The Long-Term Externalities of Short-Term Disability Insurance*

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Abstract

This paper shows that employer-provided short-term disability insurance (STDI) increases long-term disability insurance (LTDI) take-up and imposes a negative fiscal externality on the government budget. Expanding private STDI has been touted as a way to lower public LTDI costs by giving employers a financial incentive to provide workplace accommodations. But private STDI can also raise public LTDI costs, since STDI generates moral hazard by providing benefits during the waiting period for LTDI. Using variation in private STDI coverage caused by Canadian firms ending their plans, I find that the moral hazard effect dominates and private STDI raises two-year flows onto LTDI by 0.07 percentage points (33%). Extrapolating to Canada's entire population, private STDI generated 18,300 LTDI recipients and CA$230 million dollars (5%) of public LTDI spending in 2015. The efficient Pigouvian tax on Canadian private STDI that internalizes this externality is approximately CA$35 per insured worker.

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1 Introduction

Multiple insurance programs insuring the same risk impose externalities on each other when they generate moral hazard (Pauly 1974). In general, private insurance plans that supplement public insurance generate negative fiscal externalities because supplemental benefits increase moral hazard and therefore increase public insurance costs (Cabral and Mahoney 2018). The externality imposed by employer-provided short-term disability insurance (STDI) on government-provided long-term disability insurance (LTDI) could be especially large, since more than a third of American and Canadian workers have private STDI coverage and public LTDI is one of the largest government transfer programs, with 2016 expenditures exceeding $145 billion in the U.S. and CA$4 billion in Canada.[1] But economic theory is ambiguous as to whether private short-term disability insurance generates a positive or a negative fiscal externality, and there is little empirical evidence on the magnitude or even the direction of this externality.

On the one hand, long-term disability insurance uses a waiting period as a form of cost-sharing and short-term disability insurance pays benefits during this waiting period, which should increase moral hazard among disabled workers and increase flows into long-term disability. On the other hand, employers paying for private short-term disability benefits internalize some of the cost of their employees' disabilities and have an added financial incentive to offer workplace accommodations, which should decrease flows into long-term disability. Both academics and insurers have speculated that the effect of increased accommodation will dominate increased moral hazard and reduce long-term disability rates (Autor and Duggan 2010; Great-West Life 2018).[2] But the net effect remains theoretically ambiguous, and must be measured empirically.

This paper provides quasi-experimental evidence quantifying the externality from employer-provided STDI onto public LTDI. Measuring this externality requires two ingredients: data linking private STDI coverage with public LTDI take-up, and a research design generating variation in STDI coverage that is exogenous from LTDI risk. Prior work using US survey data has been limited along both dimensions and yielded inconclusive results, leading its authors to conclude that new data

[1] Private STDI coverage and public LTDI expenditures for the U.S. and Canada are reported by Monaco (2015), ESDC Evaluation Directorate (2016), Social Security Administration (2018), and ESDC (2015).

[2] Autor and Duggan (2010) propose that a system of universal private STDI for the United States "should ultimately reduce total employee and employer disability insurance costs by assisting some workers with work-limiting disabilities to remain in the labor force rather than becoming long-term beneficiaries of the [LTDI] system". One of the three largest private insurance companies in Canada claims that "products like [...] Short Term Disability allow us to intervene early, help support shorter claim durations and prevent long-term disability claims" (Great-West Life 2018).

is required (Autor et al. 2013). I construct a new dataset of linked Canadian administrative tax and benefits records to study quasi-experimental variation in STDI coverage. These administrative records allow me to observe STDI coverage linked to LTDI take-up for the full population because Canada offers a payroll tax rebate for employer-provided STDI that is unique within the OECD (HRSDC 2009). I identify the causal effect of private STDI coverage by comparing public LTDI receipt among employees whose firms have just ended their STDI plans to employees of firms that are about to end their STDI plans. I show that these two groups of employees are nearly identical on observables and that the timing of firms ending their STDI plans is uncorrelated with the observable health and socioeconomic characteristics of their employees.

I find that employer-provided STDI raises two-year flows onto LTDI by 0.07 percentage points, an increase of 33%. This result implies that the moral hazard response to increased benefits during the waiting period dominates the effect of any increased workplace accommodations associated with STDI. Employer-provision of STDI therefore imposes a negative fiscal externality on the government budget for LTDI. Extrapolating from my quasi-experimental sample to the full Canadian population, I estimate that if Canadian employers had not provided STDI during the 15 years between 2000 and 2014, there would be 18,300 fewer LTDI recipients in 2015 and government expenditures on LTDI would be CA$230 million dollars (5%) lower.

I estimate that the efficient Pigouvian tax on private STDI, which would make private insurers internalize the externality they impose on the public LTDI budget, is approximately $35 per insured worker per year. The Canadian government already operates a Pigouvian subsidy for private STDI as part of a system of universal public STDI with optional private provision. Canadian employers who provide private STDI become the first payer of STDI benefits and can receive a payroll tax rebate equal to the expected savings they generate for the public STDI budget. These Pigouvian subsidies average $150 per insured worker, and would be reduced by 23% if they incorporated the negative fiscal externality on the public LTDI budget. The implied tax rate on private STDI premiums would be less than 23% because private STDI plans are more generous than public STDI, so the cost of private STDI exceeds the reduction it generates in public STDI spending.

The evidence in this paper can inform active policy discussions. In response to rapid growth in public LTDI expenditures in the United States, Autor and Duggan (2010) proposed that universal private STDI would result in more workers with work limitations receiving assistance and returning

to work and thereby reduce long-term disability rates and expenditures. This paper shows that the opposite is true, and that expanding private STDI would increase public LTDI spending. This negative fiscal externality is not only relevant to private provision of STDI. Only five states in the U.S. currently provide universal STDI and only 25% of workers outside those states have STDI coverage.[3] Additional state governments mandating universal STDI would impose a negative fiscal externality on the Social Security Administration trust fund and the federal budget. Within Canada, the federal government spends roughly CA$2.4 billion per year on universal public STDI and payroll tax rebates to employers offering private STDI plans (CEIC 2018). Policy changes to the benefit levels or coverage of public or private STDI in Canada would not only impact their own program cost, but affect the much larger CA$4 billion spent per year on public LTDI (ESDC 2015).

This paper contributes to a small but growing literature studying how disability insurance design affects disability rates. The most directly related research is a 2013 working paper by Autor et al. measuring the effect of employer-provided STDI coverage on LTDI take-up using state-by-sector variation induced by five U.S. states with universal STDI. Their initial findings show that private STDI lowers LTDI receipt, opposite to the findings of this paper, but Autor et al. show that their identification assumptions do not hold and "caution against viewing the current results as reliable". More broadly, my results are consistent with the finding that longer waiting periods for LTDI reduce the number of LTDI claims (Autor, Duggan, and Gruber 2014), as private STDI generates variation in benefit levels during the waiting period rather than the length of the wait. The STDI policies studied here create financial disincentives to work during the waiting period for LTDI and raise LTDI receipt, which is consistent with research showing that reducing the financial disincentive to work while receiving LTDI induces recipients to return to work (Kostol and Mogstad 2014). There is also evidence that when employers face experience-rated LTDI premiums, LTDI take-up falls among their employees (de Groot and Koning 2016). My results imply that the positive incentive effects for employers of experience-rated private STDI are dominated by the negative incentive effects for employees of a more generous STDI benefit.

This paper also adds to a broader literature on externalities in overlapping insurance markets. Public insurance programs crowd out private coverage in many insurance markets, such as health insurance (Cutler and Gruber 1996) and long-term care insurance (Brown and Finkelstein 2008).

[3]The five U.S. states with universal STDI are California, Hawaii, New Jersey, New York and Rhode Island. Puerto Rico also provides universal STDI.

When insurance programs insure a related risk but are mutually exclusive (such as unemployment insurance, disability insurance, workers compensation and cash welfare), there is extensive evidence that changes in the generosity of one program affect take-up and expenditures in the others (e.g. Campolieti and Krashinsky 2003; Koning and Vuuren 2010; Staubli 2011; Borghans, Gielen, and Luttmer 2014). The spillovers between private STDI and public LTDI studied here are a case of insurance programs that overlap but are supplementary rather than exclusive. Theoretical work by Pauly (1974), Golosov and Tsyvinski (2007) and Chetty and Saez (2010) explores the "multiple dealing" externality in this setting, when multiple insurers simultaneously insure the same risk but do not internalize the cost of the moral hazard that their insurance imposes on other insurers. Cabral and Mahoney (2018) quantify this externality in the market for elderly health insurance in the US, showing that private Medigap plans increase public Medicare expenditures 22% by insuring the out-of-pocket costs generated by Medicare's cost sharing. Analogous to Medigap, private STDI insures the cost-sharing provisions of public LTDI. But private STDI is unique because it interacts with a two-sided labor market, reducing the financial incentive for disabled employees to work while increasing the financial incentive for employers to accommodate disabled employees. This paper shows that the net externality of private STDI is negative, increasing the number of LTDI recipients and LTDI costs.

The paper proceeds as follows. Section 2 describes the institutions of Canadian STDI and LTDI and the data that I use to study them. Section 3 explains how I implement the quasi-experimental research design and the assumptions required for it to identify a causal effect. Section 4 presents the results on how private STDI affects take up of LTDI, then uses the results to calculate the efficient Pigouvian tax on private STDI. Section 5 concludes.

2 Institutions and Data

2.1 Short-Term Disability Insurance in Canada

This paper measures the effects of employer-provided private STDI relative to the less generous universal public STDI coverage provided by Canada's EI Sickness program. All Canadian workers

have short-term disability insurance, with a mix of public and private provision.[4] Employers select which groups of employees to enroll in private STDI and participation in a private STDI plan is mandatory when offered: individual workers may not opt out. Workers with employer-provided STDI remain eligible for the public EI Sickness program but their private insurance is the first payer of benefits: any private benefits received are deducted one-for-one from EI sickness payments. Private STDI therefore provides benefits at least as generous as EI Sickness, but typical private insurance benefits are much more generous. According to a 2007 survey by the Canadian federal government, the average employer-provided plan had a replacement rate of 70% and the average duration of a private STDI spell is 20 weeks, compared to a replacement rate of 55% and an average duration of 9.5 weeks on EI Sickness (HRSDC 2009). Private STDI plans also offer additional ancillary services to assist employees in returning to work, unlike the public EI Sickness program which only provides monetary benefits (Meredith and Chia 2015).

