

Workers' moral hazard and private insurer effort in disability insurance

Pierre Koning, Max van Lent

NETSPAR ACADEMIC SERIES

Workers' moral hazard and private insurer effort in disability insurance

Pierre Koning^{1,2}  | Max van Lent^{2,3}

¹Vrije Universiteit, Tinbergen Institute, Amsterdam, The Netherlands

²IZA, Bonn, Germany

³Leiden University, Leiden, The Netherlands

Correspondence

Pierre Koning, Vrije Universiteit, Amsterdam, The Netherlands.

Email: p.w.c.koning@vu.nl

Abstract

While it is well known that supplementary private Disability Insurance (DI) has the potential to increase workers' moral hazard, the extra coverage may also increase incentives for private insurers to reduce caseloads by means of prevention and reintegration activities. With unique administrative data on DI contracts of firms in the Netherlands, this paper aims to disentangle these worker and insurer responses to increased coverage. Supplementary insurance increases the insurers' incentive to lower disability risks, but in our setting it also creates an incentive for the insurers to facilitate partial work resumption of disabled workers who have earnings capacity. Using firm- and time-fixed effects models on the absence and employment rates, we find that insurer effort counteracts workers' moral hazard.

KEYWORDS

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

JEL CLASSIFICATION

G22, G52, J3, J21

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs](https://creativecommons.org/licenses/by-nc-nd/4.0/) License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2024 The Authors. *Journal of Risk and Insurance* published by Wiley Periodicals LLC on behalf of American Risk and Insurance Association.

1 | INTRODUCTION

Public Disability Insurance (DI) schemes are ubiquitous in developed countries, and costly. Roughly 2% of gross domestic product (GDP) is spent on public disability and sickness benefits in the Organisation for Economic Cooperation and Development (OECD) countries on average, and 1% of GDP in the United States in 2018 (OECD, 2024). But while public DI benefits are mandatory and provide coverage for all workers, there is also an important role for private, supplementary DI. For instance, about 35% of the workers in the United States have complementary private long-term DI (Bureau of Labor Statistics, 2023).¹ Institutional details differ from country to country. In the Netherlands, private DI tops up statutory benefits whereas, in the United States, private DI typically contains offset clauses that reduce private benefits dollar by dollar when receiving public benefits (Autor et al., 2014). In Germany, public and private DI benefits are largely independent (Fischer et al., 2024).

A well-known concern with supplementary DI is that it may further increase workers' moral hazard. Workers may be encouraged to apply for DI, may reduce their effort to return to work, and may reduce their effort to combine employment with DI benefit receipt. A large empirical literature studies such workers' moral-hazard effects in DI, mostly using changes in workers' incentives of public DI schemes for causal inference.² These moral-hazard concerns are also relevant when private insurance—mostly offered as group contracts to workers in firms in the United States—imposes fiscal externalities on public insurance (Chetty & Saez, 2010; Pauly, 1974). One overlooked aspect, however, is that supplementary DI also affects the incentives of private insurers. Depending on the degree of competition in insurance markets, and given their financial interest in reducing benefit payments, private insurers may become more inclined to organize work accommodations together with the insured firms, and thus provide preventive activities or offer financial rewards to workers in case of (partial) work resumption. This raises the general question whether workers or insurers are more responsive to incentives, as well as what are the specific ways in which they differ in their ability to increase the opportunity for workers to resume work. Insurers may benefit from scale advantages and have more expertise than workers do in organizing and imposing work accommodations to firms. There is no evidence so far that disentangles the impacts of these two forces.

This paper studies the causal effect of private supplementary DI contracts on benefit- and employment outcomes in the Netherlands. In our setting, supplementary contracts top up statutory Partial and Temporary (WGA) disability benefits. Disabled workers in the WGA program are deemed to have remaining earnings capacity, which is measured by the income they could earn from functions and working hours that are still feasible. The level of WGA benefits depends on the assessed “degree of disability (DoD)”, which is the difference between the preapplication wage and the earnings capacity (i.e., the earnings loss) as a percentage of the preapplication wage. Since its start in 2006, the WGA program implemented a strong reduction in benefit generosity for workers with a DoD below 80% and increased the incentives for workers to use their earnings capacity. Specifically, disability benefits of workers without sufficient earnings were no longer tied to the preapplication wage but instead to the statutory

¹See, for example, Hemmings and Prinz (2020) for a description of private insurance programs in some European countries and Autor et al. (2014) for private long-term DI in the United States.

²We discuss the literature on moral hazard in more detail at the end of the introduction.

minimum wage. Particularly for disabled workers with higher preapplication wages, this led to a strong decrease in the replacement rate of DI benefits. But concurrent with this, insurers introduced private supplementary contracts that partially or fully offset the loss of insurance coverage due to the reform. Use of these “gap insurance” contracts, which are concluded as group contracts at the level of firms, has increased gradually over the years, amounting to 66% of all workers in 2021 (SZW, 2022).³

In our setting, firms purchasing supplementary insurance have already opted out of public insurance and have bought private insurance contracts to provide insurance for statutory DI benefits. In contrast to Workers' Compensation in the United States, however, firms that opt out in the Netherlands cannot self-insure. Instead, they must purchase a standardized plan from a private insurer that features mandatory benefit settings and automatic coverage for all workers. In effect, opting-out then implies that these firms are no longer subject to the financial risks inherent with experience-rated (public) DI premiums and typically pay uniform premiums instead that are based on the sector and the composition of the employed workers. Moreover, private insurers may offer specialized return-to-work policies to these firms. Private insurers cannot deny claims or increase monitoring activities, which is the responsibility of the public Employee Insurance Agency (UWV). In 2011, 37% of firms in the Netherlands had opted out, and since then percentage has remained quite stable (Hassink et al., 2015). When firms purchase supplemental coverage that tops up the statutory coverage levels, this increases the financial interest of the insurer to reduce disability risks. This particularly holds for disabled workers with high preapplication wages for whom the additional coverage from supplementary benefits is most substantial.⁴ Policy conditions of supplementary insurance contracts typically include increased case management both in the absence period and for WGA benefit recipients.⁵ Supplementary insurance also creates an incentive for insurers to facilitate employment for disabled workers, for instance by organizing work accommodations. In contrast to the case with statutory benefits only, any additional wage earnings crowd out part of the supplementary benefits. This implies a decrease in the marginal work incentive for disabled workers, and a commensurate increase in the incentives of the insurer.

We use unique administrative data from *Robidus Risk Consulting*, a large Dutch insurance intermediary. Our base sample is comprised of workers in firms that have opted out from public DI and therefore (already) have bought private insurance contracts for statutory DI.⁶ In the time period under investigation, a fraction of firms in this sample extends the coverage of WGA benefits from their private insurer with supplementary insurance beyond the statutory level. These voluntary contracts, which are most commonly used and were initiated at the start of the WGA scheme, supplement benefits up to 70% of either the lost earnings capacity (“Basic Supplementary Insurance” [BSI]), or the preapplication wages (“Comprehensive Supplementary Insurance” [CSI]). Compared with the counterfactual with statutory DI only, we expect that not only workers' moral hazard

³As a percentage of the total WGA benefit costs, the supplementary coverage increased from 3.5% to 12.1% (about 500 million euros) in 2021 (Cuelenaere et al., 2014; SZW, 2022).

⁴For instance, consider a disabled worker with a DoD of 50% and preapplication earnings equal to 200% of the minimum wage. He/she would receive statutory WGA benefits equal to 17.5% of the preapplication wage only, but the supplement would be equal to 52.5% of the preapplication wage with the most generous extra coverage.

⁵Appendix A provides a brief overview of the policy conditions of a standard supplementary DI contract.

⁶Since DI premiums for statutory and supplementary insurance of firms that opted out are not experience-rated, private insurers will have an increased interest to reduce disability risks and increase employment among benefit recipients.

will increase due to the extra insurance, but also that private insurers will face stronger financial incentives to counteract moral hazard.

We estimate the effect of supplementary insurance on absence, benefit awards, and employment of awarded DI recipients. We employ specifications with firm- and year-fixed effects, using the switches of firms from contracts with statutory coverage only to contracts with supplementary DI. To interpret the effect of firms' contract switches on worker outcomes as causal, two assumptions must hold. First, the worker composition of firms should not change as a consequence of the switch of DI contract. We provide evidence in favor of this assumption by comparing the worker characteristics of switching firms. Second, there should be no time variant unobservables that are correlated with the firms' decision to switch and our outcomes of interest. While we cannot test the second assumption directly, we use an IV strategy that provides us with plausibly exogenous variation in firms' switching behavior. Since *Robidus* approaches firms for supplementary insurance periodically based on their sector, we use sectoral variation in supplementary insurance as an instrumental variable for having supplementary insurance. We find a strong first stage, and a negative but noisy second stage, which is in line with our main results. This suggests that time-varying unobservables do not play a major role in our context.

Since supplementary insurance changes the incentives for both worker and insurer, our estimates of switches on the absence and DI applications can be interpreted as the *joint* effect of worker and insurer behavior. Our results provide no evidence that supplementary DI leads to a higher probability of applying for DI benefits, as workers' moral hazard would predict. Rather, our evidence indicates lower application probabilities. This suggests one of two things: either the higher benefits do not cause anticipatory behavior of workers, or insurer behavior (or other policy parameters than the extra coverage) compensates for worker moral-hazard effects.

We next separate the employment effects of worker and insurer incentives, focusing on awarded DI applicants in the WGA program. For this we use the earlier-mentioned cutoff rule for the setting of statutory WGA benefits. When the DoD exceeds 80%, workers receive 70% of their old wage, but below this threshold benefits are proportional to the DoD and tied to the statutory minimum wage. As a result, the replacement rate of the benefit jumps to a markedly lower level below the 80%-cutoff. For the sample of workers with statutory benefits only, the 80%-cutoff allows us to identify and estimate employment effects to benefits. Assuming that workers cannot earn more than their assessed earnings capacity and therefore continue receiving the same level of DI benefits, employment effects due to differences in replacement rates can be interpreted as workers' moral hazard. Stated differently, it is only the worker—and not the insurer—who has a financial interest to increase wage earnings up to the level of the earnings capacity at maximum. We then find that a 1% increase in the replacement rate for workers decreases employment by 0.11 percentage points, corresponding to a Labor-Force-Non-Participation (LFNP) elasticity of 0.12. Using the switches to supplementary insurance, we can also estimate an LFNP elasticity that represents a combined worker and insurer effect. From this, we find that workers with the supplementary insurance show slightly higher employment rates than those with statutory insurance only. Combining this LFNP elasticity estimate with the estimate derived from variation in statutory benefits, this suggests that the insurer offsets the workers' moral-hazard 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 Cabral & Dillender, 2020;

Dal Bianco, 2019). This line of research has shown the following: more generous benefit conditions increase applications to a duration of disability (Autor et al., 2014; Cabral & Dillender, 2020; Gelber et al., 2017); DI receipt decreases labor supply and wage earnings (French & Song, 2014; Garcia-Mandicó et al., 2020; Maestas et al., 2013); 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). Zooming into the literature on employment effects that focus specifically on sick pay or sick pay mandates, we see that the US evidence so far is limited—see, for example, Pichler and Ziebarth (2020), Boots et al. (2009), and Ahn and Yelowitz (2015) for contributions.⁷ Our analysis confirms the general finding that more generous DI benefits decrease labor supply. As to private supplementary insurance, however, our results suggest that these effects are counteracted by increased insurer effort to exploit the remaining earnings capacity of disabled workers.

We also contribute to a smaller literature that suggests that firm and insurer incentives reduce workers' disability claims (Koning, 2016). Although our analysis does not directly focus on the firm that is incentivized, we believe that the effects of this literature are indicative of the ability of the insurer to—directly or indirectly—reduce disability caseloads and increase work resumption. Private insurers can realize such effects with the use of work bonuses, work accommodation reimbursements for firms and enhanced case management. There is evidence for both public DI schemes and Workers' Compensation schemes that experience-rated DI premiums for firms can be an effective tool for doing so (De Groot & Koning, 2016; Koning, 2009; Korkeamäki & Kyyrä, 2012; Kyyrä & Paukkeri, 2018; Tompa et al., 2012). Similar to private insurers that are financially responsible for the costs of benefits, experience-rated or self-insured firms have an incentive to counteract workers' moral hazard. In this respect, Guo and Burton (2010) are one of the few studies that link the concepts of worker and firm incentives for Workers' Compensation. They argue that benefit and frequency elasticities for Workers' Compensation benefits decreased after 1990, when large deductibles increased the incentives of firms. Using 25 years of data on Workers' Compensation, Bronchetti and McInerney (2012) arrive at similar results.

