic identifiers, and household demographic information. It is the only national source of health spending data for Canadian households, including prescription drug spending. Since the policy change I am interested in occurred in 1997, I combined the annual 1997-2001 cycles of the SHS survey with its predecessor, the Family Expenditures Survey (FAMEX), of which I use the 1992 and 1996 cycles.[7] The major spending categories and demographic information are preserved in the FAMEX.

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in the list because it was much less "comprehensive": it required a deductible for each prescription and a dispensing fee. Eligible were families with incomes below $21,000.

[5]More details on the NCB are provided in Appendix A.

[6]The authors suggest that low take-up and high deductibles could be the reason for the lack of any effect on household spending.

[7]Earlier cycles of FAMEX do not contain province identifiers but only geographic regions that combine multiple provinces.

I restrict attention to respondents with children under the age of 18, living in one of the 10 provinces, who are under 65 years old and do not receive welfare. This is to ensure other public drug programs - such as those for seniors and welfare recipients - do not interfere with the analysis.

The key variable of interest is prescription drug spending. It has a long right tail, reaching up to $25,000 in my sub-sample. I drop a small number of observations (55 observations - less than 0.2 percent of the sample) with drug spending above $3,000. Retaining these observations, which may have been a mistake in data entry or recall, could seriously impact regression results. The resulting data set spans the period between 1992-2001 and contains 28,341 observations.

A limitation of these data is that it is not known what part of total drug expenditure goes to children's drugs. The reform in Quebec covered eligible parents as well as children, but parents had to face copayment requirements. Therefore, part of the total change in drug spending could be the change in parents' drug spending. This, however, would only be true for the parents spending above the annual 100-dollar deductible.[8]

2.4 Empirical strategy

I am interested in studying the relationship between household drug expenditures and access to comprehensive coverage for prescription drugs among families with children. To estimate the effect of insurance on spending, I use an exogenous policy change - the introduction of mandatory public drug insurance coverage for all uninsured persons in Quebec starting in January 1997. Since no other province experienced a similar change in drug coverage, my general strategy is to compare the out-of-pocket drug expenditures before and after the reform in the treatment (Quebec) and control (other than Quebec) provinces.

The baseline difference-in-differences model is presented in Equation (2.1):

$$DRUG_{ipt} = \beta_0 + \beta_1 Que_p \times Post_t + \beta_2 Prov_p + \beta_3 Year_t + X'\Lambda + e_{ipt} \qquad (2.1)$$

[8]The mean of drug spending in 1996 was 142 dollars.

where the dependent variable, $DRUG_{ipt}$, is spending on prescription drugs by household i in province p and year t. $Que_p \times Post_t$, the interaction between Quebec and the year 1997 and after, is the key variable of interest. The coefficient β_1 captures the change in annual family spending on prescription drugs associated with obtaining comprehensive public drug insurance. $Prov_p$ and $Year_t$ are provinces and years fixed effects. X is a set of controls that include household size, age, sex and marital status of the reference person, and family income characteristics. All regressions use survey weights provided by Statistics Canada. Provinces and years fixed effects control for year-specific shocks common to all provinces (such as national programs, e.g., NCB) as well as province-specific time-invariant differences in drug spending levels which could be due to provincial public drug subsidy programs already in place (such as the Ontario Trillium Drug program).

My focus is on low- and middle-income households which were more likely to be affected by the public drug reform compared to higher-income groups in Quebec. Higher-income families were more likely to have been privately insured for drugs both before and after the Quebec reform.

Therefore, I estimate Equation (2.1) for low-, middle- and higher-income families separately. I define "low income" as incomes below \$30,000,[9] "middle income" as incomes between \$30,000 to \$50,000 and higher incomes as incomes between \$50,000 to \$70,000. I set the low-income cut-off at \$30,000, adjusted for the Consumer Price Index (CPI) to ensure a reasonable sample size for the low-income group. This also allows me to align the study of the Quebec program with the Saskatchewan program studied in Chapter 4, where eligibility was linked to an income level below \$26,000. For higher income sub-samples, i.e. above \$50,000, I expect to see less of an effect as the drug insurance coverage, either public or private, did not increase as dramatically for this group as it did for the lower income groups.

Theoretically, health insurance does not need to result in lower health spending. First, non-adherence among the uninsured leads to lower utilization and spending on

[9] All expenditures are adjusted for inflation using provincial CPI with the base year 2000. Household income is not adjusted for family size, but all regressions control for household size.

medications. Second, health-seeking and physician's prescribing behaviour may be altered by the presence of insurance, i.e. lead to higher utilization, and, possibly, higher spending for the insured, if copayment requirements are present. Lastly, other categories of spending, more elastic to income, could have been sacrificed when the choice had to be made between spending on medication and other items, which would further downplay the effect of insurance on drug spending alone. There is some evidence that spending on children's medication could be less price-elastic (Karaca-Mandic et al., 2012) and medication utilization is known to have lower levels of cost-related non-adherence among children (Law et al., 2018), so the effect of comprehensive insurance for children's drugs should be working towards reducing household out-of-pocket spending on medications. However, when, in addition to children, parents get coverage but must face copayments, the negative effect could be more muted.

The identifying assumption of the difference-in-differences design - the parallel trends - requires that the trends in out-of-pocket drug spending among families in the affected and the comparison provinces would have been the same in the absence of the reforms. There are reasons to believe this. There were no other major drug insurance changes during the same years.[10]

A potential threat to the validity of this difference-in-differences strategy is the simultaneous introduction of other programs during the same period that could have affected spending on prescription drugs. One prominent program launched during this period was the NCB. Introduced in 1998, it was a new supplement that provided cash benefits to families with children (more details on NCB are provided in Appendix A). I take advantage of the fact that most provinces implementing the NCB supplement including Ontario, British Columbia, and Manitoba, did not invest the funds into child drug benefit programs. And the three provinces that did (Alberta, Saskatchewan, and Prince Edward Island) imposed such low (see Table B1) income eligibility requirements, that very few non-welfare receiving families could qualify, and those families would all be included in the below $30,000 income group. I conclude

[10]There were some changes to the catastrophic (last-dollar) plans: Ontario introduced its catastrophic plan in 1995 and Manitoba changed its catastrophic plan's schedule of deductibles in 1996. The effects of these plans on mean spending are small, according to (Alan et al., 2005). If there were effects on spending, they would bias the estimates of the Quebec plan toward zero.

that there was little confounding effect of the NCB on trends in drug spending during this time.[11]

For inference, it is common in the difference-in-differences literature to cluster standard errors at the level of the reform, i.e., at the province level. However, using the cluster-robust variance estimator (CRVE) may be unreliable with few (in this case just one) treated groups. It has been reported (MacKinnon & Webb, 2018) that with few treated clusters, using a CRVE results in severe over-rejection with t-statistics being up to five times too large. Likewise, using wild cluster bootstrap (WCB) with very few clusters has been reported to perform poorly in simulations (MacKinnon & Webb, 2018) resulting in severe under-rejection (restricted bootstrap with null imposed) and under-rejection (unrestricted bootstrap). MacKinnon and Webb (2018) suggest that whenever these two wild bootstrap tests disagree, a "subcluster" test - a wild bootstrap clustered at a finer level (e.g., a simple wild bootstrap) - could provide a better solution, provided the clusters are of similar size. In this paper, I perform tests using both the restricted and unrestricted wild cluster and subcluster bootstraps. When they agree, I use them for inference. When they disagree, other inference approaches, such as the randomization inference (as is used with the synthetic control method), should be used. The alternative procedure that I use is discussed below.

In addition, although other provinces did not undergo major drug reforms, the potential for varying trends in drug spending across provinces and among different income sub-groups still exists. Such variations could violate the identifying assumption of the difference-in-differences analysis, necessitating further investigation.

To complement the difference-in-differences analysis, I estimate the effect of the Quebec drug reform using a synthetic control method. One of its major advantages is that it does not rely on parallel trends. Furthermore, it is designed for causal inference with one or a few treated groups, overcoming the limitations of the difference-in-differences inference with a small number of treated groups. The synthetic control

[11] If there are some unaccounted effects of income transfers on drug spending, I expect them to work in the direction of increasing the spending by relaxing the income constraint and attenuating the negative effect of insurance.

method is an approach to program evaluation, introduced in Abadie and Gardeazabal (2003) and Abadie et al. (2010). It uses a weighting procedure to construct a synthetic comparison group from the existing potential control units which are chosen and assigned weights to best approximate the relevant pre-reform characteristics and outcomes of the treatment group. This proximity is based on a distance measure, root mean squared prediction error (RMSPE), applied to the pre-reform characteristics and outcomes. As a result, the comparison group comprising a linear combination of units weighted to minimize RMSPE provides a better approximation of the treated group than any single unit. In addition, it provides a transparent and reliable placebo-based inference procedure. By constructing a synthetic control for each province as a placebo treatment, one obtains a distribution of treatment effects for which one can calculate a p-value. The p-value in this case is the proportion of placebos that have a ratio of post-treatment RMSPE (the gap between the observed and predicted outcomes) over pre-treatment RMSPE (which here also stands for the quality of the pre-treatment match) at least as large as the average ratio for the treated units. In other words, the probability of obtaining the observed difference in the outcomes by chance only. I compare this p-value to the p-values of the WCB and the subcluster bootstrap from the difference-in-differences models, and base inference on the former when the latter two p-values do not agree. Finally, having a single control group makes graphical exposition appealing. Therefore, following the literature, I present the graphs of trends, effects, and placebo effects, in addition to the estimates of the average treatment effects. In this context, I expect to see more extreme effects for the treated group (Quebec) compared to placebo effects among low-income groups, and less extreme - for higher-income households, considering that higher-income households have a higher probability of holding drug insurance before the reform.

2.5 Results

First, I present the summary statistics for the main outcomes and the covariates for three groups: Quebec (treated group), rest of Canada (non-treated group) and

synthetic Quebec[12] over the pre-reform years. In my sample,[13] households had less than 2 children on average, the average age of the reference person[14] was between 37 (rest of Canada) and 38 (Quebec). The proportion of single-parent households was slightly higher in Quebec (11 percent) compared to rest of Canada (8 percent). The average income was lower in Quebec ($49,130) than in rest of Canada ($54,600). The synthetic Quebec demographic characteristics are almost identical to those in rest of Canada and very similar to Quebec, except for the female reference person rate, which is much lower in Quebec between 1992-1996, but increases afterwards. Synthetic Quebec does not have a better match to Quebec in terms of demographic characteristics than rest of Canada. With only two pre-reform periods, I use both pre-reform observations on the outcomes and therefore matching is done only on the outcome variables and does not use the covariates.[15]

In terms of outcome variables, drug spending in Quebec was lower at the beginning of the period but showed some growth, unlike rest of Canada where it remained unchanged. Health premium spending in Quebec and rest of Canada was 3-4 times as large as drug spending, and in both cases showed some decline during the pre-reform years. For drug spending and total health insurance premiums, synthetic Quebec achieves a much better match on pre-reform trends than does the simple average of rest of Canada.

[12]The demographic and prescription drug spending means in column 3 of Table 2.1 are based on the estimated synthetic control for prescription drugs using all income groups. The means of total insurance premiums in column 3 are based on the estimated synthetic control for total insurance premiums.

[13]My sample includes non-senior families with children not receiving social assistance.

[14]In the SHS, the "reference person" is defined as the household member who is "mainly responsible for its financial maintenance (e.g., pays the rent, mortgage, property taxes, and electricity)".

[15]According to Galiani and Quistorff (2017), unless some pretreatment outcome variables are dropped from the set of predictors, all other covariates are rendered redundant.

Table 2.1: Pre-reform characteristics and spending, 1992-1996

	Quebec	Rest of Canada	Synth Quebec
Panel A. Demographics			
Age of respondent	38.1	37.4	37.1
Female respondent	0.20	0.43	0.41
Single parent	0.11	0.08	0.08
Low education	0.46	0.43	0.43
N of children	1.67	1.75	1.75
Household income, 2000	49,130	54,599	53,576
N	910	4,431	.
Panel B. Average health spending, $			
Prescription Drugs, 92	108.4	132.8	118.3
Prescription Drugs, 96	141.8	132.2	138.7
Total ins premiums, 92	415.4	431.4	415.3
Total ins premiums, 96	390.8	376.9	390.6

Notes: The sample includes families with children, not on welfare, where adults are less than 65 years old. Drug spending is limited to $3000. All spending is adjusted for inflation using 2000 prices. N is not reported for synthetic Quebec as it is based on a weighted combination of aggregate data. The means of demographic variables and prescription drug spending for synthetic Quebec are based on the estimated synthetic control from the full-sample analysis of prescription drugs. Mean insurance premiums are based on the estimated synthetic control from the full-sample analysis of insurance spending.

Next, I examine the results of the difference-in-differences and the synthetic control analyses for mean drug spending. These results are presented in Table 2.2 and Table 2.3. Table 2.2 reports the results of the difference-in-differences estimation, with the results for different sub-samples in columns. In the first row, I show the estimated coefficient, and below it, I report several types of p-values. The first is based on CRVE, and it is followed by WCB estimators. The latter were clustered at different levels: *province* and *province* $\times$ *year* (i.e., the subcluster bootstrap, following MacKinnon and Webb (2018)). Acknowledging that with one treated group the CRVE as well as clustered bootstraps may be unreliable, I am looking for consistency between p-values within the same cluster level and, ideally, between the cluster levels. Using the whole sample of families with children, I do not find any effect on drug spending. However,

the results by income sub-sample suggest a reduction in spending among the middle-income group of about $43, or 31 percent of pre-reform mean drug spending, but no effect for the other two income groups. The p-values, however, are not all consistent for the middle-income group. The CRVE p-value rejects the null, the WCB p-values clustered by province do not reject the null, and the WCB p-values clustered by province and year again reject the null. I further investigate these results using the synthetic control approach below.

In Figure 2.1, I present graphically the synthetic control results for the 3 sub-samples. Panels A, C, and E present the trends for Quebec and its synthetic control. Panel A suggests that a synthetic control group with a good match in the pre-reform period could not be generated for the lowest-income sample. On the contrary, the graphs in panels C and E demonstrate a good match in the pre-reform period for the higher-income sub-samples. To estimate the effect of the reform, I take the difference between spending in Quebec and its synthetic version after the reform. To assess the significance, I compare the magnitudes of the estimated effects for Quebec to the distribution of placebo treatment effects (i.e. the estimated effects for other provinces), taking into account the pre-reform match quality between the treated (or placebo-treated) province and its synthetic control. Panels B, D, and F plot these effects for Quebec (black) and for all the control provinces (grey). The effect for the low-income group is very pronounced, but the poor pre-reform match renders it less reliable. For the middle-income group, there is a noticeable divergence in spending trends after the reform (panel C) and a large negative effect compared to the placebo effects (panel D). Finally, for the high-income group, there is not any clear divergence in drug spending after the reform (panel E) and therefore no distinctive effect relative to the distribution of placebo effects (panel F).

Table 2.3 presents the results of the synthetic control procedure including the weights that it assigned to the provinces.[16] The point estimates for the overall and the lowest-income samples (the first two columns) are larger than those reported in Table 2.2. However, the null hypothesis of zero effect cannot be rejected based on the p-values which are larger than 50 percent. These are not the standard p-values, however: they

[16]In each column, missing weights indicate that these provinces were dropped from estimation because synthetic control groups could not be generated for these provinces.

show the proportion of the control provinces that under placebo treatment scenario have an estimated effect at least as large as that for Quebec.[17] Thus the p-values suggest a high probability (over 50 percent) of obtaining an effect similar to that in Quebec by chance only. Examining the synthetic control weights for these two samples (columns 1 and 2) reveals that only 2 out of 9 potential donors contributed in both cases, which would make it a sensitive and less robust control. Furthermore, as Panel A of Figure 2.1 demonstrates, there is a poor match in drug spending in pre-reform years. As a result, despite a pronounced negative effect observed in Quebec compared to the placebo effects (Panel B), the synthetic control p-values are too large. Conversely, for the middle-income group, there is a good pre-reform match between Quebec and its synthetic control and a distinctive gap in the after-reform years, with a maximum of $63 in 1999. The average of these gaps gives the average treatment effect, which equals $45 and is very close to the difference-in-differences estimate of $42.6. The p-value is 0. Under the assumption of randomly assigned treatment, the true p-value could be calculated as the ratio of 1 (for Quebec) to 9 (all provinces), i.e. 0.11, which is relatively large but solely due to the small number of units in the analysis. Conversely, there is no sustained gap between Quebec and its synthetic version in the after-reform period for the higher-income group, hence the results suggest no effect of the reform for higher-income families.

The synthetic control analysis confirms the difference-in-differences analysis' finding that the Quebec drug reform led to a reduction of about 30 percent in drug spending among middle-income families. This is generally what one would expect - a reduction in spending among moderate- but not high-income households since the latter were more likely to have been privately insured for drugs before the reform. However, the results do not confirm that there was a reduction in spending for the lowest-income households either. The latter is likely due to the limited sample size of low-income families after I exclude all welfare-receiving households. A rather moderate reduction in out-of-pocket spending that I find for the middle-income group (despite the full coverage of children's drugs) is likely due to the presence of deductibles

[17] More specifically, to account for pre-reform match quality, these p-values calculate the proportion of control units that have a ratio of post-treatment RMSPE (the average gap) over pre-treatment RMSPE at least as large as the average ratio for the treated unit (Galiani & Quistorff, 2017).

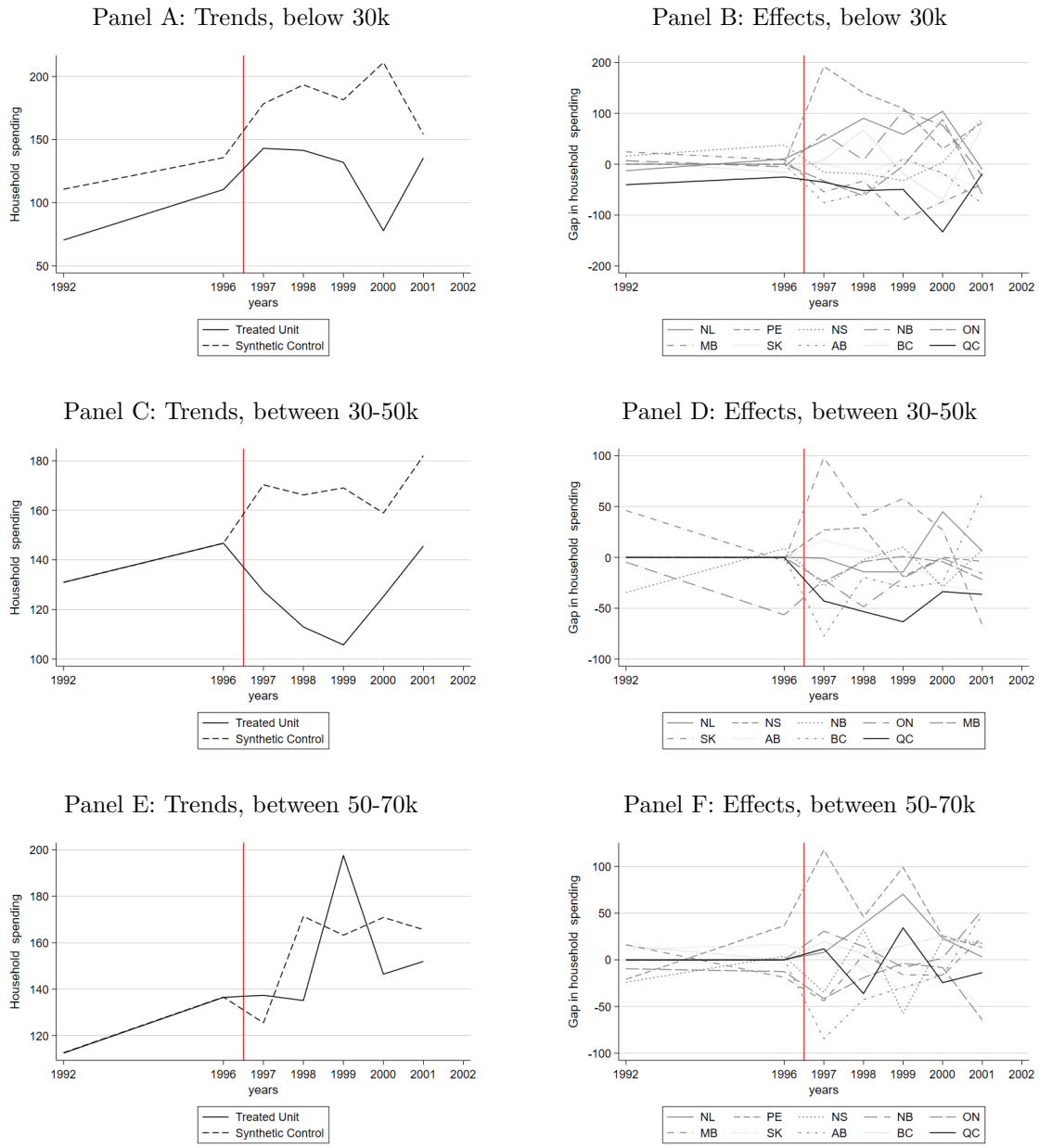
and copayments for adults. This finding suggests that, on average, only a small proportion of total drug budgets is spent on (commonly covered) children's drugs, and fully covering children's drugs has a small effect on the out-of-pocket spending of families with middle incomes.

Table 2.2: Effects of the Quebec drug reform on household average prescription drug spending, difference-in-differences

	All	below 30K	30/50K	50/70K
$Que \times Post$	-9.3	9.7	-42.6	2.9
p-value (CRVE)	0.215	0.426	0.005	0.804
p-val WCB (prov)	0.415	0.428	0.133	0.830
p-val restr WCB (prov)	0.508	0.482	0.380	0.830
p-val WCB (prov year)	0.645	0.814	0.050	0.908
p-val restr WCB (prov year)	0.707	0.814	0.090	0.909
N	28,341	4,576	10,763	7,788
Quebec N	3,845	678	1,617	1,011
Quebec pre-reform mean	122	88	139	123

Notes: This table reports estimates of the interaction of the treatment province and the post-reform years from the difference-in-differences model for prescription drug spending. Controls include year and province FE, family income, age, gender, female respondent, and family type. The estimation sample includes families with children, not on welfare, where adults are less than 65 years old. Drug spending is limited to $3000. All spending is adjusted for inflation using 2000 prices. CRVE p-values are calculated using standard errors clustered by provinces. Additionally, I report the WCB p-values from restricted and unrestricted tests clustered at the province and province-year levels.