I measure private STDI coverage using administrative tax data by observing participation in Canada's Premium Reduction Program (PRP), which offers payroll tax rebates to employers providing private STDI benefits that meet government-set adequacy criteria. 36% of Canadian workers receive private STDI coverage with a PRP rebate (Appendix Table 1). The PRP is a Pigouvian subsidy, allowing employers to internalize the positive fiscal externality of their private STDI plans on the government's public STDI budget. Private STDI plans reduce the costs of public EI Sickness benefits because EI Sickness is the second payer with respect to private benefits. The payroll tax rebate for the PRP is calculated each year as the actuarially fair rebate given the anticipated cost reductions for the government in four different categories of private STDI generosity, with no experience rating of firms (Office of the Chief Actuary 2014). In 2014 the Canadian government paid $854 million in PRP payroll tax rebates for 5.7 million workers with private STDI, an average of $150 per worker (Appendix Table 3 and CEIC 2018).

The Canadian institutional setting will generate a more positive fiscal externality from private STDI to public LTDI than a comparable setting without universal public STDI. Canadian workers with

[4]The public EI Sickness program provides STDI benefits to Canadians who have worked at least 600 hours in the previous 52 weeks and are "unable to work because of sicknss, injury or quarantine". After obtaining a medical certificate signed by a doctor and waiting two weeks (one week as of 2017), they are entitled to up to 15 weeks of benefits, with a 55% replacement rate up to a monthly maximum benefit ($2,360 per month in 2017). EI Sickness benefits are financed by a payroll tax up to the maximum insurable earnings ($51,500 in 2017). The EI payroll tax rate is actuarially adjusted each year to break even: the rate is set so that projected revenues cover projected expenditures and eliminate the surplus or deficit accumulated due to past deviations from the projections (Office of the Chief Actuary 2014). All employers and employees pay the same rate, with no experience rating or risk adjustment.

private STDI receive some additional insurance, because private STDI plans are more generous than the public STDI program. The negative component of the fiscal externality reflects the moral hazard generated by the difference between public and private insurance. But private employers and private insurers collectively bear the full cost of the private STDI benefits they provide and the full rewards of reducing their STDI expenditures by assisting employees in returning to work. Therefore the positive component of the fiscal externality reflects the behavioral response of firms to the full private STDI insurance benefit.

2.2 Long-Term Disability Insurance in Canada

The effect of private STDI on receipt of public LTDI benefits will include Canadians with private LTDI coverage since Canada's public LTDI program is the first payer of benefits: receipt of private LTDI benefits does not affect eligibility or benefit amounts for public LTDI. All Canadian workers with a sufficient work history are eligible for Canada (or Quebec) Pension Plan Disability (CPP-D) benefits if they develop a "a severe and prolonged disability that renders [them] incapable of regularly pursuing any substantially gainful occupation" (HRSDC 2011). 56% of Canadian workers have additional private LTDI coverage, typically provided through their employer (Canadian Life and Health Insurance Association 2017). All private LTDI plans require their beneficiaries to apply for CPP-D if they are eligible, then deduct CPP-D benefit payments from private LTDI benefits for successful applicants. Private insurers are able to share information with the government: if a private LTDI beneficiary is eligible for CPP-D and refuses to apply their insurer will deduct the amount of CPP-D they would receive if successful from their private benefits.

Private STDI benefits generally transition seamlessly to LTDI benefits, while workers without private STDI coverage often face a gap in benefits between the expiration of STDI benefits and the beginning of LTDI benefits. Nearly all Canadian workers with private STDI also have private LTDI coverage, and the private plans are typically aligned so that there is no gap in benefits when a worker is eligible for LTDI (HRSDC 2009). By contrast, EI Sickness benefits expire 17 weeks after the onset of the disability and CPP-D benefits start no earlier than 4 months after the onset of the disability, but often much later due to processing times and appeals (Meredith and Chia 2015). Even if they have private LTDI coverage, workers on EI Sickness may face a 9 week gap since private LTDI plans typically start paying benefits either 17 or 26 weeks after the onset of a disability.

Eliminating the "medium-term" gap in disability benefits could be an important mechanism for why private STDI raises LTDI take-up, although I am unable to isolate the effect of this specific mechanism.

2.3 Data Sources

I measure private STDI coverage and public LTDI receipt for all Canadians from 2000 to 2015 using linked administrative tax and benefits records. I link employees to their employers and measure employment rates and employment earnings using T4 tax slips, which are similar to W-2 tax slips in the U.S. and observed for both tax filers and non-filers. I define employers using their 9-digit Business Number, which is assigned by the Canada Revenue Agency and used in all tax filings.

I define a worker as having private STDI coverage in a given year if they received a T4 tax slip with a PRP payroll tax rebate for private STDI from any employer. In practice, some workers have private STDI coverage from employers that have not registered for the PRP tax rebate. This measurement error is minimal in my quasi-experimental sample, since I study employees of firms that were aware of and participating in the PRP tax rebate then chose to end their participation. To the extent that some workers continue to receive unobserved private STDI from other employers, this would attenuate my results. However this measurement error severely attenuates the results from conducting the reverse quasi-experiment, because I cannot reliably observe the timing of firms *starting* their private STDI plans as I do for firms *ending* their private STDI plans. Many firms likely start offering private STDI plans in the years before they take up the PRP tax rebate. I discuss this issue in detail in Appendix A.1.

I observe public LTDI receipt using T4A(P) tax slips issued by the government to all recipients of CPP-D and QPP-D public LTDI benefits. I observe age and sex using T1 tax returns for workers who filed their taxes in any year, which includes more than 99.9% of my sample (Appendix Table 1). I observe industry of employment as a 2-digit NAICS code for each employer and define it for each worker as the industry from which they derived the most earnings in a given year.

In some robustness checks I use inpatient hospitalization data, which I observe for all acute care hospitals outside Quebec and Manitoba. These hospital records are drawn from the Discharge Abstract Database and have been reliably linked to the tax records, as described in Sanmartin et

al. (2018). Outpatient visits to the hospital and emergency room visits that did not result in an admission are not included in the database. I exclude admissions for childbirth and exclude all residents of Quebec, Manitoba and the northern territories (who sometimes travel to Quebec and Manitoba for care) when studying hospitalization.

Statistics Canada protects individuals' privacy during the linkage process and subsequent use of linked files. The data linkage was approved by Statistics Canada's Executive Management Board, and its use is governed by Statistics Canada's Directive on Record Linkage (2017). The files used in this analysis had no personal identifiers, and all data processing was performed on a secure server onsite at Statistics Canada in Ottawa, Ontario.

3 Empirical Methods

When firms choose to start or stop offering STDI plans they cause a sudden change in private STDI coverage for their incumbent workers. This section describes a quasi-experimental research design that uses the timing of firms ending their STDI plans in order to estimate the causal effect of employer-provided STDI coverage on LTDI take-up rates. Firms' decisions to offer STDI may be endogenous to LTDI rates if firms are responding to anticipated changes in their employees' health or changes in labor market conditions, and I address these concerns below.

3.1 Ideal Experiment

This paper seeks to identify the causal effect of employer-provided STDI coverage on subsequent LTDI take-up:

$$\mathbf{1}(\text{LTDI Receipt})_{i,t+1} = \beta \cdot \mathbf{1}(\text{Employer STDI Coverage})_{it} + \theta \mathbf{X}_i + \varepsilon_i \tag{1}$$

where $\mathbf{X}_i$ is a vector of individual controls. The ideal experiment to identify the causal effect β would involve randomly assigning which employers are allowed (or prohibited) to provide their employees with private STDI. Employers randomly allowed to provide private STDI would then endogenously select the set of their employees to receive private STDI coverage, as all Canadian

employers do presently. The causal effect of private STDI coverage would be identified by observing subsequent LTDI take-up while using the random assignment as an instrument for private STDI coverage.[5]

Estimating equation (1) using cross-sectional variation in STDI coverage while controlling for observable differences in worker and firm characteristics is unlikely to identify a causal effect. Workers with private STDI coverage from their employers are very different from those without private STDI: they are older, have higher incomes, and are concentrated in large firms and specific industries (Table 1). Workers with private STDI coverage likely differ in unobservable ways as well. For example, employers may be more likely to offer STDI when their employees are healthier than average and when tight labor markets prompt investments in attracting and retaining employees. Both good health and tight labor markets are associated with lower LTDI take-up (Black, Daniel, and Sanders 2002). In practice, the estimated effect β in a linear probability regression of equation (1) is highly sensitive to the set of controls included (Appendix Table 2).

3.2 Quasi-Experimental Design

I approximate the ideal randomized experiment using a quasi-experimental research design that isolates variation in STDI coverage generated by the timing of employers ending their STDI plans. The causal effect of STDI coverage on LTDI take-up rates is identified by comparing the difference in LTDI receipt between workers whose employers just ended their STDI plans and workers whose employers still provide STDI plans but are about to end them. The intuition for this quasi-experiment is that these two groups of workers are similar to each other except for the precise timing of their firm choosing to end its STDI plan, and that the timing of firms ending their STDI plans is as good as random within a narrow time interval. The remainder of this section explains how this quasi-experiment is implemented and the identification assumptions required to estimate a causal effect.

I define a firm as ending its STDI plan if the firm provided STDI coverage to some or all of its employees during three consecutive years, then continued to operate but covered none of its

[5] Randomly selecting which employers are allowed to provide private STDI will identify the local average treatment effect of private STDI among employees who are endogenously chosen by their employers to receive private STDI. This is equal to the average treatment effect of private STDI under current Canadian policy. If private STDI has heterogeneous treatment effects, this may not be equal to the average treatment effect of private STDI in a counterfactual setting with employers mandated to provide private STDI to all employees.

employees with STDI in the subsequent three years. By this definition, 5801 Canadian firms ended their STDI plans between 2003 and 2014, ranging from 300 to 670 in a single year.

I consider an employee to be *treated* if they were employed by a firm during the last year it offered STDI coverage and the first year it offered no STDI coverage, which are defined as relative years 0 and 1. An employee is considered treated regardless of whether they were among the employees who actually received STDI coverage from their employer in relative year 0, since the subset of employees assigned to STDI coverage by the firm is potentially endogenous.[6] I construct a group of *control* employees who were employed by a different firm during relative years 0 and 1, and whose firm ends its STDI coverage in relative year 3, two years after the treated employees' STDI coverage was ended. Workers in the control group are included in the treatment group two cohorts later if they remain employed at the same firm. I restrict the sample to workers ages 25 to 59 who have sufficient earnings in the previous six years to qualify for public LTDI (as shown in Appendix Table 1).

Because of the precise year in which they ended their STDI plans, the employers of the treatment group did not have private STDI plans during relative years 1 and 2 while the employers of the control group continued to have private STDI plans until relative year 3. Yet the treated and control employees are very similar in other ways. By design, both the treated employees and the control employees were employed during two consecutive years by a firm that chose to provide STDI to some of its employes for at least three years, then chose to stop providing STDI. Table 1 shows that this design generates a treatment group and a control group that are nearly identical in observable characteristics, despite the fact that the characteristics of the full set of employees with and without private STDI differ substantially in the cross-section.