Finally, our results add to the broader discussion on not only the desirability of choice in insurance contracts (Cabral et al., 2022; Cabral & Cullen, 2019; Hendren et al., 2021), but also the welfare effects of combined public and private insurance (Chetty & Saez, 2010; Pauly, 1974). 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 fiscal externality effects in the United States and Canada (Autor et al., 2014; Stepner, 2019). In our setting, however, private insurers bear the financial risk inherent in combining statutory benefits and supplementary insurance. As a result, fiscal externalities are absent.

The remainder of this paper is organized as follows. Section 2 describes the institutional setting, followed by a description of data in Section 3. Section 4 outlines our research strategy, and Section 5 discusses the impact of supplementary insurance on the probability

⁷Sick leave and partial and temporary disability programs are more prominent outside the United States, with most evidence pointing at larger moral-hazard effects than for US sick leave (Dale-Olsen, 2014; De Paola et al., 2014; Fevang et al., 2014; Johansson & Palme, 1996, 2005; Mitra, 2009; Petterson-Lidbom & Skogman Thoursie, 2013; Pichler & Ziebarth, 2014; Yin, 2015).

of workers of recovering during the absence period and applications made to DI. Section 6 discusses the effect on employment outcomes for awarded DI applications. Section 7 concludes.

2 | INSTITUTIONAL SETTING

2.1 | DI in the Netherlands

The flowchart in Figure 1 shows that the statutory sick leave program and DI in the Netherlands are merged programs. DI applications of workers follow automatically after an absence period of 2 years. This contrasts to, for example, the United States, where mandatory sick leave programs—typically referred to as Temporary Disability Insurance benefits or “medical leave”—are limited and where workers need to initiate DI applications (Burkhauser et al., 2016; Pichler & Ziebarth, 2020). In the Netherlands, firms are obliged to continue 100% of the wages in the first year and 70% in the second year of sick leave.⁸ The so-called Gatekeeper Protocol prescribes the reintegration activities that need to be followed by firms in the 2-year absence period to become admissible for DI applications (Godard et al., 2022; Koning & Lindeboom, 2015). The public Employee Insurance Agency (UWV) assesses DI applications; their medical doctors determine the presence of impairments and labor experts assess their consequences for the earnings capacity.

Figure 1 also shows that there is no separate Workers' Compensation program for occupational disability risks in the Netherlands, but a comprehensive categorical DI transfer program (WIA) that provides public statutory insurance against loss of income due to work-related and nonwork-related conditions—see, for example, Burkhauser et al. (2016) for a detailed international comparison. DI benefit conditions are determined by the assessed loss of earnings capacity as a fraction of the preapplication wage—that is, the DoD—together with the assessed permanence of impairments. When the assessed DoD is below 35%, the worker does not receive any DI benefits. At the other extreme, workers with a DoD of 100% and medical conditions that are deemed permanent receive full and permanent benefits (IVA) replacing 75% of the old wage. In between, workers with a DoD exceeding 35% but below 100% and without current earnings capacity but temporary impairments, are entitled to the Partial and Temporary DI program (WGA). Workers with degrees of disability equal to or exceeding 80% receive WGA benefits equal to 70% of their preapplication wage. For workers with a smaller loss of earnings capacity, however, benefits are proportional to the DoD, and the level of benefits is tied to the minimum wage (see Section 3.2). Since its inception in 2006, the idea of the WGA scheme was to enhance work incentives for disabled workers with earnings capacity. The new scheme, however, also laid the groundwork for the rise of private supplementary contracts that compensate for the loss of coverage.

The Partial and Temporary (WGA) program aims to encourage not only workers to use their remaining earnings capacity, but also firms. Similar to Workers' Compensation in the United States, the premiums of the WGA scheme are experience-rated for firms (Koning, 2016). As explained earlier, about 37% of firms had opted out from public insurance to buy private insurance contracts that provide coverage against the risk of WGA

⁸See Koning (2016) for a broader discussion of the privatization of the sick leave scheme that started in 1996.

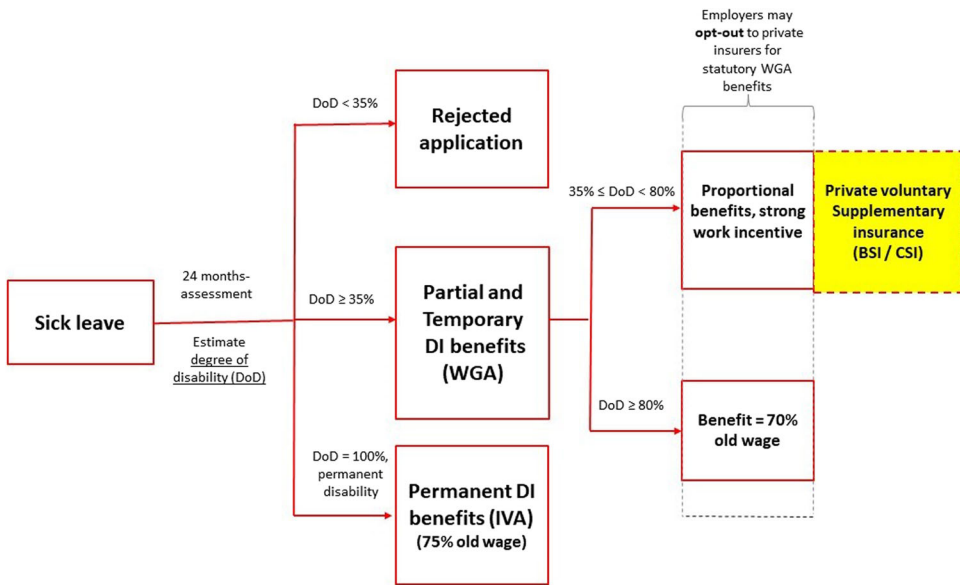


FIGURE 1 Flowchart of the Dutch sick leave and disability insurance (DI) system. BSI, Basic Supplementary Insurance; CSI, Comprehensive Supplementary Insurance; IVA, permanent DI benefits; WGA, partial and temporary DI benefits. [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/doi/10.1111/jori.12404)]

premiums (Hassink et al., 2015). Opting-out insurance contracts typically have uniform premiums, which implies that the risks inherent in WGA benefit costs are transferred to the private insurer. As part of these opting-out contracts, insurers also provide preventative and reintegration services in both the period of the absence and during DI receipt, and send out caseworkers that help firms with the requirements that need to be met to file a potential DI application.

2.2 | Private supplementary insurance: Benefit conditions

With data in this paper that come from private insurers, our analyses are conducted on workers in firms that have opted out at some point in time. Private insurers have thus already taken over the statutory WGA benefit payments of firms. In addition, the same insurers offer firm-level contracts that supplement disability benefits of their workers. These supplementary contracts take the public, statutory disability benefit level as given, and top up benefit coverage. Supplementary insurance is concluded as “group contracts” at the level of firms. Similar to private Long-Term Disability policies in the United States, the extra coverage can be considered as “fringe benefits” (Autor et al., 2014; Pichler & Ziebarth, 2020). It is estimated that 66% of all workers in the Netherlands had supplementary WGA contracts in 2021 (SZW, 2022).

We focus on two supplementary insurance contracts for DI that are most common in the Netherlands: BSI and CSI. Both contract types are referred to as “gap insurance,” since they partly or fully offset the loss of statutory insurance coverage due to the switch to the WGA

program in 2006.⁹ With this in mind, BSI and CSI contracts have become the standard since 2006, leaving little room to customize contracts in other dimensions. BSI and CSI contracts go together with intensified case management—predominantly in the absence period, but also for disabled workers with WGA benefits—and financial bonuses for disabled workers to use their earnings capacity. These bonuses are the same for BSI and CSI, and are relevant for workers with a DoD below 80%, constituting 5%–10% of the preapplication earnings. For a more detailed picture of the contract conditions, Table A1 in Appendix A provides a standard CSI contract for workers in firms within the Dutch care sector, and shows variations of contracts that *Robidus* offers.

BSI and CSI offset (part of) the work incentives for disabled workers with a DoD below 80%. For these workers, statutory WGA benefits are tied to preapplication wages only if the worker earns at least 50% of their assessed earnings capacity. If not, DI benefits are instead tied to the minimum wage. For instance, a disabled worker with a DoD of 50% should have earnings that exceed 25% of the preapplication wage to have WGA benefits tied to the preapplication wage instead of to the minimum wage.

To formalize this, we define d as the DoD of a disabled worker (compared with the old wage),¹⁰ W_{old} as the monthly preapplication earnings,¹¹ W_{min} as the statutory full-time minimum wage and W as current wage earnings. We assume that wage earnings cannot exceed the earnings capacity, $(1 - d)W_{old}$. The statutory benefits B^{STAT} for disabled workers with a DoD below 80%, and those equal to or exceeding 80% are

$$\begin{aligned} B^{STAT}(W_{old}, d \mid d < 0.8) &= 0.7dW_{min} + 0.7d(W_{old} - W_{min}) \cdot I\left(W \geq \frac{1}{2}(1 - d)W_{old}\right), \\ B^{STAT}(W_{old} \mid d \geq 0.8) &= 0.7W_{old}, \end{aligned} \quad (1)$$

with I as an indicator function that equals one if the worker uses at least 50% of the earnings capacity, and is zero otherwise. Equation (1) shows that the 50%-earnings threshold functions as a wage subsidy for workers with a DoD below 80%. Workers with a DoD higher than or equal to 80% and without any current earnings receive 70% of their preapplication wages.

BSI offsets the financial consequences of insufficient wage earnings for disabled workers with a DoD below 80%, thereby ensuring that coverage is tied to the old wage for all possible levels of earnings below or equal to the earnings capacity. The total benefit for these workers with BSI, B^{BSI} , thus equals

$$B^{BSI}(W_{old}, d \mid d < 0.8) = 0.7dW_{old}. \quad (2)$$

CSI extends coverage to 70% of the earnings loss. The benefit level is then no longer related to the DoD, and the implicit tax on wage earnings equals 70% for $W \leq W_{old}$.¹²

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

⁹The additional coverage of BSI and CSI becomes relevant in the “wage continuation period” of DI receipt. The wage continuation period is preceded by the wage-related period. This period starts at 24 months after the start of the DI spell at the latest.

¹⁰For expositional reasons, we abstract from the fact that the benefit level increases stepwise in the DoD categories of 10 percentage points. We also abstract from benefit caps, since a negligible fraction of earnings observations is capped.

¹¹Note that the number of working hours is not relevant for the calculation of the preapplication wages, and that benefits are proportional to total wages.

¹²Earnings exceeding the old wage (W_{old}) will be tapered by 100% and ultimately lead to the loss of statutory and supplementary DI benefits.

2.3 | Worker and insurer incentives

To analyze the effects of supplementary insurance, we calculate its effects on replacement rates that express the income from DI benefits and without wage earnings as a fraction of preapplication wages.¹³ The idea is that worker incentives decrease with increases in replacement rates, but are accompanied by an equal increase in the financial interest of the insurer.

To begin with, supplementary coverage is not relevant for disabled workers with a DoD equal to or exceeding 80%. For them, the replacement rate equals 70% for all coverage levels:

$$RR^{STAT}(. | d \geq 0.8) = RR^{BSI}(. | d \geq 0.8) = RR^{CSI}(. | d \geq 0.8) = 0.7. \quad (4)$$

For workers with a DoD below 80%, however, supplementary insurance matters. The replacement rates with statutory insurance, BSI and with CSI are equal to

$$RR^{STAT}(W_{old}, d | d < 0.8) = 0.7 d \left(\frac{W_{min}}{W_{old}} \right), \quad (5)$$

$$RR^{BSI}(d | d < 0.8) = 0.7 d, \quad (6)$$

$$RR^{CSI}(. | d < 0.8) = 0.7. \quad (7)$$

Defining *BSI* and *CSI* as dummies indicating insurance from either BSI or CSI (and zero otherwise), we now can write the following general expression for the replacement rate (*RR*):

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

with *I* as an indicator for the condition in parentheses. The first component of Equation (8) represents the replacement rate that prevails for disabled workers with a DoD below 80% who receive statutory DI benefits only. For them, benefits are proportional to their DoD, and benefits are tied to the minimum wage. The second component equals the jump in the replacement rate—at the 80% threshold—that follows from statutory benefits being tied to the old wage instead of the minimum wage. The third component (in square parentheses) is the increase in the replacement rate for disabled workers with a DoD below 80% when they receive private, supplementary insurance from BSI or CSI.