Figure 2.1: Prescription drug spending: trends and effects using synthetic control



Notes: The left-side panels show mean spending in Quebec (solid line) vs. its synthetic control (dashed line). The right-side panels show the gaps in spending for each province and its synthetic control. The vertical lines indicate the end of the pre-treatment period.

Table 2.3: Effects of the Quebec drug reform on household average prescription drug spending, synthetic control

	All	below 30K	30/50K	50/70K
Panel A. Synthetic control effects				
1997	-28.0	-35.2	-40.6	11.9
p-value	0.556	0.778	0.125	0.222
1998	-33.0	-51.9	-53.7	-36.2
p-value	0.556	0.778	0.000	0.222
1999	-35.4	-49.5	-63.4	34.3
p-value	0.556	0.889	0.000	0.222
2000	-47.1	-133.1	-30.9	-24.4
p-value	0.556	0.778	0.000	0.222
2001	-13.7	-18.8	-35.9	-13.7
p-value	1.000	1.000	0.125	0.222
ATT	-31.5	-57.7	-44.9	-5.6
p-value	0.556	0.889	0.000	0.222
Panel B. Weights				
NL	0.00	0.62	0.08	0.08
PE	0.36	0.00	.	0.06
NS	0.00	0.00	0.11	0.54
NB	0.00	0.00	0.26	0.08
ON	0.64	0.38	0.20	0.09
MB	0.00	0.00	0.11	0.03
SK	0.00	0.00	0.06	0.03
AB	0.00	0.00	0.10	0.06
BC	0.00	0.00	0.08	0.03

Notes: ATT is the average gap in the post-treatment years for Quebec. ATT, p-values, and synthetic weights are calculated using all non-missing provinces. Prince Edward Island is excluded from the synthetic control in column 3 because a synthetic control group could not be generated for this province in the placebo simulations.

Besides the effect on prescription drug spending, I am also interested in the effect of the Quebec reform on health insurance premiums. A public plan implemented in Quebec under the Universal Drug Insurance reform required families to pay income-indexed premiums. These premiums ranged from $0 to $175 in the first years but steadily increased reaching $350 in 2000 and $422 in 2002. It was argued that these premiums represented a serious financial burden for lower-income households, especially in the later years of the program when they were further increased (Morgan et al., 2017).

Table 2.4 reports the difference-in-differences estimates of the effect of the Quebec reform on total health insurance premiums. It suggests a consistent increase in spending, between $117-$136 for all income groups, unlike the effect on drug spending which I only find for the middle-income group. All p-values reject the null except the restricted CWB, which is known to underreject.

The synthetic control estimates in Table 2.5 also suggest a consistent pattern of positive effects for all income groups. In addition, unlike drug spending, the synthetic control weights for health premiums are more uniform and use the full pool of donors. The p-values, however, suggest that there is significant evidence of a positive effect only for the middle-income group, but not the lowest- or highest-income groups.

Figure 2.2 illustrates the synthetic control results. As Panels A, C, and D indicate, there is a good match in health insurance spending between Quebec and its synthetic control in pre-reform years (panels A, C, and D) and a noticeable divergence between them after the reform. The effects graphs (panels B, D, and F) show unusually large gaps for Quebec (dark line) in the after-reform years relative to placebo effects. There was also a sharp drop in premium spending in 1997, the year of the reform, for middle- and higher-income families. This drop is fully attributable to private plan premium spending and is likely due to the adjustment to the new policy among households and private insurers. Its large magnitude likely pushes downward the point estimates and inflates the p-values of the average post-treatment effects for the middle- and high-income groups. The years after 1997 show an unusually steep increasing trend in the effects on premium spending in Quebec relative to placebo effects for all income groups. While the average effect estimated using synthetic control is $110, which

is a little under 30 percent of the pre-reform average insurance spending, the point estimate in 2001 suggests a much larger effect of $287.7, which is above 60 percent of the pre-reform insurance spending.

To summarize, I find evidence of a substantial increase in health premiums, and a reduction, of a smaller magnitude, in drug spending for the middle-income group. The difference-in-differences and synthetic control estimates suggest premium increases for the other two income groups, but the large p-values from the synthetic control method indicate that these estimates are not statistically significant.

Since I find two opposite effects on spending for the middle-income group, I estimate the effect of the Quebec reform on the sum of drug and health insurance spending. The results are presented in Tables 2.6 and 2.7. The difference-in-differences estimates for the sum of the two categories in Table 2.6 are almost identical to the estimates for health premiums in Table 2.4 except for the middle group. The synthetic control estimate of the combined spending in Table 2.7 is also very close to the estimate for premium spending alone for the high-income group in Table 2.5. Similar to previous findings, the synthetic control p-values do not provide evidence of significant effects for the low and high-income groups but they do provide significant evidence of an *increase* in the combined spending for the middle-income group. Finding an increase in spending suggests a larger role of premium increases compared to the savings from out-of-pocket spending on prescription drugs. As is clear from panel D of Figure 2.3, the average effect is influenced by a drop in 1997, but starting in 1998 there is a pattern of steadily rising increases reaching up to $256 in 2001.

The results suggest that the Quebec reform affected the out-of-pocket spending of the middle-income group by cutting drug spending but also increasing spending on health premiums. The combined average effect was a moderate increase in spending, of about $62, or 12 percent, of pre-reform average spending. However, the pattern of the estimates indicates increasing positive effects on spending over time reaching up to $256 in 2001. There is some indication of increased spending for the high-income group, attributable to higher premium spending, but I do not obtain consistent statistical evidence to support this finding.

Although my findings are specific to prescription drug coverage and the particular features of the Quebec public insurance plan (such as the premiums and the co-payment rates), the reduction in out-of-pocket health spending that I estimate is generally in line with the effects of public health insurance on spending reported in the literature. For example, programs such as Medicare (seniors), Medicaid (very low-income households) and SCHIP (State Children's Health Insurance Program for children in low-middle income families) have all been reported to reduce out-of-pocket health spending (Banthin & Selden, 2003; Finkelstein & McKnight, 2008; Leininger et al., 2010). While Medicaid and SCHIP target only low-income families, where I did not find a significant effect, Medicare - a premium-based public program covering seniors of all income levels - more closely resembles the design of the Quebec plan for middle-income households. Medicare was found to reduce out-of-pocket medical spending by between one-quarter (hospitals, not statistically significant) and one-third (physicians), and a more recent Medicare Part D program[18] was found to reduce out-of-pocket drug spending by 13-18 percent (Polinski et al., 2010), whereas I find a one-third reduction in out-of-pocket drug spending for the Quebec universal public drug program. Medicare (not including Part D) was also found to increase total premium spending which at the mean outweighed the out-of-pocket health spending savings and led to an increase in net spending of about one-third (Finkelstein & McKnight, 2008), whereas I find a smaller net increase of about 12 percent on average, but getting much more pronounced in later years. The trend of increasing health spending due to rising premiums is alarming, as it suggests a potentially increasing financial burden instead of a benefit from the program, especially for lower-income families.

[18]Medicare itself does not cover prescription drugs. Medicare Part D, introduced in 2004, is provided by private insurance and the copayment requirements vary by plan.

Table 2.4: Effects of the Quebec drug reform on household average health insurance premiums, difference-in-differences

	All	below 30K	30/50K	50/70K
$Que \times Post$	122.2	136.5	117.4	135.9
p-value (CRVE)	0.000	0.001	0.000	0.000
p-val WCB (prov)	0.000	0.023	0.000	0.000
p-val restr WCB (prov)	0.202	0.148	0.132	0.173
p-val WCB (prov year)	0.194	0.081	0.177	0.075
p-val restr WCB (prov year)	0.199	0.161	0.188	0.132
N	28,341	4,576	10,763	7,788
Quebec N	3,845	678	1,617	1,011
Quebec pre-reform mean	412	159	374	506

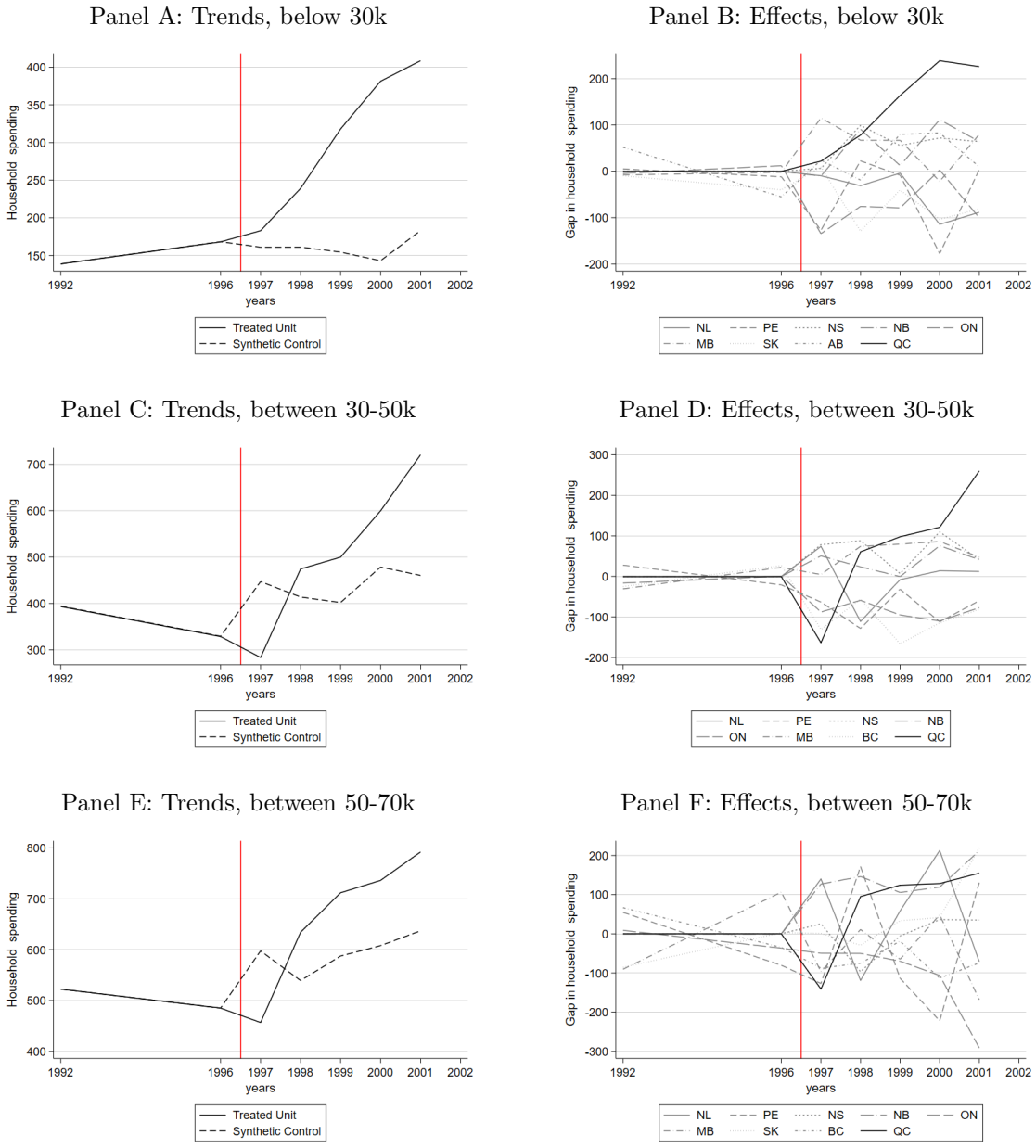
Notes: This table reports estimates of the interaction of the treatment province and the post-reform years from the difference-in-differences model for health premium spending. Controls include year and province FE, family income, age, gender, female respondent, and family type. The estimation sample includes families with children, not on welfare, where adults are less than 65 years old. All spending is adjusted for inflation using 2000 prices. CRVE p-values are calculated using standard errors clustered by provinces. Additionally, I report the WCB p-values from restricted and unrestricted tests clustered at the province and province-year levels.

Table 2.5: Effect of the Quebec drug reform on household average health insurance premiums, synthetic control

	All	below 30K	30/50K	50/70K
Panel A. Synthetic control effects				
1997	-107.5	27.5	-134.6	-108.6
p-value	0.000	0.250	0.000	0.250
1998	76.6	76.6	102.0	117.2
p-value	0.000	0.250	0.000	0.125
1999	31.4	163.5	125.5	146.1
p-value	0.000	0.125	0.000	0.000
2000	145.5	238.6	172.5	155.6
p-value	0.000	0.250	0.000	0.125
2001	307.0	226.6	287.7	185.8
p-value	0.000	0.125	0.000	0.125
ATT	90.6	146.6	110.6	99.2
p-value	0.000	0.250	0.000	0.125
Panel B. Weights				
NL	0.03	0.02	0.11	0.09
PE	0.03	0.03	0.20	0.07
NS	0.19	0.04	0.15	0.15
NB	0.04	0.38	0.12	0.10
ON	0.03	0.47	0.22	0.06
MB	0.45	0.00	0.11	0.23
SK	0.03	0.06	.	0.07
AB	.	0.01	.	.
BC	0.21	.	0.09	0.23

Notes: Panel A reports the yearly estimated effects and the ATT which is the average effect in the posttreatment years for Quebec. ATT, p-values, and synthetic weights are calculated using all non-missing provinces. Panel B reports the synthetic control weights. A missing weight indicates that the corresponding province was dropped from the estimation because a synthetic control group could not be generated for this province in the placebo simulations.

Figure 2.2: Total health insurance premium spending: trends and effects using synthetic control



Notes: The left-side panels show mean spending in Quebec (solid line) vs. its synthetic control (dashed line). The right-side panels show the gaps in spending for each province and its synthetic control. The vertical lines indicate the end of the pre-treatment period.

Table 2.6: Effects of the Quebec drug reform on combined prescription drug and insurance premium spending, difference-in-differences

	All	below 30K	30/50K	50/70K
$Que \times Post$	112.9	146.3	74.8	138.8
p-value (CRVE)	0.000	0.001	0.015	0.000
p-val WCB (prov)	0.000	0.000	0.001	0.000
p-val restr WCB (prov)	0.153	0.118	0.282	0.088
p-val WCB (prov year)	0.240	0.214	0.352	0.064
p-val restr WCB (prov year)	0.250	0.223	0.370	0.122
N	28,341	4,576	10,763	7,788
Quebec N	3,845	678	1,617	1,011
Quebec pre-reform mean	534	247	512	628

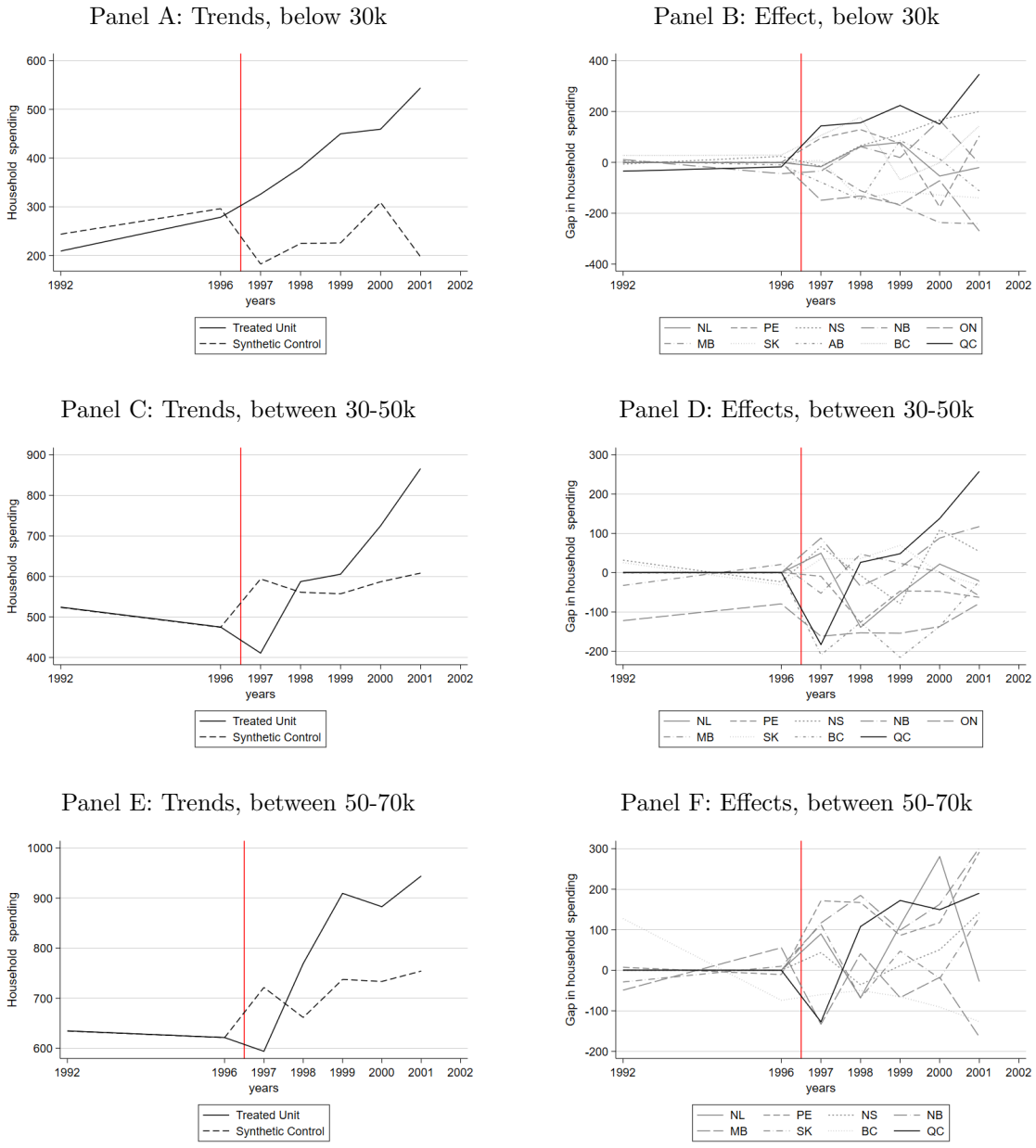
Notes: This table reports estimates of the interaction of the treatment province and the post-reform years from the difference-in-differences model for drug and health premium spending combined. Controls include year and province FE, family income, age, gender, female respondent, and family type. The estimation sample includes families with children, not on welfare, where adults are less than 65 years old. Drug spending is limited to $3000. All spending is adjusted for inflation using 2000 prices. CRVE p-values are calculated using standard errors clustered by provinces. Additionally, I report the WCB p-values from restricted and unrestricted tests clustered at the province and province-year levels.

Table 2.7: Effects of the Quebec drug reform on combined prescription drug and insurance premium spending, synthetic control

	All	below 30K	30/50K	50/70K
Panel A. Synthetic control effects				
1997	-136.4	143.5	-178.8	-118.2
p-value	0.000	0.667	0.000	0.143
1998	44.9	156.0	36.1	87.7
p-value	0.111	0.667	0.125	0.143
1999	-2.1	224.2	59.6	175.4
p-value	0.333	0.444	0.000	0.000
2000	117.3	150.5	136.2	118.7
p-value	0.000	0.556	0.000	0.143
2001	309.0	346.9	256.3	182.8
p-value	0.000	0.556	0.000	0.286
ATT	66.5	204.2	61.9	89.3
p-value	0.000	0.556	0.000	0.286
Panel B. Weights				
NL	0.04	0.00	0.06	0.11
PE	0.05	0.00	0.07	0.10
NS	0.08	0.00	0.33	0.27
NB	0.05	0.00	0.12	0.12
ON	0.01	1.00	0.05	.
MB	0.58	0.00	0.28	0.23
SK	0.04	0.00	0.03	0.09
AB	0.11	0.00	.	.
BC	0.04	0.00	0.06	0.09

Notes: Panel A reports the yearly estimated effects and the ATT which is the average effect in the posttreatment years for Quebec. ATT, p-values, and synthetic weights are calculated using all non-missing provinces. Panel B reports the synthetic control weights. A missing weight indicates that the corresponding province was dropped from the estimation because a synthetic control group could not be generated for this province in the placebo simulations.

Figure 2.3: Sum of prescription drug and health insurance premium spending: trends and effects using synthetic control



Notes: The left-side panels show mean spending in Quebec (solid line) vs. its synthetic control (dashed line). The right-side panels show the gaps in spending for each province and its synthetic control. The vertical lines indicate the end of the pre-treatment period.

2.6 Conclusion

In this paper, I have examined the effects of the Quebec drug reform of 1997. The reform, uniquely among the Canadian provinces, made prescription drug coverage mandatory in the province of Quebec; and it introduced a new public drug plan for all uninsured families. The new public plan was more comprehensive than most other provincial plans available to working families at the time, which usually only covered very high, i.e., "catastrophic", out-of-pocket spending. While there were studies of the effects on household spending of these "catastrophic" plans, there has not been a thorough investigation of the effects of the more comprehensive premium-based Quebec drug plan on household spending in the literature.

Using difference-in-differences and synthetic control approaches, I estimate the effects of the reform on mean household spending on prescription drugs and health premiums. I find a reduction in mean spending for prescription drugs after the Quebec reform of about $45 (or 30 percent of the pre-reform average spending) among the moderate-income, but no strong evidence of an effect for the lowest-income households. This is despite the lower pre-reform rates of insurance coverage for the latter. The estimated effect on drug spending for the lowest-income group is an increase of $9.7 using difference-in-differences, and a reduction of $57.7 using synthetic control. Due to the limited sample size after excluding welfare recipients and the large variance, both approaches suffer from a poor match between the treated and control groups and are not statistically significant. Further studies using larger datasets, such as administrative data, are warranted to investigate the effect of free drug insurance on mean out-of-pocket spending among lowest-income working families.

