

Essays on Swiss Accident Insurance

Doctoral Thesis

presented to the Faculty of Management, Economics and Social Sciences
at the University of Fribourg (Switzerland)
in fulfillment of the requirements for the degree of
Doctor of Economics and Social Sciences

by

Driton Berisha

from Ruswil LU

Accepted by the Faculty of Management, Economics and Social Sciences on
12.04.2021 at the proposal of
Prof. Dr. Martin Huber (first supervisor) and
Prof. Dr. Stefan Boes (second supervisor)

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Mit der Annahme einer Dissertation beabsichtigt die Wirtschaft- und Sozialwissenschaftliche Fakultät der Universität Freiburg nicht, zu den darin enthaltenen Meinungen des Verfassers Stellung zu nehmen. (Fakultätsbeschluss vom 23. Januar 1990).

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Chapter 1

Introduction

Falling from a scaffolding, overthrow while skiing or injuring a leg with a running chainsaw: Hazards lurk everywhere. These types of incidents have a major impact on the life of the injured along with their families and friends. Not only does an event of this degree cause a lot of pain and sorrow, it also triggers a long recovery process. In a world without accident insurance, costs for the medical treatment would be borne by the individual. And it is uncertain how income would be generated during the recovery process. Luckily, most of the industrialized countries have installed compensation systems for workplace and other injuries. It protects the population against the financial consequences of accidents.

Accidents cause direct and indirect costs. While direct costs include costs for medical treatment and the recovery process, indirect costs are manifested in market output losses, adjustment of the employer, or presenteeism. The European Agency for Safety and Health at Work (EU-OSHA, 2019) indicates that for European countries, the total costs resulting out of workplace accidents amount to 2.3% - 5.0% of the GDP, depending on the characteristics of a country's accident insurance system. In any case, accidents induce substantial health-related costs, especially when including non-occupational accidents to the equation. In Switzerland, accidents lead to direct costs of approximately 4.9 billion Swiss Francs per annum (Unfallstatistik, 2019).

As a product of the emerging industrialization, the need for accident insurance began to evolve in the 19th century. Presumably with the increasing pressure of trade unions, Germany was the first country to introduce a compulsory insurance system that compensates workers for workplace injuries in 1884. However, employer liability had been established earlier in e.g. Germany in 1871, and Switzerland in 1877 (Parsons, 2002). The first health and accident insurance law in Switzerland was established in 1912. Only workers of dangerous professions were insured mandatorily. As a consequence of the law, the Swiss accident insurance fund, Suva, was installed in 1918 with the task to insure said workers (Lengwiler, 2006). The Swiss Accident Insurance Act, UVG, as we know it today was established in 1984. It sets the legal foundation for compulsory accident insurance for all employed workers. Besides workplace injuries and work-related diseases,

it also covers all accidents outside of work, such as sports injuries during the free time or any other activity outside of work. There are five key elements that clearly define an incident as an accident. According to the ATSG¹, an incident has to be a (i) sudden, (ii) not intended (iii) damaging impact of an (iv) unusual external factor on the human body, that causes an (v) impairment of the physical, mental or psychological health or that leads to death.²

Since 1918, the number of accidents is recorded separately for occupational and non-occupational accidents. Figure 1.1 displays the amount of accidents per 1000 full time employees in Switzerland during the last 100 years. Occupational accidents have experienced a major decrease over the past century. This development was enabled by factors such as a lower amount of weekly working hours, a shift from the primary and secondary economic sector to the tertiary sector, and increased activity in work safety and prevention. Nonetheless, non-occupational accidents have increased. Due to the shift in the economic sectors, workers have had more time for leisure activities. E.g. Football and skiing have become the two activities with the highest injury rates, causing high amounts of costs (Unfallstatistik, 2019).

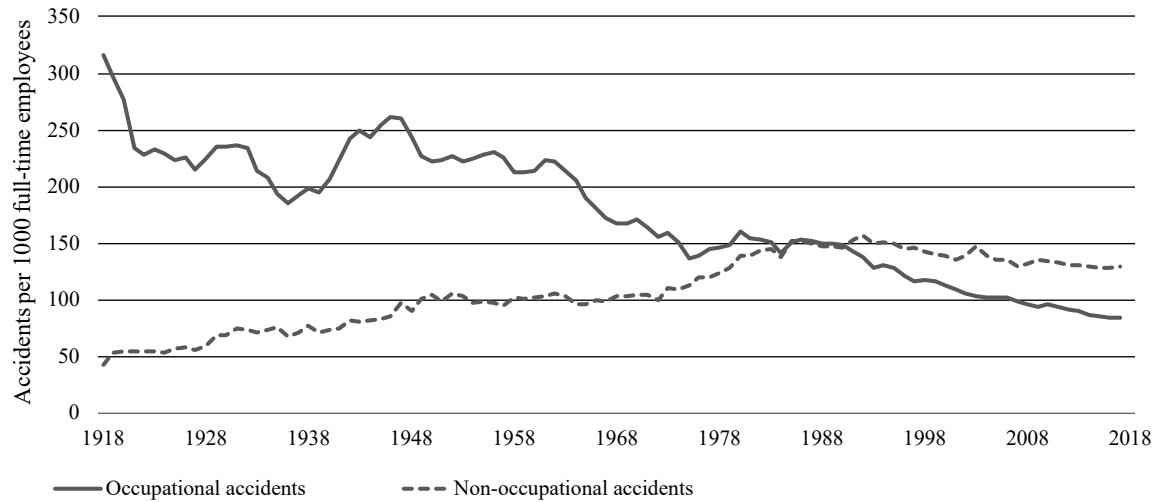
In Switzerland, accident insurance is mandatory for all employed personnel and the registered unemployed. The Swiss accident insurance fund, Suva, has been established as an integral part of the law of accident insurance, UVG, and holds a partial monopoly in accident insurance. The monopoly comprises certain economic activities, mainly blue collar industries, which include construction, manufacturing or craftsmanship. Hence, all companies that exercise these predefined activities, cannot choose their insurance carrier for accident insurance. They are obliged to insure their employee's occupational and non-occupational risk by Suva. About one third of the companies operating in Switzerland and with those, around half of the Swiss work force are insured by Suva.

With decreasing accident numbers and increased investment in workplace safety, job

¹The Federal Law on General Provisions concerning Legislation on Social Insurances (LPGA), Original: Allgemeiner Teil des Sozialversicherungsrechts (ATSG).

²Original text: "Unfall ist die plötzliche, nicht beabsichtigte schädigende Einwirkung eines ungewöhnlichen äusseren Faktors auf den menschlichen Körper, die eine Beeinträchtigung der körperlichen, geistigen oder psychischen Gesundheit oder den Tod zur Folge hat.", ATSG Art. 4.

Figure 1.1: Development of Accidents in Switzerland



Note: The figure indicates the development of occupational and non-occupational accidents in Switzerland. Source: Unfallstatistik (2019), Own.

training, and prevention measures, accident insurance has become a well managed area that does not draw much attention. Especially when compared to other social insurance programs, such as health insurance, disability insurance or unemployment insurance. Ziebarth (2018) mentions accident insurance in his comprehensive overview on the most important programs of social insurance and provides examples of recent research in this area. Butler et al. (2013) present a broad review of research in workers' compensation, mainly for the US market and as such contribute one chapter to the Handbook of Insurance by Dionne (2013). The term "workers' compensation" is mainly used in the US literature and corresponds to accident insurance for workplace accidents and occupational disabilities. In the European literature the term "accident insurance" is used more commonly.

The Swiss social insurance system entails several different programs. Previous economic literature has mainly focused on disability insurance or health insurance. Although statistically well documented, the Swiss accident insurance has merely been addressed in the economic literature. Accidents lead to temporary or permanent work incapacities. An absent worker is related to missing skills and a lack of work force. Therefore, possibili-

ties to reintegrate the injured workers into work life are gaining in importance.³ Hence, earlier research has focused on topics that affect outflow of disability insurance (see e.g. Müller and Boes, 2020; Büttler et al., 2015). However, disabilities emerging from accident insurance have not been included in past studies. This dissertation undertakes the journey to shed more light into accident insurance, and in particular the Swiss accident insurance. As it is a compulsory insurance with one big partial monopolist and many small insurance carriers⁴, policy evaluation instruments strengthen the assessment of the underlying characteristics and processes.

The present PhD thesis is a collection of three independent essays. The unifying characteristic of the three chapters is the focus on the Swiss accident insurance. In Chapter 2, we study moral hazard under experience rating. Does experience rating matter in reducing accident costs? The pricing scheme of Suva embodies a bonus-malus plan. With this pricing model, firms have incentives to invest in prevention and to reintegrate injured personnel. Hence, these firms are incentivized to minimize accident costs. Our study exploits a predefined threshold which enables firms to be in the bonus-malus plan in a regression discontinuity design. The results do not indicate the existence of moral hazard. Chapter 3 addresses the most relevant cost factor, namely disability pensions. Spendings and reserving for disability pensions make up about 30 percent of the total assets managed by Suva. Correctly predicting accidents that result in disability pensions enables the insurance carrier to better plan activities for the injured individual as well as to prepare the employer for potential absences or job-profile modifications. If we know at an early stage that the insured person will most likely not be able to fully recover, the right measures can be defined shortly after the incident takes place. In this Chapter we use machine learning techniques to predict accidents that lead to disability pensions. The results point out that costs, namely the amount of daily cash benefits, are the most important predictors for disability pensions. Furthermore, if a model is trained with a higher share of disability pensions, the classification accuracy

³Schultz and Gatchel (2015) provide a recent overview on the subject of return to work.

⁴The insurance carriers are not small per se, but their share in the accident insurance market is rather low.

of a disability pension will improve. In Chapter 4 we examine the impact of winter inactivity in construction on the behavior of temporary workers in case of an accident. During the winter months, construction sites remain closed. Temporary workers are unlikely to find new assignments when they recover from an accident that happened just before the beginning of winter. Accident insurance provides more generous benefits than other programs such as unemployment insurance (UI), especially when contribution periods to UI are patchy. They might search for alternative ways of wage replacement. Our results show that moral hazard is present when workers do not have permanent work opportunities. The incentives are put in a way that temporary workers tend to prolong a medical leave, especially for accidents before the winter months. The three chapters are briefly introduced in the next paragraphs.

Chapter 2 presents a study of the impact of experience rating on moral hazard. Arrow (1963) shows that asymmetric information represents an obstacle in the insurance business. Research in the insurance sector is closely linked to the subjects of moral hazard and adverse selection. When moral hazard is present, incentives are set in such manner that the insured entity (e.g. a company or an individual) takes a risk above the insured risk and does not bear the corresponding costs. Whereas adverse selection occurs when the entities to be insured are heterogeneous and the insurer cannot determine the actual risk before fixing a contract. Hence, the entity to be insured could choose an insurance contract that costs less than what the insurer would have charged if adequate information were available. Previous research has not been able to clearly disentangle the two concepts. The second chapter presents a unique case where adverse selection is absent, and moral hazard can be isolated. It takes place in the Swiss accident insurance and exploits the pricing scheme of Suva. Employers of certain, predominantly blue collar, industries cannot choose their insurance carrier for accident insurance. They have to be insured by Suva. The benefits of the insurance contract are standardized for all insurance takers. Suva has a specific pricing scheme where the firms are assigned to a bonus-malus- or a flat-fee-system, based on the size of the firm. While the former has its foundation on the

previous claim history of the firm (experience rating⁵), the latter does not depend on experience. Which scheme the firm is assigned to, depends on a specific combination of the firm's payroll sum and the relative risk of the industry, namely the base premium. The base premium is an artificial measure with the sole purpose to assign firms to the pricing plans. It is not identical with the premiums that the firms have to pay. Firms that are above a certain threshold, which is defined by Suva, are assigned to the bonus-malus-plan. In case they have lower accident costs than their peers, they will pay a lower premium and vice versa. The firms below the threshold are in a system where they pay a fixed rate. Hence, these firms do not have any incentives to invest in prevention or actively manage accident costs. By applying a fuzzy regression discontinuity design, the threshold for the bonus-malus plan is exploited. The differences between those firms slightly above and below are examined by performing regressions with data driven bandwidth selection. Our results suggest that firms around the threshold do not behave differently in terms of accidents. There are no significant discrepancies in the overall accident costs for these firms. One explanation for these findings is the already existing workplace safety culture in Switzerland, where mandatory measures are strictly monitored. Furthermore, costs of severe accidents often exceed the potential savings of the bonus-malus scheme.