Figure 2 illustrates how BSI and CSI affect the incentives of workers and insurers to use worker earnings capacity. Given that earnings exceeding the assessed earnings capacity are rare,¹⁴ this setting well represents the employment decision of disabled workers. We consider

¹³Note that replacement rates relate income from benefits to old wages, and not the income from benefits and the remaining earnings capacity. Koning and 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 robustness analyses we will show that using the log of *CRR* instead of the log value of *RR* yields elasticity outcomes that are virtually equivalent.

¹⁴See, for example, Koning and Van Sonsbeek (2017) for evidence.

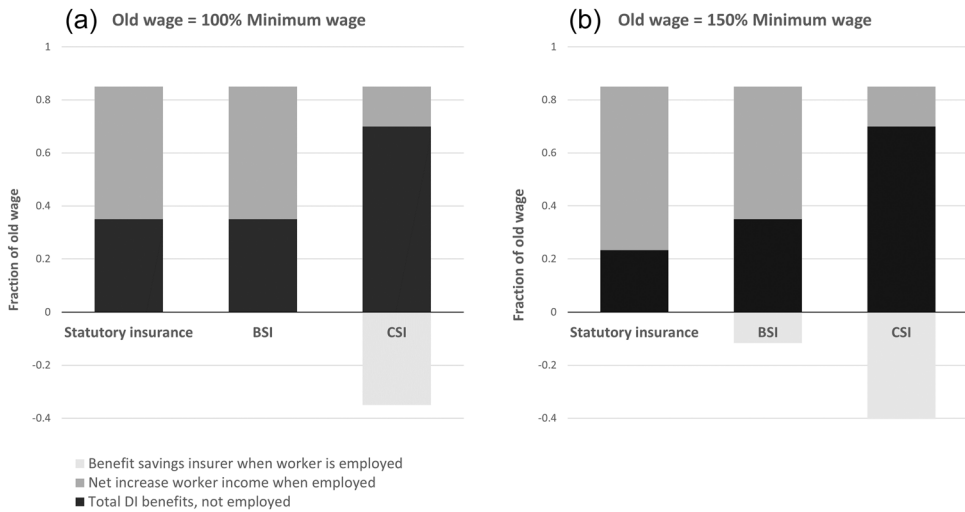


FIGURE 2 Replacement rate (in black) of a worker with degree of disability of 50% and old wage equal to 100% (panel A) and 150% of minimum wage (panel B). BSI, Basic Supplementary Insurance; CSI, Comprehensive Supplementary Insurance; DI, Disability Insurance.

two cases of a worker with a DoD of 50%: one in which the old wage equals the minimum wage (Panel a), and one in which it equals 150% of the minimum wage (Panel b).¹⁵ The black bars in Figure 2 indicate the replacement rates when the worker is unemployed; and the dark and light gray bars indicate the extra income (as a fraction of the old wage) for the worker and the insurers' benefit savings when the worker fully uses their earnings potential, respectively.

Panel (a) considers the case where the old wage of the worker equals the statutory minimum wage. Since statutory benefits are also tied to the minimum wage, BSI does not provide any additional coverage and the replacement rate equals 35% ($70\% \times 50\%$) of the old wage in both cases. CSI supplements the benefit up to 70% of the old wage. This means that 70% of the earnings potential (i.e., 35% of the old wage) goes to the insurer, and 30% to the worker (i.e., 15% of the old wage). In Panel (b) the old wage equals 150% of the statutory minimum wage. Since the benefit with BSI is tied to the old wage instead of the minimum wage, the replacement rate increases from 23% to 35%. The private insurer then 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.

The two examples show that with statutory insurance only disabled workers with a DoD below 80%—and not private insurers—have a strong financial interest to increase earnings up to the level of their assessed earnings capacity. As a percentage of the old wage, the extra income—amounting to 50% from extra earnings and 12% from the wage subsidy in the example in Panel (b)—is fully received by the worker. With BSI and CSI, however, both workers and insurers have an interest in using their earnings potential. In these cases, the insurer receives the full wage subsidy if the worker meets the 50%-earnings threshold. For CSI contracts the

¹⁵Appendix Figure C2 provides more insight into the impact of the level of old wages on (statutory) replacement rates. In addition, Figure C3 provides insight into the impact of the DoD on replacement rates.

financial interest of the insurers is larger, since they also receive 35% of the old wage (i.e., $70\% \times 50\%$) and the workers' share of the extra earnings decreases to the same extent. This can be interpreted as an implicit tax rate (of 70%) on wage earnings.

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 conducting return-to-work services and providing supplementary insurance to contracted firms for sick-listed and disabled workers. All contracted firms in our sample receive private insurance against the financial risks inherent with WGA benefits, and a fraction of firms also has supplementary DI from BSI or from CSI. Recall that all firms in our sample have already opted out to private insurance. Accordingly, we will compare firms that also buy BSI or CSI at some point in time to those firms that have not done this, and assess the effect of the extra coverage from the same insurer.¹⁶ The firms that contract with *Robidus* are relatively large. Most firms are in 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 preapplication earnings that are relatively low.¹⁷

We combine three data sources from *Robidus*. First, we have firm-level data containing contracts between 2006 and 2019. These data contain the contract type: that is, only statutory insurance, BSI, or CSI with the start and end dates of each contract. From talks with experts we infer that there is case management for all workers with BSI and CSI in the absence period, as compared with very low take-up rates without supplementary insurance. Unfortunately, however, we do not have data on the services inherent in more intensive case management. Insurer effort is therefore unobserved in our analyses, and inferences made on the importance of this follow from model assumptions that will be explained in Section 4. Although individual workers may opt out from BSI or CSI contracts, this occurs only very rarely. Experts from *Robidus* indicated that less than 1% of the workers concerned opt-out.¹⁸ Our second data source contains long-term absent workers in contracted firms with an absence 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 applied for DI after 2 years of absence from work. These data also contain award decisions and the type and level of benefits of awarded applicants. For awardees with WGA benefits, we also observe wage earnings at the moment of and after the application date.

Our data contain 2080 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

¹⁶Firms in our sample can also buy supplementary insurance from other private insurers. This however occurs rarely.

¹⁷*Robidus* provides services to a population of workers with relatively high disability risks. 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 disorders and almost 20% musculoskeletal disorders (UWV, 2021b). Given the high share of “difficult-to-verify” disorders, case managers of *Robidus* aim to reduce the scope for moral hazard.

¹⁸Although workers in the Netherlands are free to buy private DI elsewhere, a market for *individual* supplementary insurance is virtually nonexistent. 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).

the remaining 1691 firms have no supplementary insurance over the entire period.¹⁹ We observe 101,408 long-term sick-listed workers (i.e., on average 49 workers per firm) of which 15,981 (15.8%) are covered by supplementary DI. We do not see any difference in the number of workers that are long-term absent around the years of firm switches towards supplementary insurance. Our supplementary DI rate is higher than the average in the Netherlands in 2014, but lower than in 2022 (Cuelenaere et al., 2014; SZW, 2022).

In our context, we argue that selection of individuals with higher disability risks is unlikely. One major reason is that contracts are set at the level of firms or sectors. To the extent that firm-specific conditions, worker characteristics or trends drive long-term absence and disability inflow rates, *Robidus* also takes the initiative to contract new firms—mostly clustered in specific sectors—and to 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 for which *Robidus* is financially responsible. Since *Robidus* sets BSI and CSI premiums that are based on past disability risks of firms and current long-term absence rates that may add to future DI inflow rates, the room for adverse selection by firms appears limited. *Robidus* is most likely better informed about the true disability risks than their clients are. We return to this issue when discussing descriptives of firms and the effect of switches to supplementary insurance.

3.2 | Descriptive analysis

Figure 3 shows the number of long-term sick-listed workers per cohort in our sample under the different types of insurance. Worker inflow is increasing over time, which stems from an increase in the number of contracted firms, but not from increases in firm size. The fraction of workers with supplementary insurance has also increased, from nearly 2% of the cohort of 2011 to 26% of the most recent cohort of 2018. A joint F test on whether worker-observable characteristics (i.e., gender, age, and tenure) explain firm switching is rejected ($p = 0.824$).

Table 1 presents statistics of the full sample of sick-listed workers and the sub-sample of (36,537) workers who eventually applied for DI. In terms of awards, our sample covers about 10% of the full Dutch population of benefit recipients. Absence spells are not observed for all DI applications in our sample, since *Robidus* took over caseloads from other intermediaries. As a result, the number of applicant observations exceeds the number of absence spells ending at 24 months.²⁰ The sample of applicants has noticeably and significantly less often opted for supplementary insurance from BSI and CSI. This largely reflects the fact that switches to supplementary insurance are observed earlier in the absence data than in the (subsequent) application data that are registered after the 2-year absence period. Workers are on average 46.6 years old in both samples, and applicants have relatively more tenure. 71% of the workers in our sample are female. This stems from the large fraction of firms in the health and education sector. Finally, about 23% of applications are rejected, whereas 18.8% are awarded benefits for whom BSI and CSI are relevant.

Appendix Table D1 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

¹⁹We do not observe firms that switch back to statutory insurance only.

²⁰The total number of DI awardees that follows from this sample (equal to 20,424 workers) is lower than shown in Table D1 (equal to 27,838 workers).

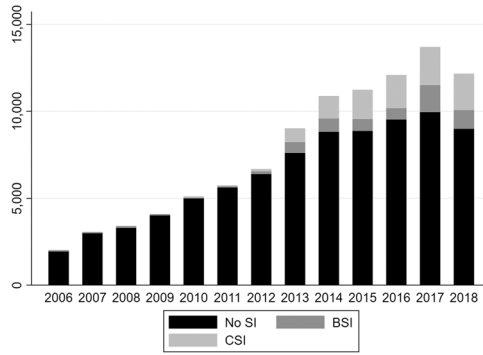


FIGURE 3 Numbers of sick-listed workers by cohort: statutory insurance, BSI, and CSI. BSI, Basic Supplementary Insurance; CSI, Comprehensive Supplementary Insurance; no SI, no supplementary insurance.

TABLE 1 Descriptive statistics of sick-listed workers with more than 9 months of absence and 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 (11.1)	46.6 (10.5)
Tenure (years)	12.9 (13.4)	15.5 (16.2)
Percentage of females (%)	71.0	72.3
Application outcomes (%)		
— Rejected applications (%)		23.4
— WGA benefits, degree of disability <80% (%)		18.8
— WGA benefits, degree of disability ≥80% (%)		37.1
— Permanent DI benefits (IVA) (%)		20.8
Observations	101,408	36,537

Note: Standard errors are shown in parentheses.

Abbreviations: DI, Disability Insurance; IVA, permanent DI benefits.

Data source: Robidus workers' long-term sickness data.

permanent DI benefits (IVA) for which there is no experience rating (see Figure 1). For sick-listed workers, the table shows that workers with supplementary insurance are older, are more often females, and have significantly less tenure than those with statutory insurance alone.²¹ These differences are also reflected in the sample of awarded applicants. Preapplication wages

²¹Table D1 also shows normalized differences of averages of BSI and CSI worker groups compared with those with only statutory benefits (Imbens & Wooldridge, 2009). As to the covariates used in our analyses, normalized differences only exceed the 0.25 criterion for tenure (which is lower for BSI and CSI). We therefore estimate the model with tenure category-dummies with normalized differences that are sufficiently small.

are generally low—reflecting the fact that some female workers have part-time jobs²²—and slightly higher for awardees with supplementary insurance. 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 preapplication earnings and are below the level of social assistance benefits (equal to about 70% of the minimum wage).