This quasi-experiment identifies the causal effect of STDI coverage on LTDI take-up if the timing of firms ending their private STDI is uncorrelated with their employees' risk of long-term disability. This identification assumption is required to ensure that the control group forms a valid counterfactual for the treatment group: i.e. if the firms in the treatment group had not ended their private STDI, then the treated employees would have had the same LTDI rates as the control employees. The assumption that the timing of an event is as good as random within a short time horizon is used in

[6]It would be troubling if the estimated treatment effect of private STDI were driven by the employees who did not have private STDI in relative year 0. I therefore replicate the baseline estimates (shown in Table 2) for the subsample of employees who endogenously had private STDI in relative year 0 (shown in Appendix Table 4), finding nearly identical results.

many empirical research designs (e.g. Fadlon and Nielsen 2017; Deshpande and Li 2017). But this assumption would certainly be violated if firms end their STDI coverage because their employees' health is deteriorating, thereby raising the costs of providing insurance. It might also be violated if firms end their STDI coverage during poor economic conditions, as a cost-cutting measure or because they don't need to offer benefits to attract and retain employees. Since poor health and poor economic conditions are both associated with increased LTDI take-up, both of these channels would bias the results toward finding that LTDI rates are higher when firms end their STDI plans (Charles, Li, and Stephens 2017). But in the results below I find the opposite: LTDI rates decrease when firms end their STDI plans. I also show in Section 4.2 that hospitalization rates and employment rates are similar in the treatment and control groups throughout the sample period and cannot explain the divergence in LTDI rates.

The key limitation of this research design is that, because the control group becomes treated two years later, I can only identify the effect of employer-provided STDI on LTDI receipt during the subsequent two years. This limitation reflects a trade-off between the similarity of the treatment and control groups and the length over which outcomes can be measured, and it is a limitation common to all research designs that use future treatment groups to form a counterfactual (Fadlon and Nielsen 2017). In order to observe the effect of employer-provided STDI coverage on LTDI receipt over T years, I would need to construct a control group of employees during relative years 0 and 1 whose firm ends its STDI plan in relative year T.[7] But firms grow and change their activities over time, and many employees leave over time. As the choice of time horizon T increases, the employees in the treatment and control groups become less comparable, the first stage effect becomes weaker, and the sample size shrinks. I therefore focus on estimating the causal effect of employer-provided STDI on LTDI receipt in the subsequent year using the shortest time horizon ($T = 2$) with the most credible control group. In Section 4.3 I extrapolate from my estimates of the impact of STDI on the short-run flow onto LTDI to its impact on the long-run stock of LTDI recipients, in order to discuss the implications of STDI for the government budget.

[7]Since the treatment group is employed in relative years 0 and 1, I cannot construct a control group conditioning on employment after relative year 1. Employment is an outcome which is negatively correlated with LTDI receipt, so conditioning on its value in the post-period would bias the results.

3.3 Instrumental Variables Implementation

An IV regression using the quasi-experimental sample recovers the effect of private STDI coverage on public LTDI take-up. I instrument the endogenous STDI coverage regressor from equation (1) using an indicator for treatment by an employer ending its STDI plan. The first stage regression estimates the effect of the employer ending its STDI plan on its employees' STDI coverage rate in relative year 1:

$$\mathbf{1}(\text{Employer STDI Coverage})_{i,t=1} = \pi_1 \cdot \mathbf{1}(\text{Treated})_i + \theta_1 \mathbf{X}_i + \varepsilon_i \tag{2}$$

The reduced form regression estimates the effect of the employer ending its STDI plan on its employees' LTDI receipt in relative year 2:

$$\mathbf{1}(\text{LTDI Receipt})_{i,t=2} = \pi_2 \cdot \mathbf{1}(\text{Treated})_i + \theta_2 \mathbf{X}_i + \varepsilon_i \tag{3}$$

The IV estimate of the effect of employer-provided STDI coverage on LTDI receipt is $\beta = \frac{\pi_2}{\pi_1}$.

To assess statistical significance I construct bootstrapped standard errors by resampling firms, since the quasi-experimental variation occurs at the firm-level. For each bootstrap draw I construct a new sample of 5801 firms by drawing with replacement from the 5801 firms that ended their STDI plans between 2003 and 2014, then construct the treatment and control groups of employees as before. I perform 100 bootstrap replications for all standard error estimates.

4 Results

4.1 Impact of Employer-Provided STDI on LTDI Take-Up

When a firm stops providing STDI to its employees, STDI coverage rates fall immediately by 61 percentage points among incumbent employees (Figure 1A). The effect is less than 100 percent for two reasons. First, only two thirds of employees had STDI coverage prior to their firm ending its STDI plan. Many firms only provide STDI to a subset of their employees—most often managers

and salaried employees rather than laborers and hourly employees. Second, some employees whose STDI coverage is ceased will continue to receive STDI from another employer, either because they switch employers or have multiple employers. As expected, STDI coverage rates in the treated and control groups converge when the control employees' firms end their STDI plans in relative year 3.

Incumbent employees whose firms stopped providing STDI are 0.040 percentage points (13%) less likely to be receiving LTDI benefits two years later (Figure 1B). This effect indicates that employer-provided STDI coverage increases take-up of LTDI benefits. The ratio of the event study estimates shown in Figure 1 is equal to the instrumental variables estimate of the effect of employer-provided STDI on LTDI take-up: $\beta = \frac{\pi_2}{\pi_1} = \frac{-0.040}{-0.61} = 0.066$ percentage points. Table 2 reports the results of this IV regression in Column 1, with fixed effects for treatment cohort, 5-year age bins and sex, earnings deciles and industry added sequentially in Columns 2-5.

The estimated effect of employer-provided STDI on LTDI take-up is extremely stable as controls are added, ranging from 0.06 to 0.07 percentage points, with bootstrapped standard errors indicating significance at the 95% level. The fact that the IV estimate is invariant to controlling for observables, unlike the cross-sectional OLS estimates reported in Appendix Table 2, reflects the fact the quasi-experiment successfully isolates two groups who are observably similar except for their STDI coverage.

Employer-provided STDI coverage raises the probability of receiving LTDI in relative year 2 by 33%, which represents a large and economically meaningful increase (Table 2, Column 5). This percent effect is identified for compliers with the quasi-experiment: workers who cease having private STDI because their employer stops offering it. The IV estimate β captures the local average treatment effect of STDI for this complier group. The percent effect of STDI on LTDI take-up is $\frac{\beta}{\bar{Y}-\beta\bar{D}}$, where $\bar{Y}$ and $\bar{D}$ are the mean LTDI take-up and STDI coverage among compliers. I estimate $\bar{Y}$ and $\bar{D}$ using the kappa-weighting procedure described by Abadie (2003), although the kappa-weighted means barely differ from the unweighted treatment group means in my setting.

Workers whose decision to take up LTDI is sensitive to private STDI coverage—the marginal LTDI recipients—are broadly similar to those who take up LTDI without private STDI (Appendix Table 5). I measure the characteristics of marginal LTDI recipients by comparing the average characteristics of workers who (endogenously) receive LTDI in relative year 2 in the treatment group and control group. This method follows the approach used by Gruber, Levine, and Staiger (1999), Finkelstein

and Notowidigdo (2018), and many others. Appendix Table 5 shows that the differences in LTDI recipients from the two groups are both economically and statistically insignificant for age, sex, tax-deferred retirement savings rates and hospitalization rates during the pre-period (proxies for liquidity and health), and LTDI benefit amounts in relative years 2 and 3. The only significant difference is that marginal LTDI recipients have higher earnings in the pre-period, as reported in Column 1 and illustrated in Appendix Figure 1.

4.2 Robustness

The quasi-experimental estimates reported in the previous section would be biased if the timing of firms ending their private STDI is correlated with their employees' risk of long-term disability. There are two major threats to identification. Firms may choose to end their private STDI coverage if they observe or anticipate their employees becoming sicker and more expensive to insure. Firms might also choose to end these employee benefits in advance of layoffs or during poor economic conditions, which are associated with increases in LTDI take up (Charles, Li, and Stephens 2017). Both of these channels would violate the exclusion restriction for my instrument and bias my estimates toward finding that private STDI reduces LTDI take up. Since I find that private STDI increases LTDI take up, my estimates would be overly conservative.

In practice, I find that the timing of firms ending their private STDI is uncorrelated with their incumbent employees' hospitalization rates or employment rates (Figure 2). I observe inpatient hospital admissions in each year (and exclude childbirths) for the subsample that does not live in Quebec, Manitoba or the northern territories between relative year -3 and relative year 2. Hospitalization rates are similar in the treatment and control groups and stable throughout the sample period.[8] Employment rates are 100% by construction in relative years 0 and 1, but flexible in other years. The employment rates in the treatment and control groups are nearly identical, and follow the same pattern over time.

[8]The slight increase in hospitalization rates from the pre-period to the post-period for both the treatment and control group reflects the fact that the sample is constructed while conditioning on not receiving LTDI benefits during the pre-period, thereby excluding some people who had disability-inducing hospitalizations in the pre-period.

4.3 Fiscal Externality of Employer-Provided STDI

This section uses the quasi-experimental estimate of the impact of employer-provided STDI on the *flow* of LTDI recipients to approximate its impact on the *stock* of LTDI recipients. Using data on LTDI flows from 2001 to 2015, I estimate the counterfactual number of LTDI recipients and dollars of LTDI expenditures in 2015 if employers had not provided STDI during the previous 15 years.

To estimate the effect of employer-provided STDI on the stock of LTDI recipients, I make five assumptions. First, I assume that employer-provided STDI increases annual LTDI flows by 0.036 percentage points, half as much as the two-year effect on LTDI stocks identified in the quasi-experiment (Table 2, Column 5).[9] Second, I assume that this treatment effect is constant for all workers with employer-provided STDI in the population. Third, I assume that marginal LTDI recipients have the same LTDI exit rates and mean benefit amounts as the average LTDI recipients who had employer-provided STDI in the year prior to LTDI take up (which is consistent with Appendix Table 5). Fourth, I calculate the effect of employer-provided STDI over the 15 years of LTDI flows observed in my sample period, not on the stock of LTDI recipients in a steady state. Using a 15 year period underestimates the effect in the steady state, but does not require a parametric model of state transitions. Finally, I ignore the second-order effects of marginal individuals who do not join LTDI remaining in the workforce, and therefore remaining at risk of taking up LTDI in subsequent years. If their hazard rate for taking up LTDI in subsequent years is equal to the mean hazard among people with employer-provided STDI, this second order effect is negligible.

