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DISCUSSION PAPER SERIES

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ABSTRACT

Workers' Moral Hazard and Insurer Effort in Disability Insurance*

Disability Insurance (DI) may affect workers' outcomes such as their probability to enter DI, to recover, and their employment. Supplementary insurance may increase these moral hazard effects, but also increases the financial gains of private insurers to reduce benefit costs. With increased insurer activities to prevent and reintegrate workers, the overall effects of increased insurance coverage on workers' outcomes are thus ambiguous. This paper aims to separate worker and insurer responses to increased insurance, using unique administrative data on firms' supplementary DI insurance contracts. Using a Two-Way Fixed-Effects model on the sickness and employment rates of worker cohorts with and without supplementary contracts at some point in time, we find that insurer efforts compensate workers' moral hazard effects.

JEL Classification: G22, G52, J3, J21

Keywords: disability insurance, private insurance, moral hazard, insurer effort, return-to-work policies

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1 Introduction

Public Disability insurance (DI) schemes are ubiquitous in developed countries. Roughly 8% of the total public expenditure on social benefits in Europe is spent on DI, Eurostat (2017).[1] But while public DI benefits are mandatory and provide coverage for all workers, an important role is also featured by private, supplementary DI. For instance, about 33% of the workers in the US have complementary private long-term disability insurance (US Bureau of Labor Statistics, 2019).[2]

One common concern with this supplementary insurance against disability risks is that it increases workers' moral hazard. Workers may be encouraged to apply for DI, to reduce their effort to return to work, and to reduce the effort to combine employment with DI benefit receipt. Such concerns are particularly relevant when private insurance imposes fiscal externalities on public insurance (Pauly, 1974; Chetty & Saez, 2010). There is a large empirical literature that studies workers' moral hazard effects, mostly using changes in workers' incentives of public DI schemes for causal inference.[3] When assessing the magnitude of workers' moral hazard effects from higher insurance coverage, however, one overlooked aspect is that private DI affects insurer incentives. Given their (financial) interest to reduce benefit costs, private insurers are more inclined than public insurers to offer work accommodations, provide preventive activities or offer financial rewards to workers in case of (partial) work resumption. Extrapolations based on changes in statutory, public DI schemes

[1] In the US 5.8% of the workforce received public DI benefits in 2017, see Maestas (2019).

[2] See e.g. Hemmings & Prinz (2020) for a description of private insurance programs in some European countries and Autor et al. (2014) for private long-term disability insurance in the US.

[3] We discuss the literature on moral hazard in DI in more detail at the end of the introduction.

may therefore overestimate the additional benefit costs inherent with private supplementary insurance. And reversely, ignoring insurer effects would underestimate workers' moral hazard effects stemming from private supplementary insurance.

This paper aims to study the causal effect of private supplementary DI contracts on worker outcomes, both stemming from worker and insurer incentives. We use unique administrative data from *Robidus Risk Consulting*, a Dutch insurance intermediary. *Robidus* does not only provide insurance against the financial risks for employers from sick pay costs and experience-rated DI costs, but also offers supplementary DI insurance for disabled workers of these employers. Our data contain detailed yearly private DI contracts, firm and worker characteristics, worker sickness spells, work resumption, and earned wages of workers awarded benefits.

We estimate the effect of supplementary insurance on absence, benefit awards, employment, and wages. For this we employ a Two-Way Fixed-Effects specification that uses switches of firms from statutory insurance to contracts that supplement benefits. Given that supplementary insurance increases the financial interest for the insurer, these estimates can be interpreted as the joint effect of worker and insurer behavior. For the sample of awarded DI applicants, we next aim to estimate the separate employment effects of worker and insurer incentives. For this we use a Control Function approach that decomposes the effect of replacement rates into two parts. The worker moral hazard effect is identified from variation in replacement rates that only affects worker incentives to exploit the earnings potential. This variation corresponds to differences in statutory DI benefit levels. The remaining variation in replacement rates that stems from supplementary insurance, however, affects both the incentives of workers and insurers. This constitutes a Difference-in-

Difference type of estimator of combined worker moral hazard and insurer effects.

Our results suggest that supplementary DI does not lead to a higher probability to apply for DI benefits or to a lower probability to recover in the absence period before any DI applications, as worker moral hazard would predict. This means that either there is no anticipatory behavior of workers or that insurer behavior or other policy parameters than the increased insurance coverage compensate any worker moral hazard effects during the sickness period. Based on the sample of applicants, we next find no overall effects of supplementary insurance on most other worker outcomes. Contrasting with the idea that increased insurance coverage lowers work incentives, we find that partially disabled workers with supplementary insurance show higher employment rates than those with statutory insurance only. When decomposing effects into workers' moral hazard and insurer effects, a 1% increase in replacement rates for workers decreases employment by 0.11 percentage-points. This corresponds to a Labor-Force-Non-Participation (LFNP) elasticity of 0.12. The insurer effect more than compensates this effect.

This paper contributes to a large body of empirical studies on the impact of DI benefits on workers' moral hazard, see e.g. recent overviews by Dal Bianco (2019), and Cabral & Dillender (2020). This line of research has shown that: more generous benefit conditions increase applications to an duration of disability (Cabral & Dillender, 2020; Autor et al., 2014; Gelber et al., 2017); DI receipt decreases labor supply and wage earnings (French & Song, 2014; Maestas et al., 2013; Garcia-Mandicó et al., 2020); and changes in benefit conditions affect employment and earnings of benefit recipients (Gruber, 2000; Koning & Van Sonsbeek, 2017; Kostøl & Mogstad, 2015; Marie & Castello, 2012; Weathers & Hemmeter, 2011). Our analysis confirms the general finding that more generous DI benefits decrease labor supply. Within the context of private supplementary insurance, however, our results suggest that these effects are entirely offset by increased insurer effort to exploit the remaining earnings capacity of disabled workers.

We also add to a smaller literature on the effectiveness of insurer and employer incentives in DI. This research suggests that employer and/or insurer incentives reduce workers' disability claims (Koning, 2016). For public DI schemes, there is evidence that experience-rated DI premiums for firms are an effective tool for doing so (De Groot & Koning, 2016; Koning, 2009; Kyyrä & Paukkeri, 2018; Korkeamäki & Kyyrä, 2012). In addition, Lurie et al. (2019) show that the number of disability claims correlate with firm size, also suggesting that employers play a role in preventing worker disability. Albeit that our analysis does not focus on the employer, we believe that effects of the above-mentioned studies are indicative of the ability of the insurer to — directly or indirectly — reduce disability caseloads and increase work resumption.

Finally, our results add to a broader discussion on the desirability of choice in insurance contracts (Hendren et al., 2021; Cabral et al., 2019; Cabral & Cullen, 2019) and the welfare effects of combined public and private insurance (Pauly, 1974; Chetty & Saez, 2010). While insurance choice in DI acknowledges variations in individual valuations, private supplementary insurance may also induce or enlarge adverse selection and moral hazard problems. The literature points to moral hazard effects in this context for the US, Canada and Germany (Autor et al., 2014; Stepner, 2019; Seitz, 2021). Our findings, however, suggest that moral hazard effects in the employment rates of insured workers are offset by increased insurer effort. Since public DI benefits costs are experience-rated, this is probably due to the absence of fiscal externalities to public insurance of the additional coverage.

The remainder of this paper is organized as follows. The next section describes the institutional setting. Section 3 describes the data, Section 4 the methodology, Sections 5 and 6 the results, and the final section concludes.

2 Institutional setting

2.1 DI in the Netherlands

In the Netherlands, DI applications of workers follow after a sickness period of two years. DI claims are assessed by the Employee Insurance Agency (UWV). Medical experts of UWV determine the presence of impairments, and labor experts assess its consequences for the earnings capacity. The resulting degree of disability equals the loss of the workers' earnings capacity as a fraction of the pre-application wage. Applicants are categorized into six disability classes: 0–35%, 35–45%, 45–55%, 55–65%, 65–80% and 80–100%. If the degree of disability is below 35%, the worker does not receive any benefits. Between 35% and 80%, applicants receive partial DI benefits with levels based on the middle point of each degree-of-disability interval: 40%, 50%, 60% and 72.5%. If workers earn more than their initially assessed earnings capacity, the degree of disability will be adapted accordingly. For degrees of disability that exceed 80%, workers are classified as fully disabled and receive full DI benefits that equal 70% of pre-application wages.[4] Fully disabled workers with permanent impairments are eligible to a more generous scheme (IVA), that replaces 75% of pre-application wages.

[4]Workers with full benefits are thus allowed to earn 20% of their old wages at maximum.

While the above settings follow from public mandates, an important role in the DI system is also featured by private insurers and employers (Koning, 2016). The "Gatekeeper Protocol" prescribes the reintegration activities that need to be followed by employers in the two-year sickness period in order to become eligible for DI applications (Godard et al., 2020). Employers are obliged to continue 100% of the wage payments in the first year and at least 70% in the second year. Together with the experience-rated DI premiums that are based on the firms' DI benefit costs, employers are facing substantial incentives to reduce absence rates and DI enrolment. And since these incentives go together with large financial risks, many firms have bought insurance policies from private insurers. These policies provide coverage against the risk of continued wages and (experience-rated) DI premiums, as well as services in the sickness period needed to adhere to the Gatekeeper responsibilities. Specifically, private insurers provide preventative and reintegration services and send out caseworkers that take care of the requirements that need to be met in order to file a DI application.[5] Such case management may also extend to awarded DI applicants, particularly those with supplementary insurance contracts.

2.2 Mandatory and private supplementary insurance

Next to insurance policies against the risk of sick pay and disability benefit costs, private insurers have developed insurance policies that supplement DI benefits of workers. As we will explain later in more detail, these policies offset benefit reductions for partially disabled workers that came together with the disability reforms

[5] Based on a survey of about 2,500 employers with less than 100 employees, De Jong et al. (2014) find that about 80% had bought private insurance, and 88% of these employers opted for coverage that was "Gatekeeper-proof". The additional wage premium for extended coverage varied between 0.23% and 0.43% of total wage costs, corresponding to 7.5% and 15% of the insurance premiums, respectively.

in 2006. Supplementary insurance contracts are concluded at the level of firms or sectors. Similar to private Long Term Disability policies in the US, supplementary insurance can be considered as fringe benefits (Autor et al., 2014). Based on data on collective agreements, it is estimated in 2014 that about 20% of all workers in the Netherlands had supplementary insurance contracts for partial DI benefits (Cuelenaere et al., 2014). Firms typically combine these contracts with insurance coverage against the risk of sick pay and (experience-rated) DI benefit costs. These contracts are concluded with one and the same private insurer.

