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PUBLIC DRUG INSURANCE AND CHILDREN'S USE OF MENTAL HEALTH MEDICATION: RISK-SPECIFIC RESPONSES TO LOWER OUT-OF-POCKET TREATMENT COSTS

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Titre

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Abstract/Résumé

While the long-term consequences of unmet child mental health needs are well-documented, out-of-pocket costs remain an important barrier to accessing medication in childhood and adolescence. This paper exploits the implementation of a public drug insurance program in Québec, Canada, to estimate the impact of out-of-pocket costs on uptake of pharmaceutical treatment for mental health issues in children. To investigate the potential for low-benefit consumption or moral hazard due to lowered drugs costs, we combine a difference-in-differences estimation framework with novel machine learning techniques to predict the likelihood of diagnosis for ADHD, anxiety or depression across childhood in a nationally representative longitudinal sample of children. Our results suggest that eliminating out-of-pocket costs led to a 3-percentage point increase in treatment uptake and adherence. When adjusting for predicted risk, the effects are concentrated among the top two deciles of risk. For children in the bottom half of the risk distribution, treatment use changes were not statistically different from zero. We find that treatment uptake is driven by changes in stimulants, which are generally prescribed for ADHD. Our results suggest that reductions in out-of-pocket costs could help achieve better uptake of mental health treatment, without leading to low-benefit care among lower-risk individuals.

Bien que les conséquences à long terme des besoins non satisfaits des enfants en matière de santé mentale soient bien documentées, les frais remboursables demeurent un obstacle important à l'accès aux médicaments pendant l'enfance et l'adolescence. Cet article exploite la mise en œuvre d'un programme public d'assurance-médicaments au Québec, Canada, pour estimer l'impact des frais remboursables sur l'adoption de traitements pharmaceutiques pour les problèmes de santé mentale chez les enfants. Pour étudier la possibilité d'une consommation à faible bénéfice ou d'un aléa moral dû à la baisse du coût des médicaments, nous combinons un cadre d'estimation de la différence dans les différences avec de nouvelles techniques d'apprentissage automatique pour prédire la probabilité d'un diagnostic de TDAH, d'anxiété ou de dépression au cours de l'enfance dans un échantillon longitudinal d'enfants représentatif au niveau national. Nos résultats suggèrent que l'élimination des frais remboursables a conduit à une augmentation de 3 points de pourcentage de la prise de traitement et de l'observance. Après ajustement du risque prédit, les effets sont concentrés sur les deux déciles supérieurs de risque. Pour les enfants situés dans la moitié inférieure de la distribution du risque, les changements dans l'utilisation du traitement n'étaient pas statistiquement différents de zéro. Nous constatons que l'utilisation du traitement est déterminée par les changements dans les stimulants, qui sont généralement prescrits pour le TDAH. Nos résultats suggèrent que la réduction des frais remboursables

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pourrait contribuer à une meilleure prise en charge des traitements de santé mentale, sans pour autant conduire à des soins à faible bénéfice chez les personnes à faible risque.

Keywords/Mots-clés: Children Health, Public Health Insurance, Mental Health, Prescription Drugs / Santé des enfants, Assurance maladie publique, Santé mentale, Médicaments sur ordonnance

JEL Codes/Codes JEL: I10, I13, I18, I19

Public drug insurance and children's use of mental health medication: Risk-specific responses to lower out-of-pocket treatment costs

Short title: **Insurance & children's mental health drugs use**

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Abstract:
While the long-term consequences of unmet child mental health needs are well-documented, out-of-pocket costs remain an important barrier to accessing medication in childhood and adolescence. This paper exploits the implementation of a public drug insurance program in Québec, Canada, to estimate the impact of out-of-pocket costs on uptake of pharmaceutical treatment for mental health issues in children. To investigate the potential for low-benefit consumption or moral hazard due to lowered drugs costs, we combine a difference-in-differences estimation framework with novel machine learning techniques to predict the likelihood of diagnosis for ADHD, anxiety or depression across childhood in a nationally representative longitudinal sample of children. Our results suggest that eliminating out-of-pocket costs led to a 3-percentage point increase in treatment uptake and adherence. When adjusting for predicted risk, the effects are concentrated among the top two deciles of risk. For children in the bottom half of the risk distribution, treatment use changes were not statistically different from zero. We find that treatment uptake is driven by changes in stimulants, which are generally prescribed for ADHD. Our results suggest that reductions in out-of-pocket costs could help achieve better uptake of mental health treatment, without leading to low-benefit care among lower-risk individuals.

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1. Introduction

One-half to three-quarters of children with mental health issues go untreated in North America.[1] Contributing to this phenomenon are issues such as a lack of access to medication, and non-initiation or non-adherence to pharmaceutical treatment (Taddeo Egedy et Frappier, 2008). Financial barriers are often cited as a potential culprit, and the literature points to a non-trivial out-of-pocket price elasticity for mental health drugs (Meyerhoefer and Zuvekas, 2010; Kaplan and Zhang, 2013). Universal drug insurance programs, thus, are believed to offer a potential solution to problems of access to prescription drugs for both physical and mental health (e.g., Kennedy and Wood, 2016; Hayden et al, 2018; Ghosh, Simon and Sommers, 2018; Borrescio-Higa, 2015). However, little is known about their longer-term impact on uptake of and adherence to mental health medication, or about the degree to which they can lead to unsustainable operating costs due to inappropriate use (or other moral hazard issues). This paper seeks to shed light on these question by estimating the effect of the implementation of a public drug insurance program in Québec, Canada, which reduced out-of-pocket costs for mental health medication to zero for eligible children.

Our work offers two primary contributions to the literature on child mental health and public health insurance programs. First, we estimate the impact of expanding drug insurance coverage to lower-income children on their likelihood of using medication for mental health disorders. Our estimated changes in treatment usage occur in a context where all children have access to free physician services, allowing us to identify the marginal contribution of lower out-of-pocket costs for medication, separately from that of gaining access to medical consultations. To estimate our causal relationship of interest, we implement a difference-in-differences framework that exploits the province-specific nature of health care policies in Canada. Second, we investigate the potential unintended consequences of lowering prescription drugs costs in terms of moral hazard and low-benefit consumption. To this end, we use a machine learning algorithm to estimate a child's underlying risk of developing a mental health disorder. We then assess how

[1] Race, gender and socioeconomic status further exacerbate these issues. See, for examples, Katoaka et al, 2019; Merikangas et al 2002; Georgiades, 2014; Snowden, 2003; Bruchmüller et al, 2012; Mullainathan et Spiess, 2017; Williams and Mohammed, 2009.

pharmaceutical treatment usage changes along this predicted distribution of mental health risk, following the implementation of the public drug insurance program.

We focus on the impact of out-of-pocket medication costs on children's mental health, which is an important and growing issue as one in five children is diagnosed with a mental health disorder before age 18 globally (Ogundele, 2018). Mortality and morbidity challenges associated with disorders like depression, anxiety, or attention-deficit hyperactive disorder (ADHD) are intensifying (Rosenfeld, 2019). Suicide, for example, is now the leading cause of death for children aged 10 to 14 in Canada (Statistics Canada, 2020). Mental health disorder incidence in childhood is also a significant driver of inequality, as it impacts educational achievements and later socioeconomic outcomes (Prinz et al, 2018; Currie, 2009; Fletcher, 2014; Currie and Stabile, 2006, 2009). Medication can, however, improve trajectories for children suffering from mental health disorders (e.g.: Dalsgaard, Nielsen and Simonsen, 2014). The long-term costs of unmet mental health needs among younger populations are therefore non-trivial, as are the potential gains from understanding how public policies can help in that regard.