The most severe accidents are responsible for a very large portion of the costs in accident insurance. Chapter 3 aims at predicting disability pensions that are a result of accidents by using supervised machine learning methods. When an accident leads to a disability pension, the pension is paid out for the entire life of the injured individual. Providing accurate predictions is important for the individual, the employer as well as the insurance carrier. If an accident is likely to lead to a permanent work disability, retraining measures can be initiated earlier. From the employer's perspective, the absence of a worker is connected to a loss of knowledge.⁶ Hence, the employer is likely interested in keeping the worker. As a result, focusing on the reintegration of the worker can happen

⁵The term «experience» refers to the accident record, namely that costs that resulted out of accidents in past years. These costs are the basis for premium calculation.

⁶Retraining measures apply when the worker won't be able to execute the same work as before an accident. E.g. a construction worker has had an accident and won't be able to work as a construction worker. With retraining, the worker can acquire a new set of skills, adapted to the injuries and resume work in another field, e.g. in an office job of the same construction company or any other company.

at an earlier stage. The insurance carrier is interested in correct classification. Because on the one hand, with the help of case workers and physicians, the right measures for the injured person can be proposed. On the other hand, more accurate predictions lead to more precise reserving and, hence, to less volatile premiums. The machine learning algorithms include Lasso, Random Forests and an ensemble learner. Disability pensions occur rather rarely. As an additional measure, we created different samples with varying shares of disability pensions and trained the models conditional on these shares. For every procedure, the data is split into a training set, where a model is trained, and a test set, where the out-of-sample performance of the model is measured. Furthermore, the model is tested on a random subsample of the full sample, which contains the actual share of disability pensions. The models produce results with an overall accuracy rate of above 90 percent, depending on the training data. However, alternative approaches, such as text-based analytics of the accident report and physician's reports could potentially attribute to an improvement of the prediction rate.

In Chapter 4, temporary construction workers and incentives to remain in accident insurance researched. The defining characteristic of a temporary work contract is that the work assignments are not permanent. Although this contract form provides employers and workers with a high flexibility, the latter might not perceive that as an advantage. During the period between assignments, the temporary worker will not receive an income. Instead, unemployment benefits apply, or the worker does not receive any wage replacement at all, due to lack of contributions to unemployment insurance. Job insecurities have been shown to provoke altering behavior in terms of accident reporting compared to conditions with stable job security (Boone et al., 2011; Boone and van Ours, 2006; Leigh, 1985). The fourth chapter focuses on temporary workers in construction, particularly slightly preceding the winter period, where assignments are rare. During the winter months, construction activities are ceased. Consequently, unemployment in construction increases during the winter months and decreases in spring, summer and autumn. Hence, if a temporary worker experiences an accident before winter inactivity starts, it will be unlikely to get a new assignment after the recovery. Because temporary workers tend

to have patchy contribution rates to unemployment insurance, they might proactively influence the recovery time and receive daily cash benefits from the accident insurance for a longer time span. Daily cash benefits from accident insurance amount to 80 percent of the insured salary. Hence, workers are incentivized to extend the recovery process, rather than to apply for unemployment benefits. To run the analysis, a semiparametric difference-in-differences estimation is applied. The semiparametric approach is favorable because it requires less assumptions, e.g. it does not assume linearity. Furthermore, we include covariates and test for a data based common trend. Construction workers with permanent contracts represent the ideal control group, because they share the same activity, seasonality and might be even working on the identical construction sites. We control for characteristics surrounding the accident and the injured person. The results indicate that accidents of temporary workers that happen right before winter, have a recovery time that is three days longer. We recommend gathering more information surrounding the accident. On the one hand, actively increasing the flow of information between worker, insurance carrier and firm could speed up the process of return to work. On the other hand, enhancing the available data set of the accident insurance with data of other social insurance programs might help to better understand the incentivisation.

Chapter 2

Experience Rating and Moral Hazard

2.1 Introduction

Workplace accidents carry lots of misfortune, pain and sorrow for the people involved. The financial situation of an injured person is in danger without a stable income. Luckily, almost every developed country foresees a mandatory accident insurance that replaces income in case of a work inability and pays for medical treatment. Still, the costs of accidents remain high for firms who must compensate this temporary loss.

The behavior of firms within insurance contracts has been studied for a variety of insurance types. Information asymmetries play a major role in the relationship between the insurance buyer (in this case the firms which employ workers) and the insurance carrier. Whereas the firm knows its potential behavior, the insurance company *ex ante* has only limited information of the firm's individual risk. Butler et al. (2013) state that one can observe moral hazard, when "individuals change behavior as insurance coverage changes" (p. 451). They conclude that firms have more incentives to prevent insurance claims when they find themselves in pricing schemes with experience rating. Experience rating refers to pricing where the premium is based on previous claim records of the insured. E.g. a company has had many costly accidents in the past, thus, it will have to pay a higher insurance premium than its peers.

The present study analyzes moral hazard in the context of the Swiss accident insurance. The insurance covers costs for medical care and partial wage replacement for workers that are victim to an occupational or non-occupational accident. Our research question is: Do employers react to the incentives for prevention at the workplace provided by experience rating? To what extent do the prevention efforts lower costs? If moral hazard is prevalent then firms who are not subject to experience rating will have a higher accident risk than those with experience rating. Thus, accident frequency and costs are expected to be on a higher level. As the employer has leverage only on the working hours, the present study focuses only on occupational accidents. We exploit the pricing system of Suva, the Swiss accident insurance fund.¹ We do not find any evidence

¹Suva is the largest insurance carrier for accident insurance in Switzerland. It has a monopoly for many economic activities in terms of accident insurance.

of altering behavior for firms with experience rating. In a further step, the analysis is extended by focusing on different industries. Industry-specific factors (i.e. business cycles, technological developments, prevention efforts) are held constant for the estimation because they apply for all the relevant observations. Again, the estimation reveals no significant results for any of the outcome variables.

Depending on the setting, previous research confirms the presence of moral hazard in the insurance sector. Ruser (1985) observes a relationship between benefits and injury rates for firms with a higher degree of experience rating in the context of workers' compensation. Other research supports these findings (Butler et al., 2013; Kruger, 1990; Worrall and Butler, 1988). Contrary to this, Lanoie (1992) finds that firms with experience rating show an increased impact on claim duration. The results were not supported by any explanation. One major source of bias in the paper of Lanoie is that moral hazard could not be isolated from adverse selection.

A number of papers have already discussed the issue of isolating moral hazard from adverse selection. As one of the first of its kind, Manning et al. (1987) present results of an experiment in health insurance for the U.S., where the insured persons are allocated to pricing schemes with different deductibles. The results show that the expenditures of individuals without any deductible are substantially higher than the expenditure of individuals with large deductibles. Chiappori et al. (1998) exploit a regime change in copayment rates for a certain type of insurance contract in the French health insurance system. They argue that the insurance is purchased by the firm and thus, the individual does not choose the coverage, which is supposed to lead to a clean separation of moral hazard and adverse selection. However, they do not consider any influence by the firm itself and the possibility of selective behavior of the firm toward certain insurance contracts. In a more recent analysis, Dionne et al. (2013) present a setup where they separate moral hazard from adverse selection for the French car insurance market. Their results indicate the presence of moral hazard for certain subpopulations.

In this work we will focus on the behavior of firms in the context of moral hazard. There are only a few papers that emphasise the behavior of firms. Westergaard-Nielsen

and Pertold (2012) show separation of moral hazard from adverse selection by exploiting variation in the Danish Firm Sickness Absence Insurance system. They apply a fuzzy regression discontinuity design and find that employees of insured firms have higher incidence of long-term sickness absence, while the absence duration is much shorter than in uninsured firms. Böheim and Leoni (2014) look at an Austrian reform from 1999, where rather small firms have full coverage for their payments, whereas larger firms pay a deductible. They do not observe moral hazard. Firms that had to pay the deductible do not show a different behavior in terms of frequency and duration of the incidents.

Previous work has faced difficulties to empirically differentiate between moral hazard and adverse selection. We are able to present a setting where moral hazard is isolated from adverse selection by design because there is no adverse selection. The Swiss accident insurance fund, Suva, provides a standard insurance coverage and has a pricing scheme with different levels of experience rating. Firms do not have the possibility to choose any option for their insurance contract and are not allowed to change their insurance carrier. Their pricing plan is determined by a set of rules that are not manipulable by the firm. Because neither, the insurance carrier, nor the employer as insurance taker can select a contract, there is no adverse selection. We will exploit the exogenously set threshold for experience rating. The threshold is decisive for the assignment to a manual rate² plan (in which the firm has no financial incentive to reinforce workplace prevention efforts), or a bonus-malus plan. Firms assigned to the latter have incentives to monitor the costs of their accidents. The data covers half of the Swiss workforce and about one third of the companies in the country.

The procedure for the calculation of the premiums is equal for all firms. The different risk groups and the corresponding manual rates range from around 0.2% to about 5.0% of the payroll. This leads to the conclusion that firms in the sample are heterogeneous and the relative importance for overall spending for accidents is differently distributed.

The so called "base premium" is an artificial measure defined by Suva to compare

²Manual rate: It is the risk rate of a certain risk group. It is the same for each company in that risk collective. Once a firm is in a plan with experience rating, the firm pays a bonus or a malus with respect to the given manual rate.

firms in their relative importance with regard to the premium. It is the sole criterion for the assignment to one of three pricing plans, which vary in the degree of experience rating. Firms with the lowest base premium are priced by a manual rate. They have lower incentives to monitor their employees as their premium does not change in case of higher accident costs. When the base premium reaches a certain threshold, firms will be assigned to the bonus-malus plan. They have the opportunity to receive premium reductions by generating lower accident costs than their peers. This is possible by providing safety training and other forms of prevention measures. Vice versa, they are penalized in case of higher costs. These firms have real financial incentives to invest in prevention at the workplace. There is also a third category: Companies with very high base premiums are assigned to the empirical pricing plan, they are almost fully experience rated. The focus of this paper will exclusively be on firms in the manual rate and the bonus-malus plan as there are only few firms that are in the plan with full experience rating.

Assignment to the different pricing plans is indicated by the base premium. It is calculated as the product of the sum of payroll of the past six years multiplied by the manual rate of the risk collective of the firm. The base premium is a fabricated measure with the sole purpose to assign firms to the pricing plan. Firms with a base premium of above 30'000 Francs are assigned to the bonus-malus system. Firms below that threshold are assigned to the manual rate plan. But once a firm has crossed the threshold of 30'000 and subsequently falls below it, it will still remain in the bonus-malus plan. When the firm's base premium falls below the threshold of 24'000 Francs, it is again assigned to the manual rate plan. The idea behind this peculiarity is that the insurer wants to provide a stable pricing scheme for companies that are sometimes above and below the threshold. The threshold for the assignment to different pricing plans will be utilized to manifest the identification strategy, a fuzzy regression discontinuity design.

The key identifying assumption underlying the use of a regression discontinuity design (RDD) is that firms located around the threshold will be perfectly comparable in terms of observed and unobserved background variables, except that some firms are exposed to experience rating (treatment group) while others are not. The threshold will serve as

an instrument for the assignment to the bonus-malus plan. We perform regressions with data driven bandwidth selection.

The remainder of the study is organized as follows: In Section 2.2 we describe the institutional background and the setting. Section 2.3 contains a description of the data. Section 2.4 explains the empirical strategy. In Section 2.5, we display the results and present further research. The paper concludes in Section 2.6 with possible explanations and an outlook for further research.

2.2 Institutional Background

2.2.1 Moral hazard and experience rating in accident insurance

Moral hazard has been studied in many different subsectors of insurance. The area of insurance ranges from automobile insurance (Dionne and Vanasse, 1992; Chiappori and Salanie, 2000; Abbring et al., 2003; Israel, 2004) to health and life insurance (Holly et al., 1998; Cardon and Hendel, 2001; Hendel and Lizzeri, 2003). In the present study, we focus on the case of accident insurance.