Supplementary insurance policies usually go together with increased case management — particularly in the sickness period — and financial bonuses for partially disabled workers to exploit their earnings capacity. These bonuses are equal among partially disabled workers, constituting 5% to 10% of the pre-application earnings. In our study we focus on two private insurance contracts for DI that are most common in the Netherlands: Basic Supplementary Insurance (BSI) and Comprehensive Supplementary Insurance (CSI). BSI and CSI supplement the statutory benefit income of workers with private partial DI benefits. The additional coverage of BSI and CSI becomes relevant in the "wage continuation period" of DI receipt. Depending on the employment history of the worker, this period starts at 24 months after the start of the DI spell at latest.

BSI and CSI offset part of the work incentives for partially disabled workers if they receive statutory benefits only. With public, statutory benefits, workers receive partial benefits that are tied to their pre-application wages if they earn at least 50% of their assessed earnings capacity. If not, DI benefits are tied to the minimum wage instead. To formalize this, we define d as the (exact) degree of disability of a disabled worker, d_{mid} as the midpoint of the relevant degree-of-disability category, W_{old} as the pre-application wages[6], W_{min} as the statutory minimum wage and W as current wages. We assume that wage earnings cannot exceed the assessed remaining earnings capacity, $(1-d)\,W_{old}$. The statutory benefit levels for partially disabled workers (B_p^S) and for fully disabled workers (B_f^S) then are equal to:

$$\begin{aligned} B_p^S &= 0.7\,d_{mid}\,W_{min} + 0.7\,d_{mid}\,(W_{old} - W_{min}) \cdot \mathrm{I}\left(W \geq \frac{d_{mid}\,W_{old}}{2}\right) \\ B_f^S &= 0.7\,W_{old} \end{aligned} \tag{1}$$

with I as an indicator function that equals one if the worker exploits at least half of his/her earnings capacity and is zero otherwise. Equation (1) shows that the 50%-earnings threshold functions as a wage subsidy. This incentive for partially disabled workers increases with respect to the midpoint of the degree of disability category and the pre-application wage. Workers with full DI benefits and without any current wage earnings receive 70% of their pre-applications wages.[7]

BSI offsets the financial consequences of insufficient wage earnings for partially disabled workers, ensuring coverage to be tied to the old wage for all possible levels of earnings below or equal to the earnings capacity. The benefit for partially disabled workers with BSI, B_p^{BSI}, equals:

$$B_p^{BSI} = 0.7\ d_{mid}\,W_{old} \tag{2}$$

CSI further extends benefit coverage to 70% of the full risk of income loss. This

[6] Pre-application wages can be capped by a maximum when calculating benefits. For expositional arguments, we abstract from this in our notation. In our data, a negligible fraction of wage observations is capped.

[7] The minimum degree of disability with full DI benefits is 80%. If the current wage equals the earnings capacity, the total income from benefits and wages would be 90% of the old wage.

implies that the benefit level is not related to the degree of disability, while the implicit tax rate on wage earnings equals 70%. Note that these benefit settings resemble those for workers receiving Unemployment Insurance (UI):

$$B^{CSI} = 0.7\ (W_{old} - W) \tag{3}$$

2.3 Worker and insurer incentives

In the literature, work incentives are usually proxied by replacement rates that express the income from benefits being unemployed as a fraction of pre-application earnings.[8] Given that there is no effective supplementary coverage for fully disabled workers, it can easily be shown that the replacement rate equals 70% for fully disabled workers for all insurance coverage levels:

$$RR_f^S = RR_f^{BSI} = RR_f^{CSI} = 0.7 \tag{4}$$

For partially disabled workers, however, supplementary insurance matters. The replacement rates with statutory insurance, BSI and with CSI are equal to:

$$RR_p^S = 0.7\ d_{mid} \left(\frac{W_{min}}{W_{old}}\right) \tag{5}$$

$$RR_p^{BSI} = 0.7\ d_{mid} \tag{6}$$

$$RR_p^{CSI} = 0.7 \tag{7}$$

With the above equations, and defining BSI and CSI as dummies indicating insur-

[8]Note that replacement rates relate income from benefits to old wages and not the income from benefits and the remaining earnings capacity. Koning & Van Sonsbeek (2017) therefore define 'conditional' replacement rates that compare the benefit income without employment to the income from benefits and the earnings capacity. In our empirical analysis, we show that using the log of CRR instead of the log value of RR yields elasticity outcomes that are virtually equivalent.

ance from BSI and CSI (or not), the replacement rate (RR) can be re-written as:

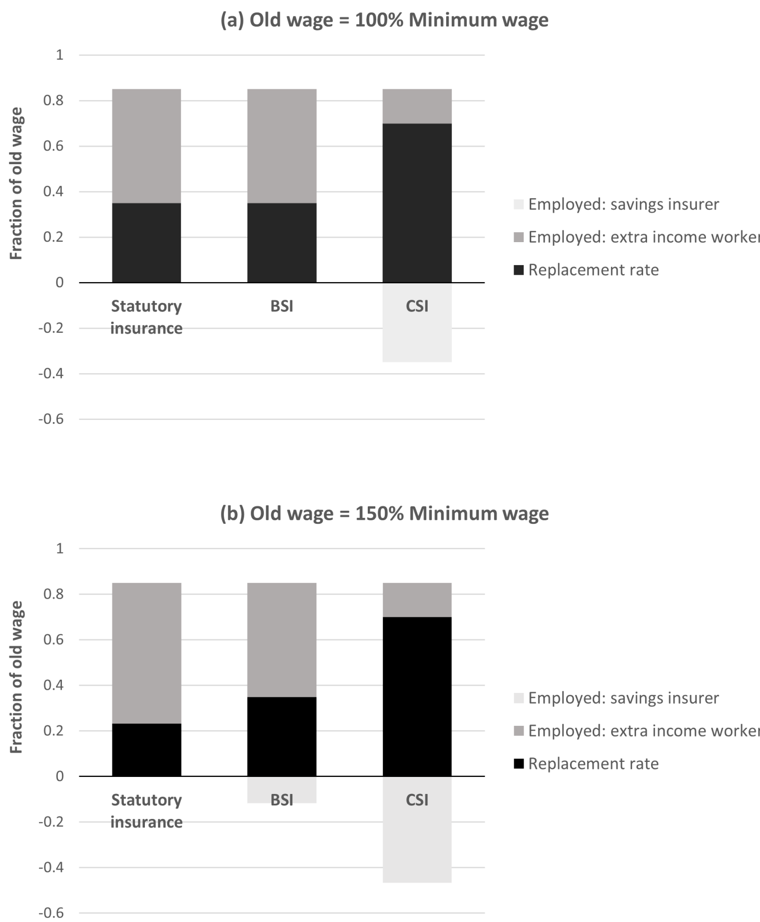
$$RR \;=\; 0.7\, d_{mid} \left(\frac{W_{min}}{W_{old}}\right) + \mathrm{I}(d \geq 0.8) \cdot 0.7 \left(\frac{W_{old} - W_{min}}{W_{old}}\right) + \\ \left[\mathrm{I}(d < 0.8) \cdot \Big(BSI + CSI\Big) \cdot 0.7\, d_{mid} \left(\frac{W_{old} - W_{min}}{W_{old}}\right) + 0.7\Big(1 - d_{mid}\Big) \cdot CSI\right], \quad (8)$$

with I representing an indicator for the outcome in parentheses. Equation (8) reads as a summary of our earlier exposition: DI benefits are relatively high for fully disabled workers and partially disabled workers with BSI and CSI.

Figure 1 illustrates how BSI and CSI affect the incentives of workers and insurers to exploit the residual earnings capacity. We consider two cases of a partially disabled worker with a degree of disability of 50%: one where the old wage equals the minimum wage (panel a) and one where it equals 150% of the minimum wage (panel c).[9] The black bars indicate the replacement rates that prevail when the worker is unemployed, and the dark and light grey bars indicate the extra income (as a fraction of the old wage) for the worker and the insurer when the worker fully exploits his/her earnings potential, respectively.

[9] We refer to Figure A1 in the appendix for more insight into the impact of variation in pre-application wages on the level of (statutory) replacement rates. In addition, Figure A2 provides insight into the impact of the degree of disability on replacement rates.

Figure 1: Replacement rate (in blue) of worker with degree of disability of 50% and old wage equal to 100% (panel A) and 150% of minimum wage (panel B)



Panel (a) of Figure 1 considers the case where the old wage of the worker equals the minimum wage. Since partial statutory benefits are also tied to the minimum wage, BSI does not provide any additional coverage and the replacement rate equals 35% (70%×50%) of the old wage in both cases. CSI supplements the benefit up to 70% of the old wage. This also implies that 70% of the (relative) income from potential earnings (i.e. 35% of the old wage) goes to the insurer, and 30% to the worker (i.e. 15% of the old wage). Panel (b) considers the case where the old wage equals 150% of the minimum wage. Supplementary insurance from BSI now increases the replacement rate up from about 23% to 35%. Concurrent with this, the private insurer experiences an equal increase in the financial interest of (partial) work resumption. This financial interest is substantially higher with supplementary insurance from CSI, amounting to about 47% of the old wage of the worker. This again highlights the fact that a substantial fraction of the earnings accrue to the insurer, not the worker.

3 Data and descriptive statistics

3.1 Data setup

We use unique administrative data from *Robidus Risk Consulting*, a large insurance intermediary in the Netherlands, that conducts return-to-work services and provides supplementary insurance to contracted firms for sick-listed and disabled workers. All contracted firms receive statutory return-to-work services. In our sample, a fraction of firms also has supplementary disability insurance, either from BSI or from CSI.