Under these five assumptions, if employers did not provide STDI during the 2000 to 2014 period the change in LTDI recipients and LTDI expenditures in 2015 would be:

[9]The effect of private STDI coverage on the stock of LTDI recipients in relative year 2 measures the effect on some individuals with a disability onset in relative year 0, nearly all individuals with a disability onset in relative year 1, and some individuals with a disability onset in the first eight months of relative year 2. On the one hand, the stock in relative year 2 excludes some individuals with a disability onset in relative years 2 (and relative year 1 to a much lesser extent) because there is a minimum four month waiting period for public LTDI after the onset of a disability, and some applicants wait much longer than four months for their applications to be processed. On the other hand, some employees in the treated group may have lost their STDI coverage and become treated midway through relative year 0, since I observe whether a firm provides any STDI during the year but I cannot reliably observe the number of months of STDI they provided during relative year 0. I therefore approximate this cumulative effect on the stock of LTDI recipients in relative year 2 as the effect on two years of flows.

$$\Delta \mathrm{N}_{2015}^{\mathrm{LTDI}} = \sum_{t=2000}^{2014} n_t \cdot \frac{\beta}{2} \cdot p_{t+1,2015} \tag{4}$$

$$\Delta \mathrm{b}_{2015}^{\mathrm{LTDI}} = \sum_{t=2000}^{2014} n_t \cdot \frac{\beta}{2} \cdot p_{t+1,2015} \cdot \bar{b}_{t+1,2015} \tag{5}$$

where the parameters are defined as follows. n_t is the number of workers with employer-provided STDI coverage in year t. $\frac{\beta}{2} = 0.036$ percentage points is the effect of employer-provided STDI coverage on LTDI take-up in year $t+1$. $p_{t+1,2015}$ is the probability that someone who had private STDI coverage in year t and took up LTDI in year $t+1$ is still receiving LTDI in 2015. And $\bar{b}_{t+1,2015}$ is the mean LTDI benefit in 2015 among these remaining recipients. Appendix Table 3 reports the data underlying each of these parameters: the number of people with employer-provided STDI coverage in each year from 2000 to 2014, the number who take up LTDI in the subsequent year, the number still on LTDI in 2015, and the average benefit amount in 2015 among the remaining recipients.

I estimate that there would be 18,300 fewer LTDI recipients in 2015 and government expenditures on LTDI benefits would be $230 million dollars (5%) lower if there had been no employer-provided STDI in the 15-year period since 2000. The 95% confidence interval for these estimates spans 2,900 to 33,700 fewer LTDI recipients in 2015 and a $40 million to $410 million reduction in LTDI benefits. These estimates of the effect on LTDI stocks should be considered an illustrative approximation, not a precise value. In addition to the wide confidence intervals, the extrapolation from LTDI flows in the quasi-experimental sample to LTDI stocks in the full population relies on untestable approximations. The main takeaway is that the negative fiscal externality of employer-provided STDI is economically meaningful, and merits consideration when evaluating the consequences of STDI policy reforms.

4.4 Efficient Pigouvian Taxation of Employer-Provided STDI

The externality imposed by employer-provided STDI on the public LTDI budget generates economic inefficiencies because private employers and insurers do not internalize these costs when they set the price and choose the quantity of private STDI provided (Pauly 1974). The standard economic

policy solution to a negative externality is a Pigouvian tax, which would make the providers of private STDI internalize the externality they impose on the government budget. In this section, I estimate the efficient Pigouvian tax on employer-provided STDI.

There are two key parameters for calculating the Pigouvian tax: the effect of private STDI on take up of LTDI and the net present value of benefits for the marginal LTDI recipients. The effect of private STDI on annual flows onto LTDI was estimated in the quasi-experiment above as $\frac{\beta}{2} = 0.036$ percentage points. To estimate the net present value of LTDI benefits among those induced to take up, I will assume that the marginal LTDI recipients have the same expected benefits as average LTDI recipients who had employer-provided STDI in the year prior to taking up LTDI. This assumption is not rejected by the data, as explained in Section 4.2 and reported in Appendix Table 5.

I estimate that the net present value of expected LTDI benefits for an average LTDI recipient who has STDI coverage is $97,000 in the year prior to taking up (Figure 3). To obtain this estimate, I begin by plotting mean LTDI benefits received in each year after take up by people who took up LTDI between 2001 and 2015 and had employer-provided STDI coverage in the prior year. There is little deviation across these 15 cohorts in the evolution of benefits over time (Figure 3A). I therefore calculate mean benefits in each year after take up by combining all observed cohorts. Mean benefits decline over time as LTDI recipients exit the program (typically by transitioning to retirement benefits at age 65 or dying). Figure 3B shows that a linear trend describes the evolution of mean benefits well after the first year. Average benefits are elevated in the first year because many recipients receive up to 12 months of retroactive payments to cover benefits during the period in which the LTDI claim was being processed. In the 15th year following take up—the last year I can observe in the data—mean benefits are $3200, and I use a linear extrapolation to approximate mean benefits in subsequent years, which hit zero approximately 19 years after first receiving LTDI. I calculate the net present value of these LTDI benefits in the year prior to LTDI take up (when recipients had private STDI coverage) using a 3% discount rate. Because the later years are heavily discounted, the inclusion of the extrapolated data makes little difference: the net present value is $94,000 using the 15 years of observed data and $97,000 including the additional 4 years of extrapolated data.

The efficient Pigouvian tax on employer-provided STDI is approximately $35 per insured employee per year, which is equal to the 0.036 percentage point increase in LTDI take up multiplied by the $97,000

net present value of benefits for those who take up. This estimate reflects the partial equilibrium effect of employer-provided STDI on the government LTDI budget (excluding administration fees), not the general equilibrium effect on the full government budget. If marginal LTDI recipients would counterfactually be working and paying taxes, the full fiscal externality would be larger than my estimate. If marginal LTDI recipients would instead be dependent on other government benefit programs, as observed in other settings by Staubli (2011) and Borghans, Gielen, and Luttmer (2014), then the fiscal externality on the government LTDI budget overstates the externality on the full government budget. Unfortunately, these spillovers to other tax and transfer programs cannot be precisely estimated due to the limited size of the quasi-experimental sample in this paper.

A Pigouvian tax on employer-provided STDI could be implemented in Canada by adjusting the existing Pigouvian subsidy offered through payroll tax rebates in Premium Reduction Program (PRP). The PRP was introduced at the same time EI Sickness benefits were introduced in 1971, with the goal of ensuring that the new public STDI benefits did not crowd out existing private STDI plans (HRSDC 2009). Private STDI plans are the first payer of benefits, so the PRP provides a payroll tax rebate to employers who provide private STDI coverage that is set actuarially to be equal to the expected savings they generate for the public EI Sickness program. This Pigouvian subsidy reflects the positive fiscal externality from private STDI onto the public STDI budget, but does not reflect the negative fiscal externality onto the public budget LTDI. In 2014, the PRP paid $848 million in payroll tax rebates to 5.7 million workers with private STDI, an average of $150 per insured worker. Incorporating the Pigouvian tax of $35 per insured worker would reduce the PRP payroll tax rebate by 23%, saving roughly $200 million per year. The effective tax rate on private STDI premiums would be less than 23% because private STDI benefits are more generous than public STDI benefits, so the cost of private STDI likely exceeds the PRP payroll tax rebate.

5 Conclusion

This paper shows that employer-provided short-term disability insurance increases long-term disability insurance take-up and imposes a negative fiscal externality on the government budget. This represents a specific case of the multiple-dealing externality described by Pauly (1974), where insurers do not internalize the costs of the moral hazard they generate for other parties insuring the same risk. In the case of private STDI, however, economists and insurers had speculated that the

incentive for employers to provide increased workplace assistance and accommodation for disabled employees receiving private STDI would outweigh the moral hazard effects of increased benefits during the waiting period for LTDI. The results in this paper demonstrate that the moral hazard effect dominates and increases LTDI take up.

There remain many unresolved questions about the effects of short-term disability insurance and the optimal design of disability insurance policy. One direction for future research would be to identify the effects of specific STDI policy parameters such as the replacement rate, the gap between the end of STDI benefits and the beginning of LTDI benefits, and the nature of the assistance programs offered to workers while receiving STDI benefits. These estimates would be useful to both public and private insurers designing benefit packages that maximize insurance while minimizing behavioral distortions.

More broadly, there is little evidence on the tradeoffs between public and private provision of STDI. Public STDI programs can use experience rating to create financial incentives for workplace accommodations. Employers providing private STDI can match the level of insurance provided to the preferences of their workers better than a one-size-fits-all universal program. A governor proposing universal STDI for one of the 45 U.S. states that does not yet have such a program would have to choose between an employer mandate and public provision, then decide how the risks of short-term disability costs should be distributed between employers and the government. Empirical estimates of the effects of experience rating in short-term disability insurance and of heterogeneity in workers' demand for STDI within firms and across firms would provide evidence to guide those policy decisions.

Table 1: Balance on Observable Characteristics

	Workers in 2010		Workers at Firms Ending Private STDI	
	Private STDI	No Private STDI	Treated	Control
Earnings Quintile in 3 Prior Years				
1 — Poorest	7%	32%	5%	4%
2	14%	25%	23%	21%
3	22%	18%	29%	29%
4	27%	13%	24%	25%
5 — Richest	30%	11%	19%	20%
Age Group				
25-29	11%	16%	14%	14%
30-39	27%	27%	28%	27%
40-49	32%	30%	33%	33%
50-59	30%	27%	25%	26%
Female	50%	46%	41%	39%
Industry				
Natural Resources and Mining	3%	3%	2%	3%
Construction	2%	11%	6%	6%
Manufacturing	13%	11%	24%	24%
Trade, Transportation, and Utilities	17%	23%	30%	28%
Information Services	4%	1%	1%	3%
Financial Services	9%	4%	3%	3%
Professional and Business Services	7%	14%	11%	9%
Education and Health Services	26%	13%	10%	10%
Leisure and Hospitality	2%	9%	4%	4%
Public Administration	17%	3%	5%	4%
Other Services	1%	6%	5%	4%
Unknown	0%	2%	0%	0%
N	5,266,000	5,752,864	176,653	187,227