Since preapplication wages are relatively low, the impact of insurance caps on benefits is limited. Replacement rates are therefore equal to 70% for almost all disabled workers with a DoD equal to or exceeding 80%, and also for disabled workers below the 80% cutoff with CSI. Average replacement rates for awarded applicants with degrees of disability below 80% and with statutory insurance equal 22.2%, as compared with 36.4% for those with BSI and 69.7% for those with CSI. Table D4, which compares the “true” replacement rates of workers (in bold) with fictitious replacement rates under different contract types, shows that the differences on average replacement rates are entirely driven by contract types and not by the selection of preapplication wages. Finally, Table D1 shows that awardees with supplementary insurance have higher employment rates and higher wage earnings than those with statutory insurance alone. The employment difference amounts to about 10 percentage points for workers with degrees of disability below 80%, as compared to an (absolute) employment rate with statutory insurance equal to 34.3%. In line with expectations, these differentials are much smaller for the sample of workers with degrees of disability exceeding 80%.

4 | ESTIMATION STRATEGY

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

4.1 | The basic model

We first model 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 model with firm- and time-fixed effects.²³ We compare changes in outcomes of 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 (yet) switched. In order for our model to reflect the causal impact of supplementary insurance contracts on absences, disability, and work, we need two

²²Note that the average monthly wage in the Netherlands amounts to 3000 euros.

²³With individual (and not firm) observations, the conventional approach would be to specify individual-fixed effects. In the current context, however, our interest lies in the effect of insurance conditions that vary across firms and time with regard to individuals.

assumptions to hold: (i) the employee composition of firms should not change as a consequence of the switch of DI contract, and (ii) there should be no time-varying unobservables that are correlated with the decision to switch insurance contracts and our outcomes of interest. To test these assumptions, we will compare the number and composition of workers who become absent around the years of a switch, and use variation in contract switching (i.e., sector-specific shocks) that are plausibly exogenous to test the robustness of our findings.

We define Y_{ijt} as an outcome variable of worker i employed at firm j during the absence 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 observe wages only for awarded applicants). We specify Y_{ijt} as

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

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 equal 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. To test the robustness of our findings we extend Equation (9) with placebo effects. In addition, for the absence spells, we also test whether treatment effects vary with respect to the timing of switching insurance contracts.

4.2 | Separating worker and insurer effects

We next aim to disentangle worker moral-hazard and insurer effort responses to differences in insurance coverage.²⁴ Our interest here is in the effect of log replacement rates on the employment of workers awarded DI. For this, we first rewrite Equation (8) of the replacement rate. With w_{old} as the ratio of the old wage to the minimum wage ($w_{old} = \frac{W_{old}}{W_{min}}$), we obtain

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

Similar to Equation (8), the log replacement rate consists of three components. As a baseline, $\ln(RR^I)$ represents the log replacement rate for statutory DI benefits of disabled workers with a DoD below 80%. This component is determined by the DoD and the level of old wages. Since both of these variables directly affect employment outcomes, we will flexibly control for all possible outcomes of these variables in all employment models.

$\ln(RR^{II})$ is an interaction term representing the increase in the log replacement rate just above the 80% DoD threshold for workers without BSI and CSI. The higher the old wage, the stronger the implications of the 80% threshold of the DoD. Given that we control for the DoD and old wages, the identification and estimation of log replacement rate effects based on

²⁴Note that assessors of UWV in principle randomly assigned to applicants and are not aware of contract types. This enables us to measure the causal effect of supplementary DI.

$\ln(RR^{II})$ come from interacted degrees of disability and old wages. The effect of $\ln(RR^{II})$ on employment can be fully interpreted as workers' moral hazard due to increases in statutory coverage. Assuming that workers cannot earn more than their earnings capacity, any changes in earnings will not crowd out statutory benefits and do not increase the financial interest of the insurer to stimulate employment.

$\ln(RR^{III})$ represents the replacement rate increase stemming from the extra nonstatutory insurance coverage from BSI and CSI for disabled workers with a DoD below 80%. The interpretation of replacement rate effects is different than for $\ln(RR^{II})$: for the insurer, changes in wage earnings of these disabled workers imply benefit savings. Part of the gains of using the workers' earnings capacity therefore shifts from the worker to the insurer, rendering a *joint* worker and insurer effect.

To allow for distinctive replacement rate effects, we extend Equation (9) with $\ln(RR^{II})$ and $\ln(RR^{III})$ ²⁵:

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

Equation (11) controls for $\ln(RR^I)$ by extending X with polynomials of the log of old wages, which is denoted as matrix \tilde{X} . $\tilde{\Psi}_t(d)$ consists of polynomial functions of the (exact) degrees of disability with parameters that vary across calendar years. δ represents workers' moral-hazard effects, and δ^{SI} represents the joint effect of supplementary insurance due to worker moral hazard and insurer effort.²⁶

5 | RESULTS: THE ABSENCE PERIOD AND APPLICATION OUTCOMES

5.1 | Graphical evidence

We first study the effect of supplementary insurance on worker recovery rates in the absence period. Although the insurance coverage is equal for workers with and without supplementary insurance before DI application, workers and insurers may anticipate higher worker benefits after 2 years. Workers may be less likely to recover, whereas private insurers may target their activities towards workers with higher expected coverage. For graphical evidence on which effect may be most relevant, Panel (a) of Figure C1 in the appendix shows the Kaplan–Meier survival rates for workers with only statutory insurance, BSI and CSI, measured for long-term sick-listed workers.²⁷ The figure shows that workers with supplementary insurance recover faster.

In line with our empirical approach, we also zoom into the smaller sample of firms that switch to BSI or CSI over time; see Panel (b) of Figure C1. Specifically, we compare the

²⁵We discuss the identification of model parameters of Equation (11) in Appendix B.

²⁶When interpreting the estimates of δ and δ^{SI} , note that each estimate concerns different worker populations. The estimate of δ is an Average Treatment Effect (ATE) that concerns WGA recipients for all degrees of disability. For the estimation of δ^{SI} , however, we use the sample of disabled workers with a DoD below 80% and in firms with supplementary insurance. To make the estimates more comparable, a robustness test uses a specification where we allow δ to vary with respect to the DoD.

²⁷Long-term sick-listed workers refer to workers who are absent for at least 10 months.

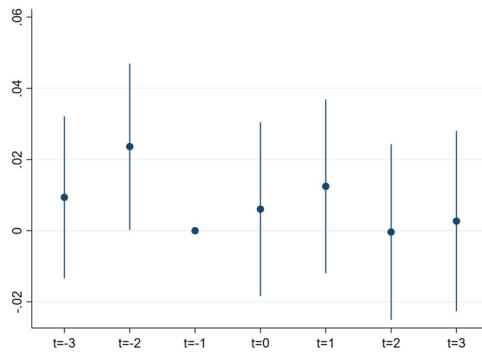


FIGURE 4 Event-time effects and confidence intervals of the switch to BSI/CSI on the probability of DI application. The coefficient shows the impact of BSI or CSI as compared with only statutory insurance in the model where we estimate the impact of BSI/CSI on being absent for at least 24 months. $t = 0$ is the year in which the firm begins using BSI/CSI. BSI, Basic Supplementary Insurance; CSI, Comprehensive Supplementary Insurance; DI, Disability Insurance. [Color figure can be viewed at wileyonlinelibrary.com]

absence spells of workers who report absent in the years around the contract switch, that is, who report absent at least 12 months before the contract switch and at most 12 months after the switch.²⁸ This plausibly renders the groups of workers that we compare more similar. Panel (b) shows that the difference in absence spells then virtually disappears. Workers with supplementary insurance still seem to recover faster, but the difference appears statistically insignificant.

Finally, we compare the likelihood of DI application for workers who start their spell just before the firm's switch towards supplementary insurance (and therefore fall under the old insurance policy) and for workers who start their spell just after. For a time window of 3 years before and after switches to supplementary insurance (either BSI or CSI), we compute the difference between the fraction of absences of at least 24 months (and its standard error) and the fraction of absences of at least 24 months 1 year before the switch. This is often referred to as an event-time model. Our model differs in one important way. In the standard model the event is at the firm level (a change in DI contract), while our analysis is at the individual level. Consequently, we mostly have multiple observations in the same time period of one firm. Figure 4 shows the estimates and standard errors, suggesting there is no significant impact of a firm switch towards supplementary insurance. Note that even without control variables our estimates are already quite precise. In addition, if we pool all of the post-switch estimates we get a coefficient of 0.005 (with confidence interval: $-0.015, 0.025$), suggesting that we can reject effect sizes of 2.5 percentage points or less.

5.2 | Estimation results

Table 2 shows the impact of BSI and CSI on the probability of a worker remaining absent for at least 2 years. Column (i) shows that supplementary insurance from both BSI and CSI

²⁸Note that whether a worker falls under supplementary insurance depends on the contract the firm has upon the date at which the absence spell started. Hence, it is possible that a sick-listed worker does not receive supplementary insurance at some point, while the firm has indeed switched.

TABLE 2 Linear probability model: Estimation results of the probability of absence of 24 months.

	(i)	(ii)	(iii)	(iv)
Basic Supplementary Insurance (BSI)	-0.022** (0.011)	0.007 (0.018)	0.012 (0.018)	0.012 (0.012)
Comprehensive Supplementary Insurance (CSI)	-0.019** (0.008)	-0.034* (0.020)	-0.033* (0.019)	-0.018 (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	2063	2063	2063	2063
Firm-year observations	98,624	98,624	98,624	98,624
R ² (within)		0.065	0.065	0.160
R ² (total)	0.071	0.070	0.070	0.142

Note: Standard errors are shown in parentheses. The dependent variable is a binary that equals 1 if a worker is absent at least 24 months, and zero if not.

^aControls include the workers' age, gender, and tenure at the firm.

^bFor the placebo test we include dummy values for firms that were in the 2 years preceding switches to BSI and CSI, respectively. The estimates of the BSI and CSI placebos are insignificant, -0.018 ($p = 0.34$) and -0.003 ($p = 0.855$).

^cWe add the firm's sector and interact it with time dummies to capture sector-level specific events that may cause changes in workers probabilities of absence.

* and ** indicate significance at 10% and 5% levels, respectively.

Data sources: Robidus workers' long-term absence and firm contract data.

increases the probability of recovering 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 these results are comparable—and with smaller standard errors—to those with Cox duration models for elapsed absence spells.²⁹ To assess the robustness of our findings, column (iii) shows similar effects for a specification that includes placebo effects for the 2 years preceding any switches to BSI and CSI. The effects become even smaller and insignificant when we add sector-specific calendar-time effects (with 49 sectors in total).³⁰ This leads us to conclude there are no strong or dominant worker moral-hazard effects in the absence period preceding DI applications.

It is possible that firms adjust other aspects of their personnel policies than insurance coverage when switching towards supplementary DI contracts. For instance, more generous DI policies may prove more attractive for workers who are absent more frequently, which may

²⁹These results are available upon request.

³⁰We 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.

then change the composition of newly hired workers. Differences in absence may therefore be wrongly assigned to the impact of the policy, while the true impact would come from compositional changes in hiring and firing of personnel. To study whether this is an issue in our data, we estimate the probability that a firm switches towards BSI or CSI using the composition of the pool of absent workers. We estimate Logit models where we regress the average characteristics of the firm (in terms of age, gender, and tenure) on the probability of a firm switch. The results in Table D2 in the appendix show that there is no significant relation between these firm characteristics and the switch towards supplementary insurance. As a second robustness exercise we add yearly firm-averaged characteristics of workers—that is, age, gender, and tenure—to the regressions in Table D3 in the appendix. The results also show that the impact of BSI and CSI on the probability of remaining absent for at least 24 months is virtually unchanged.

Another concern may be that firms still anticipate a change in the probability that workers report absent, and therefore decide to adjust DI contracts. This would imply that our estimates are biased by selection effects. We therefore analyze the timing of a contract switch in two ways. First, viewing the contract switch as an event, we use an “event-time design”; we study whether workers who become absent just before the switch differ in terms of recovery and work behavior from those workers who report absent just after the switch. With selection effects, one would expect positive coefficients—that is, more long-term sick-listed workers—directly following the contract change towards supplementary DI. Second, we analyze whether firms that switch contracts early have different worker outcomes than firms that switch later. Tables D5 and D6 in Appendix D show that there is little evidence of treatment heterogeneity over time. The event-time estimates in Table D5 are similar to those in Figure 5, but now based on a regression including workers' age, gender, and tenure at the firm as control variables. Again we see no significant impact of switching towards supplementary insurance. The coefficients of event-times “0” and “3” show marginally significant results, but a joint test on the post-event dummies suggests insignificance. The estimates in Table D6 for each insurance contract are also of similar size, suggesting that the exact year of the switch is not relevant.