The firms that contract with *Robidus* are typically larger than average. Most clients are part of the education, health, and (to a lesser extent) construction sectors. As the descriptive statistics will show later on, the over-representation of these sectors is mirrored by a high share of women with pre-application earnings that are relatively low. *Robidus* provides services to a population of workers with relatively high disability risks and therefore with a substantial interest from policymakers. Specifically, women in the Netherlands have DI risks that are 35% higher than men (UWV, 2021a). In 2021 roughly 50% of female DI recipients had mental impairments and almost 20% had musculoskeletal impairments (UWV, 2021b). With such a high share of "difficult-to-verify" impairments, case managers of *Robidus* aim to reduce the scope for moral hazard.

We combine three data sources from *Robidus*. First, we have firm-level data containing contracts over the period between 2006 and 2019. These data contain the contract type: i.e. only statutory insurance, BSI, or CSI with the start and end dates of each contract. Albeit that workers may opt-out from BSI or CSI contracts, this occurs only very rarely. In talks with the experts from *Robidus*, it was indicated that less than 1% of the concerning workers opt out.[10] Our second data source contains long-term absent workers in contracted firms with a sickness spell of at least 10 months. This corresponds with the maximum amount of elapsed time to meet a licensed doctor. The third data set includes information on every worker that has applied for DI after two years of absence from work. These data also contain award decisions and the type and level of benefits of awarded applicants. For applicants awarded benefits, we also observe wage earnings at the moment of and after the application date.

Our data contain 2,080 firms, of which 90 (4.3%) have supplementary insurance for the entire period, 299 (14.4%) switch to BSI or CSI at least once during the sample period, and the remaining 1,691 firms have no supplementary insurance over the entire period. Workers enter our data when they are absent for at least 10 months, resulting in a total of 101,408 long-term sick-listed workers in our data (i.e. on average 49 workers per firm) of which 15,981 (15.8%) are covered by supplementary

[10] Although workers in the Netherlands are free to buy private DI elsewhere, a market for *individual* supplementary insurance is virtually non-existent. Private DI for individual workers would be extremely expensive for adverse selection reasons, and because of the absence of specific tax deductibles (that only hold for firms).

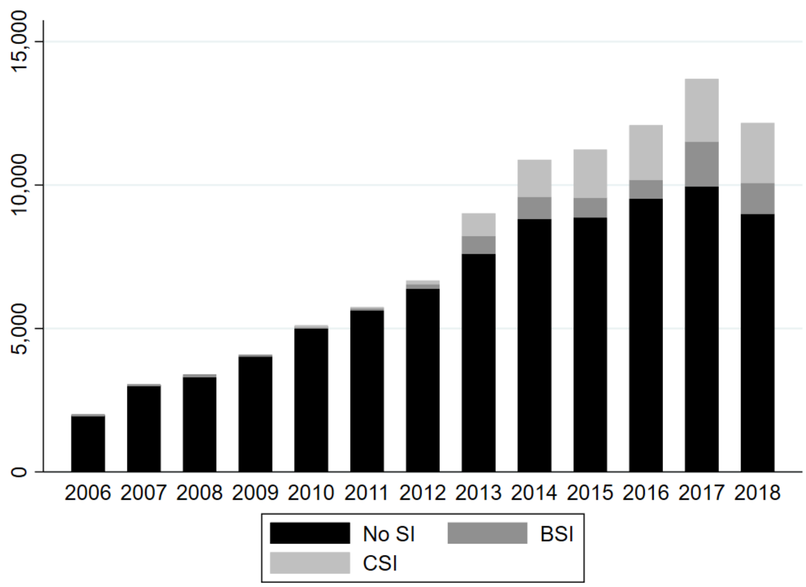
DI. Our supplementary DI rate is similar to the average in the Netherlands, which is slightly below 20% (Cuelenaere et al., 2014).

In our context, we argue that selection of specific individuals — with higher sickness or disability risks — are unlikely to occur. As argued earlier, one major reason is that contracts are set at the level of firms, not individual workers. And to the extent that firm-specific conditions or trends may drive long-term sickness and disability inflow rates, it is important to stress that *Robidus* takes the initiative to contract new firms and upgrade contracts to include supplementary insurance. For this, it uses its own network of HR managers and mostly contacts firms that already have statutory insurance at *Robidus*. Since *Robidus* sets BSI and CSI premiums that are based on past disability risks firms and current long-term sickness rates that may add to future DI inflow rates, the room for adverse selection by firms is limited. In fact, *Robidus* is most likely better informed about the true disability risks than their clients are.

3.2 Descriptive analysis

Figure 2 shows the number of sick-listed workers per cohort in our sample under the different levels of insurance coverage. Worker inflow is increasing over time, which stems from an increase in the number of firms contracted by *Robidus*, but not from increases in firm size. The fraction of workers with supplementary insurance over time has also increased, from nearly 2% of the cohort of 2011 to 26% of the most recent cohort of 2018. We perform a test on whether worker observable characteristics — i.e. gender, age, and tenure — can explain firm switching. The results from a joint F-test show that this is not the case (P=0.824).

Figure 2: Numbers of sick workers by cohort: statutory insurance, BSI and CSI.



Notes: "no SI" = no supplementary insurance, BSI = Basic Supplementary Insurance, and CSI = Comprehensive Supplementary Insurance. Standard errors in parentheses.

Table 1 presents statistics of the full sample of sick-listed workers and the sub-sample of (36,537) workers that eventually applies for DI. In terms of awards, our sample corresponds to about 10% of the full Dutch population of benefit recipients. Note that sickness spells are not observed for all DI applications in our sample. As a result, the number of applicant observations exceeds the number of sickness spells ending at 24 months.[11] The sample of applicants has noticeably and significantly less often supplementary insurance from BSI and CSI. This largely reflects the fact that switching to supplementary insurance new cohorts of sick-listed workers earlier than DI applicant cohorts that occur after the two-year sickness period. Workers are on average 46.6 years old in both samples and that applicants have relatively

[11] Over the years, *R*obidus took over DI caseloads from other intermediaries.

Table 1: Descriptives: sample of sick-listed workers and sample of DI applicants

	Full sample	DI Applicants
Basic Supplementary Insurance (BSI)	5.8%	4.1%
Comprehensive Supplementary Insurance (CSI)	10.0%	6.1%
Age (years)	46.6	46.6
	(11.1)	(10.5)
Tenure (years)	12.9	15.5
	(13.4)	(16.2)
Percentage of females	71.0%	72.3%
Application outcomes (%):		
— Rejected applications		23.4%
— Partial DI benefits		18.8%
— Full DI benefits		37.1%
— Permanent DI benefits (IVA)		20.8%
Observations	101,408	36,537

Standard errors shown in parentheses.

more tenure. 71% of the workers in our sample is female. As argued earlier, this fraction is relatively high because a large fraction of our sample consists of firms in the health and education sector. Finally, about 23% of applications is rejected, whereas 18.8% is awarded partial benefits for whom BSI and CSI are relevant.

Table 2 compares workers in firms and years with only statutory insurance to workers with BSI and CSI. For awarded applicants, the table does not include workers with permanent DI benefits ("IVA") for which private insurers have no responsibilities. For the sample of sick-listed workers, the table shows that workers with supplementary insurance are older, exist of more females and have significantly less tenure than those with mandatory insurance only. These differences are also reflected in the sub-sample of awarded applicants. Pre-application wages are gen-

Table 2: Sample statistics by insurance type

	Sick-listed workers			Awarded DI applicants[a]		
	Statutory	BSI[b]	CSI[c]	Statutory	BSI[b]	CSI[c]
Age	46.5	47.0	47.2	45.7	46.0	46.3
	(11.0)	(11.4)	(11.1)	(10.3)	(11.2)	(10.9)
Tenure	13.4	7.9	11.3	17.5	9.2	10.3
	(13.9)	(10.3)	(10.4)	(17.7)	(13.5)	(10.2)
Females (%)	70.5	80.0	79.2	70.7	77.4	81.6
Partial DI benefits (%)				30.1	27.4	30.6
Pre-application wage (euros p. month)				2,196	2,279	2,431
				(1,044)	(1,076)	(1,078)
Replacement rate				0.555	0.607	0.698
				(0.224)	(0.156)	(0.019)
– Partial DI benefits				0.222	0.364	0.697
				(0.080)	(0.080)	(0.021)
– Full DI benefits				0.699	0.699	0.698
				(0.011)	(0.015)	(0.018)
Employment at application				0.146	0.153	0.175
				(0.354)	(0.360)	(0.380)
– Partial DI benefits				0.343	0.442	0.391
				(0.475)	(0.498)	(0.488)
– Full DI benefits				0.062	0.044	0.081
				(0.240)	(0.205)	(0.272)
Wage at application (euros p. month)				217	254	282
				(620)	(669)	(719)
– Partial DI benefits				515	729	626
				(840)	(944)	(944)
– Full DI benefits				89	74	130
				(437)	(404)	(527)
Observations	85,427	5,888	10,093	24,940	1,138	1,760

Notes: Standard errors shown in parentheses. *a*: We exclude awards with full and permanent benefits (IVA); [b]: BSI = Basic Supplementary Insurance; [c]: CSI = Comprehensive Supplementary Insurance.

erally low — reflecting the fact that some female workers have part-time jobs[12] — and slightly higher for awardees with supplementary insurance.[13]

With relatively low old wages, the effective impact of insurance caps on benefits is limited. Replacement rates are therefore equal to 70% for almost all fully disabled and also partially disabled workers with the extra coverage from CSI. Aver-

[12]Note that the average monthly wage in the Netherlands amounts to 3,000 euros

[13]A small fraction of workers in our sample with part-time jobs have wage earnings below the full-time minimum wage. In these cases, benefits are also tied to pre-application earnings and may be set below the level of social assistance benefits (of about 70% of the minimum wage).

age replacement rates for awarded applicants with partial benefits from mandatory insurance equal 22.2%, as compared to 36.4% for those with BSI and 69.7% for those with CSI. Most notably, awardees with supplementary insurance have higher employment rates and higher wage earnings than those with mandatory insurance only. For partially disabled workers with BSI, the employment difference amounts to about 10 percentage-points, as compared to an (absolute) employment rate with mandatory insurance equal to 34.3%. For fully disabled workers, these differentials are considerably smaller and (absolute) employment averages are small as well. Section 4.2 further explores how these differentials vary with respect to degree of disability and pre-application wages.