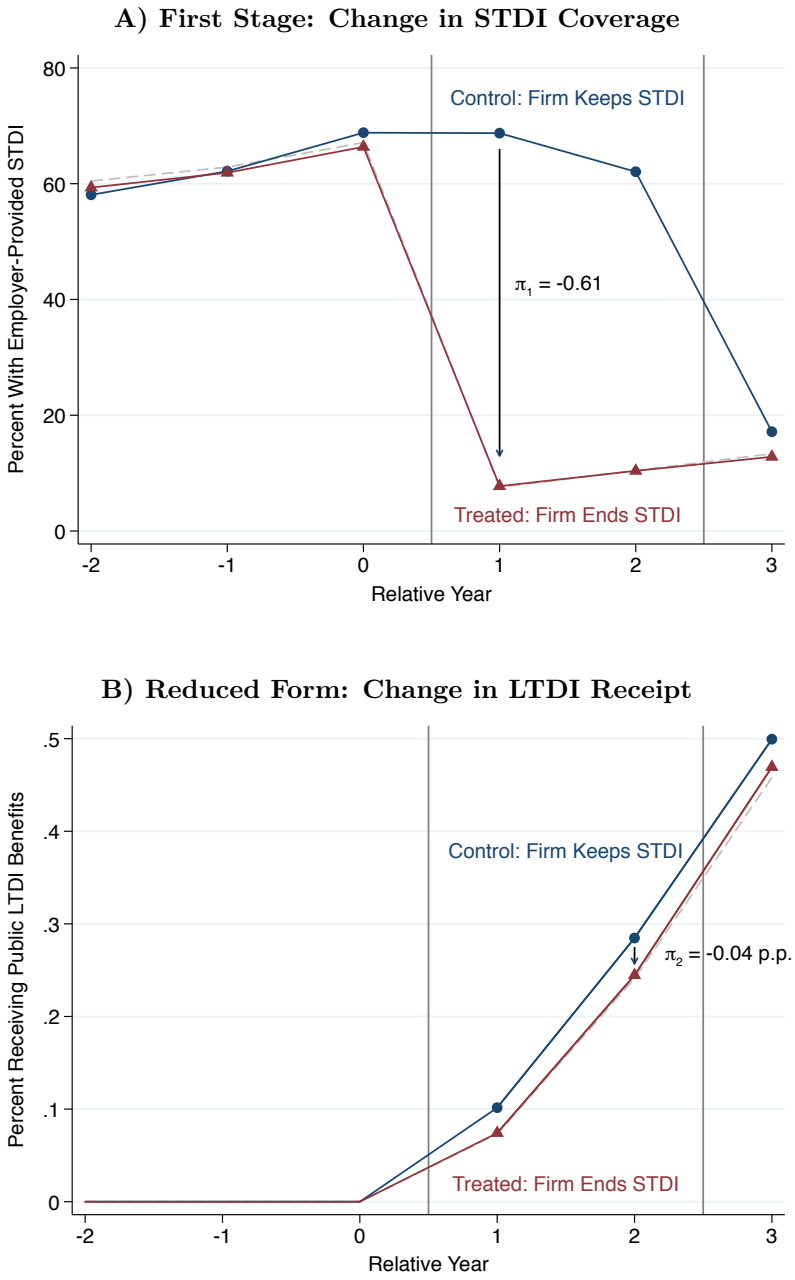
Notes: The sample of workers in 2010 includes Canadians ages 25 to 59 who had positive employment earnings in 2010. Workers in 2010 are considered to have private STDI if they had an STDI payroll tax rebate with any employer at any point during the year. Workers at firms ending private STDI are ages 25 to 59 and employed by a firm that ended its private STDI plan between 2003 and 2014. Control workers are employed by a firm that ends its private STDI two years after the treated workers, as described in more detail in Section 3.2. Earnings quintiles are calculated based on the sum of real earnings in 2007-2009 for the 2010 workers and in relative years -3, -2, -1 for the quasi-experimental sample, separately in each age, sex and year. Industries are categorized using 2-digit NAICS codes with groupings from the Bureau of Labor Statistics (2018).

Table 2: Quasi-Experimental Effect of Employer-Provided STDI Coverage on LTDI Take-Up

	% Receiving Long-Term DI Benefits in Year 2				
	(1)	(2)	(3)	(4)	(5)
Employer STDI Coverage in Year 1	0.066	0.071	0.061	0.072	0.071
	(0.032)	(0.035)	(0.027)	(0.030)	(0.031)
Fixed Effects:					
Employer Switch Cohort		X	X	X	X
Interacted 5-Year Age Group and Sex			X	X	X
Decile of Earnings in Prev. 3 Years				X	X
Industry of Employment in Year 1					X
First Stage Coefficient	-0.61	-0.61	-0.61	-0.61	-0.61
First Stage F Statistic	232648	233729	233998	239817	244701
Complier Mean Percentage:					
Receiving LTDI Benefits in Year 2	0.252	0.259	0.260	0.256	0.254
With Employer STDI Coverage in Year 1	48.5	48.9	48.8	48.6	48.8
% Effect of Employer STDI Coverage on LTDI Receipt in Year 2	30%	31%	27%	33%	33%
Sample Size	363,880	363,880	363,880	363,880	363,880

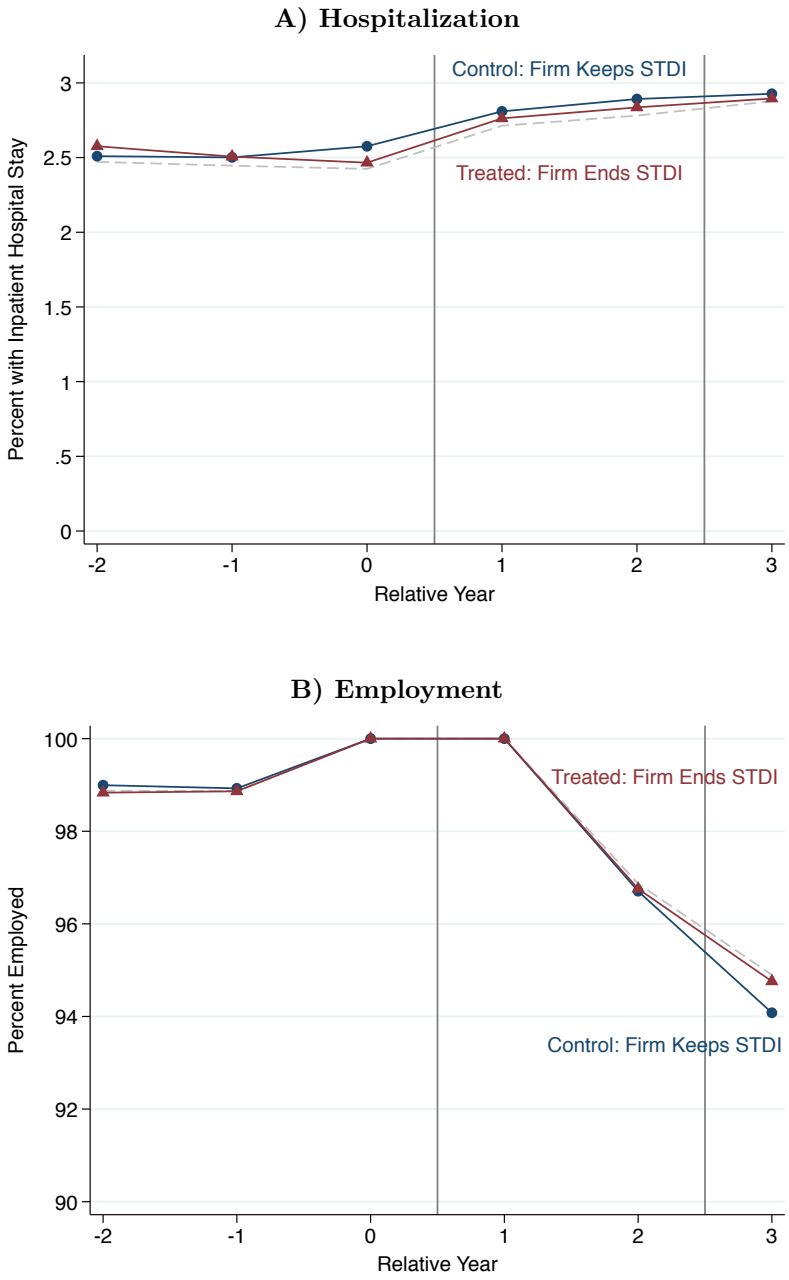
Notes: Coefficients and standard errors are reported in percentage point units. Standard errors are bootstrapped by resampling the 5,801 firms that end their private STDI coverage in the sample period with 1000 replications. Complier means are calculated using Abadie (2003) kappa-weighting.

Figure 1: Firms Ending Employer-Provided STDI Lower LTDI Take-Up



Notes: The treatment and control groups consist of workers who were employed in relative years 0 and 1 by a firm that offered private STDI to some of its employees for three consecutive years then ended its private STDI coverage in relative year 1 (treated) or relative year 3 (control), as described in Section 3.2. The red and blue series plot the mean rate of private STDI coverage (Panel A) and public LTDI receipt (Panel B) observed among treated workers (N=176,653) and control workers (N=187,227). The grey dashed line (mostly covered by the red series) plots the mean value for treated workers after controlling for fixed effects in treatment cohort, interacted 5-year age bins and sex, decile of average earnings in the relative years {-2,-1,0}, and industry of employment in relative year 1.

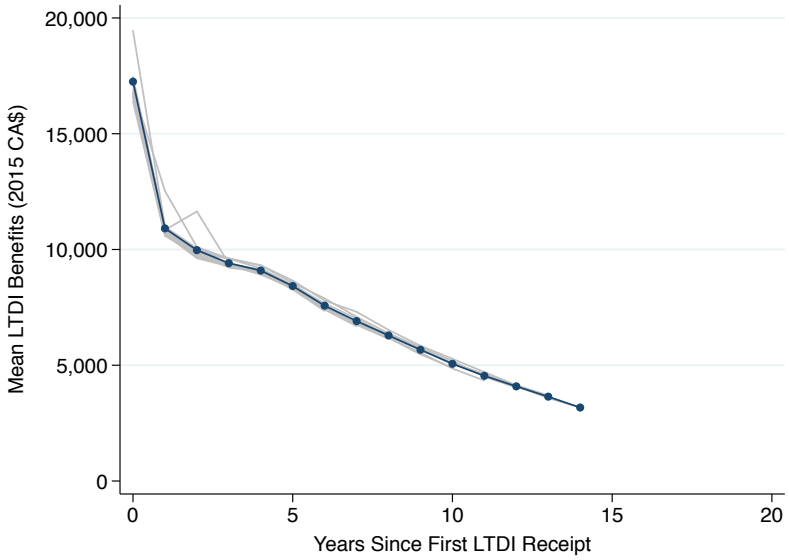
Figure 2: Validation Checks on Timing of Firms Ending Employer-Provided STDI