To what extent is it actually possible to avoid occupational injuries? Costs of accidents apply for the injured worker as well as for the employer. Medical treatment, rehabilitation expenses or lost wages and non-pecuniary loss attribute to the worker's healing process. The employer faces costs for interruption of a production process as well as cost and time related to the replacement of the temporary or sometimes permanent loss of skills. Costs associated with workplace accidents incentivize employers to prevent accidents and to invest in workplace safety. The frequency and severity of occupational accidents are expected to be influenceable by the behavior of both, employers and workers. An employer can define a range of measures, for example by providing safety training or protective equipment like safety shoes, helmet and other protective gear. Employers are only willing to make these investments when the resulting benefits exceed the expenditures (Thomason and Pozzebon, 2002).

Research on moral hazard has its roots in the seminal work of Arrow (1963), Pauly

(1974) and Rothschild and Stiglitz (1976). The latter state that at the time of the decision, whether a contract should be signed, the agent knows his own risk, whereas the insurance company does not. They describe how insurance markets can be inefficient in case of information asymmetry. Consequently, the constructs of moral hazard and adverse selection became heavily explored research subjects. Following a definition of Loubergé (2013), moral hazard occurs when the outcome of an event can be influenced by the insured and at the same time the insurance carrier is unable to observe to which extent the consequences of the event are attributable to the insured's behavior. Adverse selection results when the soon-to-be insureds are heterogeneous and the risk class to which they belong cannot be determined a priori by the insurer.

Within an insurance contract, moral hazard can be present before and after an accident happens. In the literature the concepts are named as *ex ante* and *ex post* moral hazard. The former follows the question whether the insured takes enough action to prevent an incident. In the case of *ex post* moral hazard, the incident has already happened, and the insurer cannot monitor the character of the incident without costs. Several research papers propose that insurance lowers the incentive to be careful when the insurer isn't able to monitor the insured's action (see Pauly, 1974; Hölmstrom, 1979; Shavell, 1979). According to Rubinstein and Yaari (1983) the insurer can eliminate the moral hazard problem with the choice of an applicable experience rating scheme, in case of infinite periods.

Ruser (1985) examines the impact of experience rating on US companies from 1972-1979 and finds a smaller relationship between benefits and injury rates for larger firms with a higher degree of experience rating. Worrall and Butler (1988) highlight that experience rating has a significant negative impact on injury rates when experience rating is present for the State of Carolina. Kruger (1990) shows that claims duration decreases with experience rating, using administrative data from Minnesota. Kralj (1994) assesses workers' compensation in Canada and finds that experience rating has induced employers to adapt their behavior and develop measures for accident prevention and the reduction of compensation claims. The data used by Thomason and Pozzebon (2002) contains

information on 450 firms in Canada about the firm's activities to improve workplace safety and health conditions. Their findings suggest that experience rating incentivizes firms to improve workplace safety. Yet, prior research has yielded ambiguous results. Lanoie (1992) uses data from Quebec and finds that experience rating has a positive impact on claim duration. The results were not supported by any explanation. Chelius and Smith (1983) do not find any relationship between experience rating and workplace safety. A possible explanation for the contrasting results might be the different pricing schemes along with a diversity of jurisdictions that move an employer's incentive towards divergent directions.³ Böheim and Leoni (2011) analyse the causal impact of a policy change in Austria and find clear signs of moral hazard. Worker's sickness absence duration decreased when benefits were cut. Hence, with lower benefits, the incentive to return to work more rapidly is increased.

2.2.2 Accident insurance in Switzerland

Accident insurance is a compulsory social insurance for all employees in Switzerland. It secures the financial consequences of accidents and work-related diseases. The Swiss accident insurance law has established the Swiss accident insurance fund, Suva. It is a partial monopolist insuring about half of the Swiss work force and a third of all companies that are active in Switzerland. Suva is obliged to insure predominantly blue collar industries. Firms in these predefined industries cannot select their insurance carrier for accident insurance. While private insurance carriers offer many kinds of insurance, the partial monopolist is by law enforced to exclusively provide accident insurance.

The payment of the insurance premiums lies within the responsibility of the employer.⁴ Benefits of accident insurance can be separated into benefits for medical care and reimbursement of expenses as well as cash benefits. The former contains treatment claims, medication, hospital claims, costs for additional equipment and other supplementary cost resulting out of the above-mentioned incidents. Cash benefits are a wage replacement for

³See for further literature: Spence and Zeckhauser, 1971; Dionne, 1984; Fagart and Picard, 1999.

⁴The premium for occupational accident insurance cannot be deducted from an employee's salary, whereas the premium for non-occupational accident can be deducted.

the injured worker. They can be further split into daily cash benefits (DB) and disability pensions. Cash benefits are always based on the insured salary. If an employee becomes partially or totally incapable of working, he can claim daily cash benefits which are paid after two days of incapability to work. Cash benefits amount to 80% of the insured salary. In case of a partial inability, the replacement rate decreases accordingly. Daily cash benefits are paid out until the employee has recovered her/his full working capacity or ends up receiving a disability pension.⁵

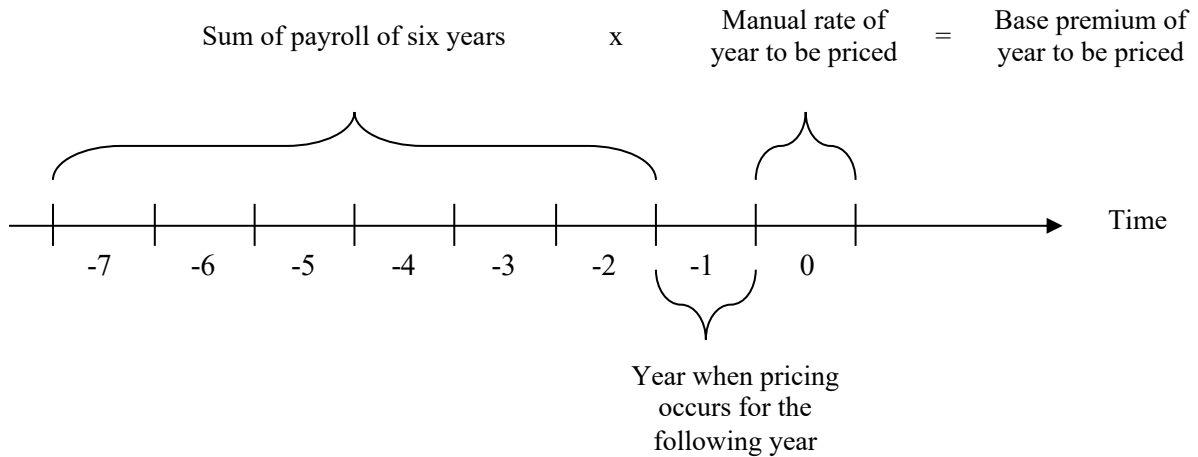
2.2.3 Experience Rating at the Swiss accident insurance fund: Manual Rate and bonus-malus plan

In this study, we will take advantage of the partial monopoly of Suva and its unique pricing system. Insurance benefits are identical for all firms. The basic procedure for the calculation of the premiums is the same for all companies. In a first step, a firm's activities are placed into one or more industrial-occupational classifications. This results in a relatively homogenous set of risks per collective (e.g. construction companies are placed in one group while architects and engineers are placed in another group). Still, there are tremendous differences within the groups, depending on the affinity and interest towards workplace safety. For each group, a manual rate is determined based on the historical risk of the corresponding group. The manual premium of a firm is the product of the firm's payroll and the manual rate.⁶ When the risk group of a certain firm is defined, the firm is assigned to one of three pricing plans, which vary in the degree of experience rating. The smallest firms are priced by the manual rate. Firms in the bonus-malus plan are partially experience rated, while firms in the empirical pricing plan are almost fully experience rated. This study exclusively focuses on firms in the plan without experience rating and the bonus-malus plan.

⁵Other cash benefits include invalidity pensions, integrity allowances, survivors' pensions, or helplessness allowances.

⁶Firms with multiple activities in multiple risk groups will be priced with a mixed rate. An overview of the different rates is presented in Appendix A1.

Figure 2.1: Calculation of Base Premium



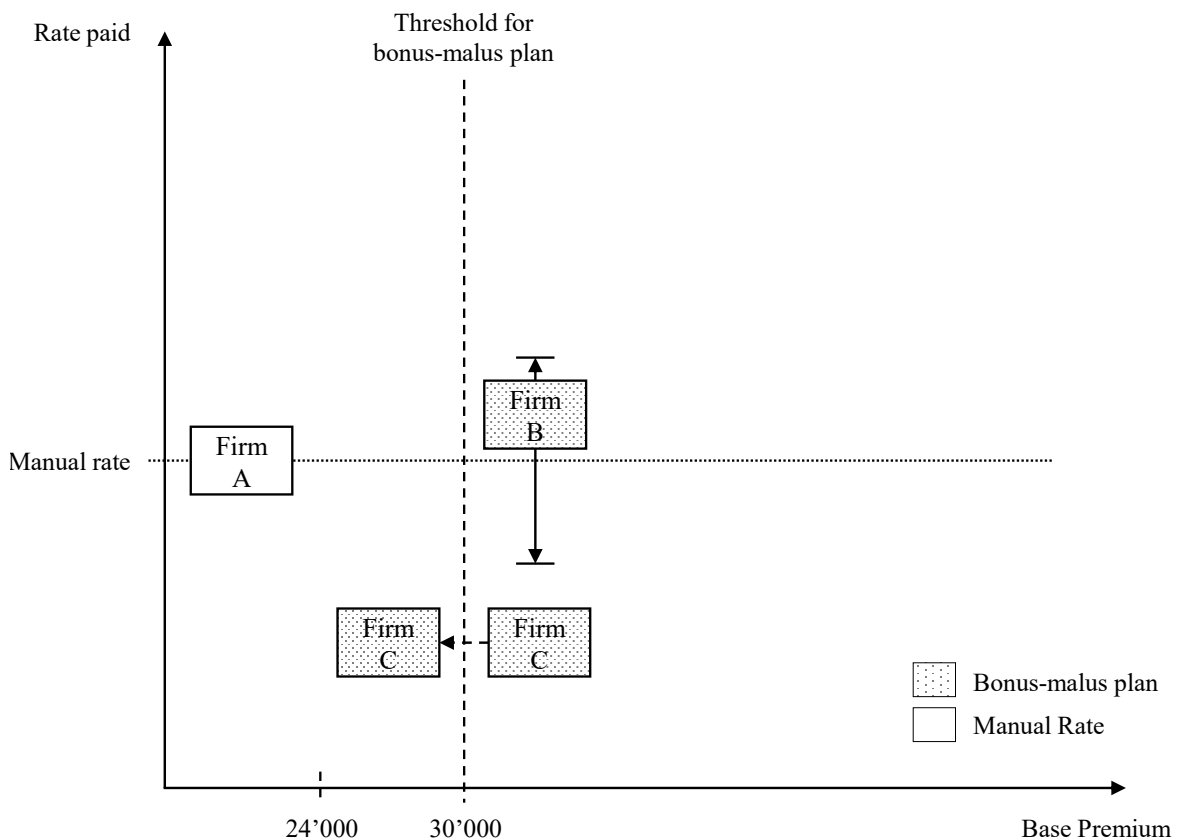
The decision to which plan a firm is assigned to depends on the base premium. The base premium is a fabricated measure with the sole purpose to define a firm's pricing plan. It is the product of the summed payroll of the previous seven to two years multiplied with the manual rate of the year to be priced. The base premium, therefore, is a function of the firm's size and its risk. If the base premium exceeds the threshold of 30'000 Swiss Francs, the firm is assigned to the bonus-malus plan. This threshold is defined by Suva and doesn't change throughout time. Figure 2.1 provides graphical support for the calculation of the base premium. Suppose the base premium of a firm for the year 2018 must be calculated. Hence, the sum of the payrolls from 2011 to 2016 is built and multiplied by the manual rate of the risk group to which the firm belongs. A firm needs to have at least two years of existence in order to be part of the bonus-malus plan.