The observed differences in replacement rates of partially disabled workers allow us to perform a simple test on advantageous selection by workers. Advantageous selection would imply that workers with higher pre-application wages sort into BSI and CSI. To investigate this, Table A1 in the appendix compares the "true" replacement rates of workers (in bold) with fictitious replacement rates that would have applied with different contract types. We then see that differences in average replacement rates are almost entirely driven by contract types — i.e. no supplementary insurance, BSI or CSI — and not by selection of worker types. Again, this most likely reflects the fact that contracts are concluded at the level of firms, not individual workers.

4 Estimation strategy

Our estimation strategy comprises two stages. We first model and estimate the effect of supplementary insurance from BSI and CSI on all relevant outcome variables. This includes both outcomes based on the information on sickness spells *before* DI application and the employment information that is relevant for the sub-sample of awarded DI applicants. For all outcome variables, the effects of supplementary insurance can then be interpreted as the joint effect of increased insurance coverage on the worker and the insurer. We next extend our model with replacement rate effects and aim to disentangle worker moral hazard effects from insurer effects. Given that employment outcomes and replacement rates are observed and relevant for awarded applicants only, we limit this part of our analysis to awarded applicants.

4.1 The basic model

We first consider a model for the *joint* effect of supplementary insurance coverage. With firms switching from providing statutory insurance to BSI and CSI at some point in time, we use a Two-Way Fixed Effects model. In terms of "difference-in-differences", we compare changes in outcomes of treated sick-listed and disabled workers of firms that have switched to supplementary insurance contracts to changes in outcomes of workers with firms that have not switched (yet). This requires the assumption that firms and private insurers do not anticipate changes in the likelihood of partial or full work resumption of sick-listed and disabled workers and (therefore) switch to BSI and CSI.

We define Y_{ijt} as an outcome variable of worker i employed at firm j during the sickness spell, measured at year t. Y includes the incidence of recovery after

24 months of absence, award decisions, and employment and relative wage earnings (as a fraction of the old wage) for the sample of awarded applicants. Employment and wages are measured just after application (recall we can only observe wages for awarded applicants). We specify Y as

$$Y_{ijt} = \beta X_{ijt} + \gamma^{BSI} BSI_{jt} + \gamma^{CSI} CSI_{jt} + \Psi_t + u_j + \epsilon_{ijt} \tag{9}$$

where X_{ijt} is a matrix with controls (gender, tenure and age) and BSI and CSI are dummy values that are equal to one if the firm has BSI or CSI, and equals zero otherwise. Ψ_t is a step function of yearly calendar time effects and u represents firm fixed-effects. The parameters β, γ^{BSI} and γ^{CSI} describe the effect of X, BSI and CSI on Y, respectively. Given that we control for common time effects and fixed firm effects, the parameters γ^{BSI} and γ^{CSI} can be interpreted as DiD estimates of the effect on Y. We assume that ϵ is i.d.d. We will extend Equation (9) with placebo effects to test for the common trends assumption, and for the sickness spells will also test whether treatment effects vary with respect to the timing of switching towards supplementary insurance.

4.2 Separating worker and insurer effects

We next aim to disentangle worker moral hazard and insurer efforts inherent with changes in insurance coverage. This model is relevant for the sample of awarded DI applicants for whom we observe and/or can derive current wages, the old wages, the degrees of disability and the replacement rates. Our interest lies in the effect of log replacement rates on employment. For this, we re-write Equation (8) for the replacement rate in logs. For notational convenience, we define w_{old} as the ratio of pre-application earnings to the minimum wage: $w_{old} = W_{old} \,/\, W_{min}$. This yields:

$$\ln(RR) = \underbrace{\ln(0.7) + \ln(d_{mid}) - \ln(w_{old})}_{\ln(RR^I)} + \underbrace{\mathrm{I}(d \geq 0.8) \cdot \ln(w_{old})}_{\ln(RR^{II})} + \\ + \underbrace{\Big[\mathrm{I}(d < 0.8) \cdot \Big(BSI + CSI\Big) \ln(w_{old}) - CSI \ln(d_{mid})\Big]}_{\ln(RR^{III})}. \qquad (10)$$

As a baseline, the first component $\ln(RR^I)$ represents the log replacement rate for statutory DI benefits of partially disabled. This component is determined by the degree of disability and pre-application wages. Since both these variables most likely directly affect employment outcomes as well, we include these variables as additional controls in all possible employment models.

The second and third component in Equation (10) can be used for the identification and estimation of replacement rate effects. $\ln(RR^{II})$ is an interaction term — the increase in the replacement rate above the 80% threshold for workers without BSI and CSI is proportional to the level of pre-application earnings. In effect, this implies that part of the variation in replacement rates that identifies δ comes from the interacted effect of degrees of disability and pre-application wages. When the worker cannot earn more than the assessed earnings capacity, the increase in the replacement rate for workers above the 80% threshold is not accompanied with increases in the financial interest of the insurer. The effect of $\ln(RR^{II})$ on employment can therefore be interpreted as workers' moral hazard effects. It is identified from the comparison of workers with similar earnings capacities — based on their degree of disability and their old wages — but different replacement rates.

The third component, $\ln(RR^{III})$, represents variation in replacement rates stemming from the additional insurance coverage from BSI and CSI that is relevant for partially disabled workers only. Since these effects are proportional to the degree of disability and the level of the old wages, we can exploit this to estimate both the effects of the replacement rates and constant (dummy) effects of BSI and CSI. Contrasting to changes in $\ln(RR^{II})$, however, the interpretation of replacement rate effects is different: changes in wage earnings of partially disabled workers imply benefit savings from the wage subsidy (for BSI and CSI) and also from exploiting the assessed earnings capacity (for CSI). To the extent that the insurers' response is proportional to the increase in the replacement rate due to supplementary insurance, δ now embodies a *joint* worker and insurer effect.

With this in mind, we propose a model specification that takes advantage of the fact that insurer incentives depend on the type of insurance, being either statutory or with supplementary insurance from BSI or CSI. We essentially adopt a Control Function approach, wherein we include both $\ln(RR^{II})$ and $\ln(RR^{III})$ in Equation (9). As a result, we allow for the effect of the log replacement rate to differ:

$$\begin{aligned} Y_{ijt} &= \beta \tilde{X}_{ijt} + \delta \ln(RR^{II}_{ijt}) + \delta^{SI} \ln(RR^{III}_{ijt}) + \\ &+ \gamma^{BSI} BSI_{jt} + \gamma^{CSI} CSI_{jt} + \tilde{\Psi}_t \ln(d_{ijt}) + u_j + \epsilon_{ijt} \qquad (11) \end{aligned}$$

In the above specification, we extend X with polynomials of the log value of pre-application wages, which is then denoted as matrix $\tilde{X}$. $\tilde{\Psi}_t(d)$ consists of polynomial functions of the (exact) degrees of disability of which the parameters vary for each year. We thus flexibly control for any variation in $\ln(RR^{I})$. While δ represents workers' moral hazard effects, δ^{SI} is essentially a DiD estimator of the effect of supplementary insurance that represents the joint effect of worker moral hazard and insurer effort. And since increases in the replacement rate vary with respect to the degree of disability and the level of old wages, the "treatment" in our model is continuous. We discuss the identification of model parameters of Equation (11) more extensively in Appendix A.

Since we effectively include all three components of $\ln(RR)$ to obtain consistent effects of worker moral hazard effects, we essentially follow a Control Function (CF) approach to estimate replacement rate effects. The estimate of δ is an Average Treatment Effect that is inferred from partially and fully disabled workers. For the estimation of δ^{SI}, however, the effect concerns the sample of partially disabled workers in firms with supplementary insurance from BSI and CSI. To make the estimates more comparable and test for robustness, we will therefore also consider a specification where we allow δ to interact with the degree of disability.

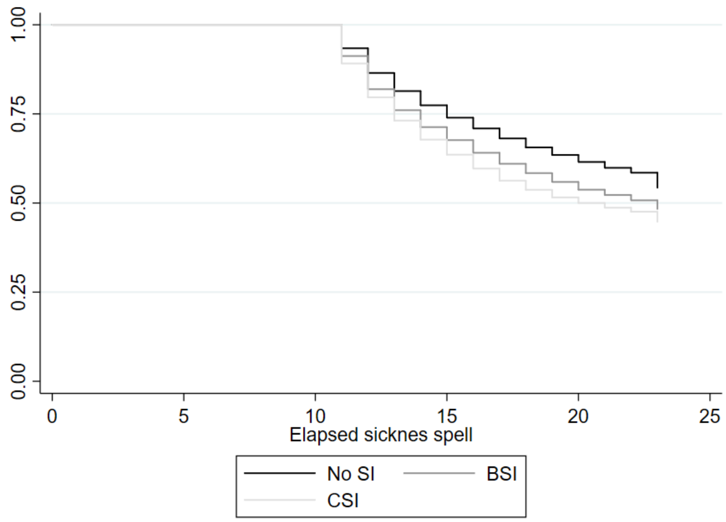
5 Results: sickness recovery and application outcomes

5.1 Graphical evidence

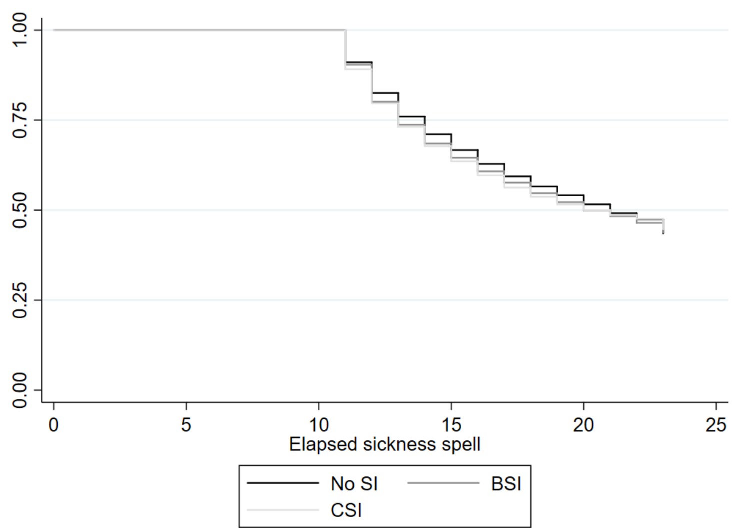
We first study the effect of supplementary insurance on worker recovery rates in the sickness period. Although insurance coverage is equal for workers with and without supplementary insurance before application, workers and insurers may anticipate higher benefits after 24 months. Workers may be less likely to recover, whereas private insurers may target their activities towards the same workers with higher expected coverage. For graphical evidence on which effect may be most relevant, Panel (a) of Figure 3 shows the Kaplan-Meier survival rates for workers with only statutory insurance, BSI and CSI, measured for long-term sick-listed workers. The figure suggests that workers with supplementary insurance recover faster, and that insurer effects dominate worker moral hazard effects in the sickness period.