The mean estimated dollar reduction in spending for prescription drugs, however, was largely offset by an estimated dollar increase in premiums spending: with both public and private plans charging premiums, all types of families faced a substantial increase in health premium spending. The estimates, however, were only significant for the middle-income group and suggested an increase on average between 1997 and 2001 of about $110.6, or 30 percent, using the synthetic control method, and $117 - using difference-in-differences.

This paper extends the literature on the Canadian healthcare system evaluations in several ways. First, it provides for the first time to our knowledge a thorough analysis of the effect of the Quebec drug reform on drug spending of families with children using quasi-experimental designs. Second, it applies the synthetic control method in the context of a few Canadian provinces. This approach is particularly suited for the case of a single treated and few control units, where the validity of the parallel trends assumption and the inferential procedure of the difference-in-differences are questionable. Finally, the results suggest that given the public plan's copayment requirements, the reform did not provide a particularly large spending reduction for prescription drugs and led to a net increase of about 12 percent on average when premium spending was added. Moreover, the spending increases were getting much more pronounced in later years.

While the estimated reduction in mean spending following the reform is modest, it reflects full coverage of children's costs, which constitute a small proportion of total household spending. The effect of covering adults is not captured at the mean since adults were required to pay deductibles equal to $100 initially, which is comparable to the average pre-reform out-of-pocket drug spending of $122, in addition to a 25 percent co-insurance. Families with above-average spending likely saw larger savings, but this is beyond the scope of the current study. Full coverage of children's costs and a moderate deductible and co-insurance for adults under the Quebec plan compares favourably to the alternative, high-deductible ("catastrophic") drug plan design that typically requires a deductible of around 3 percent of income, which would amount to $750 for a family with an income of $25,000. According to the Survey of Household Spending, very few families with children (less than 5 percent in my sample) spent that much on prescription drugs out-of-pocket, and with 3-percent income deductibles, many fewer families would benefit from the program. For comparison, the introduction of the Ontario Trillium plan, an income-indexed high-deductible universal program, did not affect mean drug spending shares (Alan et al., 2005). In addition, under a "catastrophic" plan, utilization may be reduced and financial strain may persist, compared to a more comprehensive plan like the one adopted by Quebec.

In addition, the results point to the trend of increasing health spending due to rising

premiums, which is alarming. This paper looked at the first five years of the Quebec reform when premiums were set between $0 and $175 in the first three years and increased up to $350 in the next two. However, premiums continued to increase in the following years, reaching up to $600 by 2010. As my estimates show, mean drug spending reductions were just a fraction of the premium increases, and the increasing spending on premiums after the reform likely represented an increasing financial burden for lower-income families. Thus, for a public program such as national universal pharmacare to reduce the financial burden of prescription drugs on families with children, the policy recommendation would be to limit copayment requirements, particularly for lower-income families. While the Quebec plan may have benefited financially certain groups of prescription drug users (such as very high spenders), the focus in this paper has been on families of low- and moderate incomes with average spending on prescription drugs. I find that they did not gain financially from this reform and would benefit from lower user charges.

Chapter 3

Free drug and dental benefits for children in low-income families and the out-of-pocket health spending of their families

3.1 Introduction

In this chapter, I extend the analysis of drug insurance to the study of free drug and dental insurance for children in lower-income families. Providing uninsured health services to children is a crucial investment, in particular to children in low-income families, who are at higher risk of either not accessing the necessary health care when it is not insured, or experiencing deprivations due to the high financial demands of these services. Indeed, several recent studies in Canada reported that families without comprehensive drug insurance risk facing the choice between buying medications or necessities (Law et al., 2018), and resorting to borrowing (Kolhatkar et al., 2018). Conversely, not having dental insurance primarily results in under-utilization (Statistics Canada, 2023) and seeking care within the insured sectors, such as emergency departments and physician offices (Levy et al., 2023).

The recent announcements of the new Canadian Dental Care Plan and the anticipated roll-out of the new universal pharmacare program represent an important step towards increasing access to medications and dental care for all Canadians. While the effects of these programs are yet to be seen and will depend on their final design, in this chapter I present some evidence of providing comprehensive universal coverage of drug and dental services to children using a historical program. Since in the Canadian universal healthcare system, only physician and hospital services have traditionally been universally publicly covered, accessing services such as prescription drugs and dental care required private insurance or payment out-of-pocket. Children of working parents are most often insured for these services by their parents' employer's health

benefits (Hoskins et al., 2019). However, low-income working families in Canada who do not have comprehensive employment benefits, have traditionally faced the high risk of paying for these services out-of-pocket. Based on the most recent Statistics Canada data, about one-fifth of Canadians (21%) did not have (enough) insurance to cover their prescription drug costs (Cortes & Smith, 2022), and just above one-fifth of Canadians (22.4%) avoided visiting a dental professional due to the cost (Statistics Canada, 2023).

While most studies in Canada have focused on the burden of prescription drug costs, much less is known about the burden of other not publicly insured services, such as dental care. Studies examining total out-of-pocket health spending including drug and dental services confirm that the burden is much heavier for low-income families. For example, using the data over the period of 2010-2017, Hajizadeh et al. (2023) report that 13.1 percent of households in the poorest quintile encountered health spending greater than 10 percent of their budgets, whereas only 1.6 percent of the richest quintile spent the same share of their budgets on health. This is despite the existence of the provincial public programs aimed at reducing the financial risk, predominantly of prescription drug costs, for the uninsured. The majority of these programs, however, require non-negligible contributions in the form of either deductibles or premiums. A copayment- and premium-free insurance removes all financial risks related to health care, not only the risk of very high spending, which is especially relevant to low-income families.

In this chapter, I study the effect of introducing free coverage for drugs and dental services for children in low-income working families on out-of-pocket health spending. This helps shed light on the amount of financial burden that is due to children's drug and dental services, and the degree to which covering children's services reduces the risks of high drug and high dental spending. More specifically, I study the introduction of the Saskatchewan Family Health Benefits (SFHB) program, which was launched in 1998 as part of Saskatchewan's National Child Benefit (NCB)[1] investments in health programs. In addition to drug insurance, this program provided children in lower-income families with coverage for several other uninsured services, most importantly

[1]NCB was a federal-provincial initiative which increased federal benefits for all low-income families with children. More details are available in Appendix A.

dental care. The program also provided drug coverage for parents but required parents to pay $200 deductibles and 35 percent co-insurance. I examine the program's effects on the average and top spending for prescription drugs and dental care among low-income families. Using the fact that Saskatchewan introduced the new health benefits for children in low-income families, while most other provinces which implemented the NCB did not[2], I employ triple difference and synthetic control strategies to estimate the true causal effect of the new program on household out-of-pocket health spending.

Using the Statistics Canada Survey of Household Spending (SHS), I find that the SFHB program resulted in a reduction in out-of-pocket drug spending ranging from $41 (triple difference) to $97 (synthetic control), or 30 to 66 percent, and a reduction in dental spending ranging from $57 to $75, or 37 to 48 percent. In addition, I find more diverging effects at the upper end of drug and dental out-of-pocket spending distributions. There is little effect below the 90^{th} percentile for drug spending, but I estimate large reductions between the 80^{th} and 90^{th} percentiles for dental spending. This suggests that at the above-average spending levels, children's dental spending represents a greater risk of out-of-pocket spending than prescription drug spending. Conversely, I find much larger effects for the top 5^{th} percentile of drug spending than for the top 5^{th} percentile of dental spending. The larger reductions in top drug spending are likely due to parents gaining coverage after meeting the required deductible for their drug costs. Thus, to truly minimize the risk of very high spending, both children's and parents' costs need to be covered.

This study contributes in several ways to the existing literature. First, children's insurance has not received a lot of attention in the Canadian literature. In this study, I present new findings and insights on the direct monetary value of fully covering drug and dental services for low-income children. Even though savings are only one part of the value of insurance, and I have not considered health utilization effects, these estimates shed light on the relative burden of children's healthcare costs within households. Secondly, I compare the effects of ensuring two different health services - prescription drugs and dental care - within one study. This is particularly relevant for dental care, as it adds to the limited body of knowledge about the burden of

[2]All provinces except Quebec implemented the NCB but, with the exception of Alberta and Prince Edward Island (PEI), did not introduce any new health benefits for children.

children's dental spending. Finally, I complement the triple difference method with the synthetic control method to obtain more credible estimates of the effects of a new insurance program. The synthetic control method is particularly suitable in this setting, with a single treated and a few control provinces.

The remainder of the chapter is organized as follows. Section 2 lays out the details of the public drug insurance programs and the reform that I study. Section 3 discusses the data sources and the descriptive statistics. Section 4 lays out the empirical strategy. The regression results are presented in Section 5. Section 6 provides a discussion of the study's findings and concludes.

3.2 Overview of drug and dental insurance in Canada

In this section, I provide an overview of drug and dental insurance in Canada. Although Canadian Medicare does not cover prescription drugs and dental care, there have long existed provincial programs providing these services. Primarily, these are the programs for prescription drugs, and to a much lesser extent - dental care. Traditionally, public programs have targeted the most vulnerable population groups, such as welfare recipients and seniors - for prescription drugs, and low-income children - for dental care. However, several provinces also introduced universal public programs for prescription drugs that cover "catastrophic" spending, where coverage begins after total costs of drugs reach a predefined percentage of the net family income, usually defined as 3 or 4 percent of income. Currently, 7 provinces provide such "catastrophic", i.e., high-deductible, plans for the general population (Canadian Institute for Health Information, 2021; Phillips, 2016). In addition, Alberta (1991), Quebec (1997), and New Brunswick (2015) introduced income-indexed premium plans for the general population. Still, the majority of working Canadian families obtain their prescription drug coverage through employment-based private insurance plans whereas public plans fill in the gaps in covering uninsured groups, and most of these plans only cover the very high, i.e., "catastrophic", costs. Dental care has been even more reliant on private provision of insurance, which is reflected in a much smaller share of publicly funded spending: 6 percent (2019 estimate) for dental care (Sourang & Worswick, 2020), compared to 44 percent (2020 estimate) for prescription drugs

(Canadian Institute for Health Information, 2022).

In addition, several programs specifically targeted at children emerged in the late 1990s as part of the federal-provincial NCB initiative, such as the Alberta Child Health Benefit (ACHB) in 1998, and the Saskatchewan's SFHB in 1998.[3] These programs provided drug and dental coverage for children, and in some cases, adults, with low incomes. Later, two Canadian provinces introduced universal drug benefits exclusively for children: Saskatchewan (2008) and Ontario (OHIP+, 2018). Public dental programs have historically been more scarce (Lexchin, 2022), with a few long-established programs for children, such as BC's Healthy Kids and the children's dental program in Nova Scotia.

While higher-income workers' benefits usually include rather comprehensive drug and dental coverage, low-income workers' benefits are less comprehensive, if available at all (Blomqvist & Woolley, 2018). As a result, without uniform coverage of first-dollar drug and dental spending, many Canadian families have been facing out-of-pocket costs, either in full or in part, as defined by the various deductible and copayment requirements of their private or public plans.

Most recently, the Government of Canada has made several important steps towards reducing the financial burden of drug and dental spending for Canadians. First, at the end of 2023, the federal government introduced a new public dental plan for uninsured Canadians with family incomes below $90,000. In addition, the government has committed to adopting a universal pharmacare plan in 2024. Although the details of the dental plan have been revealed, and no copayments are required by the plan for families with incomes below $70,000, it remains to be seen whether lower-income families with children will eventually obtain full coverage through this program. This will depend, among other factors, on how it interacts with private insurance that low-income families may have access to, and whether the public plan's fee schedules and services are not too restrictive and will not result in surcharges and limiting access to services.

In this chapter, I study the effects of the SFHB program introduced in Saskatchewan

[3]In addition, PEI launched a children's drug benefit in 1999, but it required non-negligible copayments and I do not include it in the study.

in 1998. Together with Alberta's ACHB, which was launched in the same year, these were the two health initiatives implemented as part of the NCB re-investments, providing full coverage of several uninsured services for children, most importantly drug and dental care. Both programs targeted low-income children: the Saskatchewan plan required incomes below $25,921, and the Alberta plan, which initially required incomes below $18,000, was only expanded to $22,397 in 2002.[4] The ACHB was implemented simultaneously with the Alberta welfare reform which seriously restricted access to welfare. Due to the narrow income eligibility rules of the ACHB during the studied period, and the changes to welfare eligibility rules that may have affected the composition of the recipients of the ACHB, I excluded Alberta from this study.

3.3 Empirical strategy

To estimate the causal effect of children's drug and dental insurance on household spending, I explore the introduction of the SFHB for children in low-income families in Saskatchewan in 1998 as a quasi-natural experiment. For most of the period, the eligibility for the SFHB was defined as family income below $25,921. Therefore, the empirical strategy relies on studying the changes in spending before and after 1998 for families with incomes below and above $25,921 (or $26,000) in Saskatchewan and other provinces, between 1992 and 2001. My baseline difference-in-differences model is presented in Equation (3.1):

$$Y_{ipt} = \beta_0 + \beta_1 SK_p \times Post_t + \beta_2 Prov_p + \beta_3 Year_t + X'\Lambda + e_{ipt} \tag{3.1}$$

where the dependent variable, Y_{ipt}, is spending[5] on prescription drugs or dental care by household i in province p and year t, $SK_p \times Post_t$ is the interaction between Saskatchewan and the years 1999 and after and is the variable of interest. The coefficient β_1 captures the change in annual family spending on prescription drugs

[4] Apart from Alberta and Saskatchewan, PEI and Newfoundland introduced additional drug benefits as part of the NCB provincial initiatives. However, the PEI program required non-negligible copayments and the Newfoundland program was a six-month extension of drug benefits to persons leaving social assistance. Due to the limited nature of these programs, I retain PEI and Newfoundland in the analysis as the control provinces.

[5] All expenditures and incomes are adjusted for inflation using provincial CPI with base year 2000.

or dental services associated with obtaining coverage for children's health expenses through the SFHB. $Prov_p$ and $Year_t$ are provinces and year fixed effects. Year fixed effects are included to control for year-specific shocks common to all provinces, such as the NCB, and province fixed effects control for the constant province-specific differences in drug and dental spending levels. X_{ipt} is a set of controls that include household type, age and sex of the respondent, and family income.

Since the Quebec drug reform was introduced around the same time as the SFHB program, I excluded Quebec from the analysis. In addition, British Columbia introduced the Healthy Kids dental program for children in low-income families in 1996. I kept it in the main analysis considering its low eligibility cut-off and reportedly low take-up (Quiñonez et al., 2005), but performed several sensitivity tests. I did not identify any other significant changes to public drug or dental programs during the 1992-2001 period. I dropped 1998 since the SFHB program was introduced mid-year.

The identifying assumption is that in the absence of the SFHB program, the trends in prescription drug and dental spending for families earning less than $26,000 would have been similar between Saskatchewan and other provinces. I investigate the potential validity of this assumption by examining changes in the spending of families in the adjacent income group that were not affected by the SFHB.

For prescription drugs, I expect to see a reduction in out-of-pocket spending for children after their costs become fully covered, considering that children's utilization is not very price-elastic (Karaca-Mandic et al., 2012; Law et al., 2018). However, spending reductions might be muted if, in addition to children, adults get drug coverage, even if it is partial. For dental care, on the other hand, the literature suggests that the out-of-pocket price elasticity for children is high, maybe even higher than for adults, and providing full or even partial coverage of dental services increases utilization (Manning & Phelps, 1979; H. Wang et al., 2007). Since the SFHB program, similar to other public dental programs for children (e.g., BC Healthy Kids, US Medicaid dental benefits), is limited to the coverage of preventive and medically necessary services and is very restricted in its coverage of non-urgent services such as orthodontics, the increase in utilization is likely concentrated among the most basic services, such as cleanings and fillings. In addition, it has been shown that family physicians

and emergency departments often act as providers of dental care of last resort among uninsured Canadians (Singhal et al., 2019; Zivkovic et al., 2020). Therefore, in the Canadian context of public coverage of physician and hospital services, providing dental insurance could result in a shift from emergency care at physician offices and hospital emergency departments to more preventative services at dentists' offices. As a result, for dental services, it is not clear a priori whether the effect of providing basic dental coverage will be toward reducing out-of-pocket dental expenditures or increasing them.

To better control for province-specific changes and to allow for differential trends in drug and dental spending across provinces, I estimate a triple difference model with the same focus on low-income families using Equation (3.2):

$$\begin{aligned} DRUG_{ipt} = \beta_1 SK_p \times Post_t \times Low_i + \\ \beta_2 SK_p \times Post_t + \beta_3 SK_p \times Low_i + \\ \beta_4 Post \times Low_i + X'\Lambda + e_{ipt} \end{aligned} \tag{3.2}$$

In this model, I limit the sample to \$40,000 to compare the changes in spending between families with incomes below the \$25,921 eligibility cutoff[6] and those with slightly higher incomes and therefore, ineligible families, allowing for differential provincial and income-group trends. Vector X, in addition to the controls used in Equation (3.1), includes the low-income indicator, *Low*, for incomes below \$25,921. The two-way interaction between Saskatchewan and the after-reform years, $SK_p \times Post_t$, controls for an overall trend in drug spending in Saskatchewan post-reform; the $SK_p \times Low_i$ interaction captures fixed differences among low-income groups in Saskatchewan and in the control provinces, and, finally, the $Post_t \times Low_i$ term captures the difference in the post-reform drug spending of the low-income families. The term of interest is the triple interaction term $SK_p \times Post_t \times Low_i$. It provides an estimate of the relative change in the drug (or dental) spending of low-income families in Saskatchewan after the reforms which I attribute to the new public coverage that became available to low-income families.

[6]In one of the specifications I use a slightly higher eligibility cut-off that came in effect 2001, but this does not seriously affect the results.

For inference, I use standard errors clustered at the province level. However, It has been shown that cluster-robust inference with few clusters is not reliable because t-tests based on cluster-robust variance estimators (CRVE) severely overreject (MacKinnon & Webb, 2018). The wild cluster bootstrap (WCB) procedure was recommended for the case of a limited number of clusters (Cameron et al., 2008). However, with few treated clusters and a dummy variable treatment at the cluster level, it was shown to also be unreliable (MacKinnon & Webb, 2018). Specifically, MacKinnon and Webb (2018) show that the WCB-based restricted t-test severely under-rejects, and the WCB-based unrestricted t-test severely over-rejects, with the under-rejection/over-rejection being the worst in the case of one treated cluster. MacKinnon and Webb (2018) propose a "subcluster" bootstrap, i.e., clustering at a finer level than the covariance matrix, to deliberately break the dependence of the bootstrap on the true data generating process. This procedure avoids the same issue that makes the WCB procedure fail and thus provides better p-values. I follow the advice in (MacKinnon & Webb, 2018) and show both versions of the WCB, restricted and unrestricted, clustered at the province level (the true cluster level), and at the province-year (i.e., subcluster) level. Consistent results between the restricted and unrestricted versions of the t-test should indicate that the test is reliable. MacKinnon and Webb (2018) note, however, that for the subcluster bootstrap procedure to be reasonably reliable, the number of treated clusters should not be too small, i.e., "two [treated clusters] is a lot better than one" (MacKinnon & Webb, 2018, p. 32). In the analysis of drug spending, I do not have access to another comparable public program. For dental spending, I identify another public dental program for low-income children—the Healthy Kids program—introduced in BC in 1996. Therefore I add BC as the second treated cluster in the analysis of dental spending.

While the triple difference model does not require common trends in the levels of drug and dental spending across provinces, it still requires a variant of the common-trends assumption. Specifically, it requires that the relative spending in higher- and lower-income households in treated and control provinces trended in the same way (Olden & Møen, 2022).

To validate the difference-in-difference and the triple difference estimates, I also employ the synthetic control method. The synthetic control method, introduced by Abadie and Gardeazabal (2003) and Abadie et al. (2010), constructs a synthetic control group from the existing control units which are assigned weights, positive or zero, to best approximate the relevant pre-reform characteristics and outcomes of the treatment group. A distance measure, the root mean squared prediction error (RMSPE), is used to determine the proximity between the pre-reform characteristics and outcomes of the treatment and the synthetic control. The resulting synthetic control group is a linear combination of control units weighted to minimize RMSPE and provides a better approximation of the treated group than any single control. In addition, the method uses a transparent and reliable placebo-based inference procedure. This procedure involves constructing a synthetic control for each province under a placebo treatment scenario and obtaining a distribution of placebo treatment effects. The p-value is calculated as the proportion of placebos that have a ratio of post-treatment RMSPE (the gap between the observed and predicted outcomes) over pre-treatment RMSPE (which here also stands for the quality of the pre-treatment match) at least as large as the average ratio for the treated units. This method is well suited for the case of a single treated and a few control groups, as instead of dealing with potentially correlated individual observations it uses aggregated data and placebo-based simulation inference. This simplicity, however, comes at the cost of losing all individual variation and relying on aggregate province-level statistics.

3.4 Data

To analyze the effects of drug and dental insurance for children on household out-of-pocket expenditure risk, I use the SHS public-use microdata files by Statistics Canada. The SHS is a national cross-sectional survey collecting detailed information on household expenditures. It also contains information on income and its sources, geographic identifiers, and provides detailed demographic characteristics of households. The SHS is the only nationally representative source of data on household health spending by type, including prescription drugs and dental care. Since the policy change occurred in 1998, I combine the annual 1997-2001 cycles of the SHS survey with the two last cycles, 1992 and 1996, of its predecessor, the Family Expenditures

Survey (FAMEX).[7] The major spending categories and demographic information are preserved in FAMEX.

In the analysis, I focus on respondents with children under the age of 18, living in one of the 8 provinces, who are under 65 years old, and do not receive welfare. This is to ensure that other public drug programs, such as those for senior citizens and welfare recipients, do not interfere with the analysis. Considering that the SFHB income eligibility was $25,921 for most of the study period, I focus my analysis on those below the $26,000 income threshold.[8] There are 2,774 observations in the resulting sub-sample of families with incomes below $26,000. I use survey weights provided by Statistics Canada.