Once a firm is assigned to the bonus-malus plan, the accident-related costs are compared to those of other firms within the same risk collective. Depending on the firm's relative performance, it will be priced on the level of the manual rate of that collective or get a bonus or malus. An accident and its costs are fully attributed to the year it occurred. The total costs of a single accident that can influence a firm's performance are capped. With this cap the insurance carrier aims to reduce the impact of one single incident on a firm's accident records. Once the relative performance of the firm is assessed, the risk group's manual rate and the bonus-malus of the firm result in the final net premium rate. The bonus or malus does not influence the base premium, and therefore

is irrelevant for the assignment to any of the pricing plans.

Due to reasons of continuity, the annual as well as the overall bonus or malus for a firm is limited.⁷ A very important feature of the bonus-malus plan is that once a firm is assigned to it and experiences a decreasing base premium (due to decreasing payroll or decreasing risk of the entire collective) it will not be assigned to the manual rate plan as long as the base premium is above 24'000. In Figure 2.2, Firm A is in the manual rate plan. It will pay only this rate. Firm B is in the bonus-malus plan and has a wider range of a potential premium. In this case it has to pay a small additional penalty, therefore the rate paid is higher than for Firm A. Firm C first has a base premium of above 30'000 and then falls below that threshold but is still above 24'000. Therefore, it still remains in the bonus-malus plan.

Figure 2.2: Threshold for bonus-malus plan



Notes: Graphical representation of three different firms within the pricing scheme of Suva. Firm A is in the manual rate plan and always pays the manual rate. The product of the manual rate and the payroll of the firm is the net premium. Firm B is above the threshold for the bonus-malus plan and pays a rate which depends on its accident history. Firm C has a net premium of below 30'000 but because the base premium used to be above 30'000 it remains in the bonus-malus plan. Source: Own.

⁷See Appendix A2 for details.

2.2.4 The mechanism for prevention

Preventing an accident not only leads to lower overall costs for the employer, it leads also to reduced premium payments when the firm is in the bonus-malus plan. Lowering the accident costs below the level of peers leads to a bonus. Firms in the bonus-malus plan are incentivized to invest in measures of prevention. These measures include education of workplace safety, investing in additional features for production machines, or providing items to work more safely, such as safety clothing. The expectation is that prevention can lower the number of accidents as well as the total costs resulting from accidents through e.g. a quicker reintegration of the worker. In contrast, firms assigned to the manual rate plan will always pay the same rate, regardless of the accident-related costs.

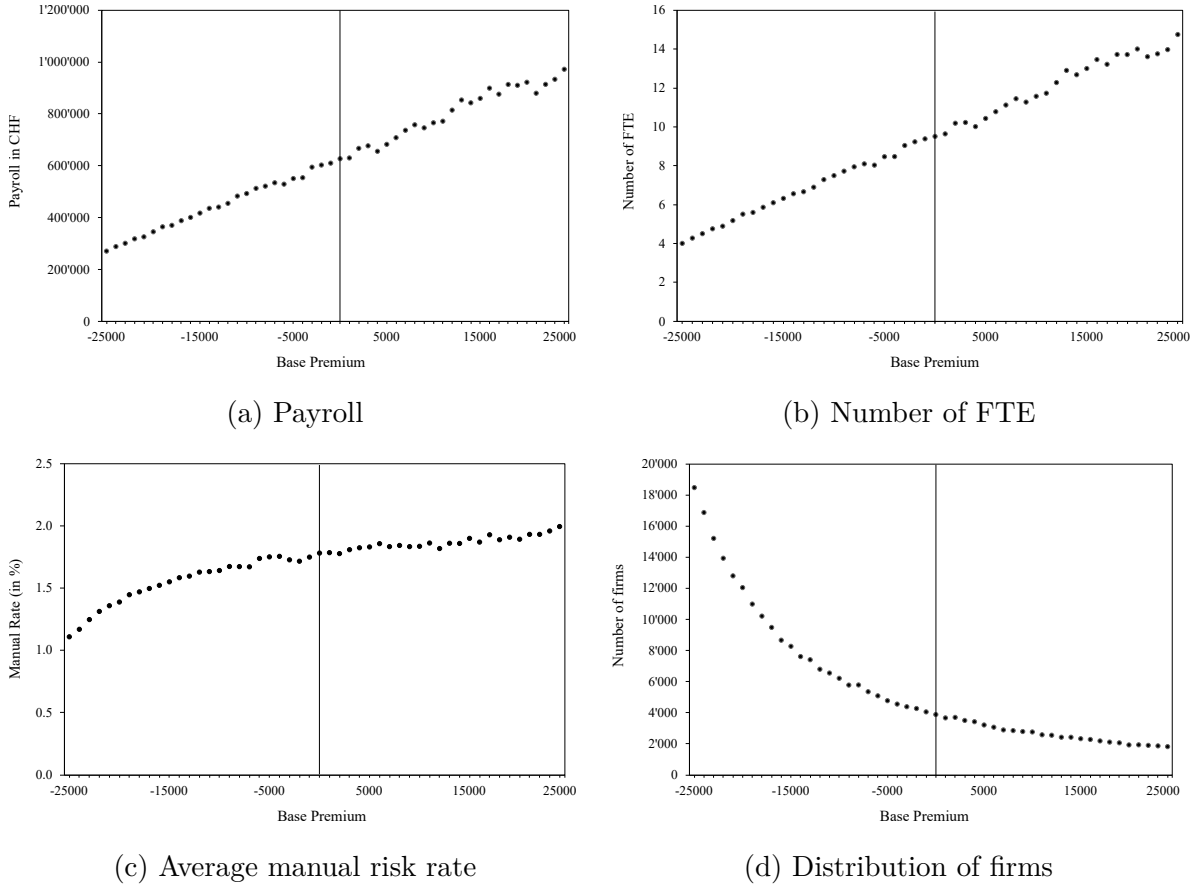
2.3 Data

This study uses data from the largest Swiss accident insurance company. The data set contains information on firms, accident-related costs and more information on a yearly basis. The data span the years 2008 to 2015. A big advantage of the data set is that Suva has full coverage of the respective economic activities it is obliged to insure by law. The firms in the data set reach from small enterprises to large international holdings. In the present study, we are interested in a restricted number of firms, namely the ones that are around the threshold for the bonus-malus plan. For each firm it is possible to observe a set of firm-specific characteristics, such as payroll, amount of full time employees, industry, region, base premium, and the corresponding information on the accidents.

The amount of accident-related costs that are caused by the accidents of workers of a given firm represent the accident-related risk. Furthermore, the incidence rate of an accident is an alternative measure of risk. Therefore, we observe multiple outcome variables expressing the firm's risk. The outcome variables can be clustered into two categories: The first category only looks at the incident rates of accidents. The total amount of accidents indicates the number of accidents per firm in a given year. Firms that invest less in prevention are expected to experience accidents more frequently and

bear higher accident costs. In a second category, we look at cases with daily cash benefits (short: DB). The idea behind the use of cases with daily cash benefits is that it is a good approximation for accident severity, because they are paid out until the worker recovers and is able to work again. Accidents with a low number of daily cash benefits are rather unsevere, whereas cases with a large amount of daily cash benefits are severe cases. The use of daily cash benefits permits us to normalize the salaries. The same absence duration for two differently paid jobs leads to different absolute costs in terms of daily cash benefits.

Figure 2.3: Graphical description of relevant variables



Notes: Dots represent bins of nonoverlapping intervals, bin size is 1'000. The threshold for the bonus-malus plan was set to zero by deducting 30'000 from the actual Base premium.

The outcome variables were chosen because the present study captures the effect of experience rating on moral hazard as broadly as possible. Information on the absolute number of accidents, as well as ratios relative to a firm's full-time employees are available. Furthermore, costs that apply in short term, up to two years after the incident are also

available. Detailed information on the outcome variables is provided in Appendix A3.

Figure 2.3 highlights a set of relevant characteristics in the total sample. The observed units are firms on a yearly basis. Plot (a) shows the average payroll per firm along the base premium. The payroll increases with the base premium. A similar pattern can be recognized for the number of full time employees in Plot (b). Plot (c) indicates the average manual rate in bins of 1000 Francs along the base premium. Again, on average a rising manual rate can be observed with an increasing base premium. The payroll as well as the overall risk rate increase with firms above the threshold. In this sample, the number of observations is decreasing with a rising base premium (Plot (d)). Therefore, firms with higher base premiums tend to have a larger payroll, have a higher risk rate and are have more employees than firms with a lower base premium.

Table 2.1: Comparison of financial incentives for two firms with different risks.

	Payroll	FTE	Manual rate (net premium)	Net premium with max. bonus	Net premium with max. malus
Base Premium of roughly 27'000					
Architects office	2'500'000	34	0.18% 4'500	-	-
Construction firm	145'000	1.9	3.36% 4'900	-	-
Base Premium of roughly 33'000					
Architects office	3'100'000	42	0.18% 5'600	0.09% 2'800	0.36% 11'000
Construction firm	165'000	2.3	3.36% 5'500	1.70% 2'800	6.65% 11'000

*Notes: FTE stands for full time employees. Net premiums of the manual rate are calculated as: Manual rate * payroll.*

Firm size and risk rate matter. Table 2.1 compares two firms working in contrasting sectors along with the magnitude of a potential bonus or malus for two different industries with contrasting risk rates. The architect's office is much larger in terms of personnel and payroll than the construction company. The potential savings of the maximum bonus for workers' compensation are obviously much higher for the construction company, but they have very similar base premiums.

Table 2.2: Descriptive Statistics

Variable	Mean	Std Dev	Minimum	Maximum	N	25th Quantile	Median	75th Quantile
Independent variables								
Payroll	857'852	2'172'302	50'000	134'963'999	621'251	131'300	294'825	714'213
Full Time Employees	12.8	31.6	0	1'647	621'251	2	5	11
Costs for medical treatment	6'115	57'003	0	10'682'397	621'251	0	0	800
DB payments	9'657	59'659	0	4'815'304	621'251	0	0	268
Days of DB	68	404	0	37'786	621'251	0	0	4
Accidents with DB	0.9	2.7	0	267	621'251	0	0	1
Number of observed cases	1.5	3.6	0	279	621'251	0	0	2
Outcome variables								
Number of accidents per FTE	0.1	0.3	0	44	621'042	0	0	0
DB per case with DB	43.5	77.6	0	1'174	160'764	9	19	44
DB in days per case	17.6	49.7	0	1'015	274'685	0	3	15
Cases with DB payments per FTE	0.1	0.2	0	44	621'042	0	0	0
DB payments per case	6'160	12'050	0	246'119	160'764	1'008	2'396	6'030
Costs per 1000 Swiss Francs of payroll	5.9	38.9	0	3'004	621'251	0	0	0
Costs for medical treatment per case	1'533	6'632	0	899'479	274'685	208	401	1'036
Total days of DB	24.8	103.7	0	9'941	621'251	0	0	3
Total number of cases	1.5	3.6	0	279	621'251	0	0	2
Total number of DB cases	0.6	1.8	0	158	621'251	0	0	1

Notes: DB stands for daily cash benefits. FTE is short for full time employees.

The initial data set contains 909'029 observations. There are a number of observations that could distort this analysis. Firms that have been part of mergers and acquisitions, firms that are part of group premiums, firms with manually manipulated pricing plans, firms with a payroll of less than 50'000 Swiss Francs, firms with zero full time equivalents, firms with a base premium of 0 (or missing), and firms with full experience rating will be removed. The process is further described in Appendix A4. The sample used for this analysis yields a total of 621'251 observations with 1'475'919 accidents.