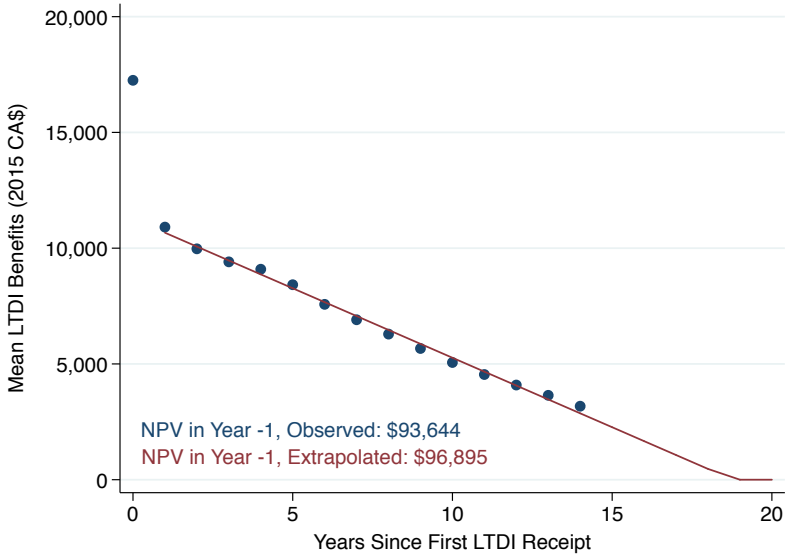
Notes: The treatment and control groups are constructed as described in Section 3.2. Panel A plots the annual inpatient hospitalization rate excluding births among treated workers (N=100,738) and control workers (N=108,711) who did not reside in Manitoba, Quebec or the northern territories during relative years {-2,-1,0,1,2,3}, since I do not observe complete hospitalization data for those areas. Panel B plots the annual employment rate for among all treated workers (N=176,653) and control workers (N=187,227), defined as having positive employment earnings during the year, and which is 100% in relative years 0 and 1 by construction. The grey dashed line plots the mean value for treated workers after controlling for fixed effects in treatment cohort, interacted 5-year age bins and sex, decile of average earnings in the relative years {-2,-1,0}, and industry of employment in relative year 1.

Figure 3: Net Present Value of LTDI Benefits for Workers with Private STDI

A) Mean LTDI Benefits Over Time, by Cohort



B) Mean LTDI Benefits Over Time, Linear Extrapolation



Notes: Each panel shows the mean public LTDI benefits received by workers who had employer-provided STDI coverage in the year prior to taking up LTDI. Workers who subsequently stop receiving LTDI benefits remain in the sample as zeros. In Panel A, the grey lines show mean benefits for each cohort of beneficiaries who took up between 2001 (observed 15 years) and 2015 (observed 1 year). The blue series shows the weighted average across all observed cohorts. In Panel B, the blue series is identical to Panel A and the red line is a linear extrapolation of observed benefits past the 15 years for which they are observed. The extrapolation excludes the first year of benefits (year 0), which is substantially higher than subsequent years because it includes up to 12 months of retroactive payments for the period in which the LTDI claim was being processed. The net present value of benefits in the year prior to LTDI receipt is calculated using a 3% discount rate.

A Appendix

A.1 Reverse Quasi-Experiment: Firms Starting STDI

The research design used in this paper measures the effect of private STDI coverage using quasi-experimental variation generated by firms *ending* their STDI plans. It would be equally natural to analyze the reverse quasi-experiment and measure the variation in STDI coverage generated by firms *starting* their STDI plans for the first time. This section explains why this reverse quasi-experiment cannot be reliably studied using the Canadian administrative data, presents the results of the reverse quasi-experiment, and argues that the estimates are severely attenuated but nonetheless consistent with the baseline results presented in the paper.

A.1.1 Data Limitations

As described in Section 2.3, I observe whether a worker has private STDI coverage indirectly when their employer claims a payroll tax rebate for providing STDI. This payroll tax rebate, called the Premium Reduction Program (PRP), was worth an average of $150 per employee per year in 2014. However, employers must make an active decision to participate and there is substantial evidence that many employers offer private STDI but fail to claim the tax rebate.

According to a 2007 survey of 607 employers conducted by the Canadian federal government, 72 percent of employers *offering private STDI plans* reported being unaware of the PRP tax rebate program (HRSDC 2009). Large firms (with at least 500 employees) are most likely to be aware of the tax rebate, most likely to offer private STDI, and employ most Canadian workers. Therefore the measurement error in private STDI coverage at the worker-level is much smaller than at the firm-level.

The adminstrative tax records can reliably identify the timing of firms ending their private STDI plans. I study the employees of firms that were claiming the PRP tax rebate for three consecutive years, then continued operating for another three years but chose to stop claiming the rebate. All of these firms were aware of the rebate, and would likely only give it up when they stop offering an eligible STDI plan.

By contrast, many firms may offer private STDI plans and only start participating in the PRP tax rebate years later when they learn that it is available. For such firms, the year in which they start claiming the PRP tax rebate does not coincide with a real change in STDI coverage, and would have no effect on incentives to take up LTDI. The inclusion of firms with no change in STDI coverage introduces measurement error that would attenuate the estimated effects of private STDI (proxied by PRP participation).

A.1.2 Results of Reverse Quasi-Experiment

In this section, I estimate the effects of private STDI using the timing of firms starting to claim the PRP tax rebate, which does not necessarily coincide with the timing of them first offering private STDI.

I construct the "reverse quasi-experiment" analogously to the main quasi-experiment in the paper. I define a firm as starting an STDI plan if the firm operated but did not receive a PRP tax rebate for three consecutive years, then received a PRP tax rebate for some or all of its employees during the subsequent three years. By this definition, 6764 Canadian firms started an STDI plan between 2003 and 2014.

I consider an employee treated if they were employed by a firm during the last year it provided no STDI coverage and the first year it provided STDI coverage, defined as relative years 0 and 1. As before, I construct a group of control employees who were employed by a different firm in relative years 0 and 1, and whose firm started its STDI plan in relative year 3. Appendix Table 6 shows that the employees in the treated and control groups are nearly identical on observables, as was reported in Table 1 for the main quasi-experiment.

The reverse quasi-experiment also shows that offering private STDI increases take up of public LTDI, but the estimated effect is roughly four times smaller and is statistically insigificant. Appendix Figure 2 replicates the event study figures from Figure 1 and shows that the first stage is similar, but the reduced form is much smaller. Appendix Table 7 replicates the IV regressions from Table 2. When firms start offering private STDI, as proxied by participating in the PRP tax rebate, private STDI coverage increases take-up of public LTDI by 0.01 to 0.02 percentage points (as opposed to 0.06 to 0.07 percentage points estimated using firms ending their private STDI). This corresponds

to a 6 to 11% increase in LTDI take up (as opposed to 27% to 33%).

A.1.3 Analysis of Attenuation Bias

The weak results of the reverse quasi-experiment could be interpreted as evidence that private STDI coverage does not have a significant effect on public LTDI take up, or they could reflect severe attenuation bias. I estimate the effect of private STDI coverage on public *STDI* take up, and use these results to gauge the magnitude of attenuation bias.

When an employer begins providing private STDI coverage, they mechanically shift employees' usage of short-term disability benefits from Canada's universal public STDI plan to the private STDI plan. By law, private STDI plans are the first payer of STDI benefits in Canada. As discussed in Section 2.1, workers with private STDI remain eligible for the universal public STDI benefit, but any private benefits received are deducted one-for-one from their public benefit payments. For most workers covered by PRP tax rebates, their private STDI benefits will completely replace public STDI benefits.

As expected, when firms stop participating in the PRP tax rebate and therefore end their private STDI, their employees become more likely to receive public STDI (Appendix Figure 3A). This effect is mechanical: employees who would have received their short-term disability benefits entirely from a private plan are instead receiving public benefits. However, when firms start participating in the PRP tax rebate, there is almost no change in their employees' likelihood to receive public STDI (Appendix Figure 3B). Because the effect of private STDI coverage on public STDI receipt is mechanical, the null result implies that few employees began receiving private STDI when their firm began receiving the PRP tax rebate.

Appendix Table 8 reports the IV estimates for the effect of private STDI coverage on public STDI receipt. Firms starting their STDI plans and firms ending their STDI plans ought have symmetrical effects on their employees' receipt of public STDI. Yet the variation in STDI coverage identified using firms ending their PRP tax rebate produces a drop in public STDI receipt of 3 percentage points, which is four times larger than the 0.8 percentage point effect identified using firms starting their PRP tax rebate.

The magnitude of attenuation bias implied by Appendix Table 8 can completely explain the

differences in the estimated effect of public STDI coverage on private LTDI take up identified by the main quasi-experiment and the reverse quasi-experiment. The estimated effects of private STDI coverage on public *STDI* take up should be considered more credible than the estimated effect on public *LTDI* take up, since the effect on public STDI receipt is mechanical and much larger in magnitude. I therefore use the ratio of the estimated effects on private STDI take up from Column 5 of Appendix Table 8 to estimate the scale of the attenuation bias. Rescaling the effect of private STDI on public LTDI take up estimated using the reverse quasi-experiment (Column 5 of Appendix Table 7) by this ratio yields an estimated effect of 0.070 percentage points. This is almost identical to the 0.071 percentage point effect estimated using the main quasi-experiment (Column 5 of Table 2).

In sum, the results of the reverse quasi-experiment are attenuated by errors in measuring the timing of firms starting their private STDI plans. But after adjusting for attenuation bias, the results are entirely consistent with the baseline results presented in the paper, which are based on a reliable measure of the timing of firms ending their private STDI plans. The results of the reverse quasi-experiment therefore provide additional evidence that private STDI coverage increases public LTDI take up.

Appendix Table 1: Sample Selection

	Workers in 2010		Quasi-Experiment, Firms Ending STDI		Reverse Quasi-Experiment, Firms Starting STDI	
	Private STDI	No Private STDI	Treated	Control	Treated	Control
Full Sample	6,456,801	11,310,906	269,210	276,575	400,614	334,758
Unique Individual in Cohort	n/a	n/a	268,207	275,786	399,003	333,182
Not Missing STDI Coverage Indicator	n/a	n/a	268,079	275,634	398,765	333,023
Not Missing Age and Sex	6,453,982	11,252,825	267,871	275,457	398,384	332,707
Ages 25-59	5,624,619	7,447,754	196,920	206,775	314,389	260,954
Sufficient Earnings History for LTDI	5,274,051	5,761,354	176,807	187,376	278,018	230,664
No LTDI in Prior 3 Years	**5,266,000**	**5,752,864**	**176,653**	**187,227**	**277,803**	**230,471**

Notes: This table describes the number of individuals remaining in the three analysis samples after each of the sample selection criteria is applied successively. The full sample for Workers in 2010 consists of all individuals with positive T4 earnings in 2010. The full sample for the quasi-experiment with firms ending STDI consists of workers who were employed in relative years 0 and 1 by a firm that provided private STDI to some of its employees for three consecutive years then ended its private STDI coverage in relative year 1 (treated) or relative year 3 (control). The full sample for the reverse quasi-experiment with firms starting STDI is constructed analogously for employees of firms that did not offer private STDI to any of its employees for three consecutive years, then provided private STDI coverage to some of its employees for at least three years starting in relative year 1 (treated) or relative year 3 (control).