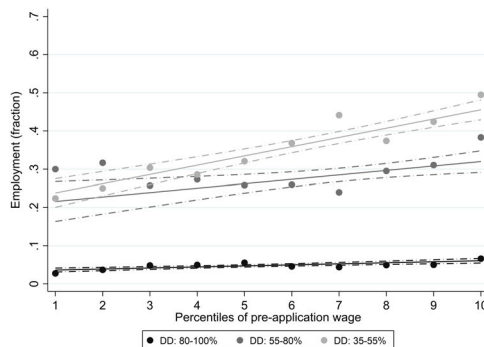


FIGURE 5 Employment of disabled workers without supplementary insurance, stratified by old-wage percentiles and degree-of-disability groups: “bins”^a and fitted lines^b. DD, degree of disability (%). ^aBins display employment averages for combined (3) degree-of-disability categories and (10) percentiles of preapplication wages. ^bLinear fitted lines with 95% confidence intervals.

We argued earlier that switches to supplementary insurance are often concentrated in sectors. This follows from the fact that *Robidus* not only approaches firms periodically, but also concentrates on particular sectors. We thus also conduct a robustness test that exploits this sectoral variation as an instrumental variable. Specifically, we use the fraction of other firms within the same sector (we have 49 sectors in the data) as an instrument for the choice of insurance. This presupposes that a given firm's decision to purchase supplementary insurance is correlated with the decision of other firms within the sector, but not with long-term absences of workers directly. For efficiency reasons, we merge CSI and BSI into one instrument. Table D7 in Appendix D reports a strong first-stage coefficient, but an imprecise second-stage coefficient. If anything, the estimation qualitatively confirms our earlier finding of supplementary insurance leading to increased absence.

Given that we find marginally higher recovery rates with CSI, we finally analyze whether this effect concerns workers with less severe health conditions who are denied benefits at a later stage. To shed light on this, Table 3 shows estimates for the probability that applicants end up with rejected applications, WGA benefits (below or above the 80% cutoff) and permanent and full benefits (IVA). We also consider a linear model which ranks the four statuses. Our results generally do not show significant differences across contract types, except for the higher share of applicants awarded IVA benefits with CSI. For the full sample of absent workers, this increase compensates for the (proportional) decline in applications for permanent benefits. The inflow into this scheme is thus less responsive to the extra coverage.

TABLE 3 Linear probability model: Estimation results for application outcomes.

	(i) Rejected applicants	(ii) WGA DoD < 80%	(iii) WGA DoD ≥ 80%	(iv) Permanent DI (IVA)	(v) Categories 1–4
Basic Supplementary Insurance (BSI)	−0.011 (0.021)	0.007 (0.018)	−0.002 (0.021)	0.005 (0.022)	0.020 (0.045)
Comprehensive Supplementary Insurance (CSI)	−0.017 (0.015)	−0.005 (0.015)	−0.011 (0.021)	0.033** (0.016)	0.072* (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 ² (within)	0.027	0.012	0.040	0.129	0.063
R ² (overall)	0.030	0.014	0.043	0.134	0.065

Note: Standard errors are shown in parentheses.

Abbreviations: DI, Disability Insurance; DoD, degree of disability.

^aControls include the workers' age, gender, and tenure at the firm.

* and ** indicate significance at 10% and 5% levels, respectively. The mean values of the categories are 0.22, 0.19, 0.38, and 0.21, respectively.

Data sources: *Robidus* workers' long-term absence and firm contract data.

6 | RESULTS: EMPLOYMENT OF AWARDED DI APPLICANTS

6.1 | Graphical evidence

We next turn to the sample of awarded DI applicants for whom we observe their degrees of disability, old wages and replacement rates *after application*. To eyeball the presence of interacted effects of preapplication wages and degrees of disability, Figure 5 presents employment rates for percentiles of preapplication wages for the sample of firms with statutory insurance alone. As argued earlier, these data may be indicative of workers' moral hazard. The employment averages shown in "bins" are stratified by three DoD categories: 35%–55%, 55%–80%, and 80%–100%. The figure also shows linear fitted lines for the three samples. Consistent with workers' moral hazard, the slope of employment probabilities with respect to the old wages is less steep for low degrees of disability and almost absent for workers with a DoD equal to or exceeding 80%. This suggests an interacted effect of old wages and degrees of disability, alongside the isolated impact of these variables. Since replacement rates are lower for disabled workers with degrees of disability below 80% and with higher old wages, it is possible that higher statutory replacement rates induce worker moral hazard.

We also graphically explore the effect of supplementary insurance on employment. Figure 6 compares the employment rates of awarded workers with different degrees of disability according to insurance status.³¹ Since we have a limited number of BSI observations for each DoD class, we pool the observations with BSI and CSI. Most strikingly, we then see that disabled workers with degrees of disability of more than 45% (and below 80%) show higher employment rates when they receive supplementary insurance from BSI or CSI. Contrasting this to Figure 5, this suggests a limited role for workers' moral hazard and/or a strong mitigating role for insurance policy parameters (and insurer activities) other than insurance coverage.

6.2 | Estimation results

Table 4 shows the estimation results of the effect of log replacement rates and supplementary insurance on the employment of awarded DI applicants. For all model variants we use three polynomials for log preapplication wages and four polynomials for degrees of disability for each year in our sample.³² As a reference point, column (i) shows the estimates of BSI and CSI contracts without replacement rates, 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 had not switched yet.

³¹Another way to visualize effects is by relating increases in replacement rates due to supplementary insurance to changes in the employment rate of disabled workers. This is shown in Figure C4, where we subtract averages of employment and replacement rates of workers with and without supplementary insurance for 10 "cells" of combined old-wage percentiles and DoD categories. In line with Figure C4, we then find that increased coverage is not associated with lower employment rates.

³²The fourth-order polynomial of log preapplication wages does not further improve the fit of our model. In effect, this yields $4 \times 15 = 60$ parameters that determine the annual DoD baseline.

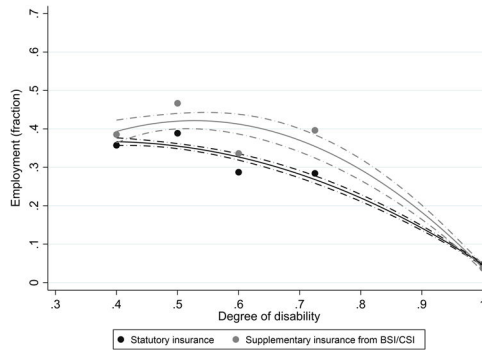


FIGURE 6 Employment of disabled workers by degree of disability, stratified by statutory insurance, and supplementary insurance: “bins”^a and fitted lines^b. DD, degree of disability (%). ^aBins represent averages for combined (5) degree-of-disability categories and (2) types of insurance. ^bQuadratic fitted lines with 95% confidence intervals.

TABLE 4 Firm-fixed effect estimates of employment model.

Model specification	(i)	(ii)	(iii)
Basic Supplementary Insurance (BSI)	0.018 (0.012)	0.020 (0.012)	0.013 (0.013)
Comprehensive Supplementary Insurance (CSI)	0.023** (0.011)	0.037*** (0.011)	0.016 (0.012)
Log replacement rate		-0.058*** (0.009)	
- “Worker moral-hazard” effect ($\ln RR^I$)			-0.107*** (0.011)
- “Joint worker and insurer” effect from BSI/CSI ($\ln RR^{III}$)			0.028* (0.015)
Degree of disability: 4 polynomials \times 15 years	YES	YES	YES
Log preapplication wages: 3 polynomials	YES	YES	YES
Age, gender, and tenure (12 dummies)	YES	YES	YES
Firm-fixed effects	YES	YES	YES
Labor-Force-Non-Participation Elasticity: Worker		0.066	0.122
Labor-Force-Non-Participation Elasticity: insurer			-0.154
Worker/firm observations	27,495	27,495	27,495
Firm observations	1612	1612	1612
R^2 (overall)	0.1742	0.1755	0.1778
R^2 (within)	0.1671	0.1683	0.1702

Notes: Standard errors are shown in parentheses.

** and *** indicate significance at 5% and 1% levels, respectively.

Data sources: Robidus Disability Insurance application data and firm contract data. The dependent variable is a dummy variable that is equal to one with positive wage earnings, and zero otherwise.

Models (ii) and (iii) of Table 4 add (log) replacement rates to the model. Model (ii) 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 and that only worker moral hazard may be relevant. This yields a significant elasticity estimate of -0.058 , which corresponds to an LFNP elasticity of 0.066 . Since the average log replacement rate is substantially higher for CSI, it is not surprising to see that the effect estimate of CSI increases compared to model (i). This compensates for the effect running through the (higher) log replacement rates.³³

Model (iii) corresponds to Equation (11) with separate log replacement rate effects. The first effect of the log replacement rates now represents only worker moral-hazard effects. Recall that this effect is identified from the cutoff-effect of the 80% threshold of the DoD. The implied LFNP elasticity of this effect equals 0.122 . This estimate is close to that of Koning and Van Sonsbeek (2017), who exploit differences in the timing of changes in WGA benefits to identify response effects. It is also close to LFNP estimates obtained by Kostøl and Mogstad (2015) for Norway. The coefficient of the second replacement rate—from supplementary coverage (RR^{III})—is positive and borderline significant. The difference between this coefficient and the first one equals the insurer effect, which equals 0.135 and corresponds to an LFNP elasticity induced by the insurer of -0.154 . Concurrent with this, 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 disabled workers with degrees of disability below 80% (for whom there is extra insurance coverage), but not for workers above the 80%-threshold (for whom replacement rates are unaffected by supplementary insurance).

To examine the robustness of the findings for the employment model, we used various other specifications, different samples and estimation methods, all of which confirm our results that indicate the joint existence of worker and insurer responses to extra coverage. Most notably, we used inverse sampling weighting to obtain samples that are comparable to the sample of long-term sick-listed workers, we conducted Placebo analyses on (unaffected) WGA recipients with a DoD exceeding 80%, and we used more flexible specifications that zoom into the 80% cutoff for the DoD. The results of these analyses, appearing in Table E1, are discussed in detail in Appendix E.

6.3 | Interpreting insurer effort

Given the effect of extra coverage on employment, one may be tempted to conclude that the response of private insurers—such as increased work accommodations or work bonuses—is proportional to the extra insurance coverage of workers. The scope for proportional actions by the insurer is, however, limited. Recall that contracts are set at the level of firms and are not fine-tuned for individual workers. Policy parameters other than coverage—such as the presence of work bonuses—are the same for BSI and CSI contracts, and apply to all disabled workers. Preventative activities are relevant for all long-term sick-listed workers in the absence period, as well as for those who do not yet know the outcome of any future application decisions. This calls for a model specification with a common effect that applies to all disabled workers with

³³The log replacement rate with CSI is about 0.30 larger than without supplementary insurance. The effect of this amounts to $0.30 * -0.058 = -0.017$.

supplementary insurance and below the 80% threshold for the DoD, irrespective of the size of the workers' increase of the replacement rate.

Related to this argument, it is unlikely that private insurers can exclusively target the extra moral hazard from supplementary insurance. Since moral hazard may also occur with statutory insurance alone, preventative actions and other insurance policy parameters may well reduce this as well. The magnitude of how these spillover effects impact statutory benefits justifies a model where the replacement rates are included in absolute levels, rather than in increases. We therefore respecify and extend our baseline regression with a "constant" effect κ^{SI} of BSI and CSI for disabled workers with degrees of disability below 80% and distinct replacement rate coefficients δ and $\tilde{\delta}^{SI}$ for disabled workers with and without supplementary insurance, respectively:

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

Table 5 shows the estimation results for Equation (12) for employment. For ease of comparison, column (i) repeats 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 those disabled workers who have supplementary insurance and a DoD below 80%. This effect of almost 10 percentage points suggests that private insurers do not target specific workers with the highest additional coverage. More strikingly, we find evidence that the marginal effect of replacement rates on employment for workers with supplementary insurance is the same as for those with only statutory benefits. So, to the extent that moral hazard is a marginal response to higher benefits, its impact is equally relevant if workers have supplementary insurance. These results indicate the presence of certain compensating actions by the insurer that apply to all workers with extra coverage, rather than targeted actions.