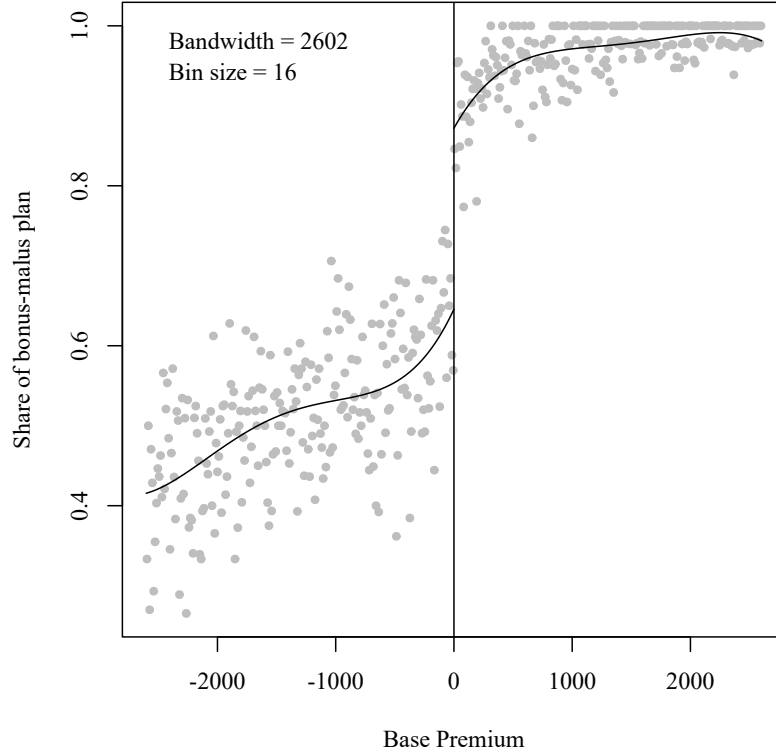
Table 2.2 reports descriptive statistics for the relevant variables. Although the research question focuses on the incentives to prevent accidents, numbers indicating spendings for prevention measures are not available. Furthermore, personal data on the injured individuals are partly available, but information on the individuals that did not have any accident are not available.

2.4 Identification and empirical strategy

This section outlines the identification strategy for answering the question whether the incentives of the bonus-malus plan motivate firms to lower accident-related costs. The present study aims at estimating the average impact of the bonus-malus plan on the accident records of the firms. Because firms can actively reduce their premium, they are incentivized to invest in prevention. To be consistent with the relevant literature, we will use the potential outcome notation proposed by Rubin (1974).

D_i indicates treatment status and is used to indicate group membership of firm i . $D_i=0$ if the firm is in the manual rate plan, and $D_i=1$ if the firm is in the bonus-malus plan. The effects of pricing-plan assignment on a set of outcome variables y are of major interest because they approximate a firm's behavior. In this particular setting, one firm can only be observed with $D_i=1$ or $D_i=0$. If firm i is assigned to the bonus-malus plan, $Y_i(1)$ will be the realized outcome and $Y_i(0)$ will be the counterfactual outcome. If firm i is not part of the bonus-malus plan, $Y_i(0)$ will be observed and $Y_i(1)$ will be the counterfactual.

Figure 2.4: Share of firms in the bonus-malus plan



Notes: Share of firms in the bonus-malus plan. Dots represent bins of nonoverlapping intervals, bin size is indicated in the graph. Optimal bandwidth is chosen by one common MSE-optimal bandwidth selector across both sides of the threshold for the RD treatment effect estimator. Threshold for the bonus-malus plan was set to zero by deducting 30'000 from the actual Base premium.

Assignment to the pricing plans isn't random. Firms with a relatively low payroll will be more likely to be below the threshold and firms with higher payroll are more likely to be above the threshold. The same accounts for the risk factor, given the equation of the base premium and shown in Section 2.2.

The empirical strategy will require comparing firms on both sides of the threshold. Firms far away from the threshold differ in firm size, organizational form, and resources. The sample is split into two groups. The first group contains firms in the manual rate plan. Their base premium is below 30'000 and they have never been in the bonus-malus plan. The second group consists of firms in the bonus-malus plan. Firm i is assigned to the bonus-malus plan when its base premium is above the exogenously defined threshold of 30'000 Francs. Following the advice of Lee and Lemieux (2010) and for reasons of simplification, the threshold for the bonus-malus plan is set to zero by subtracting 30'000 from the actual base premium. The goal is to contrast mean risk outcomes on both sides

of the threshold. Under what circumstances does the threshold inform us on the behavior of the firms in the two pricing plans? Consider $E_l(D)$ and $E_r(D)$, the share of firms in the bonus-malus plan on the left and the right hand side of the threshold. Figure 2.4 displays the distribution of the share of firms in the bonus-malus plan.

Since group membership changes at the threshold, it is possible to learn about the role of the pricing plan for the behavior of firms in situations with workplace accidents. As the focus is on the observations around that threshold, it is only possible to identify a local causal effect for firms in that specific window.

The identification strategy is a fuzzy regression discontinuity design. The discontinuity is fuzzy because, although there is a clear threshold, the probability of a firm being in the bonus-malus plan increases as the firm approaches that threshold. The jump at the threshold will be estimated as $E_r(D) - E_l(D) = Prob_r(D_r=1, D_l=0)$, where D_r denotes membership of firms in the bonus-malus plan and D_l is group membership of firms in the manual rate plan. The design solely requires a discontinuity in the probability of the treatment assignment at the threshold. Under the following assumptions, we will be able to measure the average effect of group membership on the outcome. A fuzzy RDD identifies the average effect among compliers at the threshold.

As emphasized by Lee and Lemieux (2010), the key identifying assumption is that assignment to either side of the threshold is 'as good as random'. This leads to the conclusion that the threshold for the bonus-malus plan is the sole cause for the discontinuity in the treatment (assignment to bonus-malus plan). Firms should not be able to manipulate their base premium. If they were, the assumption would be violated. According to the particular research setting of this study, sorting around the bonus-malus threshold is not expected. Recall that the base premium is a product of the manual rate and the payroll from two to seven years ago. To manipulate the future base premium, firms would have to be able to manipulate the payroll prospectively, namely at least at point of time y for the point of time $y + 2$. The second margin of maneuver is that all the firms of a specific risk collective simultaneously and intentionally change their behavior in order to get a better risk rate. Since firms are assumed to be individual actors within a risk group,

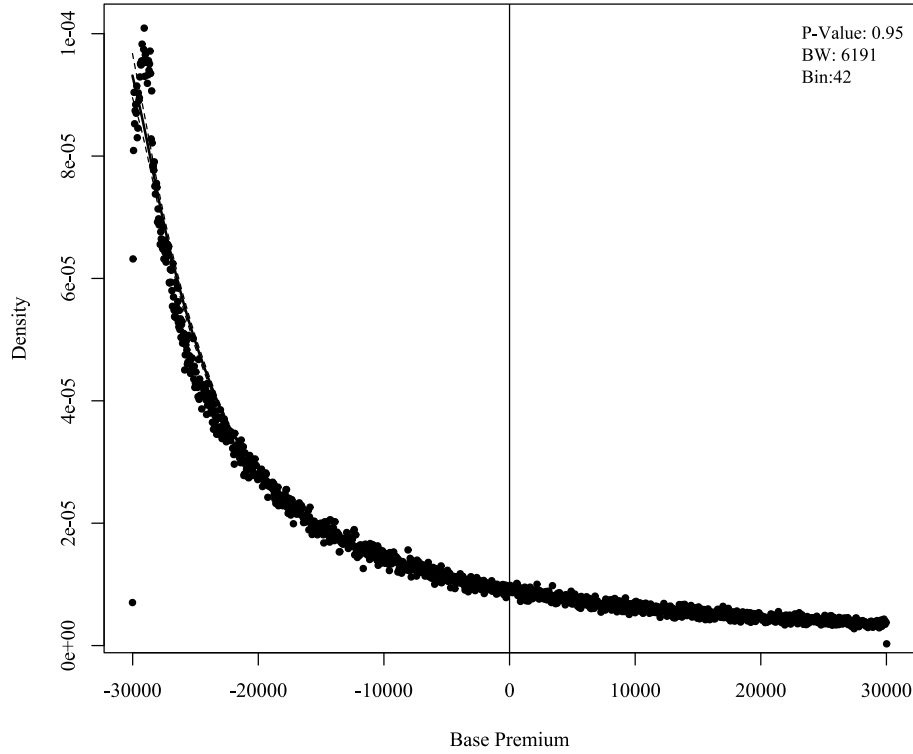
they cannot manipulate the manual rate for the entire group. Firms could potentially manipulate their payroll in order to be above or below the threshold. Even though this assumption cannot be verified with absolute certainty, it is partially testable using the McCrary (2008) test. The intuition behind this test is that if the firms are able to manipulate their placement along the base premium, above or below the threshold, the share of the firms just to the left of the threshold might in general be different from the share just on the right of the threshold. Sorting, therefore, would create also a discontinuity in the density of the running variable. Figure 2.5 shows visual description of the distribution of the firms in bins of 42 Francs. The formal test yields a p-value of 0.95 which means that the zero-hypothesis of 'There is sorting' is dismissed.

Within the given framework, we will have three types of firms. Compliers with $D_r=1$ and $D_l=0$. They are firms in the bonus-malus group if they have a base premium above 30'000, and members of the manual rate group if they have a base premium below 30'000. Never takers with $D_r=0$ and $D_l=0$. These firms are always members of the manual rate group and never part of the bonus-malus group. Always takers with $D_r=1$ and $D_l=1$. These firms are always part of the bonus-malus plan.

Monotonicity: The monotonicity assumption states that there are no defiers. In this case, defiers in the sample would mean that there are firms that can 'choose' their assignment in a particular way, namely $D_r=0$ and $D_l=1$. Since firms are assigned by a set of rules, it can be assumed that defiers are rare or non-existent in this setting.

Another important assumption is that covariate distributions have to be continuous at the threshold (Lee and Lemieux, 2010). The continuity assumption would be violated if the specific threshold was determined because of an underlying discontinuity in the relationship between the threshold and the covariates affecting the outcome. Doing this analysis shows that the covariates do not differ at the threshold. Evidence is provided in Appendix A5.

Figure 2.5: McCrary-Test for sorting



Notes: For this validity test, the sample was manually limited to observations with a base premium between -30'000 and +30'000. Dots represent bins of nonoverlapping intervals, bin size is indicated in the graph. BW is the bandwidth. Optimal bandwidth is chosen by one common MSE-optimal bandwidth selector across both sides of the threshold for the RD treatment effect estimator. Windows shown in graphs represent optimal bandwidth.

The fuzzy RDD shows an estimate of the Local Average Treatment Effect (LATE) for those firms who are part of the bonus-malus plan at the threshold (Hahn et al., 2001). Therefore, the effect for compliers, i.e. firms with experience rating above the threshold is identified as indicated in Equation 2.1. X indicates the running variable, namely the base premium, χ^r and χ^l represent the local neighbourhood above and below the threshold.

$$LATE = \frac{E(Y|X \in \chi^r) - E(Y|X \in \chi^l)}{P(D = 1|X \in \chi^r) - P(D = 1|X \in \chi^l)} \quad (2.1)$$

There are three issues tied with the identification strategy. The first is that the base premium is already a reflection of the risk. As we estimate the behavior of the firms in case of an accident, the outcome, a particular form of a firm's risk may be linked to a risk group's manual rate. But since the main assumption of RDD is that a firm cannot

select its pricing plan, RDD works if there is no endogeneity at the threshold.

The second issue is that the identification strategy may be biased by the fact that the threshold is fixed. As described in Section 2.2, firms that were in the bonus-malus plan and in the subsequent years still had a base premium above 24'000 will remain in the bonus-malus plan. There is a variety of causes underlying this kind of development. The risk rate of the risk group could have decreased, worsening economic conditions could have led to a lower payroll, or, an exceptionally good business year could have led to a one-time payroll boost with a corresponding rise of the base premium. There is a downward shift in the setting. Because of the use of a fuzzy RDD, this issue is tackled by design. Fuzzy RDD relies on exogeneous variation in the probability of being treated. In this study the threshold for the bonus-malus plan is exogenously set by the insurance carrier. Firms are assigned to a pricing plan by a predefined set of rules.

The literature on information asymmetry repeatedly refers to the presence of a third issue, adverse selection. Adverse selection is present when the insurance carrier does not know the risk of the firm and the firm actively selects a pricing plan according to its own flavor. Hence, a firm that has many costly accidents would per se choose to be in the manual rate plan because the costs would not affect the firm's premium. In this setting, all firms are mandatorily insured by the partial monopolist. There are no uninsured firms. The insurance contract and the benefits are fully standardized. Firms cannot determine which insurance plan they choose. The only margin of maneuver would be the case where a firm intentionally keeps a constant payroll in order to avoid the bonus-malus system. This is not plausible for some reasons: First, contributions for accident insurance are negligible relative to the turnover of a firm. Focusing the course of business only to avoid the bonus-malus plan would potentially influence a firm's existence. Secondly, the threshold for the bonus-malus plan has no relationship to any other social insurance program in Switzerland. Hence it is only relevant for the assignment to one of the pricing plans.