While issues of access to pharmaceutical treatment for mental and non-mental health conditions are observed in a host of countries, our focus is on the Canadian context, where cost-related non-adherence is observed across several drug classes, and non-adherence is most common for mental health drugs (Law et al, 2018). As in the US and in several other jurisdictions, medication and non-pharmaceutical therapies are not universally covered by a public insurance program in Canada and must be paid for out-of-pocket or through private health insurance. However, in 1997, the province of Québec implemented a provincial mandatory pharmaceutical coverage requirement and a public drug insurance plan to provide access to pharmaceutical treatments, free of charge, for all Québec residents without access to a private drug insurance plan (including children without private coverage from their parents). Exploiting this policy change to investigate the impact of public drug insurance on children's likelihood of filing prescriptions for mental health medication has several advantages. First, given the universal single-payer healthcare system in Canada, access to a physician remained constant before and after the implementation of the public drug insurance program, and only the out-of-pocket costs of prescription drugs decreased for patients. Second, the program did not change physicians' financial incentives to see patients, or to choose between

different treatment options (pharmaceutical or not) – factors that have been identified in prior work as determinants of mental health diagnoses and treatment among children (e.g.: Turner, 2015). Finally, healthcare is a Provincial jurisdiction in Canada, and the implementation of the Québec program wasn't similarly matched by other provinces, providing an interesting set-up for a difference-in-differences analysis.

Our results are in line with recent findings in the literature suggesting that public health insurance expansions increase coverage rates, especially among low-income individuals. Those gaining coverage then become more likely to get diagnosed and to use prescription drugs for mental health conditions (Cowan and Hao, 2021; Currie, Stabile and Jones, 2014; Kaplan and Zhang, 2013). In particular, we find that the elimination of out-of-pocket costs for eligible children increased the likelihood of having a pharmaceutical prescription for a mental health condition by three percentage points overall. We further find that these effects are mostly driven by the consumption of stimulants --a medication widely used for the treatment of ADHD.

Nevertheless, one question of crucial importance for policy makers that remains unanswered in the wider literature is whether lower out-of-pocket costs following such expansions lead to moral hazard problems. This might be a cause for concern if the decrease or elimination of financial costs for medication led individuals who derive little or no benefit from a given medication to initiate treatment. This could lead public drug insurance expansions to disproportionately increase public spending relative to their potential impacts in terms of health improvements. Beyond issues of cost, inappropriate or low-value treatment may be undesirable in the long term. For example, recent work has suggested that ADHD medication in adults could have the unintended consequence of reducing new business formation and entrepreneurship (Peltonen, Johansson and Wincent, 2020). To investigate the importance of such phenomena, we estimate treatment uptake specific to a child's predicted underlying mental health risk or severity. To this end, we incorporated an ensemble machine learning estimate of mental health risk within our difference-in-differences design to elicit risk-specific changes in treatment uptake following the implementation of the program. We find that increases in treatment uptake and adherence are concentrated among children who are most at risk of developing severe mental health disorders. Conversely, children in the bottom half of the predicted risk distributions see lower or negligible

changes in treatment uptake, which suggests that moral hazard concerns likely do not outweigh the potential benefits of universal drug insurance programs. These findings contribute to the ongoing public debate on universal pharmaceutical insurance programs as a potential tool to address increasing mental health care needs in children.

2. Background on the Québec public drug insurance program

The Québec Public Drug Insurance Plan (PDIP) was implemented in 1997, after several years of government commissioned research on drug coverage expansion. The focus of the commission was to identify a solution to address the inefficiencies and inadequacies of the existing system of drug coverage. The PDIP required that individuals who could not get private insurance through their employer enrol in the Québec government's basic public plan. Conversely, all employers who provided health benefits to their employees were required to provide private drug coverage that at least met the minimum standards of this basic public plan.

To get coverage from the PDIP, individuals must either be Québec residents who are not eligible for a private plan, be aged 65 and above without a private plan or with a private plan offering only complementary drug coverage, or be a recipient of last-resort financial assistance. Children under the age of 18 are covered by the PDIP free of charge if they do not have access to a private plan through a parent or a job, and those 18 to 25 years old must have no access to a private plan, live with their parents (spouseless), be enrolled in full-time schooling, and must not be absent from Québec for 183 days or more per calendar year. The PDIP has not meaningfully changed since 1997, with the exception of increases in premiums, deductibles, coinsurance rates, and maximum annual contributions. For example, between 1997 and 2017, monthly deductibles increased from $8.33 to $19.45. Importantly for our analysis, these changes did not apply to children, who are covered by the PDIP free of any of these charges.

Perhaps unsurprisingly, the program had a non-trivial impact on the share of Quebeckers with prescription drug coverage. In 1996, prescription drug insurance rates in Québec was 55%, ten points below the average prescription drug insurance rate in the rest of Canada (Currie et al., 2014). While insurance rates increased nationally after1997, Québec saw a much sharper increase in insurance rates, with 84% insured in the year following the PDIP's implementation.

This is in sharp contrast to the rest of Canada, with only a 72% insurance coverage rate after 1997.

3. Empirical strategy

3.1 Baseline model

As discussed in Section 2, the PDIP was an exclusive initiative of the Province of Québec in 1997 that was similarly not replicated in other Canadian provinces in the following years. This Province specific change resulted in out-of-pocket prescription drug costs decreasing disproportionately for patients in Québec compared to the rest of the country after 1997.[2] We exploit this asymmetrical policy change across provinces to implement a difference-in-differences strategy that compares mental health pharmaceutical treatment uptake before and after the implementation of the Québec Public Drug Insurance Plan in 1997, in Québec and in other Canadian Provinces.[3] This empirical approach notably enables us to account for secular trends in children's consumption of prescription drugs for mental health disorders, which has been generally rising at the turn of the 21th century.[4] Equation 1 summarizes our baseline difference-in-differences model:

$$T_{i,t} = \alpha + \beta_1 Que_{i,t} \times Post_t + \beta_2 Post_t + \beta_3 Que_{i,t} + \theta X_{i,t} + \lambda_t + \pi_i + \xi_{i,t} \quad (1)$$

The outcome variable $T_{i,t}$ measures pharmaceutical treatment for individual i in year t, either in terms of uptake of mental health drugs in general, or for specific medication classes of stimulants and tranquillizers.[5] The variable $Post_t$ identifies the observations referring to the period following the implementation of the PDIP in 1997, and Que_{it} identifies individuals residing in the province of Québec. X_{it} contains child-level time varying factors including age, school, and grade fixed effects, family size, family structure, parental education, maternal smoking, maternal depression

[2] This is mainly due to individuals previously not covered by a private insurance regime gaining access. However, the policy reform also led to improvements in the coverage offered by private insurance plans now required to meet the standard of the PDIP.

[3] Currie, Stabile and Jones (2014) use a similar difference-in-differences approach around the implementation of the 1997 PDIP in Québec to study the impact of ADHD medication use on children's academic outcomes and emotional functioning.