7 | CONCLUSION

A well-known concern with social insurance programs is that they may induce or increase risk selection and moral-hazard problems. The extensive evidence indicating the existence of moral-hazard effects for statutory public DI could therefore be used to build more of a case against supplementary insurance. Such concerns may be exacerbated by the fiscal externalities that private DI may have on public DI (Chetty & Saez, 2010; Pauly, 1974). But this argument overlooks the fact that private insurers have an interest in developing more effective prevention and work resumption activities.

This paper analyzes the effects of private supplementary DI on workers' disability risks and the employment of disabled workers who have remaining earnings capacity. We study workers in a sample of firms that have opted out to buy private insurance to offset the financial risks inherent with experience-rated, statutory DI premiums. "Treated" workers in this sample are those employed in firms that also purchase supplemental DI coverage that tops up the statutory DI coverage levels, whereas workers in the control group are in firms with no supplementary insurance (as yet). Using models with firm- and year-fixed effects that exploit switches of firms to supplementary insurance contracts, we first estimate the effect of the extra coverage on the disability risk of long-term sick-listed workers. Since the extra coverage increases the benefits

TABLE 5 Firm-fixed effect estimates of alternative employment models.^a

Model specification	(i)	(ii)	(iii)
Basic Supplementary Insurance (BSI)	0.013 (0.013)	0.008 (0.013)	0.004 (0.021)
Comprehensive Supplementary Insurance (CSI)	0.016 (0.012)	0.025* (0.011)	0.022 (0.017)
Supplementary Insurance \times DoD $< 80\%$ ($=\kappa^{SI}$)		0.097*** (0.019)	0.094*** (0.023)
Log replacement rate ($\ln RR$)		-0.089*** (0.011)	-0.089*** (0.011)
— “Worker moral-hazard” effect ($\ln RR^{II}$)	-0.107*** (0.011)		
— “Joint worker and insurer” effect ($\ln RR^{III}$)	0.028* (0.015)		
Log replacement rate \times supplementary insurance ($=\delta^{SI}$)			-0.008 (0.039)
Degree of disability: 4 polynomials \times 15 years	YES	YES	YES
Log preapplication 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	1612	1612	1612
R^2 (overall)	0.1778	0.1760	0.1760
R^2 (within)	0.1702	0.1692	0.1692

Notes: Standard errors are shown in parentheses.

Abbreviations: DI, Disability Insurance; DoD, degree of disability.

^aThe results in column (i) follow from the estimation of Equation (11), whereas columns (ii) and (iii) show results from (variants of) Equation (12).

*** and * indicate significance at 1% and 10%.

Data sources: Robidus DI application data and firm contract data. The dependent variable is a dummy variable that is equal to one with positive wage earnings, and zero otherwise.

paid by 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 replacement rate effects on the employment probability. Using exogenous variation in statutory replacement rates, we estimate incentive effects that can be interpreted as worker moral hazard. As long as workers cannot earn more than their assessed earnings capacity, their statutory benefits do not change with increased earnings. For the remaining variation that stems from supplementary insurance, however, increased earnings crowd out (supplementary) benefits. We thus obtain the joint effect of greater moral hazard among workers and greater effort expended by the insurer to reduce benefit costs.

We conclude that both worker moral hazard and insurer incentives are empirically important. In the absence period that precedes DI applications, workers with supplementary insurance are not less likely to recover. This holds both for contracts with “basic” supplementary insurance (BSI) and the more generous “comprehensive” supplementary insurance (CSI). We find that insurer incentives—aimed at reducing future claims with higher benefits—seem to counteract the effect of workers’ moral hazard. For the sample of workers awarded DI benefits, we next estimate the separate effects of worker and insurer incentives on employment. From our results, the implied LFNP elasticity is 0.122. 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 intensified case management and work bonuses—are not confined to only those workers with the highest increases in coverage.

While there is a rich literature studying the effects of worker moral hazard on worker outcomes, little attention has been paid to incentive effects of extra coverage on the insurer. Compared with workers, insurers may have an advantage in arranging or imposing work accommodations at the workplace. According to our estimates, the insurers’ ability to have workers resume work during disability is at least as strong as the workers’ ability to do so—and with equal financial incentives. These findings are relevant for any scheme in which workers have temporary or partial disability—including paid leave in the United States—and in which private insurers can play a leading role in organizing case management and work accommodations. In this respect, one should bear in mind that private insurance contracts may include more policy parameters than increased coverage alone. Most notably, both of the supplementary insurance contracts we studied include financial work bonuses, a feature which calls for analyses that take a broader perspective than solely on insurance coverage.

As a final note, our results do not necessarily inform us about which incentive structure is optimal from a welfare perspective. Welfare analysis requires us to incorporate the fact that the insurer gets the worker back to (partial) employment, with the reality that this is accompanied with administrative costs and opportunity costs of workers employed at the insurer. While interesting, such an analysis falls outside the scope of this paper.

ACKNOWLEDGMENTS

We are grateful for useful comments of seminar participants at VATT in Helsinki, the Vrije Universiteit in Amsterdam, the Essen Health Conference, the KVS new paper sessions in The Hague, the Dutch economists’ Day of 2022 in The Hague, Groningen University, and the IRDES-Dauphine Workshop on Applied Health Economics and Policy Evaluation in Paris (2022). *Robidus* is gratefully acknowledged for giving access to their microdata.

CONFLICT OF INTEREST STATEMENT

The authors herewith state to have no relevant or material financial interests that relate to research described in this paper. The authors use confidential administrative data owned by *Robidus*. To get access to the data, interested researchers should contact *Robidus*; the authors are willing to assist in doing so.

ORCID

Pierre Koning  <https://orcid.org/0000-0002-8808-9497>

REFERENCES

- Ahn, T., & Yelowitz, A. (2015). The short-term impacts of Connecticut's paid sick leave legislation. *Applied Economics Letters*, 22(15), 1267–1272.
- Autor, D., Duggan, M., & Gruber, J. (2014). Moral hazard and claims deterrence in private disability insurance. *American Economic Journal: Applied Economics*, 6(4), 110–141.
- Boots, S. W., Martinson, K., & Danziger, A. (2009). Employers' perspectives on San Francisco's Paid Sick Leave Policy (Tech. Rep.). The Urban Institute.
- Bronchetti, E. T., & McInerney, M. (2012). Revisiting incentive effects in workers' compensation: Do higher benefits really induce more claims? *ILR Review*, 65(2), 286–315.
- Bureau of Labor Statistics. (2023). *The Economics Daily. Short-term and long-term disability insurance for civilian workers in 2020*.
- Burkhauser, R. V., Daly, M. C., & Ziebarth, N. R. (2016). Protecting working-age people with disabilities: Experiences of four industrialized countries. *Journal of Labour Market Research*, 49, 367–386.
- Cabral, M., Cui, C., & Dworsky, M. (2022). The demand for insurance and rationale for a mandate: Evidence from workers' compensation insurance. *American Economic Review*, 112(5), 1621–1668.
- Cabral, M., & Cullen, M. R. (2019). Estimating the value of public insurance using complementary private insurance. *American Economic Journal: Economic Policy*, 11(3), 88–129.
- Cabral, M., & Dillender, M. (2020). The impact of benefit generosity on Workers' Compensation claims: Evidence and implications (Tech. Rep. No. 26976). National Bureau of Economic Research.
- Chetty, R., & Saez, E. (2010). Optimal taxation and social insurance with endogenous private insurance. *American Economic Journal: Economic Policy*, 2(2), 85–114.
- Cuelenaere, B., Zwinkels, W., & Oostveen, R. (2014). Praktijk en effecten van bovenwettelijke cao-aanvullingen ZW, loondoorbetaling bij ziekte, WIA en WW (Tech. Rep.).
- Dal Bianco, C. (2019). Labour supply and welfare effects of disability insurance: A survey. *Italian Economic Journal*, 5(1), 161–189.
- Dale-Olsen, H. (2014). Sick leave absence, sick leave pay, and pay schemes. *Labour*, 28(1), 40–63.
- De Groot, N., & Koning, P. (2016). Assessing the effects of disability insurance experience rating. The case of the Netherlands. *Labour Economics*, 41, 304–317.
- De Paola, M., Scoppa, V., & Pupo, V. (2014). Absenteeism in the Italian public sector: The effects of changes in sick leave policy. *Journal of Labor Economics*, 32(2), 337–360.
- Fevang, E., Markussen, S., & Røed, K. (2014). The sick pay trap. *Journal of Labor Economics*, 32(2), 305–336.
- Fischer, B., Geyer, J., & Ziebarth, N. (2024). Fundamentally reforming the DI system: Evidence from German notch cohorts (Tech. Rep. No. 30812). National Bureau of Economic Research.
- French, E., & Song, J. (2014). The effect of disability insurance receipt on labor supply. *American Economic Journal: Economic Policy*, 6(2), 291–337.
- García-Mandicó, S., García-Gómez, P., Gielen, A. C., & O'Donnell, O. (2020). Earnings responses to disability insurance stringency. *Labour Economics*, 66, 101880.
- Gelber, A., Moore, T. J., & Strand, A. (2017). The effect of disability insurance payments on beneficiaries' earnings. *American Economic Journal: Economic Policy*, 9(3), 229–261.
- Godard, M., Koning, P., & Lindeboom, M. (2022). Application and award responses to stricter screening in disability insurance. *Journal of Human Resources*, 57(3). <https://doi.org/10.3368/jhr1120-11323R1>
- Gruber, J. (2000). Disability insurance benefits and labor supply. *Journal of Political Economy*, 108(6), 1162–1183.
- Guo, X., & Burton, J. F. J. (2010). Workers' compensation: Recent developments in moral hazard and benefit payments. *ILR Review*, 63(2), 340–355.
- Hassink, W., Koning, P., & Zwinkels, W. (2015). Do firms with low disability risks opt out from public to private insurance? *B.E. Journal of Economic Analysis and Policy*, 18(1). In Press. <https://doi.org/10.1515/bejeap-2017-0022>
- Hemmings, P., & Prinz, C. (2020). *Sickness and disability systems: Comparing outcomes and policies in Norway with those in Sweden, the Netherlands, and Switzerland* (OECD Economics Department Working Papers, 1601).
- Hendren, N., Landais, C., & Spinnewijn, J. (2021). Choice in insurance markets: A Pigouvian approach to social insurance design. *Annual Review of Economics*, 13, 457–486.