As noted by Lee and Lemieux (2010), the effect of the bonus-malus plan will be estimated using an instrumental variable technique. Eligibility for the bonus-malus plan

is used in a two stage model as an instrumental variable for the pricing plan of the firm. For the estimation we use the package "rdrobust" (Calonico et al., 2014) in the statistical software R. The choice of the bandwidth for the local linear regression on both sides of the cutoff is crucial. A large bandwidth includes more data points and has a high bias and a low variance. On the contrary, a small bandwidth comes with fewer data points and has lower bias and a higher variance. In a data-driven procedure, the optimal bandwidth for each outcome variable is calculated following the descriptions of Calonico et al. (2014), Calonico, Cattaneo and Farrell (2018), and Calonico, Cattaneo, Farrell and Titiunik (2018).⁸ For our analysis, the underlying bandwidth is chosen by one common MSE-optimal bandwidth selector across both sides of the threshold, which has the same size for both sides of the threshold. The resulting point estimator for the treatment effect is MSE-optimal. MSE is the mean squared error. The optimal bandwidth is chosen in such a way that the MSE is minimized, hence MSE-optimal. The estimator is based on a local linear regression in the range of the optimal bandwidth on both sides of the threshold. This procedure is repeated for each outcome variable separately.

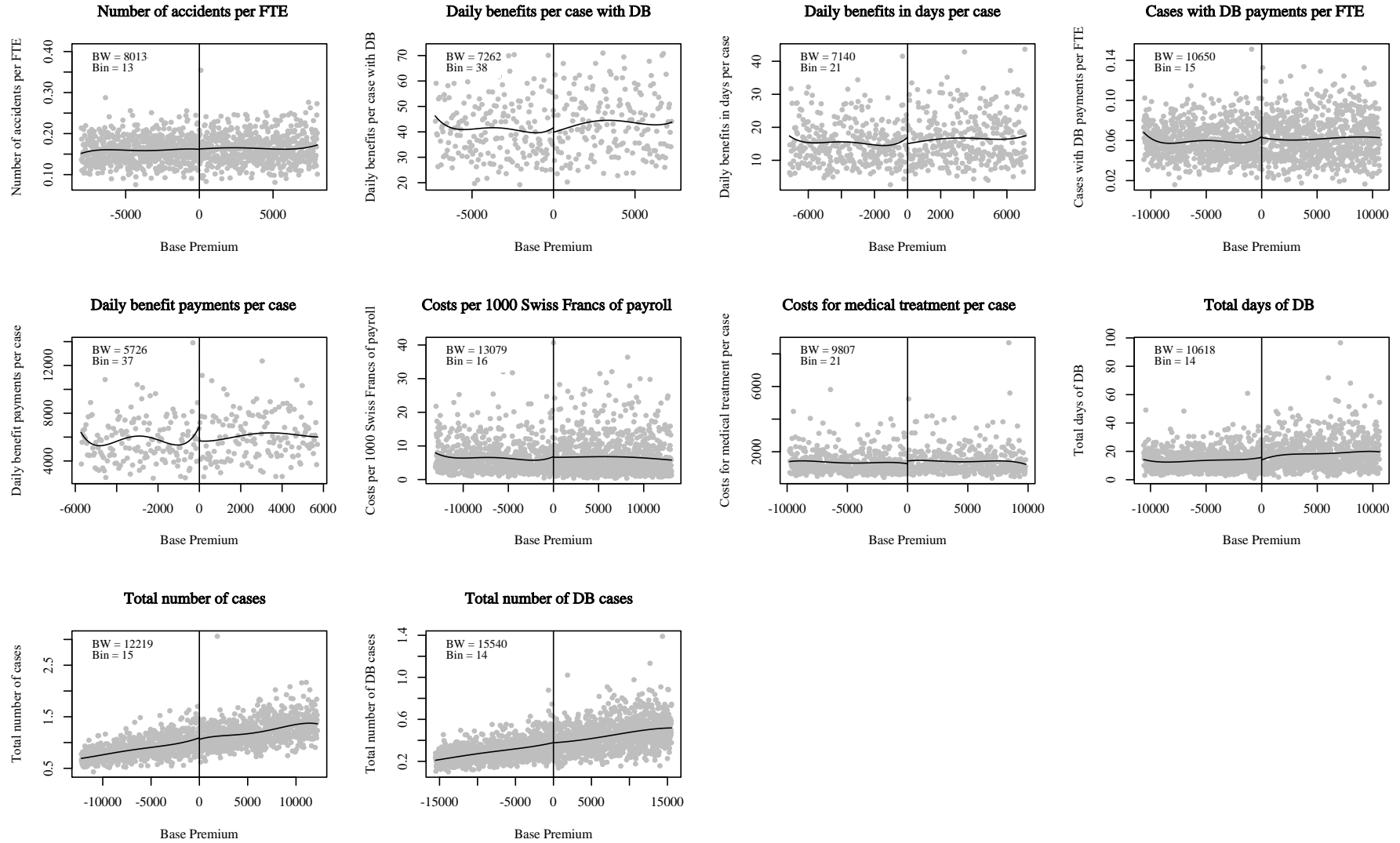
2.5 Results: Moral hazard and experience rating

2.5.1 Main results

This section discusses the causal effect of experience rating on moral hazard. The outcome variables are a broad range of ratios indicating a firm's accident risk. Figure 2.6 presents a graphical outline of the outcome variables with indication for the presence of a discontinuity at the threshold for the bonus-malus plan. The plots in Figure 2.6 display local polynomial regressions for each of the outcome variables without covariates and bins of nonoverlapping intervals. The windows indicated for each graph are the optimal bandwidth for the corresponding variable. Firms on the right-hand side of each graphic are in the bonus-malus plan.

⁸The respective argument in the package "rdrobust" for this bandwidth selector is "mserd".

Figure 2.6: Visual evidence for outcome variables



Notes: Solid line is a local polynomial regression. Dots represent bins of nonoverlapping intervals, bin size is indicated in the graph. BW is the bandwidth. Optimal bandwidth is chosen by one common MSE-optimal bandwidth selector across both sides of the threshold for the RD treatment effect estimator. Windows shown in graphs represent optimal bandwidth.

A visual analysis does not yield any discontinuities in the outcome variables. The number of accidents is stable but slightly increasing along the base premium. A clear discontinuity is not visible in the plot and the slope for both sides seems to be similar. Firms on the right-hand side tend to have an increased risk rate and are larger than firms on the left-hand side. 'DB per case with DB' do not show any clear discontinuity at the threshold. The variance seems to be quite high and the level of payments is very similar for both groups. 'DB in days per case' returns similar indications. Although the overall level is lower, we do not see any discontinuity at the threshold, nor do we observe a change in the slope for either side. The same applies for the variable 'Cases with DB per FTE', which means that for every six employees, an accident with DB payments happens. 'Daily benefit payments per case', 'Costs per 1000 Swiss Francs of payroll', 'Costs for medical treatment per case' do not yield any discontinuities and appear to be on a similar level around the threshold. The absolute number of cases, namely 'Total days of DB', 'Total number of cases', 'Total number of DB cases' show mixed signals. While there is not a relevant discontinuity at the threshold, the absolute numbers increase. This is intuitive, because as shown in Section 2.3, firm size along the base premium increases. Therefore, the number of employees increases, and the number of incidents is likely to increase on average.

What follows on the visual analysis is the numerical analysis. We now will apply regression analysis to provide further results and examine, whether the impact of the bonus-malus plan can yield substantial results. Table 2.3 displays the estimation results of a local linear regression. The local average treatment effect will be reported as a robust estimate. In a typical approach, the standard error of the coefficient is used to derive p-values and confidence intervals. Calonico et al. (2014) show that with a conventional approach, the confidence intervals can be too small which leads to excessive rejection of the null hypothesis "no treatment effect". Hence, the estimation of the standard error on a regression is one order higher than the effect estimation. E.g. if the bandwidth is chosen for a local linear estimator, the confidence intervals are constructed employing the standard error of the local quadratic estimator with the identic bandwidth (Huber, 2019).

Therefore, the estimation is robust. It is visible that none of the outcome variables yields significant results. Appendix A6 shows results for local polynomial regressions of the 2nd and 3rd polynome. The results remain the same. Furthermore, covariates are added up to the equation. We introduce a variable to distinguish between the German-speaking and the French- or Italian-speaking regions of Switzerland. To account for firm size, the number of FTE is added as a covariate. Another control variable is a dummy variable indicating whether a firm is active in multiple sectors (and not only in one). Further, industry dummies control for the membership of the firm to an economic activity. The inclusion of these covariates does not change our findings.

It should be pointed out that one of the major weaknesses of the regression discontinuity design is the lack of external validity. Hence, firms around that threshold seem not to differ, but for larger firms the potential bonus in absolute terms becomes much higher and the expected return on investment for prevention increases.

To summarize, these estimates suggest that firms in the bonus-malus plan on average do not show differing risk behavior compared to firms in the manual rate plan. Firms around the threshold are assumed to be similar in their characteristics - this is what makes them comparable and, hence, useful for the underlying fuzzy RDD. As the total number does not change, it follows that firms in the bonus-malus plan have more unsevere accidents that do not lead to a temporary work disability. On the other hand, we see that the costs per case increase for firms in the bonus-malus plan, regardless whether we check for costs for medical treatment, total costs or number of days of DB.

Table 2.3: Estimates for the effect of the bonus-malus plan

	Accidents per FTE	DB per case of DB	DB per accident	DB cases per FTE	DB (in CHF) per case	DB per 1000 CHF of payroll	Medical treatment cost p.case	DB in days (total)	No. of accidents	No. of DB cases
Robust Estimate	0.00 (1.23)	-0.57 (9.83)	-0.97 (5.10)	0.01 (0.01)	-969.37 (1890.3)	1.87 (2.15)	420.01 (512.96)	0.05 (3.73)	0.05 (0.09)	0.00 (0.03)
Bandwidth	8'023	7'261	7'173	10'709	5'734	13'547	9'796	10'586	12'118	15'583
No. of obs below	43'194	9'250	19'066	61'699	7'128	84'464	27'052	60'759	72'452	103'403
No. of obs above	30'868	8'056	16'009	39'408	6'467	47'582	21'141	39'035	43'582	53'122
Covariates	No	No	No	No	No	No	No	No	No	No
Polynome	-	-	-	-	-	-	-	-	-	-
Kernel	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular

Notes: Estimates are based on a local linear regression within the indicated windows. The optimal bandwidth is chosen by one common MSE-optimal bandwidth selector across both sides of the threshold for the RD treatment effect point estimate. Robust standard errors are in parenthesis. *** $p < 0.01$, ** $p < 0.05$,

* $p < 0.10$.

2.5.2 Intra-industry examination

The results in Table 2.3 do not indicate that firms in the bonus-malus plan influence the course of an accident more actively than firms in the manual rate plan. One of the reasons could be that the composition of the different firms and industries does make a difference and dilutes the overall reports. Although Appendix A5 shows no significant changes above the threshold for any of the industry dummies, the analysis will be executed separately for each of the industries.

Corresponding to their economic activities, firms are assigned to risk collectives. All the members of these collectives have a risk rate. The risk rates of the collectives vary. While architects have a lower risk rate, construction firms show higher risk rates. Assessing the presented outcome variables for each industry separately has many advantages. Industry-specific fixed effects like the business cycle, temporary public attention, or new particular regulations that only apply to firms in the corresponding area do not have to be considered for the intra-industry analysis. Also, the financial impact of a potential bonus or malus is different for firms that are active in different industries. The sample is therefore split into 46 different subsamples, each sample containing all observations in the corresponding area of economic activity.

Appendix A7 shows the estimates for the intra-industry analysis. Six different industries show more than five significant estimates. The results do not point to important effects. One industry shall be emphasized in particular: Construction. It is the largest sector insured by the partial monopolist. That is in terms of premiums and in terms of number of insured firms. Its premium make about 25% of total premiums for the partial monopolist. It is a risk group with a rather high risk rate, where accident insurance plays an important role. The prevention of accidents is essential, because accidents can quickly lead to total disability of the employee. We adapt the sample and rerun the regressions. The results of this analysis are displayed in Table 2.4. Again, none of the estimates show significant results.