Figure 3: Kaplan-Meier estimates and 95%-confidence intervals of absence spells by insurance type

Panel (a): Full sample



Panel (b): Sample of workers in firms around switch towards BSI/CSI



Notes: SI = supplementary insurance, BSI = Basic Supplementary Insurance, and CSI = Comprehensive Supplementary Insurance.

In line with our empirical strategy, we also zoom into the smaller sample of firms that switch to BSI or CSI over time — see panel (b) of Figure 3. Specifically, we compare the sickness spells of workers who become ill in the two years around the contract switch.[14] This plausibly makes the groups of workers that we compare more similar. Panel (b) shows that the difference in sickness spells then virtually disappears. Workers with supplementary insurance still seem to recover faster, but the difference is no longer statistically significant.

5.2 Estimation results

We next estimate model specifications for the impact of BSI and CSI on the probability to remain absent for at least two years. The results are shown in Table 3. Column (i) shows that supplementary insurance from both BSI and CSI increases the probability to recover by about two percentage-points, as compared to an average recovery rate after 24 months of 22.1%. With firm-fixed effects — in column (ii) —, the effect of CSI becomes borderline significant and equals 3.4 percentage-points. Note that estimation results are similar in size — and with smaller standard errors — when we estimate Cox duration models for the elapsed sickness spells. To assess the robustness of our findings, column (iii) shows similar effects for a specification that includes placebo effects for the two years preceding any switches to BSI and CSI. The effects become even smaller and insignificant when we add sector-specific calendar time effects (with 70 sectors in total), in order to capture events on the sector level that could affect workers' absences.[15] This leads us to conclude there

[14]Note that whether a worker falls under supplementary insurance depends on the contract the firm has at the date at which the sickness spell started. Hence, it is possible that a sick worker does not receive supplementary insurance at some point, while the firm has switched.

[15]We also estimated a Random Effects model. This leads to somewhat stronger and more precise results. However the Hausman test suggests that the Fixed Effects model is appropriate.

are no strong or dominant worker moral hazard effects in the sickness period that precedes DI applications.

Table 3: Linear Probability Model results of the probability of absence for 24 months

	(i)	(ii)	(iii)	(iv)
Basic supplementary Insurance (BSI)	–0.022**	0.007	0.012	0.012
	(0.011)	(0.018)	(0.018)	(0.012)
Comprehensive Supplementary Insurance (CSI)	–0.019**	–0.034*	–0.033*	–0.018
	(0.008)	(0.020)	(0.019)	(0.017)
Demographic and tenure controls[a]	YES	YES	YES	YES
Year effects	YES	YES	YES	YES
Firm-fixed effects	NO	YES	YES	YES
Placebo test[b]	NO	NO	YES	NO
Sector specific time effects[c]	NO	NO	NO	YES
Firms	2,063	2,063	2,063	2,063
Firm-year observations	98,624	98,624	98,624	98,624
R-squared (within)		0.065	0.065	0.160
R-squared (total)	0.071	0.070	0.070	0.142

[a]: Controls include the workers' age, gender, and tenure at the firm.
[b]: For the placebo test we include a dummy value for firms that in the two years preceding the start of BSI and CSI, respectively. The estimates of the BSI and CSI placebo's are insignificant, -0.018 (P=0.34) and -0.003 (P=0.855) respectively.
[c]: We add the firm's sector and interact it this with time dummies in order to capture sector specific events that may cause changes in workers probabilities of absence.
Standard errors are in parentheses. *, **, *** indicate significance at 10%, 5%, and 1%.

A relatively recent literature shows that heterogeneous treatment effects over time may lead to biased treatment effects with Two-Way Fixed Effects models (Sun & Abraham, 2021; Callaway & Sant'Anna, 2021). This type of heterogeneity may be present if it takes time for supplementary insurance to affect sickness spells, for instance through short run information frictions between the insurer and the employer. Also, it may be that firms who switch towards supplementary insurance earlier respond differently to the new policy conditions than firms that switch later. In order to investigate whether there are such heterogeneous effects, we study varying event-time effects and heterogeneity across firms' time of switching towards supplementary insurance. Tables A2 and A3 in the appendix show that there is little evidence of treatment heterogeneity over time. The event-time estimates show no effect before the insurance switch, which confirms our placebo test. The early (i.e. within two years after the switch) and late dummy are almost the same size. The estimates in Table A3 are for each insurance contract all of similar size, indicating that the exact year of the switch is not relevant.

Table 4: Linear Probability Model estimation results for application outcomes

	(i)	(ii)	(iii)	(iv)	(v)
Application outcomes	Rejected applicants	Partial DI benefits	Full DI benefits	Permanent DI (IVA)	Cat. 1–4
Basic Supplementary Insurance (BSI)	–0.011	0.007	–0.002	0.005	0.020
	(0.021)	(0.018)	(0.021)	(0.022)	(0.045)
Comprehensive Supplementary Ins. (CSI)	–0.017	–0.005	–0.011	0.033**	0.072*
	(0.015)	(0.015)	(0.021)	(0.016)	(0.041)
Demographic controls, tenure[a]	YES	YES	YES	YES	YES
Year effects	YES	YES	YES	YES	YES
Firm-fixed effects	YES	YES	YES	YES	YES
Observations	35,516	35,516	35,516	35,516	35,516
R-squared (within)	0.027	0.012	0.040	0.129	0.063
R-squared (total)	0.030	0.014	0.043	0.134	0.065

[a]: Controls include the workers' age, gender, and tenure at the firm.
Standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%. The mean values of the categories are 0.22, 0.19, 0.38, and 0.21, respectively.

Since our results point at marginally higher recovery rates with CSI, we next analyze whether this effect concerns workers with less severe health conditions that would have been rejected benefits. To shed light on this, Table 4 shows estimates for the probability that applicants end up with rejected applications, partial DI benefits, or full DI benefits and permanent and full benefits (IVA). We also consider a linear model where the four statuses are ranked from one to four. Our results generally do not show significant differences across contract types, except for the higher share of applicants awarded IVA benefits with CSI. In terms of the full sample of absent workers, this increase compensates for the (proportional) decline in applications for permanent benefits. The effective inflow into this scheme is thus less responsive to insurance coverage.

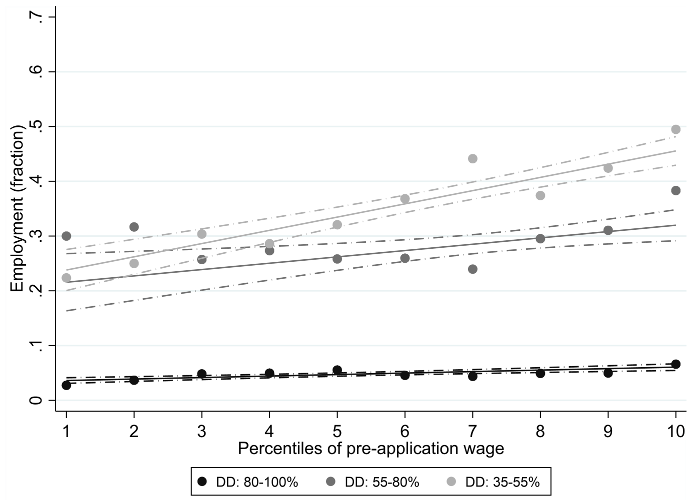
6 Results: employment of awarded DI applicants

6.1 Graphical evidence

We next turn to the sub-sample of awarded DI applicants for whom we observe their degrees of disability, old wages, replacement rates, and employment outcomes after application. With these data, we construct three figures to explore the importance of worker moral hazard effects and contract effects. These are displayed in Figures 4, 5 and 6.

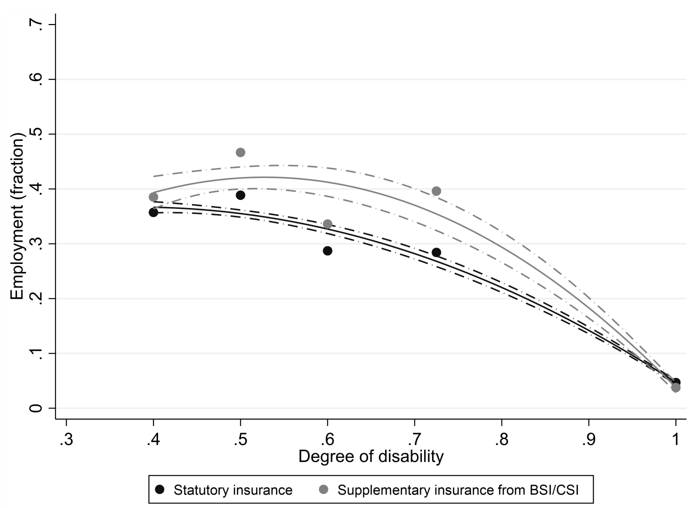
To eyeball the presence of "interacted" effects of pre-application wages and degrees of disability, Figure 4 presents employment rates for percentiles of pre-application wages for the sample of firms with statutory insurance only. The employment averages shown in 'bins' are stratified by three degree-of-disability categories: 35–55%, 55–80%, and 80–100% (i.e. full benefits). The figure also shows linear fitted lines for the three samples. Consistent with the presence of workers' moral hazard, the slope of employment probabilities with respect to the old wages is higher for low degrees of disability and almost absent for workers receiving full DI benefits. Since replacement rates are lower for partially disabled workers with higher old wages, this provides indicative evidence that variation in statutory replacement rates induces worker moral hazard.