[4] This is true in Canada, but similar trends were also observed across several other countries (e.g. Raman et al, 2018 for the case of ADHD).

[5] We also estimate a version of equation (1) in which the dependant variable is the presence of a mental health diagnosis to understand the source of any change in prescription drug usage.

as well as common co-morbidities such as learning or intellectual disabilities, and asthma. We also include interactions between each of these variables and, respectively, Que_{it} and $Post_t$. Finally, we add time and individual fixed effects to the model, λ_t and π_i. Standard errors are clustered at the individual level.

Conditional on the included control variables, interpreting our main coefficient of interest, β_1, as the impact of the PDIP on mental health drugs uptake requires that two assumptions be met. First, parallel trends between Québec and other provinces should be observed, a point that we address in section 5 using event-study specifications. These variations of equation (1) in which $Que_{i,t} \times Post_t$ is replaced by interactions between $Que_{i,t}$ and $\lambda_t$also enable us to investigate the dynamics of the responses to the implementation of the PDIP. It is also worth noting that our empirical work covers a period during which other Canadian provinces made no major health policy changes related to children's prescription drugs insurance coverage, or out-of-pocket costs for (mental health) medication. The second assumption entails that individuals in other Canadian provinces (our control group) be unaffected by the implementation of the PDIP, directly or through general equilibrium effects. A direct impact of the PDIP on Canadians outside of Québec should not be a concern given the residency requirements of the program. As for general equilibrium effects, they are unlikely to arise given that the cost of the additional coverage was absorbed by the Québec government, and not by drug manufacturers such that the latter shouldn't have altered their prices in other jurisdictions to compensate.[6]

3.2 Low-benefit uptake and heterogenous effects across the mental health risk distribution

In addition to understanding the overall average impact of the PDIP on child mental health treatment uptake, one important policy question is the issue of moral hazard in the presence of insurance coverage. Lower out-of-pocket costs for prescription drugs could indeed lead to an increase in consumption among children for whom little benefit is expected. To address this concern, we rely on an ensemble machine-learning model—a gradient boosted tree — that enables

[6] If anything, the drug insurance coverage expansion in Québec may have contributed to increase manufacturers' revenues and profits. If this policy led them to lower their prices, including in other Canadian provinces, it should make it more difficult for us to find any impact using the specification presented in equation (1). We also note that the prices of patented medication in Canada is monitored and regulated by the Patented Medicine Prices Review Board.

us to gauge a child's latent mental health risk by generating a high-dimensional non-parametric prediction of factors leading to diagnosis.

Details of our approach, based on work presented in Furzer (2021), are provided in the appendix. Importantly, extensive information relating to child health, behaviour, parent health, adverse events, and early health endowments is combined to predict diagnoses of any mental health disorder in four main steps: (i) partitioning the data based on covariate values (109 variables, 689 factorized) to create groupings of similar individuals, (ii) comparing each individual's actual current diagnosis for ADHD, anxiety or depression with their group diagnosis rate, (iii) building new trees based on randomly selected observations with a high residual error until the mean squared error was minimized[7], and, finally, (iv) summing across all relevant trees for each individual i. Compared to alternative measures such as behavioural symptom scales derived from the Diagnostic and Statistical Manual of Mental Health Disorders (DSM-V) or general health surveys, our estimated risk measure accounts for the multi-factorial etiology of mental health disorders stemming from hereditary, environmental, biological, and exogenous factors. It also enables us to identify at-risk children who may not fully express symptoms at a given point in time.[8]

The gradient boosted tree is particularly well-suited for predicting relatively rare events like annual mental illness incidence (Galar et al, 2012). While the lifetime prevalence of mental illness is around 20 percent, the annual incidence of child mental health disorders is relatively rare. By incorporating a large covariate set in a non-linear framework, the gradient boosted tree model can also reduce the likelihood that an omitted variable would bias our predicted mental health risk measure. This is helpful since little is still known about the full set of factors associated with mental health vulnerabilities.

Based on the predicted risk measure for each child at the time directly before the implementation of the PDIP, we then generate age-and-sex-standardized risk deciles.[9] To estimate the risk-specific

[7] Following Friedman (2001).

[8] Because of concerns surrounding diagnostic bias (particularly along the dimensions of race, socioeconomics or sex) we include no covariates outside of health-related factors in the prediction. In doing so, we argue we minimize base-rate prediction error. A further discussion is available in the Appendix.

[9] Effects therefore measure the impact of the insurance plan's implementation conditional on pre-PDIP risk. This alleviates the concern that exposure to the Public Drug Insurance Plan may itself impact risk.

impact of the PDIP on treatment uptake, we estimate equation 1 separately for each decile of predicted mental health risk. This stratification provides a measure of how the availability of public drug insurance differentially affected medication take-up for children at different points of the risk distribution.[10]

4. Data

4.1 Sample construction

Our main data comes from the National Longitudinal Survey of Child and Youth (NLSCY). The NLSCY initially surveyed a nationally representative cohort of children and youth aged 0 to 11 in 1994, who were then contacted for follow-up interviews every two years until 2008.[11] Additional respondents were also added to each survey cycle, creating parallel longitudinal and cross-sectional samples. The NLSCY gathers information on children and parental health history, irrespective of their health status.[12] Importantly, the survey also includes the Children's Behavioural Survey (CBS), a DSM-validated scale given to parents of children under the age of 12 to screen for ADHD, anxiety, depression, aggression and pro-social behaviour. Children 12 and older provided self-reported CBS assessments and completed additional questions corresponding to a depression scale and a property offences scale (e.g., child reports having vandalized property).

The NLSCY also collects information on diagnosed ADHD and a general indicator for emotional, psychological and nervous disorders (i.e., anxiety, depression, obsessive-compulsive disorder, conduct disorder) diagnosed by medical professionals. Since mental health disorders frequently overlap in their symptoms and are often diagnosed concurrently, we construct a general mental

[10] Our results, presented in section 5, are robust to estimating an alternative specification in which $Que_{i,t} \times Post_t$ is interacted with a vector of indicators for each risk decile in a single regression. We focus on results allowing all coefficients to vary across risk deciles, but the estimates from this single regression are available upon request.

[11] We choose to focus on the period 1994 to 2008 in order to measure longer-term associations between treatment uptake and the PDIP. However, we acknowledge that treatment of the illnesses we consider has evolved with time in a way that might not be perfectly captured by time fixed effects and that might have impacted the responsiveness of demand to these specific drug classes. For example, Meyerhoefer and Zuvekas (2010) find that the price-elasticity for mental health drugs in the U.S. has increased between 1994 and 2003, potentially as a result of direct-to-consumer advertising. Insofar as these changes are similar across Canadian provinces, they should not be an large source of bias for our estimates.

[12] This is an advantage over other sources of data, which often only include family health histories for children diagnosed with mental health disorders.

health indicator which takes a value of one if a child received any of the above-mentioned diagnoses. This is consistent with the theory that mental health is a continuum of traits over binary disorders (Caspi et al, 2014). Our main treatment indicator is based on reported use of stimulants or tranquillizers, and is set to one for every year after treatment is first reported.[13] We define a mental health drug indicator equal to one for every year following first reported treatment.