The variables of interest are prescription drug and dental spending. The descriptive statistics by treatment province before and after the SFHB program are presented in Table 3.1. All dollar values are converted to constant 2000 dollars using provincial CPI. Overall, households in Saskatchewan and the rest of Canada have comparable spending levels for drug and dental services, and similar demographic characteristics. However, for the sub-sample with incomes below $26,000, Saskatchewan families have more children, lower educational attainment, and lower incomes.

A limitation of these data is that it is not known what part of total drug and dental expenditures goes to children's services. In addition, the SFHB program covered the costs of drugs for eligible parents but it required them to pay a $200 deductible and a 35 percent co-insurance. Therefore, part of the overall effect on drug spending could result from the coverage of parents' costs. This, however, would only be true for parents spending above the annual $200 deductible.

[7]Earlier cycles of public-use FAMEX group provinces into regions where Saskatchewan is combined with Manitoba; therefore they cannot be used in this study.

[8]It should be noted that some respondents may have had received welfare and had access to public drug benefits through welfare previously. Moreover, welfare receipt could be correlated with the availability of public drug insurance outside of welfare, and the reform may have affected the decision to work, but this is out of the scope of the current study.

Table 3.1: Descriptive statistics

	SK Pre	SK Post	Rest of Canada Pre	Rest of Canada Post
Below $26,000				
Prescription drugs ($)	147	134	144	150
Dental care ($)	155	95	128	125
Prescription drugs, 80th pctl ($)	214	200	209	200
Dental care, 80th pctl ($)	188	98	161	150
Prescription drugs, 90th pctl ($)	321	350	342	349
Dental care, 90th pctl ($)	370	300	340	388
Number of children	1.83	1.78	1.57	1.56
Single-parent household	0.41	0.44	0.42	0.47
High school or less	0.53	.	0.64	.
Income <$26,000	1.00	1.00	1.00	1.00
Average income ($)	18,685	18,408	19,328	18,984
N	114	197	1,086	1,377
All income				
Prescription drugs ($)	208	194	144	173
Dental care ($)	253	231	271	294
Prescription drugs, 80th pctl ($)	317	291	211	227
Dental care, 80th pctl ($)	317	308	357	395
Prescription drugs, 90th pctl ($)	536	486	354	413
Dental care, 90th pctl ($)	750	650	741	814
Number of children	1.85	1.93	1.76	1.75
Single-parent household	0.12	0.15	0.11	0.13
High school or less	0.44	.	0.44	.
Income <$26,000	0.13	0.15	0.14	0.14
Average income ($)	47,647	48,191	50,399	52,174
N	878	1,285	5,933	7,768

Notes: This table reports selected statistics for the whole sample and the sub-sample of families with incomes below $26,000 in Saskatchewan and the rest of Canada, before 1998 (1992, 1996, 1997) and after (1999, 2000, 2001). The sample includes families with children, not on welfare, where adults are less than 65 years old. All spending is adjusted for inflation using 2000 prices. Education is not available after 1998.

3.5 Results

3.5.1 Effects on average drug and dental spending using difference-in-differences

First, I present the results of estimating the difference-in-differences model using Equation (3.1). I estimate it for families with incomes below $26,000, the treated group, and those in the adjacent income ranges: $26,000-$35,000 and $30,000-$40,000. Table 3.2 reports the estimate on the interaction between Saskatchewan and the years 1999 and after.

Table 3.2: Effects of the SFHB reform on drug and dental out-of-pocket spending, by income sub-sample, difference-in-differences

	below $26,000		$26,000-35,000		$30,000-40,000	
	DRUG	DENT	DRUG	DENT	DRUG	DENT
$Sask \times Post$	-34.95*	-70.36***	1.253	0.998	4.823	-47.17
	(10.45)	(11.90)	(11.62)	(25.14)	(17.03)	(20.69)
CRVE p-value	0.012	0.001	0.917	0.969	0.785	0.057
p-val WCB (prov)	0.028	0.004	0.917	0.984	0.808	0.000
p-val restr WCB (prov)	0.414	0.654	0.919	0.986	0.810	0.456
p-val WCB (prov year)	.	0.268	0.975	0.988	0.878	0.583
p-val restr WCB (prov year)	.	0.286	0.974	0.990	0.880	0.587
N	2,774	2,774	2,896	2,896	3,528	3,528
SK N	311	311	325	325	387	387
SK mean, pre-reform	146.7	154.7	165.2	225.4	178.5	246.8

Notes: This table reports the coefficient on the interaction of the treatment province and the post-reform years. Controls include year and province FE, family income, age, gender, female respondent and family type. The estimation sample includes families with children, not on welfare, where adults are less than 65 years old. All spending is adjusted for inflation using 2000 prices. Alberta and Quebec are excluded because they implemented public drug programs covering children in low-income families during the same period. CRVE p-values are calculated using standard errors clustered by provinces. Additionally, I report the WCB p-values from restricted and unrestricted tests clustered at the province and province-year levels.

Table 3.2 suggests that the effect of the reform on dental spending is twice as large as the corresponding effect on drug spending, and highly significant using cluster-robust standard errors (and the corresponding CRVE p-values), whereas for drug spending it is only marginally significant. The estimated coefficients suggest a reduction in dental spending by almost half (45 percent) of the pre-reform level, but only a 25 percent reduction in drug spending in Saskatchewan after the reform.

A larger reduction in dental expenditures could be an indication of a larger risk of high dental spending as opposed to spending on prescription drugs among children. However, the effect on children's prescription drug spending is muted since parents obtained partial coverage (with deductibles and co-insurance) for prescription drugs but not for dental care. Therefore, the smaller and marginally significant decrease in prescription drug spending relative to dental spending could also be due to increased expenditures on prescription drugs by parents.

For the adjacent-income (i.e., untreated) families, there is no effect of the SFHB program on drug or dental spending, which speaks in favour of my identification strategy. I also note that the estimated effect on drug spending of the SFHB program is similar to the average effect that I estimate for the Quebec drug reform, although the latter was concentrated among middle-income families and not low-income families.

As has been discussed in the empirical strategy section, both the CRVE and WCB-based t-tests may be very misleading in the case of a few clusters and one treated cluster. I follow the literature, in particular MacKinnon and Webb (2018), and calculate several alternative versions of the WCB, restricted and unrestricted, clustered at the province and province-year levels. I find a very large discrepancy in the p-values between the restricted and unrestricted versions of the test clustered at the province level. This is consistent with the theoretical prediction regarding the performance of the WCB test with one treated cluster (MacKinnon & Webb, 2018). The subcluster wild bootstrap (i.e., bootstrap clustered at the province-year level) provides more consistent p-values. These p-values suggest that I cannot reject the null for dental spending; however, they could not be calculated for drug spending.

According to MacKinnon and Webb (2018), having two treated clusters instead of

only one should improve the performance of the subcluster bootstrap test. While I do not have access to a comparable public drug program, I identify another public dental program that took place in BC in 1996. Hence, I re-estimate the model for dental care by including BC as the second treated cluster.[9] Eligibility was linked to receiving a subsidy for paying the BC Medical Services Plan premiums, without explicitly stating the cutoffs. Most publications cite the $20,000 income cutoff, and so I limit the estimation sample to families with incomes below $20,000.[10] The results are reported in Table 3.3. For the below $20,000 sub-sample, the coefficient for the Saskatchewan program (column 1) becomes twice as large, $137.7, compared to the below $26,000 sample in Table 3.2, but the combined effect of the two programs (column 2) is half this size, and the cluster-robust standard errors get larger. Conversely, with one treated cluster (column 1), the WCB restricted and unrestricted p-values are inconclusive, whereas the subcluster p-values are consistent and cannot reject the null. With two treated clusters (column 2), the WCB p-values for the same cluster level are much more consistent, as they are lower, compared to column 1. WCB p-values cannot reject the null, and the subcluster p-values are on the margin of being statistically significant at 10 percent. Thus, adding BC as the second treated cluster improves the consistency of the WCB testing procedure, but results in a more muted estimate of the effect of public dental insurance for children.

[9]It should be noted that the BC program reportedly had low uptake during the period I study (Quiñonez et al., 2005), possibly due to less publicity and less clear eligibility than the SFHB program.

[10]However, the web archive of the BC Health https://web.archive.org/web/19990427174043/http://www.health.gov.bc.ca/msp/infoben/premium.htm indicates that there were child and spouse deductions of $3000 per eligible spouse and/or child in the formula for calculating the adjusted income for premium subsidies, which suggests households with incomes up to $26,000 could be eligible. These details, however, could be less publicized.

Table 3.3: Effects of the SFHB and the BC Healthy Kids program on dental out-of-pocket spending, below $20,000 sub-sample

	SK	SK and BC
$Tr\_Prov \times Post$	-137.7**	-65.67
	(25.66)	(38.60)
CRVE p-value	0.002	0.133
p-val WCB (prov)	0.001	0.229
p-val restr WCB (prov)	0.847	0.179
p-val WCB (prov year)	0.265	0.091
p-val restr WCB (prov year)	0.225	0.107
N	1,238	1,404
SK N	169	169
SK mean, pre-reform	194.4	194.4

Notes: This table reports the coefficient on the interaction of the treatment province (Saskatchewan or BC) and the post-reform years from a difference-in-differences model. Controls include year and province FE, family income, age, gender, female respondent and family type. The estimation sample includes families with children, not on welfare, and where adults are less than 65 years old. All spending is adjusted for inflation using 2000 prices. Alberta and Quebec are excluded since they implemented public drug programs covering children in low-income families during the same period. CRVE p-values are calculated using standard errors clustered by provinces. Additionally, I report the WCB p-values from restricted and unrestricted tests clustered at the province and province-year levels.

All the reported results so far have relied on the difference-in-differences common trends assumption. As a robustness check, I run the difference-in-differences regressions including province-specific time trends (Appendix C, Table C1). They suggest that the estimates in Table 3.2 are not robust to the inclusion of province-specific time trends and there are possibly positive trends in the control provinces. This result casts doubt on the common trends assumption in the analysis. Since the

Saskatchewan program was targeted at low-income households, as a next step, I use this feature and estimate a triple difference model from Equation (3.2). Specifically, I add a low-income dimension and compare the outcomes between two income groups: the below $26,000 group (i.e., eligible) and those above $26,000 but below $40,000 (adjacent income but ineligible). Table 3.4 reports the results of estimating several specifications based on Equation (3.2). The coefficient of interest is the coefficient on the three-way interaction term $Sask \times Post \times Low$, which captures the differential change in spending for households in Saskatchewan with incomes within the range of eligibility for the FHB program after it was implemented.[11]

Column 1 estimates Equation (3.2) by including only the three-way interaction term, without the two-way interactions between Saskatchewan, years after 1998, and eligibility status. The estimated coefficient is similar between drug and dental spending, suggesting a reduction of $54 and $57 respectively for the affected families in Saskatchewan compared to higher-income families and families in other provinces. This effect becomes weaker for dental spending when I include the $Sask \times Post$ term: it reduces to $19 and becomes insignificant. The effect on drug spending is more robust to adding all two-way interactions, and suggests a reduction of about $41, although it is significant only at 10 percent. As before, inference using conventional cluster robust standard errors with few clusters and a single treated cluster could be seriously misleading, as would WCB inference. I do not pursue the approach of adding the BC Healthy Kids program into the full triple difference setup due to the difference in the low-income cutoffs for the two programs. However, I report the results of estimating a model similar to Model 1 in Table 3.4, i.e., excluding the two-way interaction terms, for the 2 programs combined, in the Appendix (Appendix C, Table C2). The resulting WCB and subcluster bootstrap p-values are generally consistent but do not reject the null, being well above 10 percent.

[11]The eligibility cut-off was set at $25,921 for the majority of the study period, but I also account for minor revisions in 2001.

Table 3.4: Effects of the SFHB program on drug and dental out-of-pocket spending using triple difference, below $40,000 sub-sample

	model 1		model 2		model 3	
	DRUG	DENT	DRUG	DENT	DRUG	DENT
$Sask \times Post \times Low$	-53.76**	-56.67***	-67.95***	-36.19**	-40.74*	-18.83
	(11.18)	(4.715)	(8.840)	(9.832)	(16.35)	(12.93)
$Sask \times Post$			17.67	-20.06	7.750	-26.80
			(7.738)	(21.47)	(15.89)	(21.25)
Low			20.38	-49.05	38.72	-30.97
			(11.50)	(30.22)	(22.32)	(27.22)
$Low \times Sask$					-10.01	1.225
					(13.73)	(4.796)
$Low \times Post$					-38.09	-38.63
					(25.46)	(16.76)
N	7,475	7,475	7,475	7,475	7,475	7,475
SK N	845	845	845	845	845	845
SK mean, pre-reform	165.6	201.8	165.6	201.8	165.6	201.8

Notes: This table reports the three-way interaction between the treatment province, the post-reform years and the eligibility status due to low income, which is the coefficient of interest, and the two-way interaction terms that were included in the estimated model. Model 1 only includes the three-way interaction term but no other additional terms. Model 2 includes the $Prov \times Post$ term and the low income dummy, but not any other interaction terms. Model 3 includes the low income dummy and all the two-way interactions between low income, Saskatchewan and years after 1998. CRVE p-values are calculated using standard errors clustered by provinces. Other controls include low income status, year and province FE, family income, age, gender, female respondent and family type. The estimation sample includes families with children, not on welfare, and where adults are less than 65 years old. All spending is adjusted for inflation using 2000 prices. Alberta and Quebec are excluded since they implemented public drug programs covering children in low-income families during the same period.

Finally, I estimate the effect of the Saskatchewan program on prescription drug and dental spending using the synthetic contort method. I do this for families in the affected income range - below $26,000, but also for families in the adjacent income range - between $26,000 and $40,000. I add an income dimension to mimic my triple difference regression analysis. The synthetic control analysis would confirm that the change in spending is due to the SFHB program if the effect is observed in the low-income group but not in the higher-income group.

Since the main output of the procedure is the synthetic control group, it is natural to present the results graphically. Figure 3.1 shows the trends in spending for Saskatchewan and the synthetic control group, for the affected (below $26,000, column 1) and the unaffected ($26,000-40,000 incomes, column 2) income groups. There is a clear divergence in prescription drug spending for the affected group (Panel A), suggesting a reduction in spending among low-income families in Saskatchewan after the SFHB program (Panel B). For dental spending, the trend shows substantial fluctuations, especially for the low-income group. However, there is some evidence of a sustained reduction in spending in Saskatchewan relative to its synthetic control for the low-income group (Panel C), although the lines cross after the reform. The untreated group does not show any divergence in trends (Panel D).

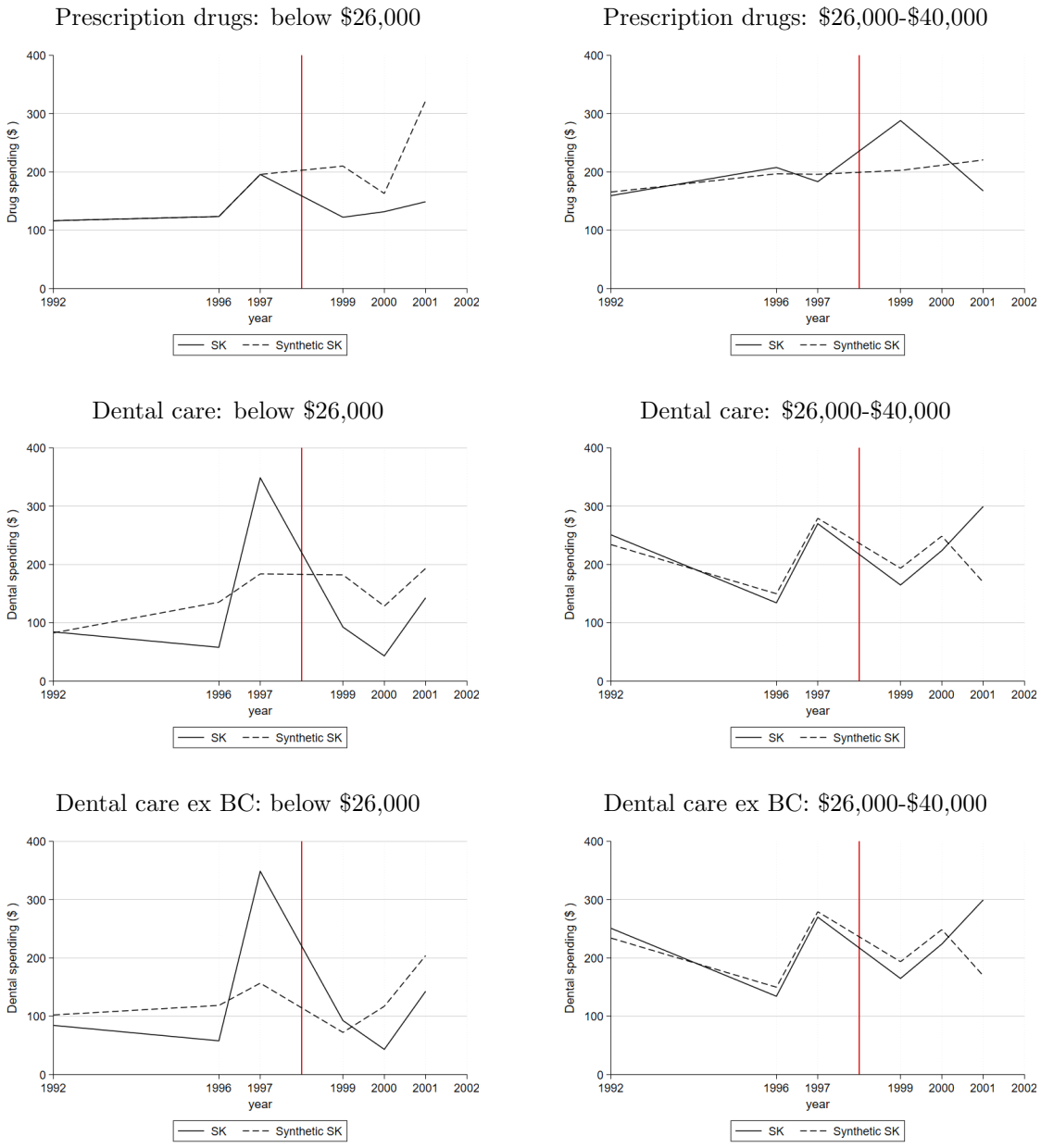
Overall, while spending levels on prescription drugs and dental care are similar, dental spending exhibits larger variation, particularly among low-income families, and therefore likely presents a greater financial risk compared to prescription drugs. For both types of spending, there is a clear gap in the after-reform period in Saskatchewan, but dental spending has a poor pre-reform match. Table 3.5 presents the estimates numerically: the estimated effect on prescription drug spending is $97, and for dental spending, it is $75. The synthetic control estimate of the reduction in drug spending is much larger than the regression estimate, suggesting a 66 percent reduction in mean drug spending in Saskatchewan. The synthetic control estimate of the reduction in dental spending is comparable to the regression estimates, but not significant. The p-value for the joint effect across all periods after the reform for drug spending is 0, while the corresponding p-value for dental spending is 0.86. The p-values suggest

that under the placebo treatment scenario, 6 out of 7 control provinces had an estimated effect on dental spending at least as large as that for Saskatchewan, while 0 out of 7 control provinces had an effect as large as that for Saskatchewan - for drug spending.[12] Additionally, I investigate whether the results are sensitive to the BC's Healthy Kids program (1996) by estimating the synthetic control excluding BC. The resulting synthetic control has lower spending, in particular in the after-reform years, which further reduces the estimated effect of the Saskatchewan program.[13] In either case, the pre-reform match is poor and the estimated p-values for dental spending are too large rendering the effects not statistically significant.

[12]The p-values for the joint effect across all periods after the reform are calculated as the proportion of placebos that have a ratio of post-treatment RMSPE over pre-treatment RMSPE at least as large as that for the treated unit. In other words, it is the proportion of placebos that have the average after-reform gap adjusted for the pre-reform match by dividing it by the average pre-reform gap, as large as that for Saskatchewan.

[13]The results of estimating the effect of BC's Healthy Kids are summarized in the Appendix (Figures C.1 and C.2). These robustness analyses reveal no meaningful effect for the below $26,000 group.

Figure 3.1: Synthetic control results for average drug and dental spending, below $26,000 vs $26,000-$40,000 sub-samples



Notes: Graphs show mean spending in Saskatchewan (solid line) vs. its synthetic control (dashed line). The vertical line indicates the end of the pre-treatment period.

Table 3.5: Synthetic control results, below $26,000 subsample

	DRUG	DENTAL	DENTAL, ex BC
Synthetic control estimates by year			
1999	-87.67	-89.58	20.30
p-value	0.000	0.857	1.000
2000	-31.24	-85.40	-73.89
p-value	0.000	0.714	0.857
2001	-173.59	-50.42	-61.22
p-value	0.000	0.714	0.857
Synthetic control estimate of ATT			
ATT	-97.50	-75.13	-38.27
p-value	0.000	0.857	1.000
Synthetic control weights			
NL	0.17	0.00	0.00
PE	0.26	0.00	0.00
NS	0.05	0.00	0.00
NB	0.29	0.00	0.39
QC	.	.	0.00
ON	0.07	0.00	0.59
MB	0.09	0.09	0.02
BC	0.08	0.91	.

Notes: Synthetic control estimates and p-values by year are obtained by running Stata synth package. The average effect (ATT) is obtained by averaging the result by year. The ATT p-value is based on placebo simulations and represents the proportion of placebos that have a ratio of post-treatment RMSPE over pre-treatment RMSPE at least as large as the average ratio for the treated unit.

3.5.2 Distributional effects of the Saskatchewan reform

Since it is the high spending that constitutes a financial risk to families, I investigate the effect of covering children's prescription drugs and dental spending at the upper end of spending distribution for these items. To start, I present the distribution of spending on these items during the period studied, by income group, in Figure 3.2.