- Imbens, G., & Wooldridge, J. M. (2009). Recent developments in the econometrics of program evaluation. *Journal of Economic Literature*, 47(1), 5–86.
- Johansson, P., & Palme, M. (1996). Do economic incentives affect work absence? Empirical evidence using Swedish micro data. *Journal of Public Economics*, 59(1), 195–218.
- Johansson, P., & Palme, M. (2005). Moral hazard and sickness insurance. *Journal of Public Economics*, 89(9–10), 1879–1890.
- Koning, P. (2009). Experience rating and the inflow into disability insurance. *De Economist*, 157(3), 315–335.
- Koning, P. (2016). Privatizing sick pay: Does it work? *IZA World of Labor*, 327, 1–9.
- Koning, P., & Lindeboom, M. (2015). The rise and fall of disability insurance enrollment in the Netherlands. *Journal of Economic Perspectives*, 29(2), 151–172.
- Koning, P., & Van Sonsbeek, J.-M. (2017). Making disability work? The effects of financial incentives on partially disabled workers. *Labour Economics*, 47, 202–215.
- Korkeamäki, O., & Kyyrä, T. (2012). Institutional rules, labour demand and retirement through disability programme participation. *Journal of Population Economics*, 25(2), 439–468.
- Kostøl, A. R., & Mogstad, M. (2015). Earnings, disposable income, and consumption of allowed and rejected disability insurance applicants. *American Economic Review*, 105(5), 137–141.
- Kyyrä, T., & Paukkeri, T. (2018). Does experience rating reduce sickness and disability claims? Evidence from policy kinks. *Journal of Health Economics*, 61, 178–192.
- Maestas, N., Mullen, K. J., & Strand, A. (2013). Does disability insurance receipt discourage work? Using examiner assignment to estimate causal effects of SSDI receipt. *American Economic Review*, 103(5), 1797–1829.
- Marie, O., & Castello, J. V. (2012). Measuring the (income) effect of disability insurance generosity on labour market participation. *Journal of Public Economics*, 96(1–2), 198–210.
- Mitra, S. (2009). Temporary and partial disability programs in nine countries: What can the United States learn from other countries? *Journal of Disability Policy Studies*, 20(1), 14–27.
- NN. (2023). WGA Hiaatverzekering Zorg en Welzijn (Tech. Rep.). Nationale Nederlanden.
- OECD. (2024). OECD data explorer.
- Pauly, M. V. (1974). Overinsurance and public provision of insurance: The roles of moral hazard. *The Quarterly Journal of Economics*, 88(1), 44–62.
- Petterson-Lidbom, P., & Skogman Thoursie, P. (2013). Temporary disability insurance and labor supply: Evidence from a natural experiment. *The Scandinavian Journal of Economics*, 115(2), 485–507.
- Pichler, S., & Ziebarth, N. R. (2014). Labor market effects of U.S. sick pay mandates. *Journal of Human Resources*, 55(2), 611–659.
- Pichler, S., & Ziebarth, N. R. (2020). Sick leave and medical leave in the United States. A categorization of recent trends. In A. Mathur, & C. Ruhm (Eds.), *Paid leave for illness, medical needs, and disabilities. Issues and answers* (pp. 31–59). AEI-Brookings Paid Leave Project.
- Stepner, M. (2019). The long-term externalities of short-term disability insurance. Mimeo.
- SZW. (2022). Cao-afspraken 2021 (Tech. Rep.). Ministerie van Sociale Zaken en Werkgelegenheid.
- Tompa, E., Cullen, K., & McLeod, C. (2012). Update on a systematic literature review on the behavioural incentives of experience rating. *Policy and Practice in Health and Safety*, 10(2), 47–65.
- UWV. (2021a). Het verschil in WGA risico tussen mannen en vrouwen.
- UWV. (2021b). Kwantitatieve informatie eerste acht maanden UWV.
- Weathers, R. R., & Hemmeter, J. (2011). The impact of changing financial work incentives on the earnings of Social Security Disability Insurance (SSDI) beneficiaries. *Journal of Policy Analysis and Management*, 30(4), 708–728.
- Yin, N. (2015). Partial benefits in the Social Security Disability Insurance program. *Journal of Risk and Insurance*, 82(2), 463–504.

How to cite this article: Koning, P., & van Lent, M. (2024). Workers' moral hazard and private insurer effort in disability insurance. *Journal of Risk and Insurance*, 1–40.
<https://doi.org/10.1111/jori.12464>

APPENDIX A: EXAMPLE OF A CSI CONTRACT

BSI and CSI contracts that are offered by private insurers can be set at the level of individual (large) firms or as part of collective agreements in specific sectors. The table below provides insight into the main elements of a collective CSI contract for the Dutch care sector, as offered by the largest private insurer in the Netherlands; see NN (2023) for the full contract. In this table, our main interest lies in the broad benefit conditions and the preventative and reintegration activities to which sick-listed and disabled workers are entitled (Table A1).

We have obtained actual (but anonymized) contracts between *Robidus* and their clients. These contracts specifically vary in the following dimensions:

- *Work bonuses*: These vary between 5% and 10% of the wage before disability if more than 50% of assessed earnings capacity is used.
- *Benefit indexation*: This is based on either collective labor agreements, it is indexed to the minimum wage, or is a fixed index (of 2% per year).

TABLE A1 Comprehensive Supplementary Insurance contract conditions for firms in the Dutch care sector.

Section	Relevant contract ingredients
(1) Insurance context	<ul style="list-style-type: none"> – Explanation of statutory schemes and insured population – Starting date of contract – Required information of insured workers (earnings, age, etc.)
(2) Coverage	<ul style="list-style-type: none"> – General explanation of benefit calculation and specific examples – Work bonus of 10% of old wage if $\geq 50\%$ of earnings capacity is used – Benefit indexation: based on inflation and/or collective labor agreements – Benefit caps – Reasons for ending benefits: decease, retirement, full work resumption
(3) Exclusion conditions	<ul style="list-style-type: none"> – Molestation, risky behaviors, and other conditions for exclusion
(4) Reintegration	<ul style="list-style-type: none"> – Absence reporting after 42 weeks – Firm should inform the insurer about reintegration activities during the absence – Reintegration obligations of sick-listed workers (sanction otherwise) – Reintegration specialists of insurers for sick-listed workers and workers with Disability Insurance (DI) – Reintegration specialists may make an appeal regarding DI award decisions – Reimbursement of reintegration activities
(5) Premium settings	<ul style="list-style-type: none"> – Insured wage sum, uniform premium percentage – Reasons for premium changes (e.g., due to new legislation)
(6) Firm changes	<ul style="list-style-type: none"> – Premium consequences of, for example, new judicial status
(7–10) Other	<ul style="list-style-type: none"> – Length of contract, stopping conditions – Compliance with financial and privacy rules

- *Expiration date*: This equals the statutory retirement age or statutory retirement age that is capped at 68 or 70 years of age.³⁴
- The premium varies between 0.510% and 0.621% of the total wage sum of the insured workers. Premiums increase most strongly with respect to the degree of indexation.

APPENDIX B: IDENTIFICATION OF WORKER AND INSURER EFFECTS

This appendix explains the identification of parameters in Equation (11) in Section 4.2 that comprise the 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:

$$Y_{ijt} = \beta \tilde{X}_{ijt} + \delta \ln(RR_{ijt}^H) + \delta^{SI} \ln(RR_{ijt}^{III}) + \gamma^{BSI} BSI_{jt} + \gamma^{CSI} CSI_{jt} + \tilde{\Psi}_t(\ln(d_{ijt})) + u_j + \epsilon_{ijt}. \quad (B1)$$

Conditioning on \tilde{X} , the DoD d , calendar time t and firm-fixed effects u , the effects of switching to BSI and CSI are equal to

$$\gamma^{BSI} + \delta^{SI} \cdot I(d < 0.8) \cdot \ln(w_{old}), \quad (B2)$$

$$\gamma^{CSI} + \delta^{SI} \cdot I(d < 0.8) \cdot (\ln(w_{old}) - \ln(d_{mid})). \quad (B3)$$

Since these 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 degrees of disability equal to or exceeding 80%. Supplementary insurance does not increase the level of benefits for this group, which therefore (largely) identifies the “constant” effects, γ^{BSI} and γ^{CSI} . The sample identifies effects that are proportional to the benefit increase (δ^{SI}) from the employment outcomes of disabled workers with a DoD below 80%.

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 WGA recipients above and below the 80% cutoff for the DoD and without supplementary insurance equals

$$\ln RR(d = 1 | w_{old}) - \ln RR(d < 1 | w_{old}) = -(\ln(d) + \ln(w_{old})). \quad (B4)$$

The above equation shows that the difference in the replacement rate between disabled workers above and below the 80% threshold for the DoD is proportional not only to the DoD itself, but also to the ratio of the preapplication wage to the minimum wage. The latter effect entails an interaction effect of preapplication wages and the DoD that we use for the 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.

³⁴The statutory retirement age is based on the distribution of life expectancy in The Netherlands, and is 66 years and 10 months in 2023. The statutory retirement ages are set until 2026. For younger cohorts they are currently unknown, and therefore the expiration dates are capped by insurance companies.

APPENDIX C: ADDITIONAL FIGURES

See Figures C1–C4.

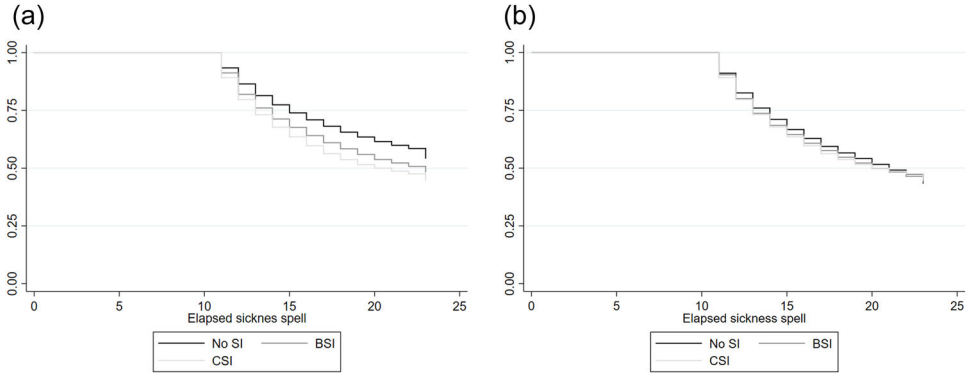


FIGURE C1 Kaplan–Meier survival rates and 95%-confidence intervals of absence spells by insurance type. BSI, Basic Supplementary Insurance; CSI, Comprehensive Supplementary Insurance; SI, supplementary insurance.

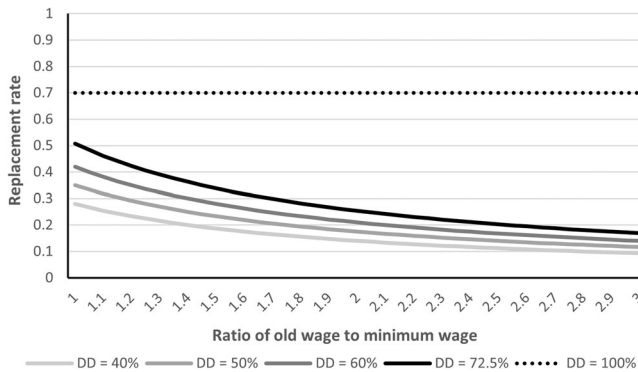


FIGURE C2 Replacement rates for *statutory* DI (WGA) benefits by the ratio of preapplication wages to the minimum wage. DD, midpoint of degree-of-disability category; DI, Disability Insurance.

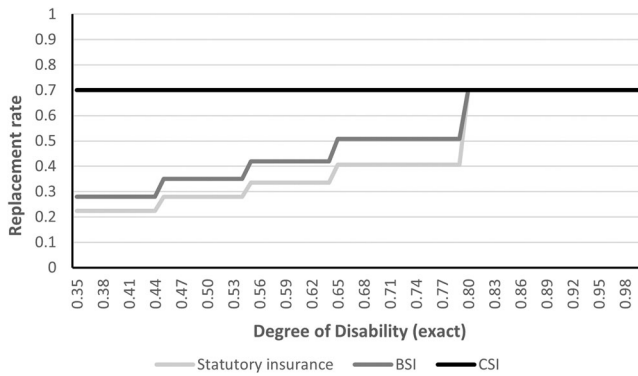


FIGURE C3 Replacement rates by degree of disability for a worker with a preapplication wage of 125% of the minimum wage: statutory benefits, BSI, and CSI. BSI, Basic Supplementary Insurance; CSI, Comprehensive Supplementary Insurance.

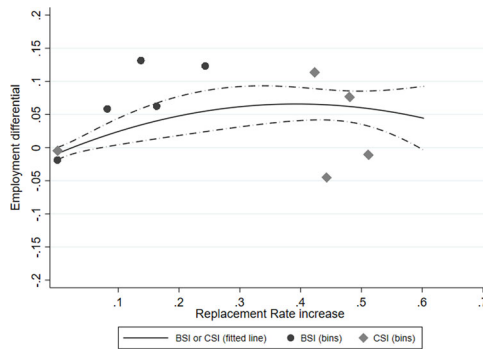


FIGURE C4 Replacement rate increases due to supplementary insurance and employment differentials of disabled workers with and without supplementary insurance: “bins”^a and fitted line^b. Replacement rate increases equal the difference in replacement rates for disabled workers with BSI or CSI, and the (fictitious) replacement rates that would prevail with statutory benefits alone. The employment differential equals the employment rate of workers with BSI/CSI, as compared with the rate of workers with similar degrees of disability and preapplication wages, and only receiving statutory insurance. ^aBins represent averages for combined (5) degree-of-disability categories and (2) types of insurance (BSI/CSI). ^bQuadratic fitted line with 95% confidence intervals. BSI, Basic Supplementary Insurance; CSI, Comprehensive Supplementary Insurance.

APPENDIX D: ADDITIONAL TABLES

See Tables D1–D8.