Excluding individuals for whom information on mental health diagnosis and prescription drug use is missing, the full sample used to test and train our gradient boosted tree algorithm includes 209,890 total child-year observations, composed of 66,670 individual children from 57,130 households[14], observed on average over four survey cycles. We divide this sample into a training set, used to build and calibrate the model algorithm (105,360 observations and 48,230 children), and a test set for the main analysis (104,530 observations and 18,440 children). A full list of the variables used for predicting mental health risk is available in the Appendix. We construct our main difference-in-differences sample from the test set defined above. From the 105,530 observations over which we generated a predicted mental health risk score, we retain 72,600 (approximately 27,000 children per year) for which the full list of covariates mentioned in Section 3 are non-missing.

One data limitation stems from the fact that we cannot directly observe children's eligibility to Public Drug Insurance Plan in our data. Indeed, some children residing in Québec in our NLSCY sample would have been covered by their parents' private insurance in 1997 and after. These children would thus not have been eligible for PDIP coverage, nor would they have seen their insurance coverage or their out-of-pocket medication costs change as a result of the implementation of the PDIP. Our results estimating equation (1) should therefore be interpreted as quasi-experimental intent-to-treat parameters. Additionally, since some children in our treatment group did not receive any treatment in 1997, our estimates can be thought of as lower-bound

[13] The NLSCY also reports if an individual takes anti-convulsants, which are sometimes used as a mood stabilizer to treat bi-polar disorder, schizophrenia, or borderline personality disorder. We however do not consider anti-convulsants when defining our main treatment variable, given that they are considered off-label use and that we cannot identify which children use them to treat the mental disorders we are interested in as opposed to, for example, conditions such as epilepsy or nerve damage.

[14] All observation counts are rounded to the nearest multiple of 5, in accordance with Statistics Canada disclosure rules.

estimates of the true effects of similar programs among eligible individuals. We also note that the NLSCY contains no information on dosing and non-pharmaceutical treatment. This limits our ability to understand how out-of-pocket treatment cost might impact critical factors for mental health, and to investigate potential substitution effects between medication and other treatment options not covered by the PDIP, such as talk therapy.

Finally, it is important to note that while designed to be nationally representative, 95% of the surveyed child in the NLSCY were non-Hispanic white, which is not representative of the demographic diversity of either Quebec, or the rest of Canada. To the extent that visible minorities face higher unmet care needs (Saunders et al, 2018), we could further think of our results as lower-bound estimates of the true effect.

4.2 Descriptive statistics

Table 1 presents the summary statistics for the four main groups considered in our analysis: children in Québec and children in the rest of Canada, before and after 1997. Before the implementation of the PDIP, 2.11% of children in Québec had received any mental health diagnosis, and 1.44% were taking medication for these conditions. Across all other Canadian Provinces, the corresponding rates were 2.37% and 1.55%, respectively. After 1997, diagnosis rates rose by 8.31 percentage points (to 10.42%) in Quebec, and by 5.38 percentage points (to 7.75%) in other provinces. Rates of medication usage for mental health conditions in Québec rose by 5 percentage points (to 6.44%) over the same period, while the increase was only 2.66 percentage points (to 4.21%) in the rest of Canada. While there were no statistically significant differences in diagnoses of ADHD, anxiety and depression, or asthma before 1997, a statistically significant difference in ADHD diagnoses emerged after the implementation of the PDIP; Québec rates of ADHD increased at a faster rate than in the rest of the country. Use of prescription drugs such as stimulants and tranquillizers in Quebec, which were initially lower, also increased at a faster rate after 1997. At the same time, the prevalence of learning disabilities, which were lower in Quebec, evolved similarly throughout the country. Self-reported maternal depression evolved slightly more rapidly in Quebec, but remained lower than in other provinces. Finally, we note that

household income, already higher in other Canadian provinces before 1997, increased more slowly in Québec over the years covered by our data.[15]

Table 1 – Descriptive statistics by treatment status, before and after the PDIP implementation

	Pre PDIP			Post PDIP		
	Other Provinces	Québec	Difference	Other Provinces	Québec	Difference
Any Mental Health Diagnosis	0.02	0.02	0.003	0.08	0.10	-0.027***
	(0.15)	(0.15)	(0.002)	(0.27)	(0.31)	(0.003)
Prescribed Any Mental Health Medication	0.02	0.01	0.001	0.04	0.06	-0.022***
	(0.12)	(0.12)	(0.002)	(0.20)	(0.25)	(0.002)
ADHD Diagnosis	0.01	0.01	0.001	0.05	0.07	-0.025***
	(0.12)	(0.11)	(0.002)	(0.21)	(0.26)	(0.002)
Anxiety/Depression Diagnosis	0.01	0.01	0.002	0.05	0.00	0.001
	(0.11)	(0.10)	(0.002)	(0.21)	(0.21)	(0.002)
Prescribed Stimulants	0.05	0.03	0.021*	0.04	0.06	-0.023***
	(0.56)	(0.37)	(0.008)	(0.22)	(0.27)	(0.002)
Prescribed Tranquilizers	0.04	0.02	0.021*	0.01	0.01	0.001
	(0.55)	(0.36)	(0.008)	(0.16)	(0.16)	(0.001)
Diagnosed Asthma	0.14	0.14	0.004	0.24	0.24	-0.002
	(0.35)	(0.34)	(0.005)	(0.43)	(0.43)	(0.004)
Prescribed Inhaler	0.11	0.09	0.015	0.15	0.15	-0.004
	(0.60)	(0.44)	(0.009)	(0.38)	(0.38)	(0.003)
Log Household Income	10.62	10.56	0.056***	10.98	10.88	0.098***
	(0.65)	(0.62)	(0.001)	(0.70)	(0.63)	(0.006)
Number of children in Household	2.24	2.10	0.142***	1.86	1.76	0.107***
	(0.96)	(0.89)	(0.015)	(1.13)	(1.07)	(0.010)
Maternal Depression Score	4.78	4.47	0.308***	4.17	3.93	0.233***
	(5.37)	(5.16)	(0.082)	(5.34)	(5.20)	(0.049)
Diagnosed Learning Disability	0.02	0.01	0.010***	0.07	0.06	0.010***
	(0.15)	(0.12)	(0.002)	(0.25)	(0.23)	(0.002)
Child Age	5.84	5.68	0.162**	12.13	12.23	-0.104*
	(3.69)	(3.71)	(0.057)	(5.67)	(5.59)	(0.052)
Predicted risk decile (1-10)	5.42	5.54	-0.113*	5.50	5.58	-0.077**
	(2.86)	(2.88)	(0.044)	(2.88)	(2.87)	(0.027)

PDIP = Prescription Drug Insurance Plan

Table presents mean values and standard errors for key diagnosis and treatment variables as well as key control variables in Quebec and all other Provinces (excluding Territories) before 1997 (Pre-PDIP) and after 1997 (Post-PDIP) and the difference between these two locations. Standard errors on difference presented with significance represented by: + $p < 0.10$; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5. Results

5.1 Predicting mental health risk

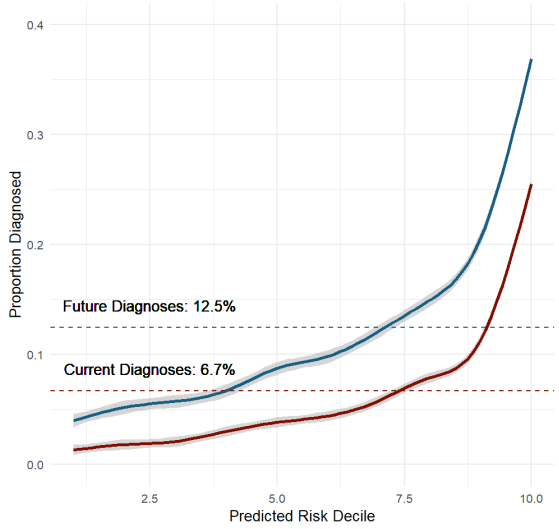
[15] These descriptive statistics suggest that if medication is a normal good, relative income growth in Québec is unlikely to explain the trends observed in terms of mental health drug use before and after 1997.