The distribution of spending on prescription drugs and dental care for the lowest-income group reveals two salient features. First, this group has lower spending throughout the distribution for both types of health spending compared to the higher income group. More interestingly, there is a larger probability of positive spending on prescription drugs versus dental care in the middle of the distribution, but prescription drug and dental spending levels converge above the 80^{th} percentile. For higher income groups, dental spending dominates prescription drug spending at upper percentiles. This latter fact is likely due to the design of private insurance plans, which have more comprehensive coverage for prescription drugs than for dental care, and to which few low-income families have access.

To estimate the effect of the reform at the 80^{th} and 90^{th} percentiles using the synthetic control method, I calculate these percentiles for drug and dental spending for each income group in each province and year and run the synthetic control procedure on these data. The graphical results are presented in Figures 3.2 and 3.3. For the 80^{th} percentile, Figure 3.2 shows that a good pre-reform match could not be achieved for either variable in either income group. There is hardly any effect on drug spending after the reform for either income group. Conversely, there appears an increasing gap in dental spending after the reform for the low income group, but not for the higher income. When BC is excluded from the analysis, these results remain unchanged. As Table 3.6 shows, the estimated average gap for drug spending is \$11.7, while it is \$129.5 for dental spending. The p-value for the average effect on drug spending is 0.857, suggesting that the majority of control provinces had a gap at least as large in the after-reform period; for the effect on dental spending, the p-value is 0.429, meaning that 3 out of 7 control groups had a gap at least as large after the reform, rendering the estimate not significant by conventional levels.

Figure 3.3 reports the synthetic control results for the 90^{th} percentile. There is a more pronounced effect on drug spending, as well as a large effect on dental spending. The latter effect, however, is imprecise due to the poor pre-reform match. In addition, excluding BC (panel E) virtually cancels the effect on dental spending. But since I do not find any effect of the BC public dental program for families with incomes below $26,000 (Appendix, Table C.2), and since the synthetic control including BC has a better pre-reform match, my preferred synthetic control is the one including BC. The estimated average effects using this synthetic control are $186 - for drug spending, and $181 - for dental spending. The p-values are some of the lowest among my results too: 0 - for drug spending and 0.286 - for dental spending. Relative to the average pre-reform spending in Saskatchewan, the spending is reduced by 58 percent and 49 percent for drug and dental care respectively.

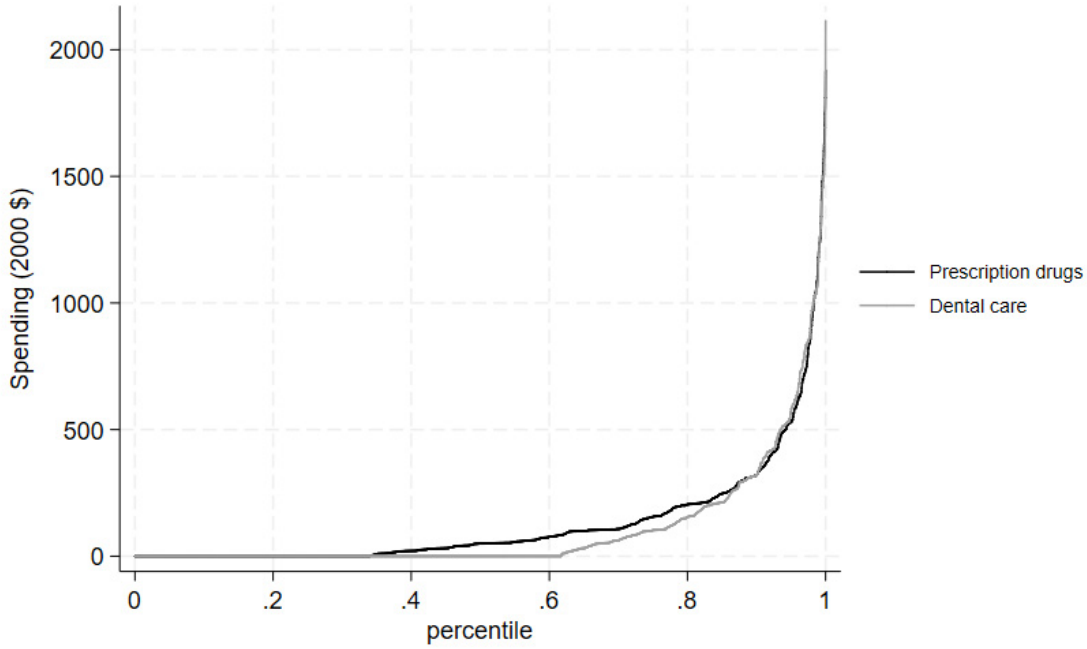
Finally, Figure 3.4 reports estimated effects for all upper percentiles of drug and dental spending. Together, these results provide evidence of a clear reduction in drug spending and of a less precise but consistent reduction in dental spending for low-income families after the Saskatchewan program. For drug spending, the estimated average effects (ranging from $41 or 30 percent using triple difference to $97 or 66 percent using synthetic control) appear to be primarily driven by the effects at the top: large and significant effects only emerge at the 90^{th} percentile and above. The estimated average effects on dental spending are also large: between $57 or 37 percent using difference-in-difference and $75 or 48 percent using synthetic control. However, the pattern of the estimated coefficients at top percentiles is different (Figure 3.4): the reductions in dental spending are consistently larger between the 80^{th} and 90^{th} percentiles, the effects in the range between 90^{th} and 95^{th} percentiles coincide, and the effects for the 95^{th} percentile and above are much larger for drug spending. Considering that the drug and dental spending distributions for the low-income families almost coincide above the 80^{th} percentile, a larger reduction in drug spending suggests the program was more effective in lowering the high costs of drugs rather than dental costs. The likely reason is that while the program only covered children's dental care, it covered both children's and parents' drug costs, but parents faced $200 annual deductible (and 35 percent co-insurance), which is near the pre-reform 80^{th} percentile ($214). Therefore, the estimates reflect the effect of covering children's costs on all

spending budgets for dental care, but only for total spending below $200 - for drug costs; above that - it is the combined effect of covering children's and parents' drug costs.

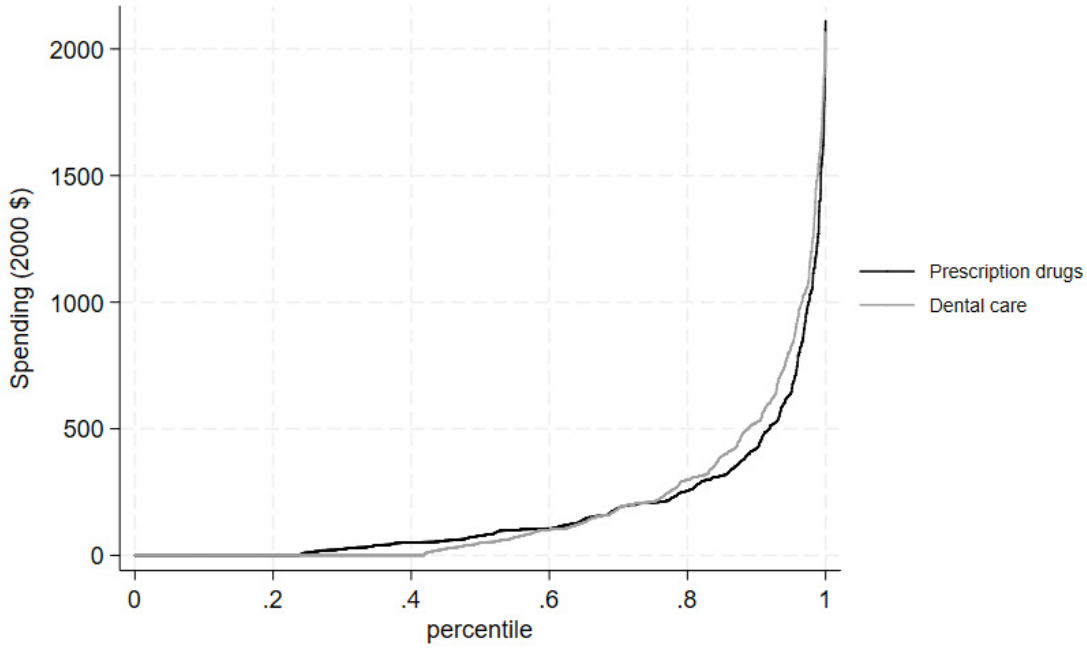
To summarize, the results suggest that covering children's drug and dental costs reduced total family spending on these items by 30-60 percent. In addition, the larger estimated effects for dental costs at the top percentiles indicate that the share of children's costs is larger for total dental budgets relative to drug budgets. And therefore, covering children's dental care could reduce the financial burden of these out-of-pocket costs to a greater degree than does covering children's drug costs. On the other hand, to help families reduce the risk of very high spending, which, for the period studied, could reach $1,000 for the top five percent of spenders, providing insurance to parents is necessary, as suggested by the results for drug spending.

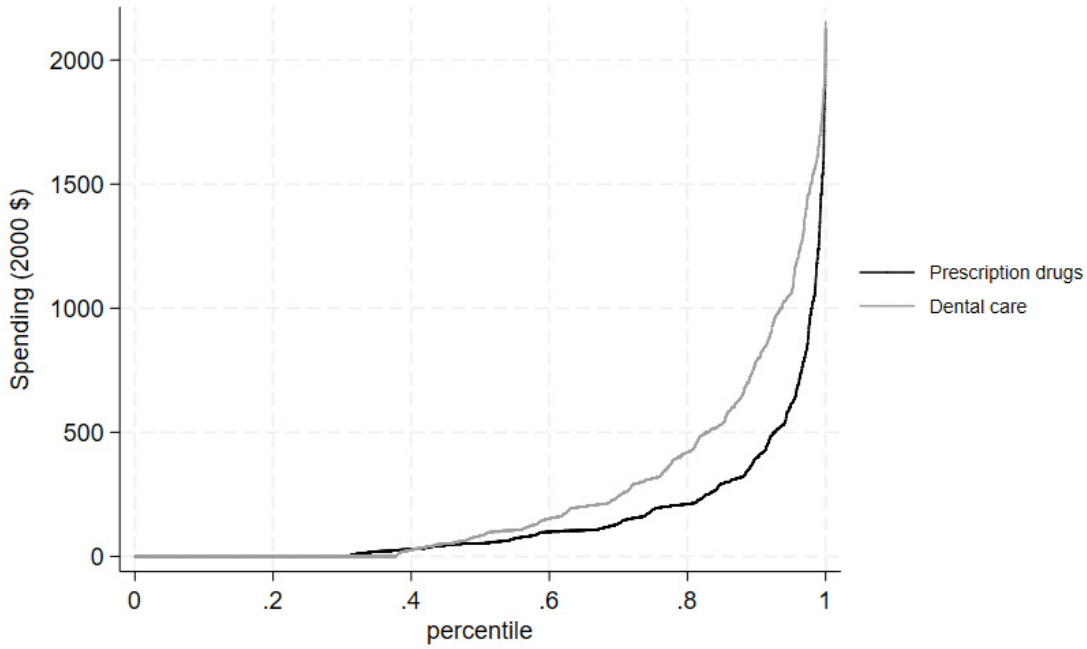
Figure 3.2: Spending distribution by sub-sample

Panel A: below $26,000



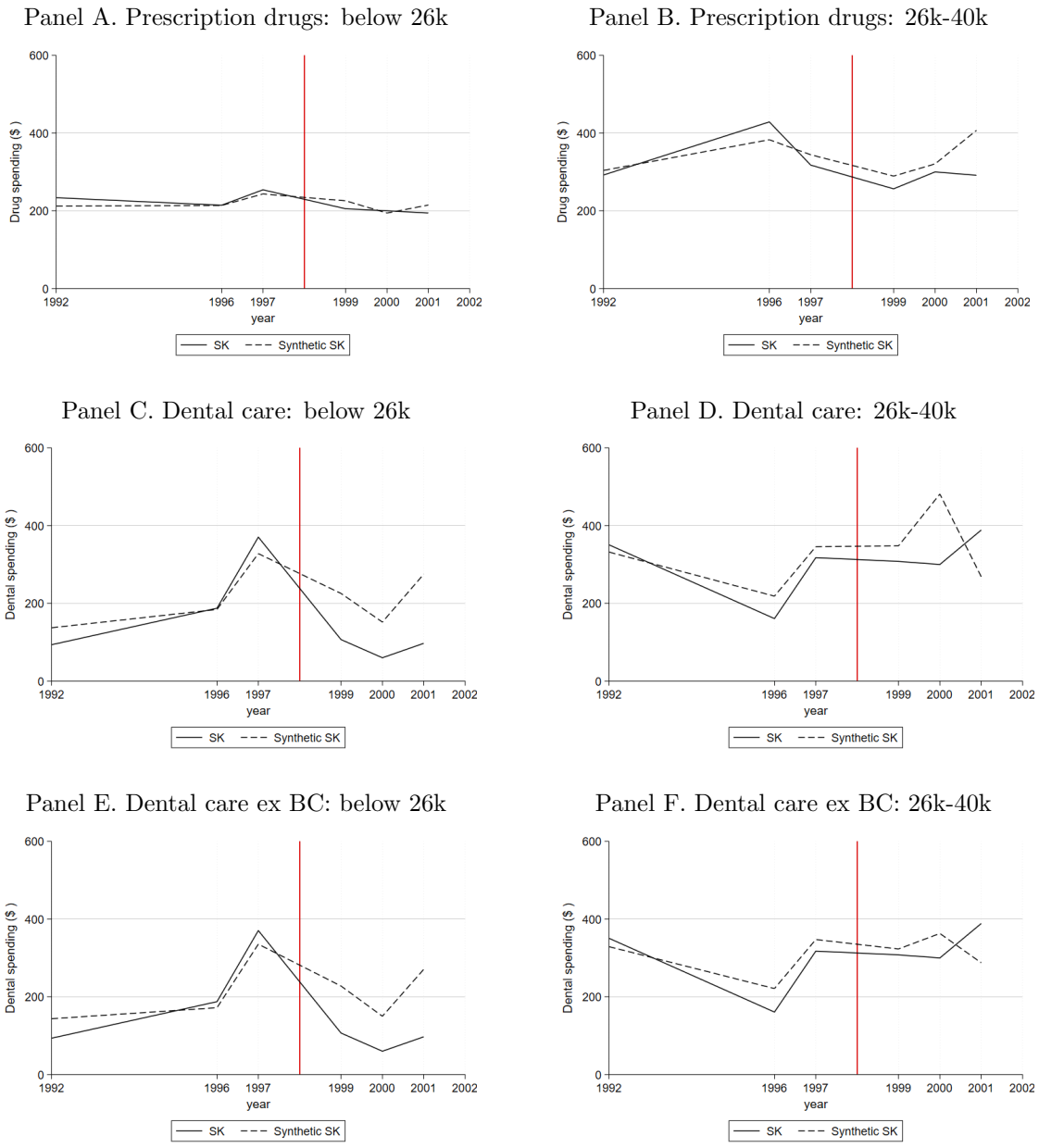
Panel B: $30,000-$40,000





Panel C: $50,000 and above

Figure 3.2: Synthetic control results for the 80^{th} percentiles of drug and dental spending, below $26,000 vs $26,000-40,000 sub-samples



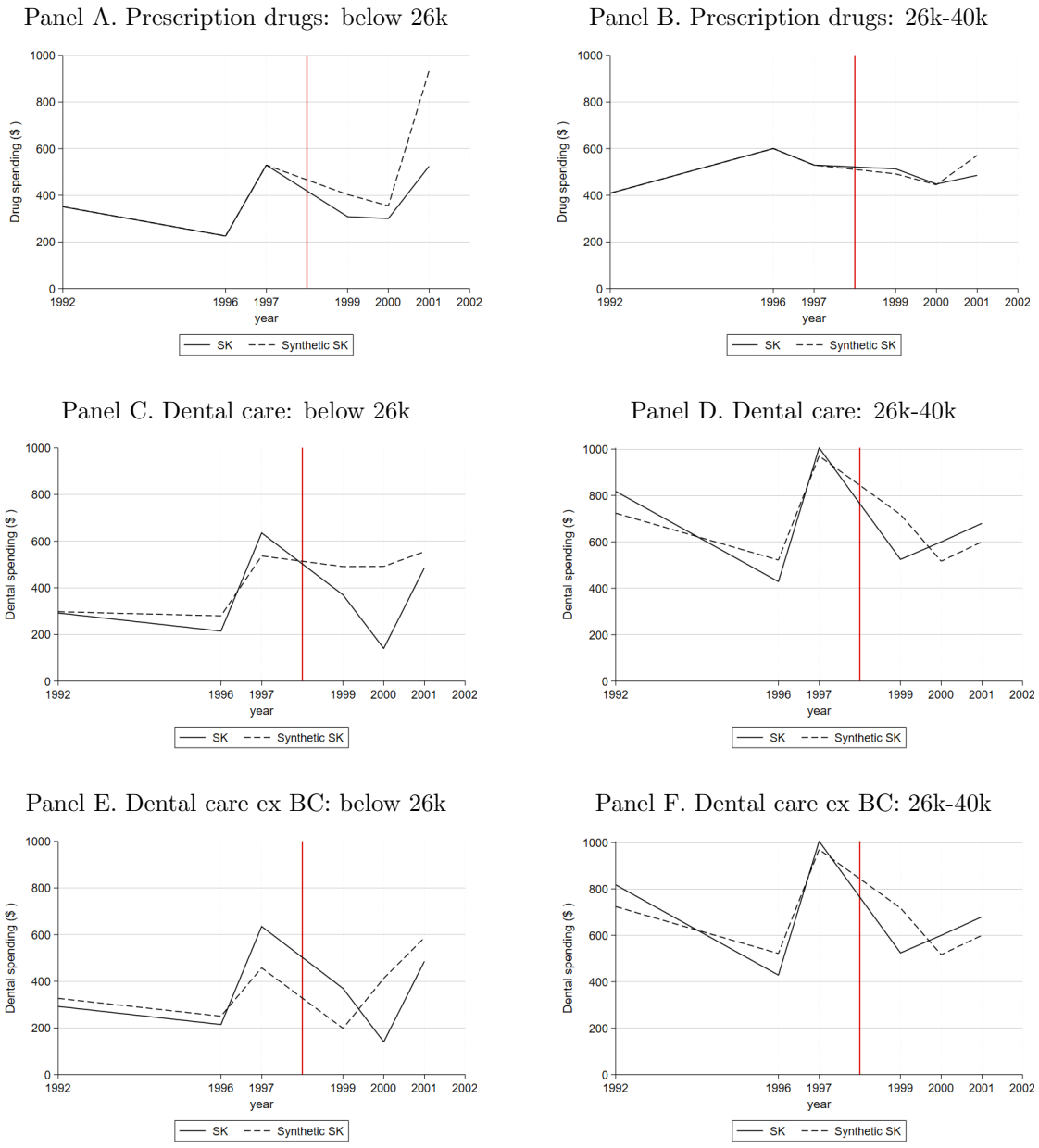
Notes: Graphs show the 80^{th} percentile of spending in Saskatchewan (solid line) vs. its synthetic control (dashed line). The vertical lines indicate the end of the pre-treatment period.

Table 3.6: Synthetic control results for the 80^{th} percentiles of drug and dental spending, below $26,000 sub-sample

	DRUG	DENTAL	DENTAL, ex BC
Synthetic control estimates by year			
1999	-20.41	-118.71	-120.96
p-value	0.857	0.286	0.429
2000	5.84	-91.82	-90.00
p-value	0.857	0.286	0.286
2001	-20.59	-177.97	-173.62
p-value	0.714	0.286	0.286
Synthetic control estimate of ATT			
ATT	-11.72	-129.50	-128.19
p-value	0.857	0.429	0.429
Synthetic control weights			
NL	0.10	0.00	0.00
PE	0.00	0.37	0.41
NS	0.58	0.00	0.00
NB	0.32	0.00	0.00
QC	.	.	0.00
ON	0.00	0.00	0.00
MB	0.00	0.55	0.59
BC	0.00	0.07	.

Notes: synthetic control estimates and p-values by year are obtained by running Stata synth package. The average effect (ATT) is obtained by averaging the result by year. The ATT p-value is based on placebo simulations and represents the proportion of placebos that have a ratio of post-treatment RMSPE over pre-treatment RMSPE at least as large as the average ratio for the treated units.

Figure 3.3: Synthetic control results for the 90^{th} percentiles of drug and dental spending, below $26,000 vs $26,000-40,000 sub-samples



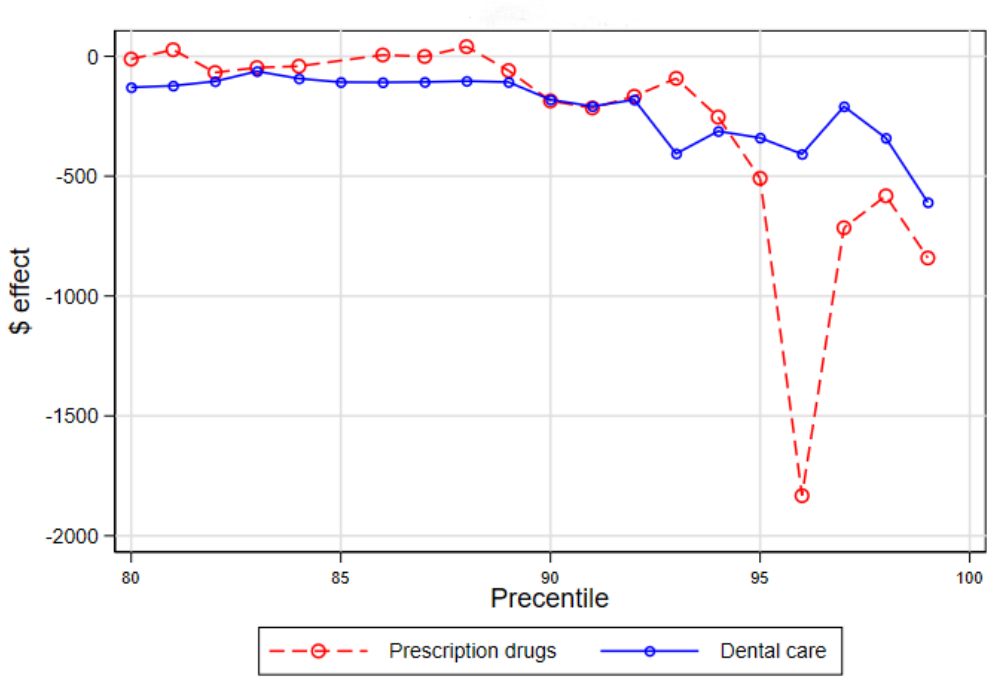
Notes: Graphs show the 90^{th} percentile of spending in Saskatchewan (solid line) vs. its synthetic control (dashed line). The vertical lines indicate the end of the pre-treatment period.