TABLE D1 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 (11.0)	47.0 (11.4) [0.031]	47.2 (11.1) [0.045]	45.7 (10.3)	46.0 (11.2) [0.019]	46.3 (10.9) [0.040]
Tenure	13.4 (13.9)	7.9 (10.3) [−0.318]	11.3 (10.4) [−0.210]	17.5 (17.7)	9.2 (13.5) [−0.373]	10.3 (10.2) [−0.352]
Females (fraction)	0.705 (0.456)	0.800 (0.400) [0.157]	0.792 (0.406) [0.143]	0.707 (0.455)	0.774 (0.418) [0.141]	0.816 (0.387) [0.186]
WGA benefits, degree of disability <80% (fraction)				0.301 (0.455)	0.274 (0.418) [−0.042]	0.306 (0.387) [0.008]
Preapplication wage (euros per month)				2196 (1044)	2279 (1076) [0.055]	2431 (1078) [0.157]
Replacement rate				0.555 (0.224)	0.607 (0.156) [0.190]	0.698 (0.019) [0.636]
– Degree of disability <80%				0.222 (0.080)	0.364 (0.080) [1.255]	0.697 (0.021) [5.743]
– Degree of disability ≥80%				0.699 (0.011)	0.699 (0.015) [0.005]	0.698 (0.018) [−0.048]
Employment at application				0.146 (0.354)	0.153 (0.360) [0.014]	0.175 (0.380) [0.056]
– Degree of disability <80%				0.343 (0.475)	0.442 (0.498) [0.144]	0.391 (0.488) [0.070]

(Continues)

TABLE D1 (Continued)

	Sick-listed workers			Awarded DI applicants ^a		
	Statutory	BSI ^b	CSI ^c	Statutory	BSI ^b	CSI ^c
- Degree of disability $\geq 80\%$				0.062 (0.240)	0.044 (0.205)	0.081 (0.272)
					[-0.057]	[0.053]
Wage at application (euros per month)				217 (620)	254 (669)	282 (719)
					[0.040]	[0.068]
- Degree of disability $< 80\%$				515 (840)	729 (944)	626 (945)
					[0.169]	[0.088]
- Degree of disability $\geq 80\%$				89 (437)	74 (404)	130 (527)
					[-0.025]	[0.060]
Observations	85,427	5888	10,093	24,940	1138	1760

Notes: Standard errors are shown in parentheses. Normalized differences with statutory benefits as reference are shown in brackets (Imbens & Wooldridge, 2009).

Abbreviations: DI, Disability Insurance.

^aWe exclude awards with permanent benefits (IVA).

^bBSI, Basic Supplementary Insurance.

^cCSI, Comprehensive Supplementary Insurance.

Data sources: Robidus workers' long-term absence data, DI application data and firm contract data.

TABLE D2 Logit model estimates of the probability of a firm switch to supplementary contracts (BSI or CSI).

	(i)	(ii)
Mean of worker age in firm	0.007 (0.032)	-0.010 (0.022)
Fraction of workers' gender in firm	0.672 (0.661)	-0.126 (0.473)
Man of worker tenure in firm	-0.016 (0.020)	-0.015 (0.014)
Year effects	YES	YES
Sector-specific time effects	NO	YES
Firms	2063	2063
F test on firm-level mean age, gender, and tenure	$p = 0.611$	$p = 0.752$

Note: The dependent variable equals zero if the firm has no supplementary insurance and equals one if the firm has either BSI or CSI. Standard errors are shown in parentheses.

Abbreviations: BSI, Basic Supplementary Insurance; CSI, Comprehensive Supplementary Insurance.

*, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Data sources: Robidus workers' long-term absence data, DI application data, and firm contract data.

TABLE D3 Linear probability model results of probability of absence for 24 months.

	(i)	(ii)	(iii)	(iv)
Basic Supplementary Insurance (BSI)	-0.023** (0.010)	0.007 (0.018)	0.012 (0.018)	0.011 (0.013)
Comprehensive Supplementary Insurance (CSI)	-0.020** (0.008)	-0.034* (0.019)	-0.033* (0.019)	0.013 (0.015)
Demographic and tenure controls ^a	YES	YES	YES	YES
Year effects	YES	YES	YES	YES
Firm averages of worker demographics ^b	YES	YES	YES	YES
Firm-fixed effects	NO	YES	YES	YES
Placebo test ^c	NO	NO	YES	NO
Sector-specific time effects ^d	NO	NO	NO	YES
Firms	2063	2063	2063	2063
Firm-year observations	98,624	98,624	98,624	98,624
R ² (within)		0.065	0.065	0.136
R ² (total)	0.071	0.070	0.070	0.108

Note: Standard errors are shown in parentheses.

^aControls include the workers' age, gender, and tenure at the firm.

^bWorker demographics include age, gender, and tenure.

^cFor the placebo test we include a dummy value equal to one for firms that in the 2 years preceding the start of BSI and CSI, respectively. The estimates of the BSI and CSI placebos are insignificant, -0.018 ($p = 0.34$) and -0.003 ($p = 0.855$), respectively.

^dWe add the firm's sector and interact it with time dummies to capture sector-specific events that may cause changes in workers' probabilities of absence.

* and ** indicate significance at 10% and 5% levels, respectively.

Data sources: Worker long-term absence data and firm contract data.

TABLE D4 Counterfactual simulation of average replacement rates of disabled workers by samples according to contract types.

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

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

Data sources: Worker Disability Insurance application data and firm contract data.

TABLE D5 Linear probability model for the absence of 24 months: Event-time analysis.

Event-time t around switch	Estimates
$t = -3$	-0.019 (0.012)
$t = -2$	-0.003 (0.012)
$t = -1$ (baseline)	
$t = 0$	-0.022* (0.013)
$t = 1$	-0.016 (0.013)
$t = 2$	-0.015 (0.013)
$t = 3$	0.025* (0.013)
Observations	14,975

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 are shown in parentheses.

Abbreviations: BSI, Basic Supplementary Insurance; CSI, Comprehensive Supplementary Insurance.

* indicates significance at 10%.

Data sources: Worker long-term absence data and firm contract data.

TABLE D6 Linear probability model for the probability of the absence of 24 months: Heterogeneous treatment effects by cohorts.

	Treatment effect
<i>Basic Supplementary Insurance (BSI)</i>	
2006–2013	–0.020 (0.029)
2014–2016	0.042 (0.030)
2017–2019	0.034** (0.014)
<i>Comprehensive Supplementary Insurance (CSI)</i>	
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 worker age, gender, and tenure at the firm as control variables. Standard errors are shown in parentheses.

* and ** indicate significance at 10% and 5% levels, respectively.

Data sources: Worker long-term absence data and firm contract data.

TABLE D7 TSLS regression with sector average of supplementary insurance as an instrument.

	Supplementary insurance
First stage: sector average of supplementary insurance	0.552*** (0.124)
Second stage: supplementary insurance	–0.382*** (0.141)
Observations	98,624

Notes: We estimate a linear two-stage least-squares (TSLS) model. In the first stage we use the sector average (excluding the firm itself) of supplementary insurance as an instrument for the insurance status of the firm. In the second stage we estimate the impact of supplementary insurance on the probability that a worker remains absent for at least 24 months. This regression includes the worker's age, gender, and tenure at the firm as control variables, and includes firm-fixed effects. Standard errors are shown in parentheses.

*** indicates significance at 1% level.

Data sources: Worker long-term absence data and firm contract data.

TABLE D8 Fixed-effect estimates for wages as a fraction of old wages.

	(i)	(ii)	(iii)
Basic Supplementary Insurance (BSI)	0.012 (0.014)	0.012 (0.011)	0.008 (0.012)
Comprehensive Supplementary Insurance (CSI)	0.012 (0.011)	0.024* (0.011)	0.013 (0.012)
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 \times 15 years	YES	YES	YES
Log preapplication wages: 3 polynomials	YES	YES	YES
Age, gender, and tenure (12 dummies)	YES	YES	YES
Firm-fixed effects	YES	YES	YES
Individual-firm observations	20,845	20,845	20,845
Firm observations	1471	1471	1471
R^2 (overall)	0.1026	0.1031	0.1037
R^2 (within)	0.0905	0.0907	0.0915

Note: Standard errors are shown in parentheses.

* and *** indicate significance at 10%, and 1% levels, respectively.

Data sources: Worker DI application data of *Robidus* and firm contract data.

APPENDIX E: ROBUSTNESS OF EMPLOYMENT MODEL OUTCOMES

Table E1 shows the results of robustness tests on the employment model. We first consider the potential impact of using a selected sample of individuals who are awarded DI benefits. Using the full sample of long-term absent workers, we estimate the employment propensities based on year, age, tenure, and tenure-fixed effects. We then re-estimate Equation (11) with the resulting inverse sampling probabilities, which yields similar outcomes as the estimation without weights (i.e., row (i)).

We also re-estimate Equation (11) with placebo dummies for the 2 years before the firms switch to BSI or CSI (row (ii)). Both 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 (iii). In line with our earlier results, we conclude that there is no evidence indicating 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 E1 Robustness tests for the employment model.

	BSI	CSI	$\ln(RR^I)$ “Worker effect”	$\ln(RR^{III})$ “Joint effect”
Baseline results	0.013 (0.013)	0.016 (0.012)	-0.107** (0.011)	0.028* (0.015)
(i) Inverse sampling weights	0.005 (0.013)	0.010 (0.011)	-0.077*** (0.017)	0.050** (0.025)
(ii) Placebo analysis ^a	0.014 (0.013)	0.009 (0.012)	-0.107*** (0.011)	0.028*** (0.015)
(iii) Random firm effects	-0.004 (0.009)	-0.012 (0.008)	-0.102*** (0.011)	0.037*** (0.014)
(iv) Logit model (marginal effects)	-0.009 (0.012)	-0.025 (0.017)	-0.046*** (0.009)	0.025 (0.018)
(v) Heterogeneous effects replacement rate	0.013 (0.012)	0.016 (0.012)	-0.104*** (0.013)	0.028* (0.015)
—Interacted: Below 65% degree of disability			-0.005 (0.011)	
(vi) Relative wages as an outcome	0.006 (0.011)	0.005 (0.011)	-0.045*** (0.009)	0.007 (0.012)
(vii) Current employment as outcome	0.011 (0.016)	-0.013 (0.016)	-0.093*** (0.013)	0.048*** (0.017)
(viii) Conditional replacement rate (log)	0.011 (0.016)	-0.013 (0.016)	-0.097*** (0.013)	0.048*** (0.017)

Notes: Model estimates build upon Equation (11), which includes effects for BSI, CSI, $\ln(RR)$, and $\ln(RR^{III})$. The dependent variable is a dummy variable that is equal to one with positive wage earnings, and zero otherwise.

Abbreviations: BSI, Basic Supplementary Insurance; CSI, Comprehensive Supplementary Insurance.

^aThe placebo estimates for BSI and CSI are equal to -0.017 (0.029) and 0.010 (0.025), respectively.

*, **, and *** indicate significance at 1%, 5%, and 10% levels, respectively.

Knowing that our analysis exploits additive interacted effects of preapplication wages and degrees of disability on log replacement rates, robustness test (iv) shows marginal employment effects with a Logit specification instead. The results for this model, which induces interaction effects by construction, show that our replacement rate coefficient δ reduces to -0.046***, and that 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 ATE. However, increases in replacement rates due to supplementary insurance that constitutes the “DiD (Difference-in-difference)” estimates (δ^{SI}) only affect disabled workers with degrees of disability below 80% and are “Average Treatment effects for the Treated”. So if replacement rate effects vary by DoD, the estimates of δ and δ^{SI} may not be compatible. To address this issue, we re-estimate our

model with separate replacement rate effects for disabled workers with degrees of disability below and above 65%.³⁵ Using this cutoff, we find no evidence for different effects for awardees with degrees of disability below and above 65%—see robustness test (v).

Lines (vi), (vii), and (viii) 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.³⁶ If one was to assume that extra earnings stem exclusively from extensive margin effects, this suggests that changes in employment imply wages that correspond to 50% of preapplication wages. Robustness test (vi) analyzes the effects on current employment outcomes—measured at the end of 2019. This yields a similar result, so that long-term effects appear to be similar to those at the start of the benefit spell. 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 uses his/her earnings capacity (instead of the old wage). Again, this yields results similar to those obtained with conventional replacement rates.

³⁵Note 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 workers with degrees of disability equal to or exceeding 80% with replacement rates that are equal to 70% in all cases.

³⁶Table D8 reports extensively the estimation results for relative wages.