Figure 4: Employment of disabled workers without supplementary insurance, stratified by old-wage percentiles and degree-of-disability groups: 'bins'[a] and fitted lines[b]



Notes: DD = Degree of disability (%). [a]: Bins display employment averages for combined (3) degree-of-disability categories and (10) percentiles of pre-application wages; [b]: Linear fitted lines with 95% confidence intervals.

Figure 5: Employment of disabled workers by degree of disability, stratified by statutory insurance and supplementary insurance: 'bins'[a] and fitted lines[b]

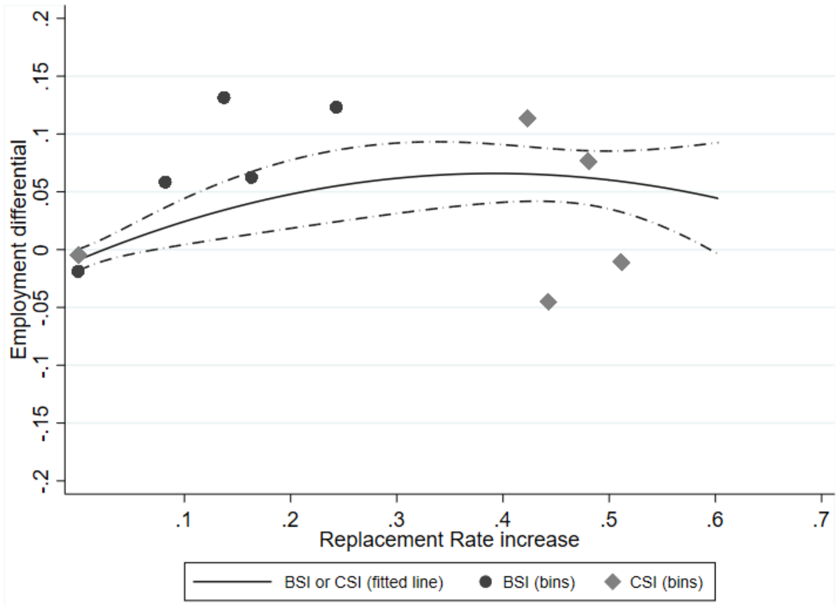


Notes: DD = Degree of disability (%). [a]: Bins represent averages for combined (5) degree-of-disability categories and (2) types of insurance; [b]: Quadratic fitted lines with 95% confidence intervals.

We next explore the effect of supplementary insurance on employment rates. For this, Figure 5 compares the employment rates of awarded workers with different degrees of disability by their insurance status. Since we have a limited number of observations for BSI for each degree-of-disability class, we pool the observations with BSI and CSI. Most strikingly, we then see that partially disabled workers with degrees of disability of more than 45% show higher employment rates when they receive supplementary insurance from BSI or CSI. So contrasting to Figure 4, this suggests a limited role for workers' moral hazard or a strong role for insurance policy parameters other than insurance coverage.

Another way to visualize the effects of supplementary insurance is by relating increases in replacement rates due to supplementary insurance to employment rate differentials of disabled workers with and without supplementary insurance. This is shown in Figure 6. To obtain employment differentials, we first calculate average employment rates for each 'cell' of combinations of old-wage percentiles and degree-of-disability categories for disabled workers with statutory insurance only. We next subtract these averages from those of corresponding disabled workers with BSI and CSI. Figure 6 shows the resulting 10 'bin' values for combined degree-of-disability categories and types of supplementary insurance (BSI or CSI) and a quadratic fitted regression line (with 95% confidence intervals). Importantly, we see that the level of increased coverage is not associated with lower employment rates. Rather, replacement rate increases — which are relevant for partially disabled workers only — go together with employment rates that are about 5 percentage-points higher. Still, there is no evidence that these increases are also proportional to increases in the size of the replacement rate increase.

Figure 6: Replacement rate increases due to supplementary insurance and employment differentials of disabled workers with and and without supplementary insurance: 'bins'[a] and fitted line[b]



Notes: BSI = Basic Supplementary Insurance, CSI = Comprehensive Supplementary Insurance. Replacement rate increases equal the difference in replacement rates for disabled workers with BSI or CSI, and the (fictitious) replacement rates that would prevail with statutory benefits only. The employment differential equals the employment rate of workers with BSI/CSI, as compared to those of workers with similar degrees of disability and pre-application wages and receiving statutory insurance only.
[a]: Bins represent averages for combined (5) degree-of-disability categories and (2) types of insurance (BSI/CSI); [b]: Quadratic fitted line with 95% confidence intervals.

6.2 Estimation results

Table 5 shows the estimation results of the effect of log replacement rates and supplementary insurance coverage on the employment of awarded DI applicants. For all model variants, we use three polynomials for log pre-application wages and four polynomials for degrees of disability for each year in our sample.[16] As a reference

[16]The fourth-order polynomial of log pre-application wages does not further improve the fit of our model. Also, comparisons of the adjusted R-squared lead us to conclude that improvements in the fit of the model are achieved up to four polynomials for the observed degree of disability. In effect, this yields 4x15 = 60 parameters that determine the annual degree-of-disability baseline.

Table 5: Two-way Fixed-effect estimates of employment model

Specification	(i)	(ii)	(iii)	(iv)
Basic Supplementary Insurance (BSI)	0.018	0.007	0.020	0.013
	(0.012)	(0.013)	(0.012)	(0.013)
— Interacted: partial DI benefits		0.063***		
		(0.024)		
Comprehensive Supplementary Insurance (CSI)	0.023**	0.027**	0.037***	0.016
	(0.011)	(0.012)	(0.011)	(0.012)
— Interacted: partial DI benefits		–0.020		
		(0.019)		
Log replacement rate			–0.058***	
			(0.009)	
— "Worker moral hard" effect ($\ln RR^{II}$)				–0.107***
				(0.011)
— "Joint worker and insurer" effect ($\ln RR^{III}$)				0.028*
				(0.015)
Degree of disability: 4 polynomials x 15 yrs	YES	YES	YES	YES
Log pre-application wages: 3 polynomials	YES	YES	YES	YES
Age, gender and tenure (12 dummies)	YES	YES	YES	YES
Firm-fixed effects	YES	YES	YES	YES
Labor Force Non-Participation Elasticity			0.066	0.122
Worker/firm observations	27,495	27,495	27,495	27,495
Firm observations	1,612	1,612	1,612	1,612
R-squared: overall	0.1742	0.1743	0.1755	0.1778
R-squared: within	0.1671	0.1674	0.1683	0.1702

Notes: ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Standard errors are shown in parentheses.

point, column (i) shows the "DiD" estimates of BSI and CSI contracts, as in Equation (9). Recall that these dummies capture the *joint* effect of worker moral hazard and insurer effort. For the full population of workers that switched to these two contract forms, employment rates do not differ significantly with respect to the control group of individuals that did not switch or did not switch yet. When allowing for differential effects by type of benefits, however, we see that employment rates are higher for partially disabled workers with BSI, see column (ii). The employment effect of BSI for this group amounts to about 6 percentage-points. This suggests that any moral hazard effects from higher coverage for partially disabled are more than compensated by other effects.

Models (iii) and (iv) add (log) replacement rates to the model. Model (iii) assumes equal effects of changes in replacement rates due to statutory and supplementary DI benefits, which implies that there are no effects of additional insurer effort. This yields a significant elasticity estimate of –0.058, which corresponds to a Labor Force Non-Participation (LFNP) elasticity of 0.066. At the same time, the dummy estimates for BSI and CSI increase. To some extent, this compensates the worker moral hazard effects that decrease employment with supplementary insurance.

Model (iv) corresponds to our preferred model in Equation (11). As argued earlier, the effect of replacement rates in this model represents workers' moral hazard. The implied LFNP-elasticy amounts to 0.122, whereas the replacement rate effect from supplementary coverage is positive and borderline significant. At the same time, the "constant" effects of extra coverage indicated by the BSI and CSI dummies become statistically insignificant. This suggests that private insurers focus on — and succeed in — reducing worker moral hazard among partially disabled workers for whom there is extra insurance coverage, but not for workers with full benefits for whom replacement rates are unaffected by supplementary insurance. From the perspective of potential benefit savings, this is in line with expectations.

The main takeaway from these results is that the interpretation of worker moral hazard effects is contextual. The LFNP estimate based on variation in non-statutory benefits is 0.122, which is in the ballpark of estimates obtained by e.g. Koning & Van Sonsbeek (2017) and Kostøl & Mogstad (2015). As long as workers can only exploit their assessed earnings capacity, this estimate presumes no financial interest in work resumption for the insurer. This is also relevant for most empirical analyses that study changes in statutory benefits. Based on switches to supplementary insurance, however, the implied LFNP-elasticity does not differ significantly from zero. As far as it concerns partially disabled workers, this most likely stems from the financial interest private insurers have to increase the employment of insured workers.

6.3 Interpreting insurer effort

Given our interest in the effect of extra insurance coverage on employment, one may be tempted to conclude that private insurers take stronger actions — such as increasing monitoring or prevention — for workers with higher extra insurance coverage. These actions are then proportional to moral hazard effects. In the current setting, however, the scope for proportional actions by the insurer is limited. First and foremost, it should be stressed once more that contracts are set at the level of firms and not fine-tuned for individual workers. Consistent with this, preventative activities are relevant for all long-term sick workers that have not made DI applications (yet) and for whom the outcome of any application decisions is not known yet as well. We also observe that the policy parameters other than coverage — such as the presence of work bonuses — are the same for BSI and CSI contracts and apply to all partially disabled workers. This calls for a model specification with a common effect that applies to all partially disabled workers with supplementary insurance, regardless of the size of the individual's increase of the replacement rate.

Related to this argument, it is also unlikely that private insurers target exclusively the potential extra moral hazard that originates from supplementary insurance. Knowing that moral hazard is also present with statutory insurance only, preventative actions and other insurance policy parameters may well reduce this source of moral hazard as well. These 'spillover' effects to the effect of statutory benefits justify a model specification where the replacement rates are included in absolute levels, rather than increases in it.