Table 3.7: Synthetic control results for the 90^{th} percentiles of drug and dental spending, below $26,000 sub-sample

	DRUG	DENTAL	DENTAL, ex BC
Synthetic control estimates by year			
1999	-94.90	-121.67	171.25
p-value	0.000	0.714	0.571
2000	-54.70	-351.90	-272.48
p-value	0.000	0.143	0.571
2001	-408.84	-68.99	-101.08
p-value	0.000	0.714	0.857
Synthetic control estimate of ATT			
ATT	-186.15	-180.85	-67.44
p-value	0.000	0.286	0.571
Synthetic control weights			
NL	0.08	0.00	0.00
PE	0.26	0.00	0.00
NS	0.05	0.00	0.00
NB	0.17	0.41	0.70
QC	.	.	0.00
ON	0.06	0.00	0.24
MB	0.04	0.10	0.05
BC	0.34	0.49	.

Notes: Synthetic control estimates and p-values by year are obtained by running Stata synth package. The average effect (ATT) is obtained by averaging the result by year. The ATT p-value is based on placebo simulations and represents the proportion of placebos that have a ratio of post-treatment RMSPE over pre-treatment RMSPE at least as large as the average ratio for the treated units.

Figure 3.4: Effects of the SFHB program at top percentiles of drug and dental spending, below $26,000 sub-sample



Notes: Graph shows the effects estimated separately for each percentile of spending using synthetic control

3.6 Conclusion

This chapter has examined the degree to which covering children's drug and dental costs reduces the burden of out-of-pocket spending for low income families. The analyses make use of the new program introduced in 1998 in the province of Saskatchewan as part of the NCB initiatives and that uniquely provided both drug and dental insurance for children in low income families. Using several empirical strategies, I find that the reform significantly reduced both types of spending, by at least 30 percent on average, compared to pre-reform mean out-of-pocket spending in Saskatchewan. Additionally, the reductions in dental costs were consistently larger than those for drug spending, up to the top deciles of the spending distributions. This suggests that children's dental spending represents a larger risk than prescription drug spending. This is likely due to the lower likelihood of having any type of dental insurance compared to drug insurance that covered children's services before the reform. However, for the top 5 percentile, I find that there were larger reductions in drug costs, for which parents got coverage, compared to dental costs, for which parents did not gain coverage, suggesting that to achieve a meaningful reduction in the risk of very high spending, both children's and parents' costs need to be covered, as was the case for drug costs under the SFHB program.

This study provides several important insights. First, it explores the effects of insurance specifically for children, a topic that has not received much attention in the Canadian literature. In the context of limited data regarding the distribution of health costs within a family, the study sheds light on children's share in total drug and dental costs, and the potential risk reduction from covering these costs, among low-income families in Canada. Secondly, using a quasi-natural experiment framework, it provides reliable estimates of the effect of insuring children's drug and dental services. This is especially relevant for dental spending, which received little attention in the economics literature. Finally, it combines the more commonly used difference-in-differences method with the synthetic control method. The synthetic control approach is particularly well suited for the case of a single treated and few control provinces, where the difference-in-differences parallel trends assumption and the traditional cluster-robust inference method may not be valid.

While multiple studies conclude that copayment-free insurance for children in low-income families is crucial for adequate access to necessary health care, this chapter provides evidence of its role in reducing risks of high out-of-pocket spending for their families. The new Canadian Dental Care Plan program introduced in 2023 is very promising in this regard, as by extending free coverage to both children and adults, the program intends to not only improve access to dental services but essentially eliminate the risk of any out-of-pocket spending on dental care. It remains to be seen whether the highly anticipated universal pharmacare plan will retain the same features.

Chapter 4

Effects of the Quebec drug insurance reform on medication use and health of children and mental health of their parents

4.1 Introduction

Providing comprehensive drug insurance for children is crucial to ensuring that children get adequate access to necessary medicines. In Canada, where physician and hospital services have long been universally covered, there has not been universal insurance for prescription drugs. Its introduction is highly anticipated, as it is believed to remove the financial burden for families and improve access to necessary medicines for children of all incomes. However, there is surprisingly little research in Canada on the effects of drug insurance on children's overall health and the well-being of their families.

The existing evidence suggests that children who are not fully insured receive fewer prescriptions (Kozyrskyj et al., 2001), and face a higher risk of disease exacerbations and avoidable hospitalizations (Ungar et al., 2011). These effects, however, could be smaller for children than for adults, if parents prioritize their children's health.[1] On the other hand, having to pay the full price for expensive necessary medications may result in financial stress (Galbraith et al., 2023; Ungar et al., 2005). For families with children suffering from chronic conditions, the potential non-adherence and financial stress may have detrimental effects on physical and mental health of both children and their parents. In this context, comprehensive drug insurance may have broader effects beyond increased medication utilization. Indeed, recent studies on health insurance

[1]The evidence on children's health care elasticities, however, is more limited than for adults, and less conclusive. While the results of the famous RAND Health Insurance Experiment (Manning et al., 1987) conducted in the 1970s suggested similar elasticities for children's and adults' outpatient care, more recent studies, such as Ellis et al. (2017) and Han et al. (2020), report that spending on children is less elastic than spending on adults. Even less is known about children's pharmaceutical spending elasticity and its heterogeneity by income.

expansions for children in the US put in focus broader effects of insurance, such as the spill-over effects on parental labour (Kim & Koh, 2022; Kunze, 2022) and parental mental health (Grossman et al., 2022).

In this study, I examine whether providing comprehensive insurance for children's medications in the context of free physician and hospital care improves children's health and parental mental health. More specifically, using the 1994-2000 cycles of the National Longitudinal Survey of Children and Youth (NLSCY), I examine the effect of the Quebec universal drug reform introduced in 1997 on medication use and the health of children diagnosed with asthma, as well as the mental health of their parents. Asthma is the most common chronic condition among children requiring maintenance medications, and these medications are generally effective (Falk et al., 2016). Asthma medication costs are non-trivial: the annual costs of asthma medications can reach several thousands of dollars. There are few up-to-date estimates for Canada; however, based on 2010 Quebec administrative data, the total cost of asthma medications ranged from $1,839 to $4,132, depending on the severity of asthma (Ismaila et al., 2019). In addition, studies report a close connection between asthma management in children and parental mental health, with causality operating in both directions (Fletcher et al., 2010; Ungar et al., 2012).

Exploiting the fact that free access to medication must have a larger effect on families with children diagnosed with asthma who require maintenance medications compared to families with healthy children, I build the identification strategy based on the contrast between these two types of families and estimate a triple difference model. I complement this analysis, which utilizes a discrete policy change, with an approach using a continuous treatment measure that summarizes public drug plans' coverage of asthma medications. This latter approach allows incorporating changes in public drug programs in other provinces, thus increasing the number of treated provinces in the analysis.

The financial burden of asthma medications is highest for low-income families, who also face a high risk of not being fully insured for drug costs (Angus Reid Institute, 2020; Barnes & Anderson, 2015; Grootendorst, 2002). Hence, I focus the analysis on lower-income families, as they are most likely to be impacted by the Quebec universal

drug insurance reform.

There are several studies of the health effects of the Quebec reform, but no comprehensive study of children's outcomes. A major study of the effects of the Quebec reform by Wang et al. (2015) reports a marked increase in the probability of prescription drug use and physician visits, as well as health status improvements for the less healthy. This analysis, however, is limited to respondents 12 years and older and does not provide separate estimates by age group. Currie et al. (2014) study the effect of the Quebec reform on children through the lens of attention-deficit/hyperactivity disorder (ADHD) diagnosis. The authors report a disproportionate increase in the uptake of ADHD medications, but no noticeable effects on the uptake of other major medications, including asthma inhalants. Considering children's outcomes, the authors report that the increase in ADHD medication uptake did not result in an improvement in children's emotional or academic outcomes. Instead, they report an increased probability of grade repetition, lower math scores, and a deterioration in the relationship with parents (Currie et al., 2014). Neither of these studies investigates the heterogeneity of the effects across income groups.

I confirm a significant rise in ADHD medication use following the reform. Additionally, I observe increased use of other medications and asthma inhalants, particularly among children from families earning less than $40,000, where the effects are more pronounced. For families with incomes below $30,000, the results are less conclusive, due to smaller sample sizes and the likely presence of differential trends across provinces. Turning to health outcomes, I find an increase in the probability of a child reported to be in "excellent" health and "often in good health", and a decrease in the depression score[2] of the responding parent (most often the mother) among lower-income families. This result remains robust across the two specifications.

This paper complements previous literature in several ways. First, it provides new estimates of the direct effects of comprehensive drug insurance for children such as medication utilization and children's health outcomes, in the context of free access to physician and hospital care. Second, it explores the broader effects of children's

[2]The depression score is based on a scale administered by the survey which includes 12 questions about the presence and severity of depression symptoms.

drug insurance by studying the indirect effects on parental mental health among parents of children diagnosed with asthma. Unlike the more controversial case of ADHD medications, there is no ambiguity about the general effectiveness of asthma medications, and this study explores the direct and indirect benefits of improved access to effective treatment. Finally, this study emphasizes the heterogeneity of these effects by income, which has not been addressed in the literature studying the health effects of the Quebec universal drug insurance reform.

The paper proceeds as follows. Section 4.2 reviews the Quebec drug reform and several other public drug programs and lays down the empirical strategy. Section 4.3 gives details about the data source and provides the summary statistics. Section 4.4 presents the results and Section 4.5 concludes.

4.2 Empirical strategy

4.2.1 Effects on medication use

To study the effects of prescription drug insurance on children and their families, I explore the introduction of universal drug insurance in Quebec in 1997 as a quasi-natural experiment. The Quebec reform made it mandatory for all residents of Quebec to have drug insurance and it provided a public drug plan to those residents who did not have coverage through their employers. The public plan required income-indexed premiums, deductibles, and co-insurance; however, it was free for the children of premium-paying parents.

As a first step, I estimate the effect of the reform on medication utilization among children. This is done using the difference-in-differences model in Equation (4.1):

$$Y_{ipt} = \beta_1 Que_p \times Post_t + \beta_3 Year_t + \beta_6 ID_i + X'\Lambda + e_{ipt} \tag{4.1}$$

where the dependent variable, Y_{ipt}, indicates whether the child i in province p and year t takes a medication (any medication, inhalants or Ritalin) "on a regular basis". $Que_p \times Post_t$ is the interaction between Quebec and the years after 1997, and the coefficient β_1 captures the change in medication use associated with obtaining comprehensive public drug insurance after the reform in Quebec. ID_i and $Year_t$ are child

and year fixed effects, and X is a set of controls that include household type, age and sex of the respondent, education and marital status of the responding parent, and family income.

The key identifying assumption of the difference-in-differences model is the parallel trends assumption which states that children's average medication utilization would have evolved in parallel in Quebec and the rest of Canada in the absence of the Quebec reform. If the parallel trends assumption were to hold, this model would estimate the true effect of the Quebec drug insurance reform on children's medication uptake. The effect, however, would be biased if other factors affected medication utilization across provinces and resulted in differential trends. These could include province-specific changes in drug coverage, the prescribing patterns of ADHD and asthma medications, or trends in the prevalence and severity of childhood ADHD and asthma. As a robustness check, I estimate this model excluding Saskatchewan and Alberta, the two provinces that introduced public drug coverage for children in low-income families in 1998. This is to make sure that the effect of the Quebec reform is not biased by the presence of these drug programs for low-income children.[3]

In a difference-in-differences model with a single treated group and a dummy variable treatment, the issue of having a small number of clusters arises, making cluster-robust inference unreliable (MacKinnon & Webb, 2018). However, it has been reported that in a setting with a single treated cluster, using clustered wild bootstrap tests is also unreliable (MacKinnon & Webb, 2018). Therefore, I do not pursue these tests here and take the results of the difference-in-differences model as suggestive evidence of the relative effect of the reform on the utilization of the different types of medications.

4.2.2 Effects on children's health and parental depression

As a next step, I develop a strategy to answer the key research question of whether drug insurance for children has important repercussions on children's health and parents' well-being. In particular, I study whether the reform resulted in an increased

[3]These programs only covered children in families with incomes below $26,000 in Saskatchewan and below $23,000 in Alberta.

probability of children's health being rated as excellent and children being always or often in good health and whether there were spill-over effects on parental depression. Considering that the effects of improved access to all types of medications could be heterogeneous, depending on medical need, type of condition, and type of medication,[4] I narrow down my analysis to unambiguously beneficial medications.

Specifically, I focus on children diagnosed with asthma, since it is one of the most common chronic conditions among children[5] that often requires routine medication use. According to Servais et al. (2021), use of prescription medication is at least twice as common for children and youth with the selected chronic conditions including asthma and several other,[6] compared to children without each of these conditions. Moreover, unlike ADHD medications, there is no controversy about the benefits of the commonly prescribed medications for asthma treatment, such as inhaled corticosteroids. These medications are known to reduce the severity of asthma symptoms and improve quality of life (Falk et al., 2016). The cost of asthma medications is non-trivial: during the period studied, the annual costs of asthma medications for a child suffering from moderate to severe asthma could exceed $1,000 (Ungar & Witkos, 2005).

There could be at least two channels through which improved access to asthma medications may affect families. First, through improved medication adherence, asthma symptoms could improve, leading to a better quality of life for the child and the family. Alternatively, full insurance could lower the financial burden of paying for asthma medications out-of-pocket, thereby reducing stress for both parents and children and potentially improving their health and well-being.

For identification, I use the introduction of the Quebec universal drug insurance and I assume that the reform must have had a larger effect on families with children diagnosed with asthma relative to families with healthy children. I define treated children as those who were diagnosed with asthma before the Quebec reform, and I

[4]For example, the improved access to ADHD medication, which led to a significant increase in their use in Quebec, was found to have negative effects on ADHD symptoms, children's behaviour and learning outcomes (Currie et al., 2014).

[5]In 2000, 13% of children were diagnosed with asthma in Canada (Garner & Kohen, 2008).

[6]The other selected conditions include a mood disorder, attention deficit disorder and a learning disability.

exclude children diagnosed after the reform. To make the contrast sharper, I drop children diagnosed with any other chronic conditions. Since children are some of the lowest users of prescription medications (Rotermann et al., 2014), children who are not diagnosed with any major chronic conditions are unlikely to need medications regularly. Hence, I estimate a triple difference model where the third difference captures the differential effect of expanded access to medications for families with less healthy children who require maintenance medications, such as those diagnosed with asthma. In addition, I take advantage of the longitudinal nature of the NLSCY survey and include child-specific fixed effects. Therefore, the effects are identified through changes in insurance coverage for the same child before and after the policy change. The model is specified in Equation (4.2):

$$\begin{aligned} Y_{ipt} = \beta_1 Que_p \times Post_t \times Asthma_i + \beta_2 Que_p \times Post_t + \\ \beta_3 Post_t \times Asthma_i + \beta_4 Que_p \times Asthma_i + \\ \beta_5 Year_t + + \beta_6 ID_i + X'\Lambda + e_{ipt} \end{aligned} \tag{4.2}$$

where Y_{ipt} is the outcome for the child i (or the person most knowledgeable (PMK) of the child) in province p and year t. $Que_p \times Post_t \times Asthma_i$ is the interaction between Quebec, the years 1997 and after, and asthma diagnosis. The coefficient on this interaction, β_1, is of key interest and captures the change in the outcome associated with obtaining comprehensive public drug insurance after the reform in Quebec for a child diagnosed with asthma. I assume that compared to other children without any diagnosed conditions, this is the group that most benefits from free access to medications. The terms $Que_p \times Post_t$ and $Post_t \times Asthma_i$ capture trends in the average outcomes in Quebec relative to rest of Canada and among children diagnosed with asthma relative to healthy children. ID_i and $Year_t$ are child and years fixed effects. X is a set of controls that include household type, household size, education and marital status of the parents, age and sex of the child, and family income. Year fixed effects allow controlling for year-specific shocks common to children in all provinces (such as the National Child Benefit (NCB)). Child fixed effects control for child-specific time-invariant differences, which simultaneously capture provincial fixed effects. Therefore, the model controls for both individual and family-level fixed characteristics, like the presence of chronic conditions, that affect medication use and

health outcomes, as well as province-level fixed effects, such as provincial public drug programs that did not change (such as the Alberta voluntary drug benefit program).[7]

Since the financial burden of asthma medications is highest for low-income families, I focus the analysis on lower-income families and estimate Equation (4.2) for the sub-samples of families with incomes below $30,000 and below $40,000. Given that welfare recipients have public drug coverage, I exclude children whose parents reported receiving any welfare income.

Although the triple difference model does not require the same parallel trends assumption as difference-in-differences, it still requires a variant of this assumption. More specifically, according to a recent formal exposition (Olden & Møen, 2022), it requires the relative outcomes of children diagnosed with asthma and healthy children in Quebec to trend similarly to the relative outcomes of children diagnosed with asthma and healthy children in rest of Canada in the absence of treatment. Thus, trends across subgroups are allowed to differ, but their differentials should trend similarly. With two pre-reform periods, this assumption is hard to test, but generally, it is less restrictive as it allows for province-specific differential trends. For inference, I use cluster-robust standard errors with clustering by province.[8] However, with one treated province, there remains the issue of too few treated clusters, which results in both cluster-robust standard errors or clustered wild bootstrap t-tests being unreliable (MacKinnon & Webb, 2018; Olden & Møen, 2022). To address the issue of a single treated group, I estimate an alternative specification where I use a continuous measure of provincial public drug coverage for asthma medications, which incorporates several provincial public drug changes.

Below, I review the relevant changes to the provincial public drug plans, as well as the method used to construct a measure of asthma medication costs.

[7]The two-way interaction term $Que_p \times Asthma_i$ is not in the model since this variation is accounted for by the child fixed effects.

[8]It should be noted that in the context of a triple difference model, there are two groups within a province, making it less clear how to determine the correct number of clusters.

Provincial drug plans

Although the Quebec reform was the only one that provided universal and free coverage for children (when their parents enrolled in the Quebec public plan and paid the income-indexed premiums), there were also programs in other provinces that provided drug insurance for children (and sometimes their parents). However, eligibility and generosity of the coverage could vary, depending on the plan. Below I review these programs.

As has been mentioned earlier, Saskatchewan and Alberta introduced free coverage of prescription drugs for children in low-income families in 1998.[9] The eligibility varied: while the Saskatchewan plan required incomes below $25,921, the eligibility for the Alberta plan was especially restrictive, initially requiring incomes below $18,000, and only expanding to $22,397 in 2002.[10] Apart from these two programs for children, there were two other changes to the provincial public drug programs. One was the new "catastrophic", i.e., high deductible, drug plan in Ontario (the "Trillium" plan) introduced in 1995. In addition, Manitoba restructured the deductible schedule of its "catastrophic" plan, reducing deductibles for low-income families while increasing them for higher-income ones. Further details can be found in the overview of drug plans in Chapter 2 of the thesis.

Finally, some programs remained relatively unchanged throughout the study period. These include the Alberta premium-based voluntary drug benefit, which offered lower premiums for low-income families, as well as the "catastrophic" plans in Saskatchewan and BC. During the studied period, only the Atlantic provinces (excluding PEI) did not have any such programs.

[9]Parents also got drug coverage but had to pay deductibles and co-insurance.

[10]Apart from Alberta and Saskatchewan, PEI and Newfoundland introduced additional drug benefits as part of the NCB provincial initiatives. However, the PEI program required non-negligible copayments and the Newfoundland program was a six-month extension of drug benefits to persons leaving social assistance. Due to the lack of detail on the PEI plan, I exclude PEI from the analysis; I keep Newfoundland in the analysis because of the temporary nature of its program.

Asthma cost simulation

Since the NLSCY survey does not contain detailed information on medication utilization or medical spending,[11] I simulate the out-of-pocket cost of asthma treatment based on a moderate to severe pediatric asthma scenario laid out in Ungar and Witkos (2005).[12] My goal is to go beyond the insurance status indicator and explore the public plans' ability to minimize the burden of out-of-pocket costs. While high-deductible ("catastrophic") plans have little effect on average drug costs, they do make a difference for high-cost scenarios, such as annual asthma treatment. The results of the simulation of the out-of-pocket costs of asthma medications are presented in Figure 4.1.