Appendix Table 2: Cross-Sectional Relationship Between Employer-Provided STDI Coverage and LTDI Take-Up

	% Receiving Long-Term DI Benefits in 2011			
	(1)	(2)	(3)	(4)
Employer STDI Coverage in 2010	0.011	-0.004	0.145	0.129
	(0.003)	(0.003)	(0.003)	(0.004)
Fixed Effects:				
Interacted Age and Sex		X	X	X
Decile of Earnings in 2007-2009			X	X
Industry of Employment in 2010				X
Mean Percentage:				
Receiving LTDI Benefits in 2011	0.268	0.268	0.268	0.268
With Employer STDI Coverage in 2010	47.8	47.8	47.8	47.8
% Effect of Employer STDI Coverage on LTDI Receipt in 2011	4%	-1%	73%	63%
Sample Size	11,018,864	11,018,864	11,018,864	11,018,864

Notes: Coefficients and standard errors are reported in percentage point units. Standard errors are calculated using the regular OIM forumla. Earnings deciles are calculated based on real earnings in 2007-2009 separately for each age and sex. Industry fixed effects use 20 categories of 2-digit NAICS codes, with a separate category for unknown industry.

Appendix Table 3: LTDI Take-Up, Persistence and Benefits Among People with Employer STDI

Year	Number of Workers with Employer-Provided STDI	...Who Take Up LTDI In The Following Year	...And Still Receive LTDI in 2015	Mean 2015 LTDI Benefit Given Receipt
2000	5,352,030	9,250	2,529	$11,605
2001	5,413,879	10,619	3,392	$11,564
2002	5,420,660	10,681	3,748	$11,496
2003	5,427,436	10,271	3,906	$11,399
2004	5,428,214	10,838	4,676	$11,337
2005	5,563,131	11,694	5,787	$11,443
2006	5,621,993	10,593	5,717	$11,374
2007	5,714,908	11,169	6,540	$11,416
2008	5,700,237	11,082	7,162	$11,365
2009	5,593,129	10,661	7,825	$11,307
2010	5,589,851	10,469	7,980	$11,975
2011	5,675,616	10,913	8,739	$11,973
2012	5,702,720	10,021	8,304	$11,846
2013	5,516,764	9,668	8,797	$12,083
2014	5,693,876	11,134	11,134	$18,865

Notes: For each calendar year, column 2 reports the number of Canadian workers aged 25 to 59 who received private STDI coverage from any employer at any point during the year and received no public LTDI benefits. Column 3 reports the number of the workers among the set in Column 2 who received public LTDI benefits during the subsequent calendar year. Column 4 reports the number of workers among the set in Column 3 who continued to receive public LTDI benefits in 2015. Column 5 reports the mean amount of public LTDI benefits received in 2015 among the set of workers in Column 4.

Appendix Table 4: IV Regression Analysis using Employees of Firms Ending Private STDI Coverage with STDI in Year 0

	% Receiving Long-Term DI Benefits in Year 2				
	(1)	(2)	(3)	(4)	(5)
Employer STDI Coverage in Year 1	0.060	0.064	0.056	0.066	0.064
	(0.027)	(0.031)	(0.026)	(0.024)	(0.026)
Fixed Effects:					
Employer Switch Cohort		X	X	X	X
Interacted 5-Year Age Group and Sex			X	X	X
Decile of Earnings in Prev. 3 Years				X	X
Industry of Employment in Year 1					X
First Stage Coefficient	-0.86	-0.86	-0.86	-0.86	-0.86
First Stage F Statistic	734528	732140	732587	732695	733131
Complier Mean Percentage:					
Receiving LTDI Benefits in Year 2	0.263	0.267	0.266	0.264	0.264
With Employer STDI Coverage in Year 1	47.6	47.6	47.6	47.6	47.8
% Effect of Employer STDI Coverage on LTDI Receipt in Year 2	26%	27%	23%	29%	27%
Sample Size	245,960	245,960	245,960	245,960	245,960

Notes: Coefficients and standard errors are reported in percentage point units. Standard errors are bootstrapped by resampling the 5,801 firms that end their private STDI coverage in the sample period with 1000 replications. Complier means are calculated using Abadie (2003) kappa-weighting.

Appendix Table 5: Characteristics of Marginal LTDI Recipients

	Earnings in Prior 3 Years	Retirement Saver in Prior 3 Years	Hospitalized in Prior 3 Years	Female	Age in Year 1	LTDI Benefits in Year 2	LTDI Benefits in Year 3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: LTDI Recipients in Year 2							
IV Estimate of Difference Between People	11176	0.018	-0.020	-0.019	0.21	506	9
With–Without Private STDI Coverage	(3093)	(0.056)	(0.059)	(0.058)	(0.85)	(750)	(471)
Fixed Effects:							
Employer Switch Cohort	X	X	X	X	X	X	X
Mean in Control Group	43251	0.495	0.311	0.409	50.72	11764	9380
Mean in Treated Group	36229	0.484	0.319	0.419	50.55	11428	9356
N	965	965	629	965	965	965	965
Panel B: Full Quasi-Experiment Sample							
IV Estimate of Difference Between People	2556	0.011	0.002	-0.025	0.48		
With–Without Private STDI Coverage	(1486)	(0.010)	(0.002)	(0.014)	(0.22)		
Fixed Effects:							
Employer Switch Cohort	X	X	X	X	X		
Mean in Control Group	53466	0.579	0.069	0.392	41.94		
Mean in Treated Group	51848	0.574	0.068	0.406	41.61		
N	363,880	363,880	202,006	363,880	363,880		

Notes: Each column reports the results of an IV regression analogous to Column 2 of Table 2, but with a different outcome variable. In Panel A, the sample is restricted to individuals in the quasi-experimental sample who (endogenously) received LTDI benefits in relative year 2. In Panel B, the sample includes all individuals in the baseline results reported in Table 2.

Appendix Table 6: Balance on Observable Characteristics in Reverse Quasi-Experiment

	Workers at Firms Starting Private STDI	
	Treated	Control
Earnings Quintile in 3 Prior Years		
1 — Poorest	4%	4%
2	17%	18%
3	25%	25%
4	26%	26%
5 — Richest	28%	27%
Age Group		
25-29	16%	16%
30-39	31%	31%
40-49	31%	31%
50-59	21%	22%
Female	41%	42%
Industry		
Natural Resources and Mining	4%	4%
Construction	7%	7%
Manufacturing	18%	18%
Trade, Transportation, and Utilities	22%	24%
Information Services	3%	3%
Financial Services	7%	5%
Professional and Business Services	16%	16%
Education and Health Services	9%	10%
Leisure and Hospitality	6%	4%
Public Administration	5%	5%
Other Services	3%	3%
Unknown	0%	0%
N	277,803	230,471

Notes: This table replicates Table 1 for the sample of workers aged 25 to 59 employed by a firm that started receiving a payroll tax rebate for providing a private STDI plan between 2003 and 2014.

Appendix Table 7: Reverse Quasi-Experiment, Effect of Employer-Provided STDI Coverage on LTDI Take-Up

	% Receiving Long-Term DI Benefits in Year 2				
	(1)	(2)	(3)	(4)	(5)
Employer STDI Coverage in Year 1	0.013	0.011	0.016	0.020	0.018
	(0.024)	(0.022)	(0.024)	(0.021)	(0.023)
Fixed Effects:					
Employer Switch Cohort		X	X	X	X
Interacted 5-Year Age Group and Sex			X	X	X
Decile of Earnings in Prev. 3 Years				X	X
Industry of Employment in Year 1					X
First Stage Coefficient	0.64	0.64	0.64	0.64	0.64
First Stage F Statistic	348527	351151	351849	366002	382969
Complier Mean Percentage:					
Receiving LTDI Benefits in Year 2	0.198	0.197	0.197	0.196	0.197
With Employer STDI Coverage in Year 1	54.7	54.7	54.7	54.8	54.7
% Effect of Employer STDI Coverage on LTDI Receipt in Year 2	7%	6%	8%	11%	10%
Sample Size	508,274	508,274	508,274	508,274	508,274

Notes: Coefficients and standard errors are reported in percentage point units. Standard errors are bootstrapped by resampling the 6,764 firms that start their private STDI coverage in the sample period with 1000 replications. Complier means are calculated using Abadie (2003) kappa-weighting.

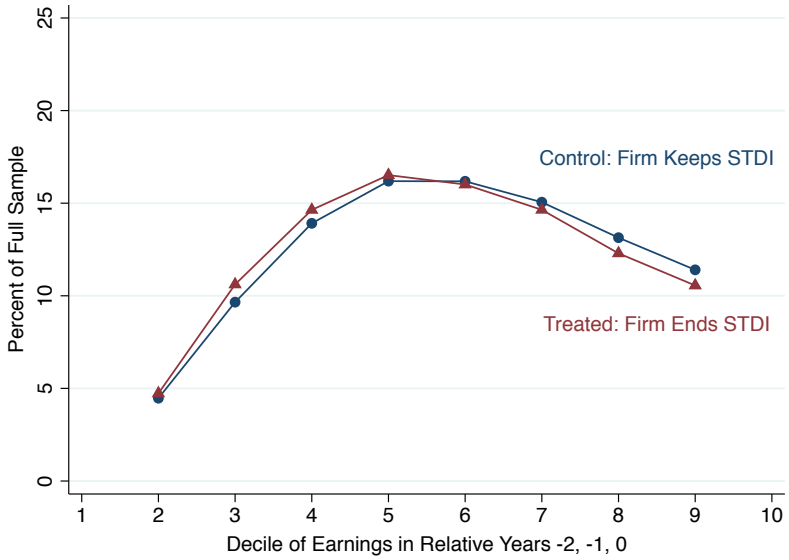
Appendix Table 8: Quasi-Experimental Effect of Employer-Provided STDI Coverage on Public STDI Take-Up

	% Receiving Public Short-Term DI Benefits in Year 1				
	(1)	(2)	(3)	(4)	(5)
Panel A: Firms Ending Private STDI					
Employer STDI Coverage in Year 1	-3.224	-3.265	-3.259	-3.119	-3.087
	(0.290)	(0.228)	(0.218)	(0.212)	(0.179)
Fixed Effects:					
Employer Switch Cohort		X	X	X	X
Interacted 5-Year Age Group and Sex			X	X	X
Decile of Earnings in Prev. 3 Years				X	X
Industry of Employment in Year 1					X
Sample Size	363,880	363,880	363,880	363,880	363,880
Panel B: Firms Starting Private STDI					
Employer STDI Coverage in Year 1	-0.854	-0.879	-0.850	-0.807	-0.791
	(0.176)	(0.166)	(0.156)	(0.139)	(0.130)
Fixed Effects:					
Employer Switch Cohort		X	X	X	X
Interacted 5-Year Age Group and Sex			X	X	X
Decile of Earnings in Prev. 3 Years				X	X
Industry of Employment in Year 1					X
Sample Size	508,274	508,274	508,274	508,274	508,274