Latent mental health risk is estimated for each child in our test sample using the procedure described in Section 3. As mentioned, the occurrence of mental health disorders at a given point in time is a relatively rare event in children. This generally leads traditional prediction methods to predict zero or close-to-zero rates of mental health. To compare the value of using machine learning compared to more traditional approaches, we estimate parallel predictions using a standard linear probability model and a logistic regression model in our test sample. We find that the latter are particularly unhelpful in predicting mental health incidence. Using a 0.5 threshold to indicate diagnosis, they predict a mental health disorder rate of zero.

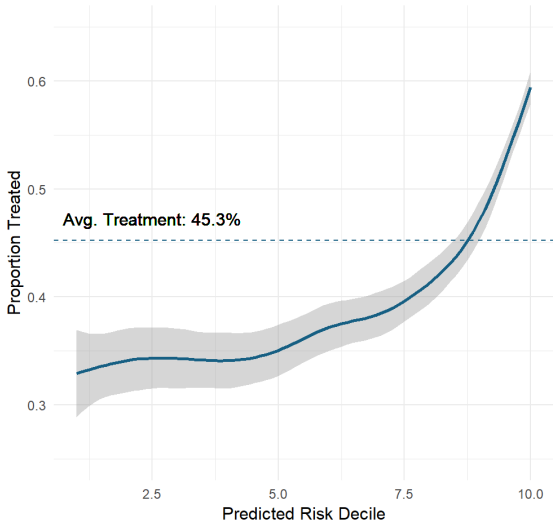
Figure 1 shows that our gradient boosted tree algorithm offers a relatively good performance in terms predicting mental health needs in our test sample. Indeed, there is a strong correlation between the age-standardized predicted risk of mental health incidence, measured in deciles, and realized diagnostic status (either concurrent or observed in future cycles) (Panel A) and treatment status within the diagnosed subset (Panel B). More than half of realized diagnoses in the sample are concentrated in the top two predicted risk deciles, and less than three percent of children in the bottom half of the predicted risk distribution receive a mental health diagnosis. There could be additional concerns that symptoms and risk factors are mitigated among diagnosed children, who may then be predicted to be low risk based on the observed variables entering the algorithm. Figure 1 Panel B plots the proportion of individuals diagnosed with a mental health disorder who report being prescribed a pharmaceutical treatment for their mental health disorder, conditional on individual predicted risk decile, and alleviates such concerns. Indeed, the figure shows that the likelihood of mental health treatment increases with the level of predicted mental health risk.
Overall, although the two measures are positively correlated, our predicted latent mental health risk measure conveys richer information than reported diagnoses. First, it allows us to rank mental health vulnerabilities even within the group of diagnosed individuals. Second, it also captures information on the mental health risk faced by individuals who have not received a diagnosis (either through a lack of access, for stigma reasons, etc.) and who likely face unmet needs.

Figure 1: Treatment Rate by Predicted Risk in Diagnosed Sample

Panel A



Panel B



Notes: Risk deciles are estimated based on a gradient boosted decision tree algorithm of mental health risk across childhood. Shaded region shows 95 percent confidence interval around the risk-conditional proportion treated.

5.2 Treatment uptake and public drug insurance coverage

Having validated our predicted mental health risk estimates, we turn to our main difference-in-differences model. The results from the baseline specifications are presented in Table 2. The first line in the table presents the main difference-in-differences coefficient estimated on our full sample, without regards to predicted mental health risk. The subsequent rows each present the same coefficient but estimated on a stratified sample formed exclusively of children within a single mental health predicted risk decile. We note that results from a single regression in which $Que_{i,t} \times Post_t$ is interacted with indicators for each risk decile yield similar conclusions.[16]

We first present the results when considering the use of any drug for mental health disorders as an outcome. Looking at our full sample, we find that the PDIP had an average impact over the ten years following its implementation corresponding to a 3.3 percentage point increase in the share of children taking at least one form of medication for mental health disorders. Looking at specific drug classes (columns 2 and 3), a strong response (5.6 percentage points) is estimated for

[16] Results available from the authors upon request.

stimulants, a category of drugs used to treat symptoms of ADHD. A smaller (1.9 percentage points) but statistically significant impact is also obtained for the use of tranquilizers.

Table 2: Estimates of Treatment Up Take following the implementation of the Public Drug Insurance Plan Implementation in Québec in 1997 [a]

Treatment Uptake by Decile [b]	Any Treatment	Stimulants	Tranquilizers	Any Diagnosis	Inhalers	N
	(1)	(2)	(3)	(4)	(5)	
Overall	0.033***	0.056***	0.019*	0.039***	0.018	72,660
	(0.006)	(0.011)	(0.009)	(0.007)	(0.012)	
Risk Decile 1	0.026+	0.045	0.020	0.036*	0.020	6,720
	(0.012)	(0.032)	(0.031)	(0.016)	(0.033)	
Risk Decile 2	0.005	0.067**	0.059**	0.007	0.039	6,400
	(0.008)	(0.022)	(0.021)	(0.014)	(0.027)	
Risk Decile 3	0.016	0.042*	0.023+	0.022	-0.004	6,755
	(0.013)	(0.018)	(0.0140)	(0.017)	(0.022)	
Risk Decile 4	0.020+	-0.009	-0.039	0.0343+	-0.040	5,800
	(0.012)	(0.048)	(0.047)	(0.018)	(0.051)	
Risk Decile 5	0.028*	0.054	0.036	0.042*	0.038	6,130
	(0.014)	(0.040)	(0.039)	(0.018)	(0.045)	
Risk Decile 6	0.014	0.011	-0.001	0.023	-0.014	6,495
	(0.013)	(0.031)	(0.029)	(0.017)	(0.032)	
Risk Decile 7	0.002	0.042*	0.026+	0.004	0.028	6,155
	(0.013)	(0.020)	(0.016)	(0.017)	(0.026)	
Risk Decile 8	0.036*	0.058**	0.028+	0.075***	0.042	6,110
	(0.016)	(0.020)	(0.015)	(0.021)	(0.028)	
Risk Decile 9	0.078***	0.082*	-0.006	0.083***	-0.014	6,330
	(0.021)	(0.036)	(0.030)	(0.023)	(0.037)	
Risk Decile 10	0.071**	0.116***	0.028	0.036	0.064*	6,605
	(0.024)	(0.028)	(0.017)	(0.025)	(0.028)	