The variation in coverage of asthma medication costs across different provincial public programs becomes more pronounced when one focuses on lower-income families. On the one hand, as mentioned above, Saskatchewan and Alberta implemented drug programs specifically for low-income children during this period. On the other hand, the "catastrophic" drug plans usually define their deductibles as a share of income, hence low-income families are more likely to reach the required deductible and obtain coverage under these programs. Finally, since various public drug programs were in place before the implementation of the Quebec drug reform, the baseline coverage was different across provinces. It should be noted that for higher-income families, most of the variation is due to the Quebec reform. Using this measure, I estimate a difference-in-differences model with a continuous treatment of the following form:

$$\begin{aligned} Y_{ipt} = \beta_1 Asthma_i \times Asthmacost_{ipt} + \beta_2 Asthmacost_{ipt} + \\ \beta_3 Year_t + + \beta_4 ID_i + X'\Lambda + e_{ipt} \end{aligned} \tag{4.3}$$

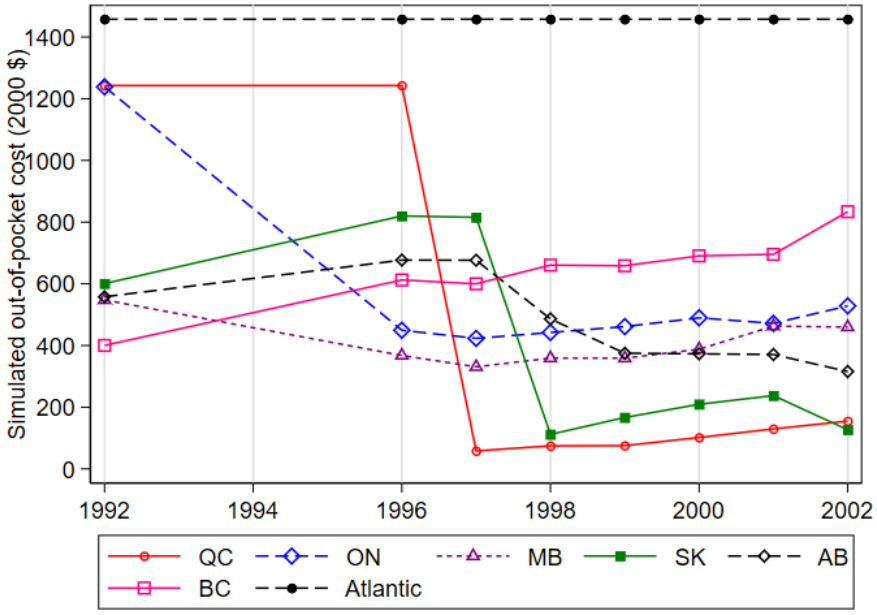
where $Asthmacost_{ipt}$ is the simulated out-of-pocket cost of asthma medications. It reflects the degree to which a public plan reduces the out-of-pocket burden of a high-cost medication basket. This measure should be relevant to uninsured families

[11] More generally, to the best of my knowledge, at the time of writing, there was no nationally representative public source of data on children's drug utilization or spending in Canada that could be used to calculate the costs of asthma medications for children.

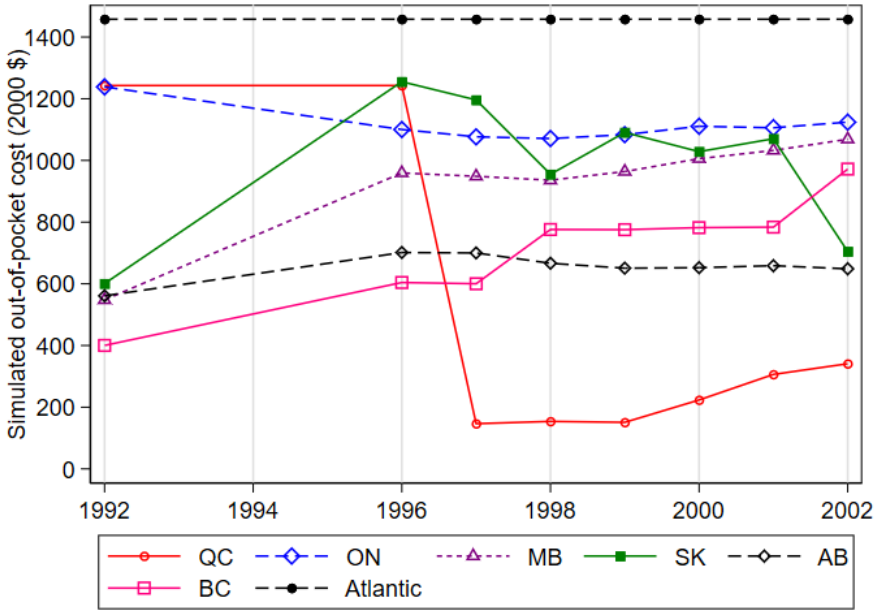
[12] The simulation uses eligibility and copayment requirements of all public plans, and prices and fees that were in effect during the period studied.

Figure 4.1: Simulated cost of asthma medications, by income

Panel A: Below $30,000



Panel B: All income levels



Notes: These graphs show the average of the total simulated uninsured costs after applying the best available public drug coverage in a province, given the distribution of incomes and family sizes in that province in a given year. The cost is simulated based on the asthma treatment scenario outlined in (Ungar & Witkos, 2005).

with high medication costs. I interpret it as a measure of the generosity of the public plans and evaluate its effect at meaningful values. To emphasize the Quebec reform, a meaningful change would be a reduction by $1,000, which is approximately the amount by which the simulated costs decreased after the Quebec reform. For the Saskatchewan and Ontario plans, the average reductions were around $600-$800, however, these reductions were only relevant for families with incomes below $30,000.

To focus on children's drug insurance as opposed to parents' insurance, I interact this measure with the child's asthma diagnosis.[13] Hence, the coefficient of interest is β_1. It captures the differential effect of having access to a more generous public plan for families with asthmatic children, i.e., children who are most likely to use expensive medications. As before, I exclude children diagnosed with any other chronic condition.

4.3 Data

The main source of data is the Statistics Canada NLSCY survey. It is a national longitudinal survey of children that began in 1994 and was conducted up to 2008. I use the first four cycles, spanning 1994 to 2000. The first cycle covered children aged 0-11 who formed the longitudinal cohort, and younger children were added in each cycle.

I limit my sample to children whose parents were under 65 and did not receive welfare. To estimate the fixed-effects models with standard errors clustered by province, I keep only those children who did not change province over the period studied. The resulting dataset contains 33,740 observations. Since the survey oversamples smaller provinces and families with younger children, I use the provided weights to correct for this oversampling. However, to estimate the fixed effects models, I can only apply a single weight to each longitudinal respondent, which I calculate as the average longitudinal weight across all cycles with a non-missing response.

Most health-related questions about the child are asked of the PMK. These include questions on medications and health status. I focus on three indicators of medication use: taking inhalants, taking Ritalin, and taking any medication. The indicator for

[13]The new plans in Quebec, Saskatchewan and Ontario covered both children and their parents, although parents often had to face user fees.

taking asthma medications is based on a survey question "Does [the child] take any of the following prescribed medication on a regular basis: Ventolin, inhalers or puffers for asthma?". Similarly, the indicator for taking Ritalin is based on the survey question "Does [the child] take any of the following prescribed medication on a regular basis: Ritalin or other similar medication". Finally, the indicator for taking any medications is a derived variable, which is based on responses to a series of questions similar to those mentioned above.

For the child's health, I focus on two variables: "excellent health status" and whether "the child is often in good health". The first is the answer to the question "In general, would you say this child's health is: ...", with 5 categories, from "poor" to "excellent", which I recode to indicate that health is "excellent". The second variable is based on the question "Over the past few months, how often has this child been in good health?" which I recode to indicate that the child is "often in good health" by combining "almost always" and "often" categories.

The special advantage of the NLSCY is that in addition to questions about the child, it also contains information on parental health. In particular, the survey places a special emphasis on PMK's depression symptoms using a detailed depression rating scale.[14] The total depression score varies between 0 and 36, with a high score indicating the presence of depression symptoms.

Since my identification strategy relies on the comparison between children diagnosed with asthma and healthy children, I identify the children who were diagnosed with asthma in the pre-reform cycles (1994 or 1996) and drop the children who were diagnosed with asthma after the reform. To make sure the control group includes relatively healthy children, I drop children diagnosed with any other chronic condition, in any cycle. Asthma diagnosis as well as other chronic conditions are based on a survey question asking whether "a health professional has ever diagnosed any

[14]The scale includes twelve questions, each of which contains four response categories. It measures the occurrence and severity of symptoms associated with depression during the previous week. The depression scale administered in the NLSCY is a shorter version of the depression rating scale (CES-D), comprising 20 questions, developed by L. S. Radloff of the Epidemiology Study Center of the National Institute of Mental Health in the United States. The rating scale was reduced to 12 questions by Dr. M. Boyle of the Chedoke-McMaster Hospital of McMaster University.

of the following long-term conditions..." and the conditions include any type of allergy, bronchitis, heart conditions, epilepsy, cerebral palsy, kidney conditions, mental handicaps, learning disabilities, attention deficit disorder, emotional or psychological difficulties, eating disorders, autism, migraines, or any other chronic condition. The summary statistics for medication use and the key independent variables are presented in Table 4.1, and the summary statistics for the child health outcomes and PMK's depression score are presented in Table 4.2. Both tables show the means for Quebec and the rest of Canada. A clear increase is apparent in "Any medication" use and "Ritalin" after the reform in Quebec relative to the rest of Canada. There are some differences in children's health characteristics between Quebec and the rest of Canada, such as the rates of diagnosed asthma and chronic conditions, which were lower in Quebec before the reform. Other key child and family characteristics are quite similar between Quebec and the rest of Canada before the reform.

Table 4.1: Descriptive statistics by income

	All Pre	All Post	Below $30K Pre	Below $30K Post
	Quebec			
Demographic characteristics				
PMK is mother	0.87	0.88	0.9	0.94
Age of Child	6.38	9.59	6.23	9.02
PMK education less than high school	0.15	0.13	0.26	0.28
Number of children 0-17	2.10	2.20	2.03	1.85
PMK married or lives common law	0.87	0.99	0.64	1.00
Family income ($2000)	58,890	72,786	21,608	24,615
Medication use				
Taking any medication	0.093	0.124	0.115	0.193
Inhalants	0.055	0.074	0.069	0.068
Ritalin	0.015	0.024	0.028	0.035
Chronic conditions				
Asthma (Child)	0.109	0.170	0.124	0.201
Any Chronic Condition (Child)	0.218	0.244	0.198	0.208
N	3,445	2,955	540	170
	Rest of Canada			
Demographic characteristics				
PMK is mother	0.90	0.92	0.90	0.91
Age of Child	6.53	9.87	6.12	9.41
PMK education less than high school	0.09	0.08	0.21	0.24
Number of children 0-17	2.36	2.39	2.35	2.57
PMK married or lives common law	0.93	0.99	0.73	1.00
Family income ($2000)	65,851	80,048	21,568	23,529
Medication use				
Taking any medication	0.103	0.119	0.127	0.128
Inhalants	0.064	0.071	0.086	0.079
Ritalin	0.012	0.012	0.012	0.018
Chronic conditions				
Asthma (Child)	0.127	0.165	0.167	0.159
Any Chronic Condition (Child)	0.244	0.265	0.262	0.274
N	14,795	12,300	2,115	855

Notes: The estimation sample includes families with children, not on welfare, where adults are less than 65 years old and who did not move across provinces. The total number of observations here is N=33,495 which is slightly lower than the 33,740 used in the regression analysis of medications. The reason is that these summary statistics include indicators for asthma and any chronic condition, and therefore lose the respondents with missing data for asthma and chronic condition diagnoses.

Table 4.2: Health outcomes by asthma diagnosis

	All Pre	All Post	Asthma Pre	Asthma Post
Quebec				
Taking any medication	0.09	0.13	0.51	0.44
Excellent health status	0.63	0.57	0.34	0.36
Health is good often	0.96	0.96	0.83	0.91
PMK depression score (0-36)	4.12	3.70	4.34	4.50
N	3,370	2,925	335	430
Rest of Canada				
Taking any medication	0.10	0.12	0.48	0.42
Excellent health status	0.61	0.55	0.32	0.32
Health is good often	0.97	0.97	0.91	0.95
PMK depression score (0-36)	4.17	3.81	4.77	4.02
N	14,450	12,095	1,740	1,885

Notes: The estimation sample includes families with children, not on welfare, where adults are less than 65 years old and who did not move across provinces. The number of observations here is larger (N=32,840) than the one used in the regression analysis of health outcomes (N=27,300). The reason is that these statistics do not exclude children with chronic conditions other than asthma and children diagnosed with asthma after the reform.

4.4 Results

4.4.1 Effects on medication use

In this subsection, I present the estimates of the effect of the reform on children's medication use.[15] The three types of medications include two specific types of medication: inhalants to treat asthma, and Ritalin, which is used to treat children with ADHD, as well as "any medication" use. The two former types of medications are prescribed to treat the most common chronic conditions in children. Table 4.3 reports

[15]All results include Alberta and Saskatchewan. I decided to keep them in the analysis since their reforms were narrowly targeted at low-income families and their effect would be contained in the below $30,000 sub-sample. I run the regressions excluding these two provinces and find that the results are robust to their exclusion.

the coefficient on the interaction between Quebec and the years 1998 and later from estimating the difference-in-differences model in Equation (4.1) for the whole sample and two income sub-samples: families with incomes below $30,000 and below $40,000. For the whole sample, the results suggest an increase of 1.8 percentage points for any medication, 1.3 for inhalants and 1.2 for Ritalin. The relative effect is the largest for Ritalin: an increase of over 80 percent, compared to a 25 percent increase for inhalants. The finding of a disproportionate increase in Ritalin uptake in the short term aligns with the observations made by Currie et al. (2014). They investigated the impact of the Quebec reform on children diagnosed with ADHD over a longer term. The finding of an increase in inhalant uptake in the short run, however, differs from the results of Currie et al. (2014), who report no effect on asthma medication uptake in the long run. As they point out, the larger effect on Ritalin could be due to the larger price elasticity of demand for mental health medications compared to asthma medications, and the variation in physician prescribing practices of stimulant medications. In addition, as has been discussed earlier, there is more controversy about the effectiveness of the ADHD medications and much less about the effectiveness of inhalants. A disproportionate uptake of less effective medications could result in less clear effects on the health of all children, hence the focus of this study is on children who require unambiguously effective medications. My estimate of the increase in asthma medication use is relatively modest and comparable to the estimated increase in taking "any medication". Although the questions on medication use between the two surveys are somewhat different, my results are comparable to the results of Wang et al. (2015) who estimate the effects of the Quebec reform for adults and youth based on the National Population Health Survey and report an increase in "any medication use" between 2.2 and 3.2 percentage points.[16]

The results reveal the presence of heterogeneity in the effects by income: the effects are larger for the below $40,000 sub-sample. This finding is consistent with the fact that lower-income families were more likely to gain drug insurance as a result of the reform and therefore the effect must be stronger for them. However, for the below

[16]Wang et al. (2015) study the effect of the Quebec reform on health use and health outcomes using the National Population Health Survey where the respondents are individuals aged 12 and above. In NLSCY, the question on medication use asks if a medication is taken "on a regular basis", while the NPHS question asks if the respondent took "any medication past month".

$30,000 sub-sample, the effect on the use of "any medication" becomes smaller and the standard errors become larger, rendering the estimate insignificant. For the other two variables, the results for the below $30,000 sub-sample suggest no change in the use of Ritalin, and a reduction in the use of inhalants.

The absence of the effect on medication use for the lowest income group mirrors the result for out-of-pocket drug spending in Chapter 2, where I find a decrease in the average out-of-pocket drug spending for the middle-income families, but no significant decrease for the lowest-income families (i.e., families with incomes below $30,000). I also discover that the drug spending patterns of low-income families in Quebec differ from those in the rest of Canada, evidenced by the inability to match them using the synthetic control method.[17] This is another indication that for the lowest-income group, the difference-in-differences common trends assumption may not hold, and the estimated effects for inhalant and Ritalin may be biased.[18] The results for the below $40,000 group, however, are more robust.

[17]More specifically, synthetic control cannot find weights that would provide a good approximation for the Quebec pre-reform out-of-pocket drug spending, and therefore the results for the low-income families suffer from poor match quality and have large p-values.

[18]In the results not shown, I find that the effect on inhalant uptake for the lowest-income subsample is sensitive to the inclusion of time trends. However, with only two pre-reform periods, estimating time trends may not be reliable.

Table 4.3: Effects of the Quebec drug reform on medication use, difference-in-differences

	(1) Any Medication	(2) Inhalants	(3) Ritalin
Income below $30,000			
$Que \times Post$	0.006	-0.054***	-0.000
	(0.024)	(0.013)	(0.009)
N	3,700	3,700	3,700
Income below $40,000			
$Que \times Post$	0.017	0.021***	0.020**
	(0.010)	(0.007)	(0.009)
N	8,420	8,420	8,420
All income			
$Que \times Post$	0.018**	0.013**	0.013***
	(0.007)	(0.006)	(0.002)
N	33,740	33,740	33,740
Quebec mean, pre-reform	0.093	0.055	0.015

Notes: This table reports the coefficient on the interaction of the treatment province and the post-reform years. P-values are calculated using cluster-robust standard errors clustered by province. Controls include year and child FE, age and gender of the child, family income and parental education and marital status. The estimation sample includes families with children, not on welfare, where adults are less than 65 years old.

4.4.2 Effects on children's health and parental depression

Here I present the estimates of the effects of the reform on children's health outcomes and parental depression. As was mentioned in the empirical strategy section, there are two possible channels for drug insurance to improve health outcomes: directly through improved medication use or indirectly by lowering financial and, potentially, overall stress in the family. Therefore, I argue that even in the absence of an observed increase in medication use, drug insurance can improve the health outcomes of both

children and parents, particularly in low-income families.

First, I present the results of estimating the triple difference model for children diagnosed with asthma relative to healthy children based on Equation (4.2). Table 4.4 shows the results for all health outcomes. The first two panels report the child outcomes. I expect to see a larger improvement in the health of children diagnosed with asthma, as they were more likely to gain insurance and face lower barriers to accessing medications after the reform compared to higher-income groups. For "Excellent health", there is indeed a positive coefficient suggesting a differential increase in the proportion of children with asthma reporting to be in excellent health. The coefficient is the largest for the below $30,000 sub-sample, but not statistically significant. I estimate a statistically significant (at 10 percent) effect for the below $40,000 sub-sample. It suggests an increase of about 8 percentage points, which is quite large considering that only 32 percent of children with asthma in my sample reported being in excellent health before the reform in Quebec. Interestingly, the coefficient is positive, although not statistically significant, for all control group children (the coefficient on the $Que \times Post$ interaction) in the lower-income sub-samples, suggesting a positive impact on health for all lower-income children. A similar pattern of coefficients emerges for the "Health is good often" variable: the coefficients on the triple interaction are positive (although not statistically significant) for lower-income children. Large positive coefficients are also obtained for all control children (the coefficient on the $Que \times Post$ interaction) in the lower-income sub-samples. The baseline levels for this outcome are higher: 0.83 (asthma) and 0.96 (no asthma), therefore the relative improvements are not as pronounced as the improvements for the previous outcome. Together, these results confirm that lower-income families were more affected by the reform relative to other families, and the health benefits to children were non-negligible.

Finally, I turn to the question of whether improved access to medication among children has led to improvements in the mental health of parents. Since the new Quebec public plan provided drug insurance to all uninsured families, including both children and parents, parental health could have improved directly through higher use of medications. Therefore, to study the effects of children's drug insurance on

parental outcomes, I focus on the differential effect for the parents of children with high medication needs, such as children diagnosed with asthma. I assume that the direct health care effect on all parents would be captured by the two-way interaction term, $Que \times Post$.[19] The original depression score is constructed on a scale 0 to 36, with 12 questions, each with 4 response categories, so that higher scores represent worse outcomes (e.g., more severe depression symptoms). To be able to interpret positive coefficients on the depression score as improvements, similar to children's health outcomes, I multiply the coefficients by minus 1. For the PMK depression score, the estimated effects (i.e., the regression coefficients multiplied by minus 1) are positive, although not statistically significant, for lower-income parents. The estimated effects for the depression score relative to the baseline levels imply improvements by between 8 (below $30,000 sub-sample) and 30 (below $40,000 sub-sample) percent.

[19] Although there is an established link between parental and children's asthma, asthma is one of many conditions related to high drug use among adults. I assume that parents with high medication use are present in both the treatment and control groups. Parental depression, as the summary statistics demonstrate, is present in the parents of both relatively healthy children and children diagnosed with asthma.

Table 4.4: Effects of the Quebec drug reform on health outcomes using triple difference by child's pre-reform asthma diagnosis

	(1) All income	(2) Below $30,000	(3) Below $40,000
Child: Excellent health			
$Que \times Post \times Asthma$	0.040***	0.195	0.080*
	(0.008)	(0.110)	(0.040)
$Que \times Post$	-0.006	0.079	0.065
	(0.008)	(0.125)	(0.048)
Child: Health is good often			
$Que \times Post \times Asthma$	-0.002	0.071	0.008
	(0.006)	(0.061)	(0.024)
$Que \times Post$	0.002	0.011	0.023**
	(0.003)	(0.009)	(0.008)
PMK Depression score			
$Que \times Post \times Asthma$	-1.103***	0.324	1.370
	(0.174)	(1.328)	(0.940)
$Que \times Post$	0.093	-0.624	-0.945
	(0.063)	(0.488)	(0.595)
N	27,300	3,000	6,870

Notes: This table reports the coefficients from estimating the triple difference model where the coefficient of interest is the one on the interaction between Quebec, the post-reform years and the pre-reform asthma diagnosis. All children diagnosed with any other chronic condition or diagnosed with asthma after the reform are excluded. P-values are calculated using cluster-robust standard errors clustered by province. Controls include year and child FE, age and gender of the child, family income and parental education and marital status. The estimation sample includes families with children, not on welfare, where adults are less than 65 years old. For the N's, the last digits were masked and replaced with zeros due to the confidentiality rules of the Statistics Canada Research Data Centres.

However, for the triple difference model with only one treated province, the question arises whether the clustered standard errors are reliable. As there were no comparable reforms in other provinces, I cannot add more treated groups to this model. Considering that during that time several other provinces introduced public drug plans, albeit varying in generosity, I take advantage of this variation and estimate an alternative specification with multiple treated provinces. This model is based on a difference-in-differences strategy with a continuous treatment representing the public plans' generosity in covering asthma medications.[20] As discussed in the empirical strategy section, the treatment variable is the simulated out-of-pocket cost of asthma medications under each provincial public plan. Since the focus is on the Quebec plan, I evaluate the effect in terms of a reduction in the simulated out-of-pocket cost by $1,000, which is an approximate reduction in simulated children's asthma costs under the Quebec public plan. Table 4.5 presents the results from estimating Equation (4.3) for the same 3 outcomes. The coefficient of interest is the interaction between the reduction in simulated asthma cost and asthma diagnosis, $Asthma \times Asthmacost$. For this specification, the effect on "Health is good often" is more pronounced, suggesting more children with lower incomes were often in good health after obtaining good coverage such as the one provided by the Quebec public drug plan, compared to higher-income children. The effects on the PMK depression scores are also very pronounced, with a larger estimated effect for the lowest-income group. Thus, the results are generally more pronounced using this specification and confirm the findings reported above based on Equation (4.2).