Table 2.4: Estimates for firms in the construction industry

	Accidents per FTE	DB per case of DB	DB per accident	DB cases per FTE	DB (in CHF) per case	DB per 1000 CHF of payroll	Medical treatment cost p.case	DB in days (total)	No. of accidents	No. of DB cases
Robust Estimate	-0.06 (0.06)	8.00 (8.74)	5.74 (6.81)	-0.04 (0.04)	1245.66 (1385.92)	14.25 (15.5)	-40.30 (659.31)	4.36 (12.66)	-0.03 (0.29)	-0.10 (0.16)
Bandwidth	8'915	23'280	16'708	11'146	22'566	10'261	17'980	10'395	8'747	9'757
No. of obs. below	4'447	4'110	4'577	5'860	3'942	5'278	4'976	5'358	4'351	4'955
No. of obs. above	3'490	2'884	3'380	4'246	2'794	3'967	3'614	4'021	3'440	3'795
Covariates	No	No	No	No	No	No	No	No	No	No
Polynome	-	-	-	-	-	-	-	-	-	-
Kernel	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular

Notes: Estimates are based on a local linear regression within the indicated windows. The optimal bandwidth is chosen by one common MSE-optimal bandwidth selector across both sides of the threshold for the RD treatment effect point estimate. Robust standard errors are in parenthesis. *** $p < 0.01$, ** $p < 0.05$,

* $p < 0.10$.

2.6 Conclusion

A longstanding question in the literature on information asymmetry in the insurance sector is whether experience rating is able to reduce moral hazard. This question is studied here in the context of the Swiss accident insurance.

Accident insurance in Switzerland is partly monopolized by the Swiss accident insurance fund, Suva, which covers about half of the Swiss workforce and has full coverage on numerous industries. Suva's insurance contracts are standardized, firms cannot choose their pricing plan and they have to be mandatorily insured by Suva. The present study analyses the effect of experience rating on moral hazard, based on two pricing plans of Suva: The manual rate plan and the bonus-malus plan. The former foresees no experience rating, the latter penalizes firms with bad accident records and rewards firms with relatively good accident records. Assignment to these plans is primarily bound to one criterion, the base premium. It is a function of the payroll of the past six years and the manual rate of a firm's risk collective. If the base premium exceeds the exogenously defined threshold of 30'000 Francs, the firm is assigned to the bonus-malus plan. Firms below that value are assigned to the manual rate plan, without experience rating. We utilize this setting to identify moral hazard in differences of frequency as well as costs of accidents per firm by performing a fuzzy regression discontinuity design. By doing so, we focus on firms around that threshold. Differences on either side of the cutoff indicate differences in accident records between the firms. The firms are assumed to be very similar just around the threshold.

The results indicate no differing behavior for the firms in the bonus-malus plan. As the overall sample is heterogeneous in risk and in size and may be unbalanced in unobservables, the analysis is extended by an intra-industry estimation. The sample is split into subsamples of different industries. Also, this estimation yields no significant effects.

We want to point out two potential explanations for our findings. The first explanation is the already established workplace safety culture in Switzerland. Workplace safety is an important topic in Switzerland. It is rooted in mandatory measures, such as the duty to wear a helmet on a construction site, or to install safety ropes when working in heights,

or many other measures. Not applying these kind of measures results in penalty, or temporary closing of the working site, until the equipment is installed. A second layer of workplace safety lies in the voluntary commitment of a firm to a Safety Charter. Mainly firms that work in economic activities insured by Suva are part of this charter. Another part of this second layer are measures that proactively educate the employees on how to work and behave safely. One limitation of the present study is the lack of reliable data on a firm's prevention efforts. It could be the case that the firm cannot do more, and the accidents are a product of sheer coincidence. The second area of explanations is the question about the impact of the financial incentives. As shown in Section 2.3, the financial impact for two firms with the same base premium can differ substantially. But is this really enough of an incentive to invest in prevention? When an accident happens, the gain resulting out of a bonus can quickly become small, when compared to the cost of that accident. If we take the example from Section 2.3, the construction firm can save up to 2'500 Swiss Francs per year. These are daily cash benefits for less than 10 working days for one employee in that sector. That worker needs to be replaced quickly. Usually a staff leasing company can provide workforce within a couple of hours, but the costs are very high. The new, temporary, worker must be introduced, which requires some time. Furthermore, time for additional administration has to be calculated.

The costs of an accident consist of direct and indirect components and seem to be much higher than the gain from a bonus. This applies to a firm in the manual rate plan as well as for a firm in the bonus-malus plan. As a consequence, it is possible that these firms already have enough incentives to prevent accidents and already invest in prevention. The incentives in this pricing model seem to be low-powered. The firm has already an intrinsic motivation to prevent accidents, also without the pricing model. We would expect to see an effect for firms that are further away from the threshold and have a larger base premium. When firms can potentially save five-figure amounts, prevention efforts will certainly become more important.

Chapter 3

Predicting Disability Pensions With Machine Learning Techniques

3.1 Introduction

A single disability pension in the Swiss accident insurance has an average net present value of around 350'000 Swiss Francs (Unfallstatistik, 2019). When a disability pension is paid out, the replacement rate for insured earnings is 80 percent. The total amount for future cash flows needs to be reserved by the accident insurance on the year of the incident. This is also the case when it's not apparent if an accident will result in a permanent work disability. In addition to high costs, human capital is torn out of the labor market. Disability pensions have a big impact on the lives of the insured as well as on the cost structure of an insurance company. Improving the quality of the correct classification of an accident will help to increase the prediction quality for the recovery process.

The present paper aims at classifying accidents that result in a disability pension (short: DP) with machine learning methods. Correct classification means that an accident which leads to a disability pension after some years is recognized as such by the machine learning algorithm much sooner. Being able to detect potential long term disabilities at an early stage helps to set up the right measures for the return to work process of the injured. Disability pensions are responsible for the major part of insurance reservings in accident insurance. Hence, accurate predictions support the estimation of future costs and reserving for the insurance company. There is a diversity of potential use cases in the prediction of disability pensions. Machine learning methods are becoming increasingly important for problems in the insurance sector. The literature on how to apply machine learning models in economical context is growing and leading the way for more applications (e.g. Athey and Imbens, 2019; Mullainathan and Spiess, 2017; Varian, 2014). In a discussion paper that was published by the consulting agency McKinsey (McKinsey, 2017), insurance and health care are named as two of the most promising industries for applications of artificial intelligence. Machine learning is used in various fields of insurance, the most researched one being fraud detection (see e.g. Wang and Xu, 2018; Kose et al., 2015; Dua and Bais, 2014). The algorithms can help to detect patterns quickly and show a high classification rate. Moreover, machine learning methods are

found in the prediction and plausibilisation of health insurance claims (e.g. Bauder et al., 2016; Kumar et al., 2010). Some recent work focuses on pricing of non-life insurance (e.g. Wuthrich and Buser, 2019). Early detection of potential disability pensions can lead the way to reintegrate the individual to the work life.

A sudden, heavy accident has a major impact on the life of injured persons and their family and friends. Most of the industrialised countries have installed social insurance institutions to protect the population against the financial consequences of accidents or sicknesses. In Switzerland, accidents and work-related disabilities are covered by the accident insurance. A permanent work incapacity caused by an accident or illness lastly leads to a disability pension. The medical process is usually very complex, long lasting and involves specialists from various areas. Physicians, medical experts and case workers not only accompany the injured person, they also to judge about the future earnings capacity. Furthermore, the administrative process takes up a lot of time and effort. The direct and indirect costs of disability pensions are high for the economy. Direct costs consist of wage replacement, disability settlement, health care providers, hospitalizations, and surgeries. Indirect costs are the reduction of work productivity, expenditures for training of replacement workers and administrative expenses. Reintegrating the injured person back to the labor market by all means is therefore crucial. The Swiss Skills Shortage Index has been steadily increasing since 2007.¹ Employers are looking for qualified personnel. Thus, the willingness to reintegrate previously injured personnel has potentially increased. Long periods between the accident and the decision of a disability pension could be reduced with early detection.

Work disabilities have been subject to previous research in many fields, especially in the medical literature (see reviews of Knardahl et al., 2017; Crook et al., 2002; Turner et al., 2000). Besides the illness or injury type, potential predictors of work disability include sociodemographic factors which focus on characteristics such as age, sex or marital status of the person. Biomedical and health care causes target the diagnosis, pain site, accident type or injury severity. Furthermore, occupational aspects, namely occupation, tenure,

¹See <https://www.stellenmarktmonitor.uzh.ch/de/indices/fachkraeftemangel.html>, 26. June 2020.

firm size, and physical demands of the job seem to be important as well. The economic branch of the literature captures economic determinants for disability pensions and the effects of disability pensions on the welfare state. Autor and Duggan (2003) show that a reduced screening stringency for disability insurance along with declining demand for less skilled workers causes an increase in disability insurance beneficiaries. Consequently, unemployment rates in the US decrease. On the contrary, Mueller et al. (2013) find that the exhaustion of unemployment benefits did not cause more disability insurance applications for the US during the Great Recession. Maestas et al. (2013) find that for a large part of the applicants for SSDI in the US on the margin of program entry, employment would have been higher if they had not received disability benefits. Benitez-Silva et al. (2010) find evidence that work-related disability claims are very sensitive to economic fluctuations for a range of OECD countries. Across OECD countries, disability benefits amount to 2 percent of the GDP, whereas around 6 percent of the working-age population receive disability benefits, although these indications contain also pensions not coming from accidents (OECD, 2010). For the years 1992 to 2006, Steiger and Andermatt (2009) show a correlation between the number of work-related disability pensions and the unemployment rate for accident insurance in Switzerland. In periods of high unemployment, the amount of disability pensions is higher compared to periods of lower unemployment. During an economic boom, companies struggle to find qualified personnel.

Luckily, only a small share of all accidents leads to disability pensions in Switzerland, but they come with immense costs, which make about 30 percent of the costs of accident insurance. The present paper contributes to the existing literature by providing an important application of machine learning in the insurance sector. Although there have been different perspectives for predicting disabilities, this is the first paper to predict them with machine learning methods. Furthermore, the data used for this application stems from Suva, the Swiss accident insurance fund, which insures about half of the Swiss working population. We use machine learning algorithms to predict the outcomes of accidents at an early stage. More specifically, we want to predict accidents that lead to disability pensions. The statistical office for accident insurance in the framework of

UVG² reports a yearly incidence rate for around 800'000 accidents, and a steadily stabilizing number of approximately 1'700 disability pensions (Unfallstatistik, 2019). Suva has a partial monopoly in Switzerland, which means that firms that are active in certain economic activities have to insure their staff by the partial monopolist against the consequences of occupational and non-occupational accidents as well as occupational diseases. The data span the years 2003 to 2015 and includes information on the accident, personal characteristics of the injured person, and the employer.

The machine learning algorithms used in this study include a lasso logit regression, random forests and an ensemble learner. However, none of these algorithms solve a causal question. The procedures return the covariates with the highest predictive power. We split the sample into a training and a test sample. The algorithm learns with the former and predicts the outcome on the untouched test sample. While the training sample contains 75 percent of the sample, the test sample makes 25 percent. Only a small share of accidents results in disability pensions. Therefore, we run the tests with many samples, with each sample containing a different share of disability pensions. The shares range from 90 percent to one percent. It turns out that these shares have a crucial impact on the classification accuracy.

Our results indicate an overall classification rate of above 90 percent, depending of the share of disability pensions in the training sample. All three algorithms provide similar accuracy, with the ensemble learner slightly outperforming lasso and random forests. Nevertheless, as the absolute number of disability pensions is relatively small, this overall accuracy can be misleading. To explore the possibility to reduce false classification, the probability threshold for the final classification is moved stepwise from 0.5 to 0.9. Furthermore, the algorithms are trained with multiple training samples, varying in the proportion of disability pensions. Here, the tradeoff between correctly predicting disability pensions and "no disability pension" is revealed. E.g. a higher probability threshold leads to higher accuracy of disability pensions, but it also classifies many disability pensions not as such.

²UVG: Unfallversicherungsgesetz. It is the Swiss Accident Insurance act.