In light of the above arguments, we re-specify our baseline regression with a 'constant' effect of BSI and CSI for partially disabled workers and distinct replacement rate effects for disabled workers with and without supplementary insurance:

$$
\begin{aligned}
Y_{ijt} &= \beta\tilde{X}_{ijt} + \delta \ln(RR_{ijt}) + \tilde{\delta}^{SI} \cdot \Big(BSI_{jt} + CSI_{jt}\Big) \cdot \ln(RR_{ijt}) \\
&+ \kappa^{SI} \cdot I(d_{ijt} < 0.8) \cdot \Big(BSI_{jt} + CSI_{jt}\Big) \\
&+ \gamma^{BSI} BSI_{jt} + \gamma^{CSI} CSI_{jt} + \tilde{\Psi}_t\Big(\ln(d_{ijt})\Big) + u_j + \epsilon_{ijt}, \qquad (12)
\end{aligned}
$$

where $\tilde{\delta}^{SI}$ denotes the interacted effect of supplementary insurance and the log replacement rate and κ^{SI} the 'constant' insurer effort effect for all partially disabled workers with supplementary insurance.

Table 6 shows the estimation results for Equation (12) for employment. For ease of comparison, column (i) shows the results from the baseline specification of Equation (11). The results in columns (ii) and (iii) show substantial and positive additional employment effects that are relevant for all partially disabled workers with supplementary insurance. This effect, which is almost 10 percentage-points, suggests that private insurers do not target specific workers with the highest additional coverage but that their effort affects all insured partially disabled workers equally. More strikingly, we also find evidence that the effect of replacement rates on employment is the same for workers with supplementary insurance as for those with statutory benefits only. So to the extent that moral hazard is a response to higher benefits, the impact of this is equally relevant if they have supplementary insurance. Overall, the results point at compensating actions by the insurer that apply to all workers with extra coverage, rather than targeted actions.

Table 6: Two-way Fixed-effect estimates of alternative employment models[a]

Specification	(i)	(ii)	(iii)
Basic Supplementary Insurance (BSI)	0.013	0.008	0.004
	(0.013)	(0.013)	(0.021)
Comprehensive Supplementary Insurance (CSI)	0.016	0.025*	0.022
	(0.012)	(0.011)	(0.017)
Supplementary insurance × partial DI ($= \kappa^{SI}$)		0.097***	0.094***
		(0.019)	(0.023)
Log replacement rate ($lnRR$)		–0.089***	–0.089***
		(0.011)	(0.011)
— "Worker moral hard" effect ($\ln RR^{II}$)	–0.107***		
	(0.011)		
— "Joint worker and insurer" effect ($\ln RR^{III}$)	0.028*		
	(0.015)		
Log replacement rate × supplementary insurance ($= \tilde{\delta}^{SI}$)			–0.008
			(0.039)
Degree of disability: 4 polynomials x 15 yrs	YES	YES	YES
Log pre-application wages: 3 polynomials	YES	YES	YES
Age, gender and tenure (12 dummies)	YES	YES	YES
Firm-fixed effects	YES	YES	YES
Worker/firm observations	27,495	27,495	27,495
Firm observations	1,612	1,612	1,612
R-squared: overall	0.1778	0.1760	0.1760
R-squared: within	0.1702	0.1692	0.1692

Notes: ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Standard errors are shown in parentheses. [a]: The results in column (i) follow from estimation of Equation (11), whereas columns (ii) and (iii) show results from (variants of) Equation (12)

6.4 Robustness

Table 7 shows results of robustness tests on the employment model. To start with, we re-estimate Equation (11) with placebo dummies for the two years before the firms' switch to BSI or CSI (see row (i)). Both placebo dummies are statistically insignificant and other coefficients remain unaffected. Assuming random firm effects as a robustness test also yields results similar to the firm-fixed effects estimates in our baseline specification — see row (ii). In line with our earlier results, we conclude there is no evidence pointing at anticipation or selection effects. This corresponds to Autor et al. (2014), who find similar estimation results for behavioral effects with and without the use of detailed firm-fixed effects.

Table 7: Robustness tests for employment model

	BSI	CSI	$\ln(RR^{II})$ "Worker effect"	$\ln(RR^{III})$ "Joint effect"
Baseline results	0.013	0.016	–0.107**	0.028*
	(0.013)	(0.012)	(0.011)	(0.015)
(i) Placebo-analysis[a]	0.014	0.009	–0.107***	0.028***
	(0.013)	(0.012)	(0.011)	(0.015)
(ii) Random firm effects	–0.004	–0.012	–0.102***	0.037***
	(0.009)	(0.008)	(0.011)	(0.014)
(iii) Logit model (marginal effects)	–0.009	–0.025	–0.046***	0.025
	(0.012)	(0.017)	(0.009)	(0.018)
(iv) Heterogeneous effects replacement rate	0.013	0.016	–0.104***	0.028*
	(0.012)	(0.012)	(0.013)	(0.015)
— Interacted: below 65% degree of disability			–0.005	
			(0.011)	
(v) Relative wages as outcome	0.006	0.005	–0.045***	0.007
	(0.011)	(0.011)	(0.009)	0.012)
(vi) Current employment as outcome	0.011	–0.013	–0.093***	0.048***
	(0.016)	(0.016)	(0.013)	(0.017)
(vii) Conditional replacement rate (log)	0.011	–0.013	–0.097***	0.048***
	(0.016)	(0.016)	(0.013)	(0.017)

Notes: ***, **, and * indicate significance at 1%, 5% and 10%. Model estimates build upon Equation (11) that includes effects for BSI, CSI, $\ln(RR)$, and $\ln(RR^{III}$.
[a]: The placebo estimates for BSI and CSI are equal to –0.017 (0.029) and 0.010 (0.025), respectively.

As another important ingredient of our analysis, we exploit interacted effects of pre-application wages and degrees of disability on log replacement rates and control for additive effects. Robustness test (iii) shows marginal employment effects if we use a

Logit specification that induces interaction effects by construction. The results for the Logit model show that our replacement rate coefficient δ reduces to –0.046***, and the coefficient δ^{SI} reduces to 0.025. We can interpret these estimates as a lower bound for the replacement rate effects.

We argued earlier that the estimate of δ can be considered as an Average Treatment effect (ATE). However, increases in replacement rates due to supplementary insurance that constitute the "DiD" estimates only affect partially disabled workers and are Average Treatment effects for the Treated (ATT). If replacement rate effects vary by degree of disability, the elasticity effects for workers' moral hazard and the insurer effort may not be compatible. To address this concern, we re-estimate our model with separate replacement rate effects for partially disabled workers with degrees of disability below and above 65%.[17] Using this cutoff, we find no evidence for different effects for awardees with degrees of disability below and above 65% — see robustness test (iv).

Lines (v), (vi), and (vii) report the estimation results for related employment outcomes and with conditional replacement rates as an alternative proxy for workers' incentives. We define relative wages as the fraction of current wages of the old wages. Roughly speaking, for this variable we find replacement rate effects that are half of the coefficients obtained for the incidence of employment.[18] If one was to assume that extra earnings exclusively stem from extensive margin effects, this suggests that changes in employment imply wages that correspond to 50% of pre-application wages. Robustness test (vi) analyzes the effects on current employment

[17]Note that our estimation strategy relies on interacted effects below/above the 80% threshold. By construction, we therefore cannot estimate response effects for the sub-sample of those with full benefits with replacement rates that are equal to 70% in all cases.

[18]Table A4 reports an extensive table with estimation results for relative wages.

outcomes — measured at the end of 2019. This yields similar result. Finally, row (vi) shows the effect of (log) conditional replacement rates, where the denominator of the replacement rate equals the income from benefits and earnings if the worker exploits his/her earnings capacity (instead of the old wage). While this proxy may appear more suitable to describe incentives for partially disabled workers, this yields results that are again similar to those obtained with conventional replacement rates.

7 Conclusion

A well-known concern with voluntary social insurance programs is that it may induce or increase risk selection and moral hazard problems. While these problems are studied extensively in e.g. health insurance, less is known for private and voluntary Disability Insurance (DI) benefits. With extensive evidence that points at the existence of moral hazard effects for mandatory public DI, one could hold the case against supplementary insurance. These concerns may be aggravated by fiscal externalities that private DI may have on public DI (Chetty & Saez, 2010; Pauly, 1974). But this argument overlooks the fact that the financial interests of private insurers are different from public organizations. Existing insights on moral hazard effects may therefore be less relevant when it comes to private supplementary insurance.

This paper analyzes the effects of such private, supplementary DI on workers' absences and employment. We use unique and rich administrative data from a large Dutch insurance intermediary on firm-level insurance contracts, workers' absences, and employment and wages of awarded DI applicants. Voluntary private supplementary contracts are concluded at the level of firms. Using a Two-way Fixed-Effects model that uses switches of firms to supplementary insurance contracts, we first estimate the effect of supplementary insurance on various outcome variables. Since supplementary insurance also increases the financial interest at the side of the insurer, these estimates can be interpreted as the joint effect of worker and insurer behavior. For the sample of awarded DI applicants, we next derive and estimate (log) replacement rate effects on the employment probability. With variation in replacement rates stemming from differences in statutory DI benefits, we infer worker moral hazard effects. As to the remaining variation that stems from supplementary insurance, however, the treatment represents the joint effect of increases in worker moral hazard and increased effort of the insurer to reduce benefit costs.

From our results, we conclude that both worker moral hazard and insurer incentives are empirically important. In the sickness period that precedes DI applications, workers with supplementary insurance are not less likely to recover as moral hazard would predict. This holds both for contracts with "basic" supplementary insurance (BSI) and the more generous "comprehensive" supplementary insurance (CSI). Insurer incentives — to reduce future claims with higher benefits — thus seem to offset the effect of (any) worker incentives. For the sample of workers awarded DI benefits, we next estimate the effects of worker and insurer incentives on employment. From our estimation results, the implied Labor Force Non-Participation (LFNP) elasticity is 0.122, which is close to recent estimates for the Netherlands and Norway. For switches to supplementary insurance, however, the joint effect of increased workers' moral hazard and increased insurer effort is statistically insignificant. This suggests that the insurer incentives — stemming from more generous payments to disabled workers — compensate for workers' moral hazard. Additional analyses, together with insights from the strategies pursued by the insurer, suggest that these compensating actions — such as increase prevention and work bonuses — apply to all partially disabled workers and are not confined to those with the highest increases in coverage.