Taken together, the results confirm that there are important health effects of the reform both on children's overall health status and the mental health of their parents, when the children are regular users of medications and the medications are known to be effective. While children's health outcomes tend to increase for both children with asthma and relatively healthy children (as the coefficients on $Que \times Post$ and $Asthmacost$ suggest), improvements in parental depression are only found among the parents of children diagnosed with asthma, and not in the control group.

[20] As a result, it cannot control for province-specific trends in outcomes as does the pure triple difference model.

Table 4.5: Effects of the Quebec drug reform on health outcomes using difference-in-differences with continuous treatment

	All income	Below $30,000	Below $40,000
Child: Excellent health			
$Asthma \times Asthmacost$, $1000s	0.038	0.060	0.042
	(0.026)	(0.062)	(0.039)
$Asthmacost$, $1000s	0.000	0.080	0.063*
	(0.014)	(0.056)	(0.033)
Child: Health is good often			
$Asthma \times Asthmacost$, $1000s	0.030**	0.197*	0.108**
	(0.012)	(0.108)	(0.034)
$Asthmacostin\$1000s$	-0.008**	-0.002	0.002
	(0.003)	(0.016)	(0.006)
PMK Depression score			
$Asthma \times Asthmacost$, $1000s	-0.641**	2.576	1.243***
	(0.201)	(1.591)	(0.281)
$Asthmacost$, $1000s	0.077	-0.276	-0.068
	(0.087)	(0.314)	(0.768)
N	27,300	3,000	6,870

Notes: This table reports the coefficients from estimating the difference-in-differences model with continuous treatment representing the potential coverage of asthma medications by the provincial public plan and its interaction with asthma diagnosed before the reform. All children diagnosed with any other chronic condition or asthma but after the reform are excluded. P-values are calculated using cluster-robust standard errors clustered by province. Controls include year and child FE, age and gender of the child, family income, and parental education and marital status. The estimation sample includes families with children, not on welfare, where adults are less than 65 years old. For the N's, the last digits were masked and replaced with zeros due to the confidentiality rules of the Statistics Canada Research Data Centres.

4.5 Conclusion

This chapter has examined the health effects of providing free universal public drug insurance for children, focusing on children in lower-income families. Using the Quebec

drug insurance reform of 1997, which made drug insurance mandatory and provided a premium-based public plan with free coverage for children to all uninsured families, I estimate how it affected medication utilization in children and whether it had important repercussions on health outcomes. I find that medication utilization increased, with some important heterogeneity by type of medication. Specifically, while I find modest increases in the use of asthma medications, a type of medication with known health benefits, my estimates confirm the earlier findings of disproportionately larger increases in the use of Ritalin, a medication to treat ADHD, where the health benefits are less straightforward (Cortese et al., 2018). This suggests that free access to all medications improves the use of necessary medications and may also increase the use of the more controversial ones.

The implication for the study of the health effects of the reform is that instead of improvements in health outcomes across the board of health conditions, one may expect to find mixed effects depending on the condition and type of medication. Indeed, the earlier study by Currie et al. (2014) finds that mental health outcomes of children in Quebec diagnosed with ADHD worsened following the increased use of Ritalin in the community. For this reason, I focus more narrowly on the potential health benefits of free access to medications to treat asthma, which are generally effective in controlling asthma symptoms and improving the quality of life (Falk et al., 2016). The price elasticity for asthma drugs appears to be lower than for mental health medications, such as Ritalin, and parents often prioritize their children's costly asthma medications (Galbraith et al., 2023). This suggests that the health benefits of improved access to asthma medications may extend beyond better medication utilization and asthma control. By reducing financial stress in the family, it could also positively impact parental mental health. Therefore, in addition to children's health outcomes such as "excellent health" and "health is good often", I estimate the effects on parental depression.

My findings confirm that there are stronger health benefits of free access to medications for children with asthma, in particular in lower-income sub-samples. Moreover, there are noticeable reductions in depression scores for parents of asthmatic children

in lower-income families. Thus, this paper contributes important new evidence regarding the effects of free drug insurance for children, set against the backdrop of free physician and hospital care. It identifies enhancements in the health status of children, notably children in lower-income families who require maintenance medications. Furthermore, it uncovers broader implications of drug insurance for children, including improved mental health outcomes for their parents. This discovery is consistent with recent literature from the US, which reports positive effects of children's health insurance on parental well-being (Grossman et al., 2022). Finally, it finds important heterogeneity in the increase in medication uptake, which raises the question of the potential increase in the use of less effective and more controversial drug treatments under a plan design with free coverage of all medications. Overall, these findings provide important evidence of the benefits of free drug insurance for children. These findings seem especially relevant now that the federal government has committed to the implementation of a national universal drug insurance in Canada. These findings could inform the work of the policymakers regarding the effects of providing free drug insurance for children and the optimal design of a universal pharmacare plan for Canada.

Chapter 5

Conclusion

In Canada, where hospital and physician services have long been publicly and universally covered, the universal coverage of other health care services, in particular prescription drugs, has long been debated. There is a general agreement that the costs of such services as prescription drugs and dental care, when they are not insured, present a serious barrier to many families, in particular those with lower incomes.

This thesis examines the effects of providing copayment-free insurance for drugs and dental services for children using historical data on two programs that were implemented in two Canadian provinces in the late 1990s. The thesis consists of three chapters each studying the impacts of drug insurance (and, in one instance, dental insurance) on various facets of family life with a focus on low-income families.

In chapter 2, I study the effects of a universal drug insurance reform implemented in the province of Quebec in 1997 on household spending. Using two different empirical strategies I estimate a small reduction in household drug spending among middle-income families but find no evidence of spending reductions among low-income families. Instead, I find larger offsetting increases in spending on health premiums for all income groups, although only statistically significant for the middle-income group. The finding of increasing health spending due to rising premiums is alarming, as it suggests a potentially increasing financial burden instead of a benefit from a drug insurance program for a family with average spending on prescription drugs.

In chapter 3, I study the impact of free coverage for prescription drugs and dental services for children in low-income working families introduced in Saskatchewan in 1998. Using a combination of several empirical approaches, I find that total drug and dental out-of-pocket spending of households declined on average by 30 percent. Moreover, above the 90^{th} percentile, the decrease in drug spending was considerably

larger than the decrease in dental spending, particularly among those in the top 5^{th} percentile. I attribute the larger effect at the top of the drug spending distribution to parents becoming covered for drug costs but not for dental costs. These findings suggest that providing dental insurance to children may have a comparable effect on reducing mean out-of-pocket health costs as providing drug insurance. However, the larger effects on drug spending compared to dental spending at the top of their spending distributions suggest that the risk of very high costs is truly reduced when both children's and parents' costs are covered.

Finally, in chapter 4, I explore whether providing free drug coverage for children leads to improvements in children's health and parental mental health. Here I once again use the Quebec universal drug insurance reform as an exogenous policy change. I find heterogeneous effects on medication use, with larger increases in the use of more controversial medications such as Ritalin, compared to modest increases in the use of more common medications such as asthma inhalants. This suggests that free access to all medications not only improves the use of necessary medications but may also increase the use of the more controversial ones. Therefore, in my further analysis of the health outcomes of children and their parents, I focus more narrowly on children diagnosed with asthma. I find an increase in the probability of a child being often in good health and a decrease in the parental depression score for lower-income families. These findings suggest that providing drug insurance to children from low-income families, who require medication with known beneficial effects, improves the well-being of both the child and the family.

This thesis demonstrates that the effects of providing free drug (and dental) insurance to children in lower-income families are multifaceted. While average out-of-pocket spending on prescription drugs and dental care is modest, free or subsidized insurance for children covers the risk of above-average spending on these services and channels resources to medical care. It may also provide an incentive to work for parents relying on welfare for supplemental health services, in particular drug insurance, for their children. The magnitude of this effect, however, is not known and warrants further investigation. In addition, savings and risk reduction are just a part of the overall benefits. There are important benefits due to better health and well-being

of both children and their parents. These health benefits, however, are associated with better access to necessary and beneficial services: for example, free drug insurance may have undesirable effects as a result of increased use of more controversial medications. The design of the highly anticipated national universal pharmacare program in Canada should take into account these broader benefits and the potential challenges of providing free drug insurance to children.

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Appendix A

The National Child Benefit (NCB) program

The NCB program was launched in 1998 and had as its stated goals to "help prevent and reduce the depth of child poverty [and] promote attachment to the labour market" (Human Resources Development Canada, 1999). Through this program, the federal government increased federal benefits for all low-income families with children, regardless of the parents' working status. As a result, provinces could free up and re-invest their funds from social assistance towards new and enhanced services and benefits for children. These benefits included provincial cash child benefits (e.g., child benefits in Saskatchewan, Nova Scotia and BC), child care supplements and early years intervention programs (almost all provinces), as well as health programs, primarily drug and other supplementary health benefits (Human Resources Development Canada, 1999). Specifically, as part of these re-investments, Saskatchewan, Alberta and PEI introduced new public drug coverage for low-income families with children. However, only Saskatchewan's and Alberta's drug benefits provided free coverage for children, whereas the program in PEI required non-negligible co-payments.

Appendix B

Supplementary material for Chapter 2

Table B1: New provincial public plans covering prescription drugs for children introduced in the 1990s

Program	**Year**	**Eligibility**	**Income cut-off**	**Copayment**	**Beneficiaries**
QC Universal Drug Plan	1997	Universal (mandatory if no other coverage)	Universal	None for children. Adults pay income-indexed family premium, 0-175$ per year (1997-2001), 100$ (8.33$ monthly) annual deductible and 25% co-insurance	All children have coverage
AB Child Health Benefit	1998	Children in families with incomes below the cut-off	$18,000 (1998) $20,921 (1999) $21,214 (2000) $21,744 (2001)	None	50,000 children (2000) 66,293 children (2001) 6̃% of children
SK Family Health Benefit	1998	Children eligible for Saskatchewan Child Benefit (August 1998) and their parents	$25,921 (1998)	None for children. Adults pay $200 deductible and 35% co-insurance	40,092 children (2000) 1̃3% of children

Appendix C

Supplementary material for Chapter 3

Table C1: Effects of the SFHB program on drug and dental out-of-pocket spending, by income sub-sample, including province-specific time trends

	below $26,000		$26,000-$35,000		$30,000-$40,000	
	DRUG	DENT	DRUG	DENT	DRUG	DENT
$Sask \times Post$	-92.34***	-181.9**	-17.52	-88.68	19.54	-111.1*
	(12.37)	(34.01)	(7.949)	(46.24)	(18.53)	(38.04)
CRVE p-value	0.000	0.001	0.063	0.097	0.327	0.022
p-val WCB (prov)	0.000	0.011	0.000	0.231	0.530	0.048
p-val restr WCB (prov)	0.251	0.845	0.456	0.559	0.568	0.445
p-val WCB (prov year)	.	0.457	0.746	0.685	.	0.398
p-val restr WCB (prov year)	.	0.556	0.735	0.774	.	0.486
N	2,774	2,774	2,896	2,896	3,528	3,528
Sask N	311	311	325	325	387	387
Sask mean pre-reform	146.7	154.7	165.2	225.4	178.5	246.8

Notes: This table reports the coefficient on the interaction of the treatment province and the post-reform years including province-specific time trends. Controls include year and province FE, province-specific time trends, family income, age, gender, female respondent and family type. The estimation sample includes families with children not on welfare where adults are less than 65 years old. All spending is adjusted for inflation using 2000 prices. Alberta and Quebec are excluded since they implemented public drug programs covering children in low-income families during the same period. CRVE p-values are calculated using standard errors clustered by provinces. Additionally, I report the WCB p-values from restricted and unrestricted tests clustered at the province and province-year levels.

Using a larger sample, up to $30,000 and $40,000, I estimate the effect of the programs on all eligible families, i.e., up to $26,000 in Saskatchewan and $20,000 in BC. The estimated effects on spending are $50-$55 for Saskatchewan alone, or $83–$90 for Saskatchewan and BC programs combined. The subcluster wild bootstrap p-values are consistent but do not reject the null, being well above 10 percent.

Table C2: Effects of the SFHB and the BC Healthy Kids program on dental out-of-pocket spending

	under-$30,000		under-$40,000	
	SK	SK and BC	SK	SK and BC
$Tr\_Prov \times Post \times Low$	-55.11***	-89.26**	-49.98***	-83.26***
	(7.070)	(17.39)	(5.816)	(14.66)
CRVE p-value	0.000	0.001	0.000	0.001
p-val WCB (prov)	0.000	0.097	0.000	0.057
p-val restr WCB (prov)	0.881	0.342	0.344	0.287
p-val WCB (prov year)	0.577	0.146	0.351	.
p-val restr WCB (prov year)	0.563	0.202	0.383	.
N	3,450	3,949	6,509	7,475
SK N	458	458	845	845
SK mean pre-reform	162.6	162.6	201.8	201.8

Notes: This table reports the three-way interaction between the treatment province (Saskatchewan or British Columbia), the post-reform years and the eligibility status due to low income. There are no two-way interaction terms in this model. Other controls include low-income status, year and province FE, family income, age, gender, female respondent and family type. The estimation sample includes families with children not on welfare and where adults are less than 65 years old. All spending is adjusted for inflation using 2000 prices. Alberta and Quebec are excluded since they implemented public drug programs covering children in low-income families during the same period. CRVE p-values are calculated using standard errors clustered by provinces. Additionally, I report the WCB p-values from restricted and unrestricted tests clustered at the province and province-year levels.

Table C3: Effects of the SFHB program at top percentiles of drug and dental spending, below $26,000 sub-sample

	DRUG	p-val	DENTAL	p-val
Synthetic control estimates by percentile				
p80	-11.7	0.86	-129.5	0.43
p81	27.3	0.71	-122.8	0.14
p82	-67.7	0.14	-104.7	0.71
p83	-47.2	0.86	-62.7	0.86
p84	-41.4	0.57	-92.9	0.71
p85	.	.	-108.0	0.71
p86	5.4	0.00	-108.9	0.71
p87	-0.8	0.00	-107.3	0.57
p88	40.4	0.00	-103.3	0.57
p89	-59.6	0.00	-107.8	0.29
p90	-186.1	0.00	-180.9	0.29
p91	-215.6	0.00	-208.6	0.57
p92	-166.9	0.00	-181.3	0.29
p93	-92.0	0.00	-405.9	0.71
p94	-253.6	1.00	-312.5	0.86
p95	-509.0	0.14	-340.1	1.00
p96	-1832.8	0.29	-408.0	0.86
p97	-715.2	0.00	-209.2	0.71
p98	-582.0	0.14	-341.0	1.00
p99	-841.2	0.00	-609.5	0.86

Notes: synthetic control estimates and p-values for each percentile are first estimated by year by running Stata synth package. The reported average effect (ATT) is obtained by taking the average over the yearly estimated effects. The ATT p-value is based on placebo simulations and represents the proportion of placebos that have a ratio of post-treatment RMSPE over pre-treatment RMSPE at least as large as the average ratio for the treated units.

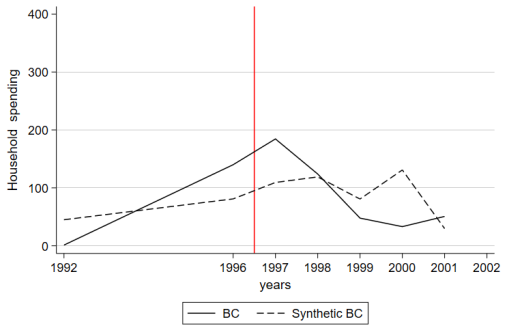
Effects of the BC Healthy Kids program on dental spending estimated using synthetic control

There is a noticeable and sustained reduction in mean dental spending among the below $20,000 group after 1997, but not among the below $26,000 income group. I attribute this differential reduction to the BC Healthy Kids dental program targeted at lower-income families. However, a synthetic control with a good match could not be produced due to high variation and a low number of observations for the lowest income groups. As a result, I could not obtain a reliable estimate of the program's effect on these groups using synthetic control.

A similar pattern emerges for the top dental spending, with a sharp reduction in post-reform years for the lowest-income families, but no good match in terms of synthetic control and no reliable estimate of the effect of the program on spending among the top spenders.

Figure C.1: Effects of the BC Healthy Kids program on average dental spending using synthetic control

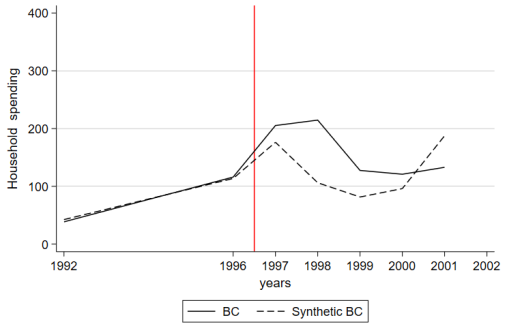
Panel A: SC graph, below 20k



Panel B: SC weights, below 20k

	Synthetic control weights
NL	0.00
PEI	0.61
NS	0.39
NB	0.00
QC	0.00
ON	0.00
MB	0.00

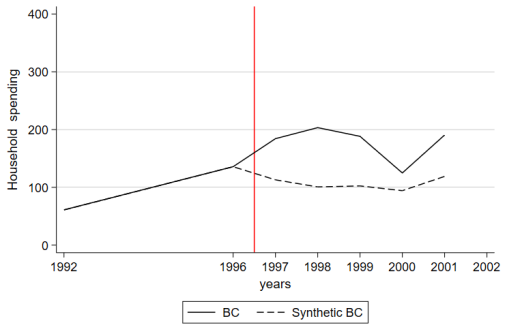
Panel C: SC graph, below 23k



Panel D: SC weights, below 23k

	Synthetic control weights
NL	0.00
PEI	0.15
NS	0.00
NB	0.00
QC	0.00
ON	0.85
MB	0.00

Panel E: SC graph, below 26k



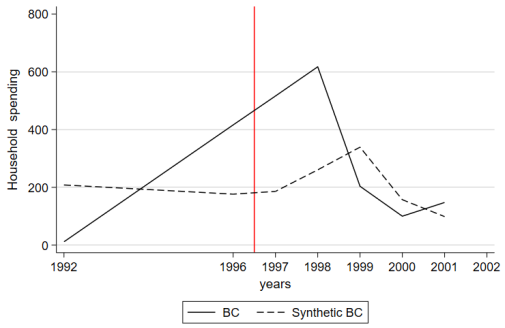
Panel F: SC weights, below 26k

	Synthetic control weights
NL	0.64
PEI	0.01
NS	0.02
NB	0.01
QC	0.02
ON	0.28
MB	0.01

Notes: Graphs show mean spending in BC (solid line) vs. its synthetic control (dashed line). The vertical lines indicate the end of the pre-treatment period.

Figure C.2: Effects of the BC Healthy Kids program at the 90^{th} percentile of dental spending using synthetic control

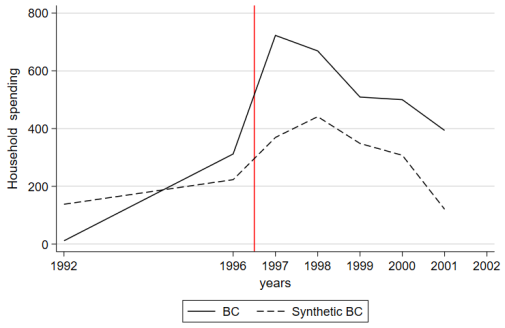
Panel A: SC graph, below 20k



Panel B: SC weights, below 20k

	Synthetic control weights
NL	0.62
PEI	0.00
NS	0.38
NB	0.00
QC	0.00
ON	0.00
MB	0.00

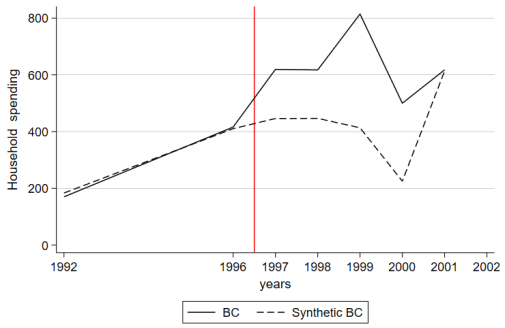
Panel C: SC graph, below 23k



Panel D: SC weights, below 23k

	Synthetic control weights
NL	0.00
PEI	0.36
NS	0.64
NB	0.00
QC	0.00
ON	0.00
MB	0.00

Panel E: SC graph, below 26k



Panel F: SC weights, below 26k

	Synthetic control weights
NL	0.00
PEI	0.39
NS	0.00
NB	0.00
QC	0.00
ON	0.61
MB	0.00

Notes: Graphs show 90^{th} percentile of spending in BC (solid line) vs. its synthetic control (dashed line). The vertical lines indicate the end of the pre-treatment period.

Appendix D

Supplementary material for Chapter 4

Table D1: Effects of the Quebec drug reform on medication use, excluding AB and SK, difference-in-differences

	(1) Any Medication	(2) Inhalants	(3) Ritalin
Income below 30,000			
$Que \times Post$	0.009 (0.027)	-0.059*** (0.016)	-0.001 (0.009)
N	3,120	3,120	3,120
Income below 40,000			
$Que \times Post$	0.013 (0.009)	0.023** (0.008)	0.016* (0.008)
N	7,090	7,090	7,090
All income groups			
$Que \times Post$	0.022*** (0.006)	0.017*** (0.004)	0.013*** (0.002)
N	27,840	27,840	27,840
Quebec mean, pre-reform	0.093	0.055	0.015

Notes: This table reports the coefficient on the interaction of the treatment province and the post-reform years. P-values are calculated using cluster-robust standard errors clustered by province. Controls include year and child FE, age and gender of the child, family income, and parental education and marital status. The estimation sample includes families with children, not on welfare, where adults are less than 65 years old.