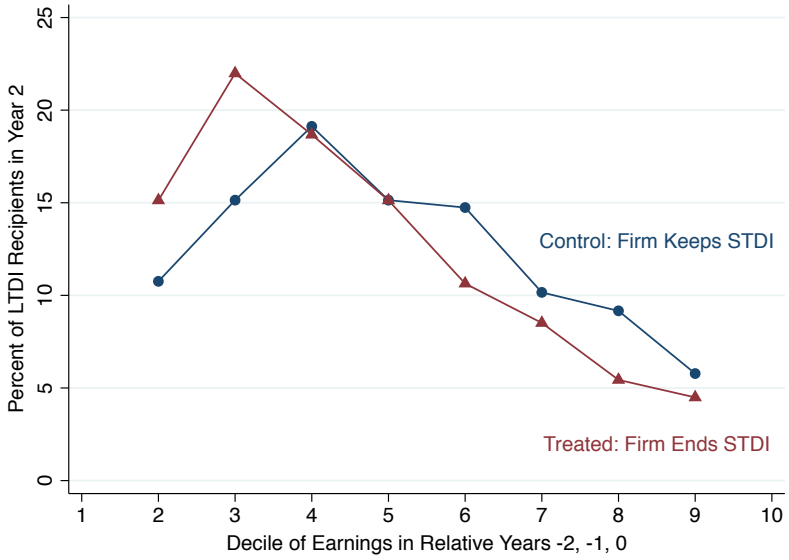
Notes: Coefficients and standard errors are reported in percentage point units. Standard errors are bootstrapped by resampling the 5,801 (6,764) firms that end (start) their private STDI coverage in the sample period with 1000 replications.

Appendix Figure 1: Marginal LTDI Recipients Induced by Employer-Provided STDI Have Higher Earnings

A) Distribution of Prior Earnings, Quasi-Experiment Sample

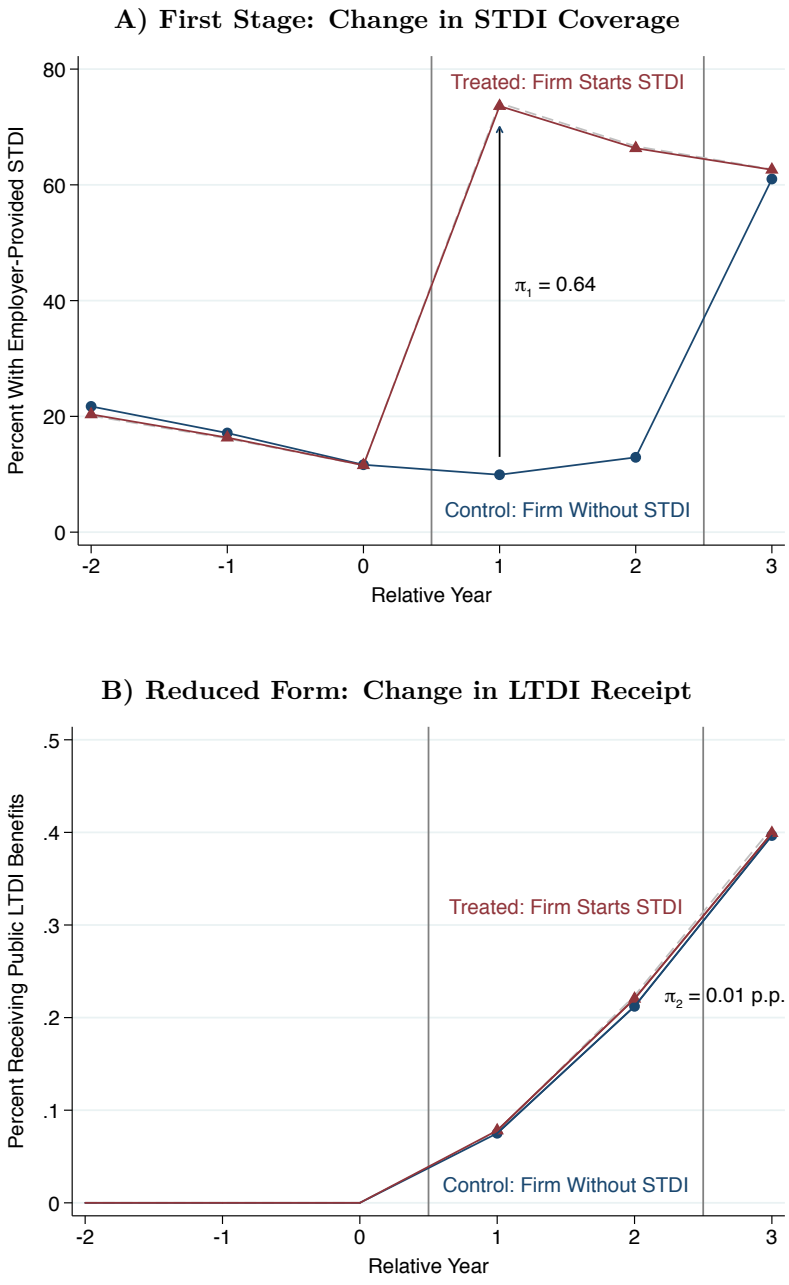


B) Distribution of Prior Earnings, Subsample Who Take-Up LTDI in Year 2



Notes: This figure plots the distribution of earnings deciles during the pre-period (the 3-year sum of earnings during relative years -2, -1 and 0) for workers whose firms ended their private STDI plan in relative year 1 (treated) or relative year 3 (control). Panel A shows the distribution for all treated and control workers in the main quasi-experimental sample. Panel B plots the distribution for the subsample of treated and control workers who endogenously take up LTDI in relative year 2. Earnings deciles are calculated relative to the full population of Canadian workers, separately for each age, sex and 3-calendar-year period. The bottom and top deciles are suppressed due to small sample sizes.

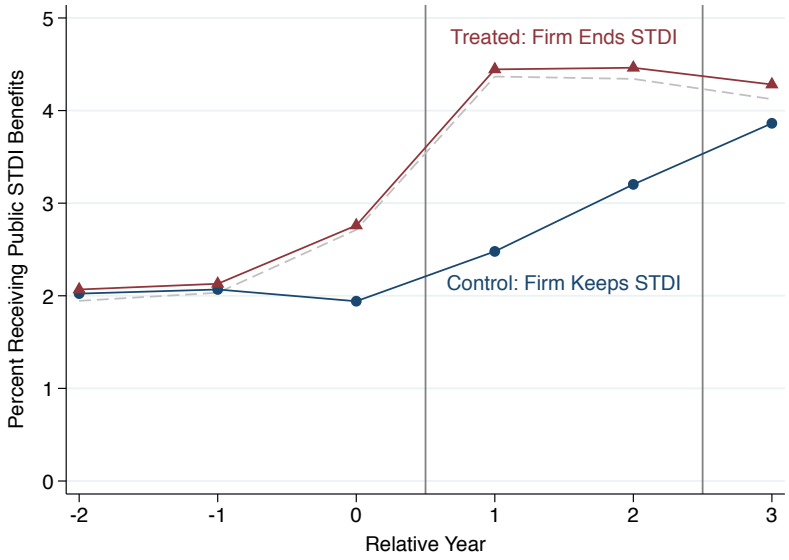
Appendix Figure 2: Effect of Firms Starting Employer-Provided STDI on Receipt of LTDI



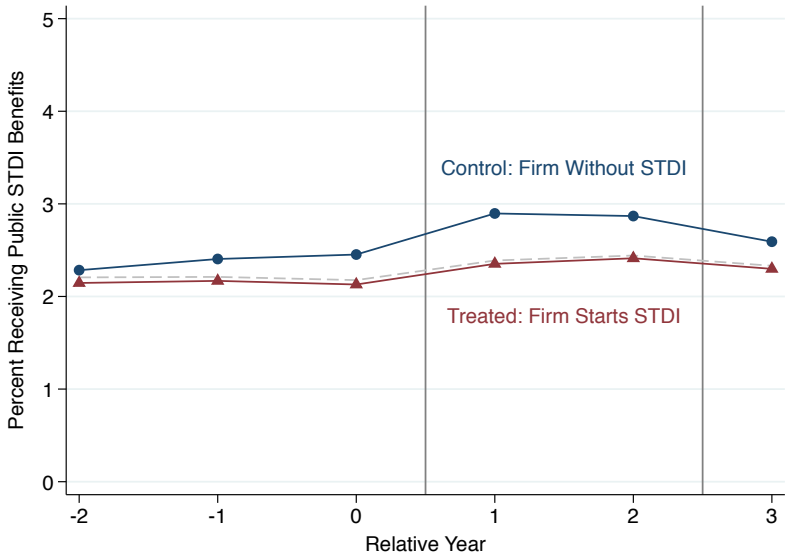
Notes: This figure replicates the analysis shown in Figure 1 for the reverse quasi-experiment of firms *starting* their STDI plans, instead of firms *ending* their STDI plans as shown in Figure 1. Appendix Section A.1 describes how the treatment and control groups are constructed, and explains how the results shown in Panel B are attenuated by unreliable measurements of the timing of firms starting their STDI plans. The red and blue series plot the mean rate of private STDI coverage proxied by tax rebates (Panel A) and public LTDI receipt (Panel B) observed among treated workers (N=277,803) and control workers (N=230,471). The grey dashed line (mostly covered by the red series) plots the mean value for treated workers after controlling for fixed effects in treatment cohort, interacted 5-year age bins and sex, decile of average earnings in the relative years {-2,-1,0}, and industry of employment in relative year 1.

Appendix Figure 3: Effect of Employer-Provided STDI on Receipt of Public STDI

A) Quasi-Experiment: Firms Ending Private STDI



B) Reverse Quasi-Experiment: Firms Starting Private STDI



Notes: This figure plots the mean annual rate of public STDI benefit receipt, among workers at firms observed *ending* their STDI plans (Panel A, main quasi-experiment) and among workers at firms observed *starting* their STDI plans (Panel B, reverse quasi-experiment). Appendix Section A.1 explains how the results shown in Panel B are mechanically attenuated by unreliable measurements of the timing of firms starting their STDI plans. For details on the treatment and control groups in each quasi-experimental sample, and a description of how each plot was constructed, see the notes to Figure 1 for Panel A and the notes to Appendix Figure 2 for Panel B.

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