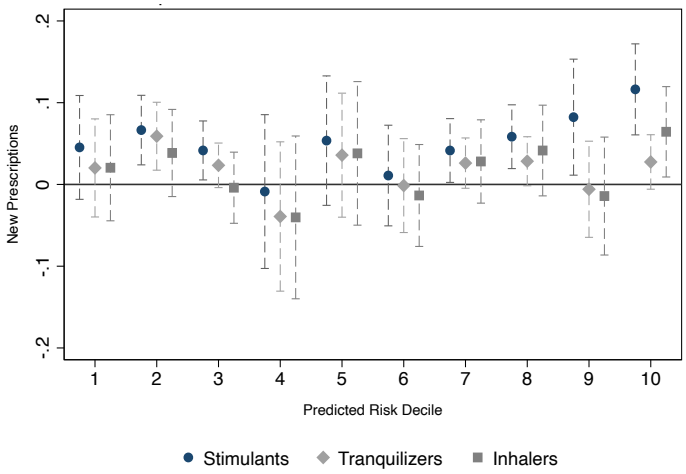
[a] Table presents the estimated effect of being in Québec in the post PDIP period, stratified by predicted risk deciles, and all models include controls for family structure, parental education, maternal smoking and depression. They also include confounder controls for whether the child has a learning disability, their exact age, and year and province fixed effects as well as individual child fixed effects. The treatment group is formed of all children in Québec and the control group is formed of children in all other Canadian provinces. The data used spans the years 1994 to 2008. All N are rounded to the nearest 5. Standard errors clustered at the individual level, with significance represented by: + $p < 0.10$; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

[b] Deciles of predicted risk in 1996 based on gradient boosted decision tree algorithm prediction of mental health risk.

Looking at specific risk deciles, the PDIP caused an increase in children taking at least one prescription drug for a mental health disorder ranging from 3.6 to 7.8 percentage points for children

predicted to be in the top 30% of the mental health risk distribution. Small treatment uptake was observed among lower-risk individuals; however, these associations are generally not statistically significant at the 5% level. Focusing once again on the use of specific mental health medications, we find that uptake in stimulants for individuals in the three top deciles of mental-health risks yields similar, and slightly stronger, patterns than the ones uncovered for mental health drugs more generally. The increase observed among the top three deciles of latent mental health risk ranges from 5.8 to 11.6 percentage points, albeit with a few other smaller but statistically significant increases observed towards the bottom of the risk distribution. These estimates are graphically represented in Figure 2. The same table and figure also highlight that the use of tranquillizers was generally unchanged across the risk distribution. In the top three risk deciles, changes ranged from a 0.6pp decline to a 2.8pp increase. The more muted changes may result from a lower prevalence of diagnosed depression or anxiety among children over the sample period (and in general).

Figure 2: Heterogenous impact of the PDIP on Treatment Uptake across predicted risk deciles, for Stimulants, Tranquilizers and Inhalers

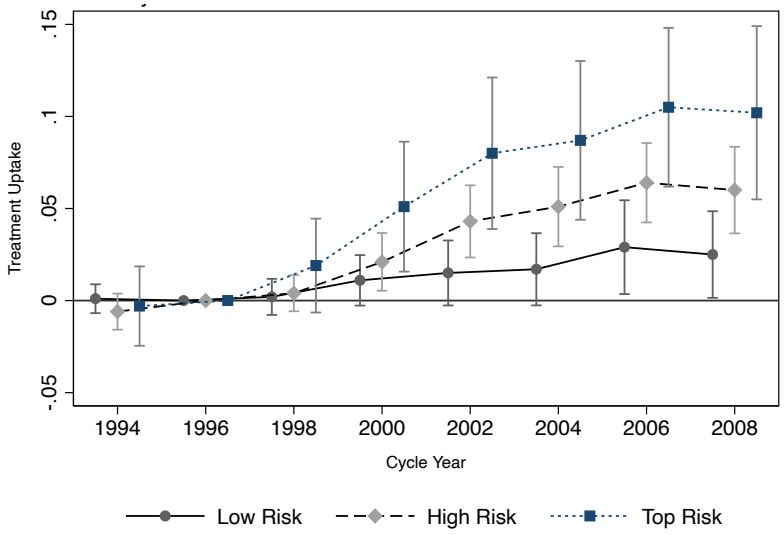


Notes: Risk is estimated using a gradient boosted tree model and measured in 1996, prior to the public drug insurance program. Error bars represent 95% confidence intervals.

The validity of these estimates of course relies on the same parallel trends assumption on which rests the difference-in-differences identification strategy. Figure 3 presents results from event study regressions for three groups: children in the bottom 20% of the mental health risk distribution (low risk), those in the top half of the distribution (high risk), and those at the top 20% of the risk

distribution (top risk).[17] For each group, the estimates for the years preceding the implementation of the PDIP are very close to, and not statistically different from, zero, lending credibility to the parallel trends assumption. While our main estimates speak to the average response to the PDIP in the ten years following its implementation, Figure 3 also highlights a gradual response to the PDIP in Quebec. The magnitudes are coherent with our estimates from Table 2. By 2008, medication uptake had increased by 10.5 percentage points in the top 20% predicted risk. In comparison, increases in the use of mental health medication had increased by a little more than 5 percentage points for children in the top 50% predicted risk, and by a mere 2.5 percentage points for those in the bottom 20% predicted risk. We further note that for almost all years, the estimated impact of the PDIP for the low-risk group is not statistically significant.

Figure 3: New Treatment Uptake Following Public Insurance Expansion, by Predicted Risk



Notes: Low risk (circle) corresponds to the bottom 20% of the risk distribution; high risk (diamond) corresponds to the top 50% of the risk distribution; very high risk (square) corresponds to the top 20% of the risk distribution. Risk rankings are estimated based on a gradient boosted decision tree algorithm of mental health risk across childhood. Error bars show 95 percent confidence intervals.

As highlighted above, the first three columns of Table 2 suggest that the PDIP increased access to medication for children suffering from mental health disorders, especially ADHD. One potential

[17] In the regressions, 1996 is set as the base year.

mechanism through which this could have occurred is that children who already had a diagnosis were unable to initiate or adhere to a pharmaceutical treatment due to lack of financial resources in the absence of an insurance coverage. Another possibility is that the PDIP also led to more mental health diagnoses, and that the newly diagnosed children started using medication. The intuition for this mechanism is that even though physician visits are covered by universal public health insurance in Canada, knowing that out-of-pocket costs for medication would be unaffordable if their children were to be diagnosed by a health professional might have discouraged individuals without drug coverage to seek a mental health diagnosis. Access to a public drug insurance coverage after 1997 might have encouraged parents of eligible children who were previously without drug coverage to consult for their children's mental health needs. As a result, more children could have received diagnoses after 1997 in Québec compared to other Canadian provinces.

Our estimates looking specifically at mental health diagnoses, presented in column 4 of Table 2, suggest that the PDIP led diagnoses to increase by 3.9 percentage points. Interestingly, when estimating the model separately for each predicted risk decile, the main difference-in-differences coefficient is larger and statistically significant for children in the 8th and 9th deciles. The smaller effect and the absence of statistical significance within the 10th decile may be due to the fact that parents of children with most acute needs would likely have had to seek care, even in the absence of the capacity to follow through with treatment post-diagnosis.