Our results have important implications. While there is a rich literature that studies the effects of worker moral hazard on worker outcomes, the incentive effects of the insurer are largely ignored. Private insurance contracts may include more policy parameters than increased coverage only, with the aim to compensate for unintended behavioral effects. Most notably, both supplementary insurance contracts we studied include financial work bonuses. This calls for analyses that take a broader perspective than on insurance coverage only.

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Appendix: Identification

This appendix explains the identification of parameters in Equation (11) in Section 4.2 that comprises the Two-way Fixed-Effects employment model with separate effects of worker moral hazard and the 'constant' effects of switches from statutory insurance to BSI and CSI. This model is relevant for the sample of workers awarded benefits:

$$\begin{aligned} Y_{ijt} &= \beta \tilde{X}_{ijt} + \delta \ln(RR^{II}_{ijt}) + \delta^{SI} \ln(RR^{III}_{ijt}) + \\ &+ \gamma^{BSI} BSI_{jt} + \gamma^{CSI} CSI_{jt} + \tilde{\Psi}_t \Big(\ln(d_{ijt}) \Big) + u_j + \epsilon_{ijt} \end{aligned} \tag{A.1}$$

Conditioning on $\tilde{X}$, degree of disability d, calendar time t and firm-fixed effects u, the "DiD" estimators of switching to BSI and CSI are equal to:

$$\gamma^{BSI} \ + \ \delta^{SI} \cdot \mathrm{I}(d < 0.8) \cdot \ln(w_{old}) \tag{A.2}$$

$$\gamma^{CSI} \ + \ \delta^{SI} \cdot \mathrm{I}(d < 0.8) \cdot \Big(\ln(w_{old}) - \ln(d_{mid}) \Big) \tag{A.3}$$

Since the DiD estimates vary with respect to $\ln(w_{old})$ and d, we can identify γ^{BSI}, γ^{CSI}, and δ^{SI}. Note that a large share of our sample consists of workers with full DI benefits. Since supplementary insurance does not increase benefits for this group, this largely identifies the 'constant' effects, γ^{BSI} and γ^{CSI}. Effects that are proportional to the benefit increase (δ^{SI}) are identified from the employment outcomes of partially disabled workers.

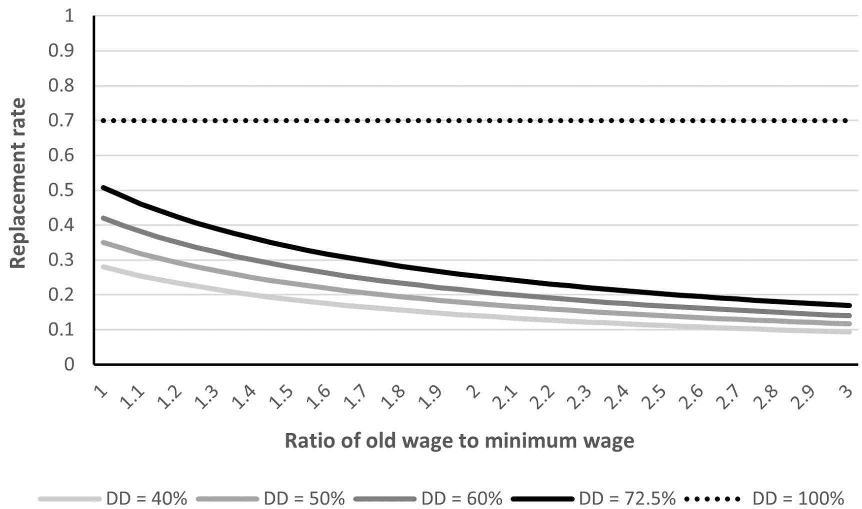
To identify δ, we exploit variation from awardees without any supplementary insurance. This variation stems from the *interacted* effect of changes in the log replacement rate due to d and $\ln(w_{old})$, conditional on d and $\ln(w_{old})$). Specifically, the difference between the log replacement rate for full benefits and partial benefits for workers without supplementary insurance equals:

$$\ln RR(d = 1 \,|\, w_{old}) - \ln RR(d < 1 \,|\, w_{old}) \;=\; -\Big(\ln(d) + \ln(w_{old})\Big) \qquad \text{(A.4)}$$

The above equation shows that the difference in the replacement rate between fully and partially disabled workers is not only proportional to the degree of disability, but also to the ratio of the pre-application wage to the minimum wage. The latter effect entails an interaction effect of pre-application wages and the degree of disability that we use for identification of δ. And since the associated change in DI benefits does not change the incentive for the insurer to increase work resumption, δ can be interpreted as worker moral hazard effects.

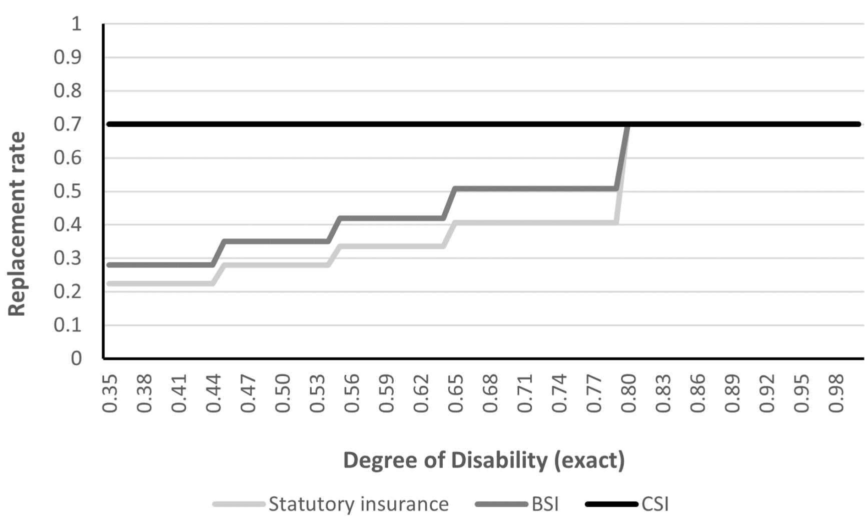
Appendix: Additional figures

Figure A1: Replacement rates for *statutory* DI benefits by the ratio of pre-application wages to the minimum wage



Note: DD = midpoint of degree-of-disability category

Figure A2: Replacement rates by degree of disability for a worker with pre-application wage of 125% of the minimum wage: statutory benefits, BSI, and CSI



Appendix: Additional tables

Table A1: Fictitious and "true" average replacement rates of partially disabled workers by samples with contract types

	Samples of awardees with:		
Fictitious replacement rates ↓	Mandatory Insurance	BSI	CSI
Mandatory insurance	**0.222**	0.222	0.223
	(0.080)	(0.074)	(0.079)
Basic Supplementary Insurance (BSI)	0.373	**0.364**	0.364
	(0.082)	**(0.081)**	(0082)
Comprehensive Supplementary Insurance (CSI)	0.699	0.700	**0.700**
	(0.011)	(0.001)	**(0.002)**

Note: Standard errors shown in parentheses. Replacement rates shown in bold represent averages based on the "true" sample of workers for whom the specific insurance type applies.

Table A2: LPM for probability of absence of 24 months: Event-time analysis

Event-time t around switch	Estimates
$-2 \leq t \leq -1$	–0.003
	(0.014)
$0 \leq t \leq 2$	–0.038*
	(0.022)
$t > 2$	–0.036
	(0.025)
Observations	98,624

Notes: The event time t=0 refers to the year of the switch towards supplementary insurance, either BSI or CSI. This regression includes the workers' age, gender, and tenure at the firm as control variables. Standard errors shown in parentheses, *,**,*** indicate significance at 10%, 5%, and 1%.

Table A3: LPM for probability of absence of 24 months: heterogeneity in treatment effects by cohorts

	Treatment effect
Basic Supplementary Insurance (BSI):	
2006 — 2013	–0.020
	(0.029)
2014 — 2016	0.042
	(0.030)
2017 — 2019	0.034**
	(0.014)
Comprehensive Supplementary Insurance (CSI):	
2006 — 2013	–0.044
	(0.033)
2014 — 2016	–0.037*
	(0.019)
2017— 2019	0.004
	(0.020)
Observations	98,624

Notes: Each variable is a dummy that equals one if the firm has switched towards BSI/CSI in this time period. This regression includes the workers' age, gender, and tenure at the firm as control variables. Standard errors shown in parentheses, *,**,*** indicate significance at 10%, 5%, and 1%.

Table A4: Two-way Fixed Effect estimates for wages as a fraction of old wages

	(i)	(ii)	(iii)	(iv)
Basic Supplementary Insurance (BSI)	0.012	–0.001	0.012	0.008
	(0.014)	(0.015)	(0.011)	(0.012)
–Interacted: partial DI benefits		0.060***		
		(0.023)		
Comprehensive Suppl. Insurance (CSI)	0.012	0.023*	0.024*	0.013
	(0.011)	(0.012)	(0.011)	(0.012)
–Interacted: partial DI benefits		–0.036*		
		(0.019)		
Log Replacement rate			–0.030***	
			(0.008)	
– "Worker effect"				–0.044***
				(0.010)
– "Worker and Insurer effect": $\Delta \ln(RR)^{SI}$				0.007
				(0.012)
Degree of disability: 4 polynomials x 15 yrs	YES	YES	YES	YES
Log pre-application wages: 3 polynomials	YES	YES	YES	YES
Age, gender and tenure (12 dummies)	YES	YES	YES	YES
Firm-fixed effects	YES	YES	YES	YES
Average net insurer and worker effect				
Basic Supplementary Insurance (BSI)	0.012		0.006	0.008
Comprehensive Supplementary Insurance (CSI)	0.012		0.015	0.013
Individual-Firm observations	20,845	20,845	20,494	20,491
Firm observations	1,471	1.471	1,465	1,465
R-squared: overall	0.1026	0.1032	0.1031	0.1037
R-squared: within	0.0905	0.0911	0.0907	0.0915

***, **, and * indicate significance at 1%, 5%, and 10%. Standard errors in parentheses.