Putting these results in context with the estimates from columns 1 to 3 highlights two pathways, each operating at different points of the risk distribution. For children with the highest levels of latent mental health risk (top decile), the estimated increase in medication usage exceeds the increase in diagnoses, which is not statistically different from zero. For these children, the severity of their mental health needs might have required physician visits and a diagnosis might have been unavoidable even in the absence of drug insurance coverage. While they were more likely to obtain diagnoses before the implementation of the PDIP, some of them might not initially have been able to act on the diagnosis with medication, given the high out-of-pocket costs. The implementation of the PDIP would however have facilitated access to mental health medication for this group. Moving lower down the risk distribution, however, the PDIP had a different impact: the removal

of financial barriers to access medication may have led more parents to consult for their children's mental health needs. At lower estimated risk deciles, this increase in diagnoses was not matched by higher mental health drug usage, given the lower expected benefits from that type of treatment among this group.

5.3 Income status and selective eligibility to the PDIP

One alternative explanation for the heterogeneous treatment uptake by initial latent mental health risk is that the PDIP reduced out-of-pocket costs only for children in higher-risk deciles.[18] As mentioned in Section 2, the public program provided mandatory drug insurance coverage to individuals without access to a private plan. However, individuals with access to private drug insurance before 1997 remained obligated to purchase such coverage after the implementation of the PDIP, and thus did not experience important changes to out-of-pocket prescription drug costs for their children as a result of the implementation of the public program. Only Québec residents without access to private insurance would thus experience changes to their out-of-pocket treatment costs because of the PDIP. If characteristics correlated with eligibility for the public plan, based on either lower income or weak employment ties, were also correlated with our predicted mental health risk deciles, our results could reflect a concentration of eligible people higher up in the mental health risk distribution. Indeed, higher-risk children tend to come from less affluent families ($p < 0.001$), despite excluding socioeconomic factors from the risk algorithm.[19]

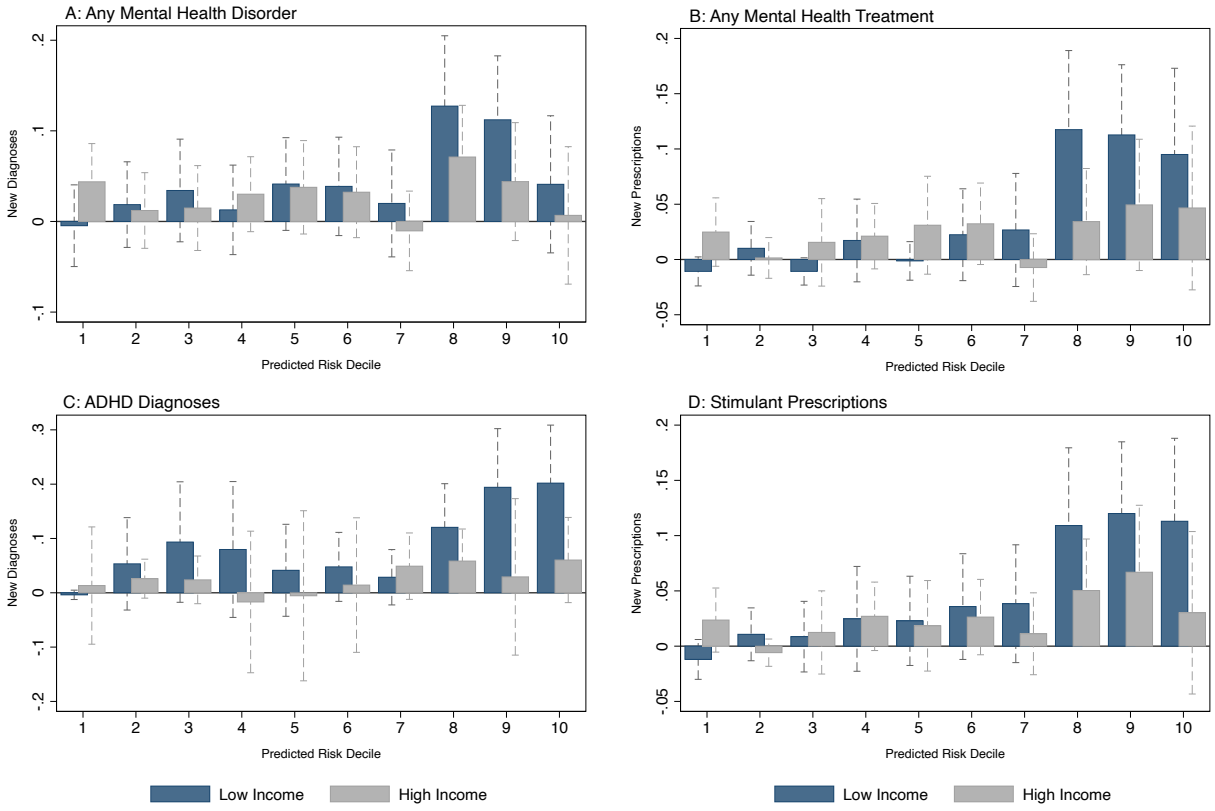
To investigate if our results are driven by this alternative explanation, we re-estimate equation (1) separately for children from families with an income below and above the median in 1996. Results, presented in Figure 4 and in Table 3, show that even within a sample of lower-income children most likely to be affected by the policy treatment, changes in use of mental health medication are concentrated in the top deciles of the mental health risk distribution. Indeed, among low-income children who were less likely to have access to drug insurance prior to 1997, the largest increases

[18] We estimate intent-to-treat effects as we do not observe each individual's eligibility to the Public Drug Insurance Plan.

[19] See Appendix table A1 for a comparison of the observable characteristics of children for whom we predict a low latent mental health risk, and those for whom we predict a high-risk level. The Appendix also contains a detailed discussion of which dependent variables were used in the gradient boosted tree algorithm to construct the predicted risk levels.

to overall treatment uptake after 1997 (between 9.5 percentage points and 11.8 percentage points) can be found in the top three deciles of mental health risks (Fgiure 4, Panel B). Unsurprisingly, we find much more muted and statistically insignificant estimated responses for children from households with above-median levels of income, with increases in treatment uptake ranging from by 3.4 to 4.9 percentage points in the highest mental health risk deciles. Similar, but more stark patterns are observed when focusing specifically on diagnoses for mental health disorders (Figure 4, Panel A) or ADHD (Figure 4, Panel C), or for prescribed stimulants or tranquilizers (Figure 4, Panel D).

Figure 4: Income Stratified New Diagnoses and Treatment Uptake, by underlying mental health risk and income group



Notes: Income and risk are measured in 1996, prior to the PDIP implementation. Risk is estimated using a gradient boosted tree model. Error bars represent 95% confidence intervals.

These results are reassuring for two reasons. First, a positive risk gradient can generally be observed for both lower- and higher-income children, suggesting that the concentration of

responses among high-risk children in Table 2 was not driven by an overrepresentation of families eligible to the PDIP in higher mental health risk deciles in the full sample. Second, among the risk deciles in which we observe statistically significant responses, the estimates for lower-income children are at least twice as large as those for higher-income children. Given that lower-income children are more likely to be eligible to the PDIP, and to see their out-of-pocket costs for medication decrease following its implementation, our income-stratified results thus lend some support to the idea that what we are capturing is the impact of the public drug insurance program

Table 3: Treatment Up Take with PDIP Implementation by Income Level[a]

	Any Mental Health Treatment		**Prescribed Stimulants**		**Prescribed Tranquilizers**	
Risk Decile[b]	Low Income	High Income	Low Income	High Income	Low Income	High Income
1	-0.0108	0.0248	-0.0038	0.0133	-0.0120	0.0236
	(0.0067)	(0.0158	(0.0044)	(0.0551)	(0.0092)	(0.0148)
2	0.0101	0.0014	0.0533	0.0260	0.0107	-0.0059
	(0.0124)	(0.0094)	(0.0434)	(0.0183)	(0.0122)	(0.0063)
3	-0.0108+	0.0155	0.0934+	0.0238	0.0086	0.0124
	(0.0063)	(0.0202)	(0.0566)	(0.0224)	(0.0163)	(0.0192)
4	0.0172	0.0211	0.0797	-0.0169	0.0247	0.0270+
	(0.0191)	(0.0151)	(0.0638)	(0.0665)	(0.0242)	(0.0158)
5	-0.0013	0.0310	0.0414	-0.0055	0.0229	0.0184
	(0.0089)	(0.0226)	(0.0432)	(0.0799)	(0.0206)	(0.0209)
6	0.0224	0.0323+	0.0477	0.0142	0.0358	0.0263
	(0.0212)	(0.0188)	(0.0324)	(0.0632)	(0.0244)	(0.0174)
7	0.0267	-0.0073	0.0286	0.0490	0.0384	0.0112
	(0.0212)	(0.0156)	(0.0260)	(0.0312)	(0.0272)	(0.0189)
8	0.1175**	0.0343	0.1205**	0.0584+	0.1091**	0.0503*
	(0.0365)	(0.0245)	(0.0410)	(0.0301)	(0.0359)	(0.0238)
9	0.1127***	0.0494	0.1942***	0.0293	0.1200***	0.0669*
	(0.0324)	(0.0303)	(0.0551)	(0.0735)	(0.0331)	(0.0309)
10	0.0950*	0.0466	0.2019***	0.0603	0.1130**	0.0302
	(0.0398)	(0.0378)	(0.0545)	(0.0400)	(0.0383)	(0.0375)

[a] Table presents the estimated effect of being in Québec in the post-PDIP period. Results are from specifications stratified by predicted risk deciles and for samples of children with above or below median household income. All models include controls for family structure, parental education, maternal smoking and depression. They also include controls for whether the child has a learning disability, their exact age, and year and province fixed effects as well as individual child fixed effects. All N are rounded to the nearest 5. Standard errors are clustered at the individual level: + $p < 0.10$; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

[b] Deciles of predicted risk in 1996 based on gradient boosted decision tree algorithm prediction of mental health risk.

5.4 Comparing Treatment Uptake in Mental versus Physical health

As a final step, we investigate potential differences in the price sensitivity of mental health treatments compared to that of medication for other common childhood disorders. Asymmetric responses across classes of drugs could indeed be expected for a few reasons. First, the symptoms of physical illnesses are often less subjective, and the expected impact of medication can be less uncertain, with higher perceived (or easier to gauge) benefits and fewer perceived harms from treatment. Second, stigma often act as a non-pecuniary cost of receiving an appropriate diagnosis and initiating or maintaining treatment for mental health disorders (Link and Phelan, 2010). By lowering the monetary costs associated with medication, the PDIP may have enabled benefits to surpass total (monetary and non-monetary) treatment costs only for children with higher mental health risks. The perceived benefits for physical health medication might, on the other hand, have already been greater than its out-of-pocket costs, even before the implementation of the PDIP.

Column 5 of Table 2 shows the results from our main empirical specifications, with use of inhaler products as a dependent variable. Our estimates suggest that the PDIP was associated with a change in inhaler prescription drugs ranging from a 1.4 percentage point decline to a 6.4 percentage points increase for children in the top three deciles of predicted mental health risk or severity. These increases are overall small and not statistically different from zero, pointing to a higher price elasticity for mental health medication.

6. Conclusion

This paper presents evidence that mental health medication uptake responds to out-of-pocket prices, especially for children with greater underlying vulnerabilities. Our findings, based on the implementation of a public drug insurance plan in Quebec, Canada, in 1997, align well with common economic principles and with prior work in the Canadian and US contexts[20]: a decrease in out-of-pocket costs increased the volume of treatment demanded. Our intent-to-treat estimates indicate that ADHD treatment are exceptionally responsive to changes in insurance coverage and out-of-pocket costs, with an elimination of out-of-pocket costs leading to a 5.6 percentage points

[20] See, for example, Baicker et al (2017), Wen, Druss and Cummings (2015) or Kozloff and Sommers (2017), Meyerhoefer and Zuvekas (2010), Borrescio-Higa (2015), Ghosh, Simon and Sommers (2018), Kaplan and Zhang (2013).

increase in stimulant take-up. Conversely, similar changes are not observed when looking at medication for asthma, highlighting the relative importance of financial barriers to treatment for mental health compared to other physical health disorders common in childhood. Given the stigma associated with mental health disorders compared to most physical health conditions, both pecuniary and non-pecuniary costs are likely weighed against expected benefits of diagnosis and treatment. Reducing out-of-pocket costs could therefore prove to be a non-negligeable way of addressing issues of undertreatment and of non-adherence to treatment for these disorders.

Looking at the impact of the Québec public drug insurance program on the rate of mental health diagnoses among children, we also find evidence that is in line with previous estimates of negative cross-price elasticities between mental health drugs and medical visits (Meyerhoefer and Zuvekas, 2010). Indeed, our results suggest that reducing out-of-pocket costs for medication to zero led to a little more than a three percentage points increase in the rate of mental health diagnoses in children, suggesting that treatment affordability may be a determining factor in families seeking medical help for their child's mental health challenges.

Importantly, our findings provide new evidence that reducing the out-of-pocket price of prescription medication for mental health disorders is unlikely to be associated with moral hazard effects resulting in over-treatment or low-benefit care. We find that a broad reduction in out-of-pocket costs caused little to no change in prescription drug usage for children with a low predicted risk of mental health issues, who would likely obtain little benefit from care. However, non-trivial responses were concentrated in children for whom the predicted mental health risk was among the highest. Seeing treatment uptake concentrated in high-risk individuals suggests that, even if benefits of treatment likely increase with risk or severity, the costs of mental health medications before the PDIP were prohibitively high, acting as a barrier to treatment. Thus, despite their role in lowering treatment costs, we find that public drug insurance plans do not necessarily lead to low-benefit over-treatment due to either patient demand (moral hazard) or supplier-induced demand.

These results have direct policy implications for broad or potentially universal drug coverage policies that ease barriers to diagnosis and treatment for mental illness in childhood. Commonly

expressed concerns, including in the U.S. in the context of Medicaid, often raise the hypothesis that coverage for mental health treatment may lead to unsustainable increases in the cost of large-scale public insurance plans (Frank and McGuire, 2000), notably because of moral hazard concerns. That the availability of a public drug plan increased mental health drug use only for individuals with more severe needs suggest that such a policy's impact is concentrated among those for whom under- or inconsistent treatment is likely to result in higher private and social cost, both in the short and long run (Silva et al, 2014). Furthermore, unlike studies looking at the extension of existing coverage as children age out of parents' private plans, our study offers insight into the behavioural response from an expansion to previously uninsured populations. In contrast to studies of children enrolled in Medicaid or State Child Health Insurance Programs, who tend to be disproportionately low income (Hamersma and Ye, 2021; Chorniy et al., 2018), our results are from a nationally representative sample of children. This sample strengthens the generalizability of these findings in the context of various policy discussions around broader access to prescription drug coverage or moving towards a universal coverage plan.

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