The paper is organized as follows: Section 3.2 describes the institutional background. In Section 3.3 the data is described. Section 3.4 provides details on the machine learning algorithms that are used in this paper. The results are presented in Section 3.5. Section 3.6 concludes the study and presents ideas for further research and extensions of this study.

3.2 Background

3.2.1 Disability pensions in accident insurance in Switzerland

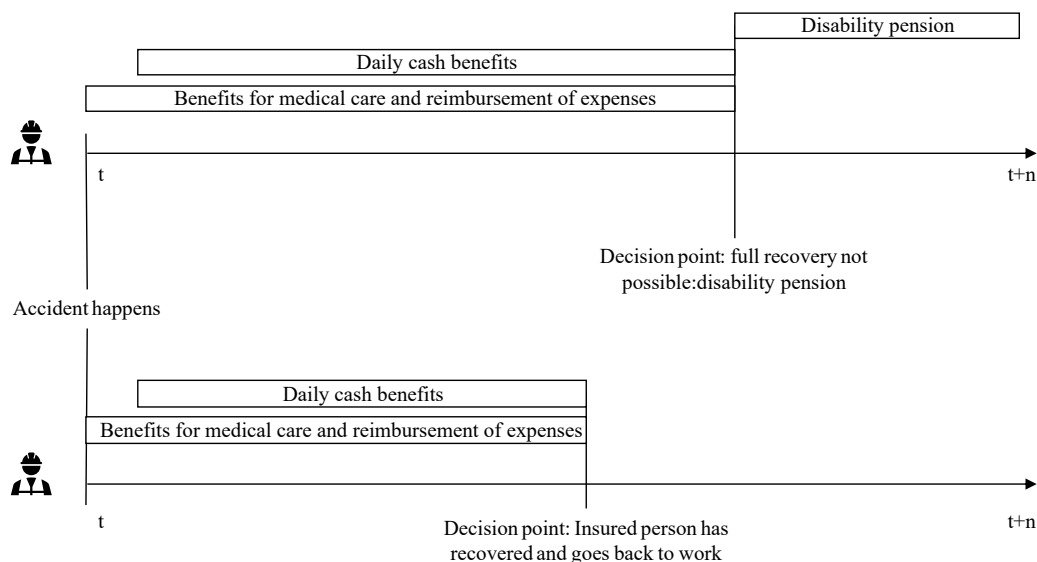
The Swiss social insurance system has installed two institutions for disability pensions. On the one hand, the old-age, survivors and invalidity insurance covers disabilities that do not result out of accidents or work-related diseases. It comprises the whole population. On the other hand, accident insurance covers accidents and occupational diseases for the employed persons working in Switzerland, as well as unemployed persons that are in unemployment insurance. The present study focuses on disability pensions in the framework of accident insurance. Within accident insurance, the population is insured against both, occupational and non-occupational accidents and occupational diseases. Invalidity is defined as a "full or partial earnings incapacity, presumed to be permanent or of long duration. Earnings incapacity refers to any reduction of all or part of the insured person's earnings possibilities in a balanced labour market that comes into consideration, if this reduction results from physical, mental, or psychological impairment and persists after completion of the required treatments and rehabilitation measure." (FSIO, 2020, p. 15).

Costs resulting from an accident are categorized as benefits for medical care and reimbursement of expenses, and cash benefits. The former consists of expenses for medical appointments, medicaments, hospitalization, equipment required for healing and so forth. They are required for an appropriate medical treatment and recovery measures of the injured persons. Cash benefits are earnings replacements and can be divided into several benefits. Daily cash benefits apply when the injured person is unable to work for at

least three days following the accident. They are paid out until the full recovery of the injured person, or when a disability pension can be obtained. Daily cash benefits amount to 80 percent of the insured salary. A partial working inability proportionally reduces the benefits. Another form of cash benefits are disability pensions. A full disability pension amounts to 80 percent of the insured salary and is paid out until death or until the person is no longer considered disabled.

The insured salary is currently capped at 148'200 Swiss Francs within the framework of the UVG. Hence, salaries exceeding the cap are not insured in the context of UVG. A disability pension applies when the injured person has a permanent full or partial earnings incapacity. Hence, the term of disability in this context is not necessarily linked to a medical disability. It is the inability to retrieve the level of earnings as before the injury or illness. E.g. an amputation of a leg does not have the same earnings effect for an office worker and a construction worker. The former will probably be able to continue his/her line of work, whereas the construction worker will not.

Figure 3.1: Course of two different accidents



Notes: Figurative and simplified course of two accidents. The top one leads to a disability pension, the worker in the example below is able to work again. Source: Own.

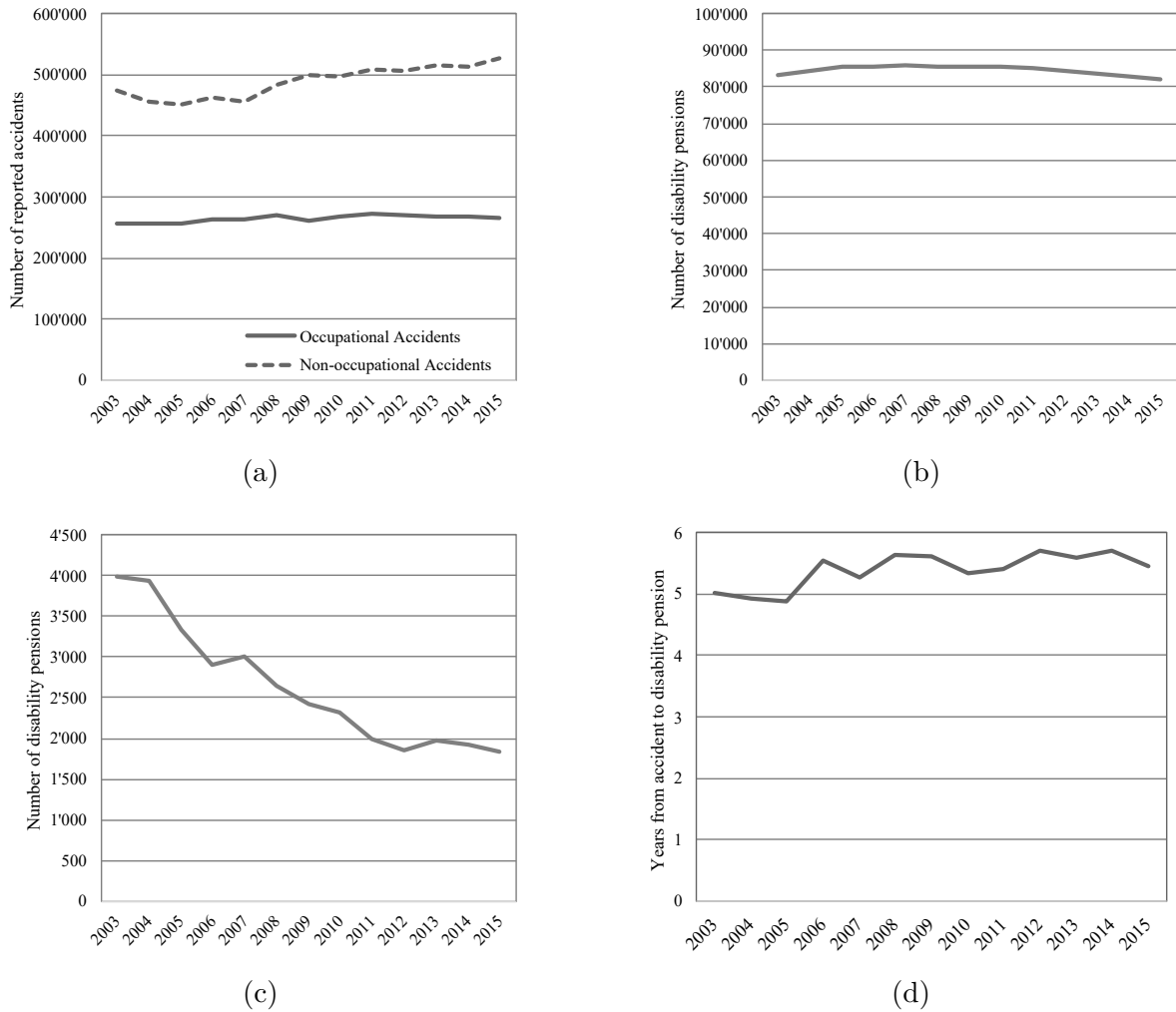
In a chronological sequence, after the happening of an accident, costs for medical care and reimbursement of expenses apply. In the case of a minor injury, the worker will be able to return to work immediately. Figure 3.1 displays two different accidents

with different outcomes. In the upper example, the worker is not able to pick up work again. At some point, the final medical measure has been taken with no improvements in work inability. And the worker is eligible for a disability pension. On the example below, the injury has taken another course and the worker will be finally able to work again. At that moment, the benefits stop. In both cases the benefits for medical expenses are paid out whenever needed in connection with that incident. Furthermore, earnings replacements in the form of daily cash benefits are paid out after the third day of absence from work. Cases with a work incapacity of two days or less are regarded as minor cases, because no daily cash benefits apply. Ordinary cases are considered as such when they entail a work incapacity of at least three days. In some cases, the injured person recovers within a couple of weeks, months or years and retrieves full earnings capacity as before the accident. But there remains a small share of cases in which the person has a permanent work inability. During the time of the injury, medical experts and case workers will try to reintegrate the injured person into the workplace. Also retraining for other professions is considered. Different therapies and measures are taken during the time of the recovery. After many attempts, a physician's diagnosis will state that all possible measures for recovery were taken and that the final medical state is reached. At this point, the physician diagnoses the patient's permanent inability to work. The result can be a full or partial disability pension, depending on the final earnings capacity.

3.2.2 Incidence of disability pensions

Since 2003, the yearly average number of accidents in Switzerland has been about 800'000, out of which only a small share had resulted in disability pensions. Despite the low incidence rates, disability pensions make about one third of the spending in expenses for the entire accident insurance in Switzerland (Unfallstatistik, 2019). Figure 3.2 shows the development of the reported accidents. Plot 3.2a indicates that the major part of accidents does not happen while at work. The injured person has a clear incentive to report an accident because all the costs resulting out of an accident are covered by the insurance, there is no deductible. On the contrary, for health insurance benefits there

Figure 3.2: Number of reported accidents, stock of disability pensions, and number of new disability pensions in the context of UVG.



Notes: (a) Number of reported accidents in the context of UVG; (b) Stock of disability pensions in the context of UVG; (c) Number of new disability pensions in the context of UVG; (d) Average duration from accident to receipt of disability pension.

is a deductible. The stock of disability pensions in accident insurance has been stable over the last 15 years. With a peak of around 86'000 in 2007, it has reached a level of approximately 82'000 disability pensions in the recent years (Plot 3.2b). New disability pensions have steadily decreased, as shown in Plot 3.2c.

There are several explanations for this development. The most important one is the change in the legal regime, starting in the year 2006. For whiplash injuries of the cervical spine, only injured persons with visible damages have been entitled to disability pensions. Furthermore, an overall increased screening stringency in the assessment of work disabilities has come along with this development. Also, accident prevention has

been more present in the past years. The enforced efforts of reintegration of heavily injured workers into the job market due to the lack of qualified personnel are important as well. Nevertheless, the isolated effect of each explanation must be further researched. A detailed discussion is beyond the scope of this study. Plot 3.2d shows the average duration from the happening of the accident to the decision for a disability. It appears that the tendency has grown to pay out daily cash benefits in return for a longer decision period. Hence, case workers are trying to reintegrate the injured worker and only determine a disability pension as the last possibility.

Switzerland also knows a separate disability insurance, covering disabilities that do not result out of accidents or work-related diseases of the working population. Also, the Swiss disability insurance shares a decreasing trend in terms of the inflow of new pensions. Rosenstein (2019) finds that the decrease in disability pension inflow since the mid-2000s is caused by a "tightening of eligibility criteria". Whereas reintegration is not considered an important factor. Although accident insurance and disability insurance do not share the same legal basis, the trends are very similar.

3.3 Data

3.3.1 Data set

We use a unique data set from the Swiss Accident Insurance Fund (Suva). Suva insures half of the Swiss work force and has by law full coverage of certain economic activities. Those include mainly blue collar industries such as e.g. construction, forestry or manufacturing. Out of the 800'000 cases, about 440'000 are managed by Suva.

A case can be a registered accident or an occupational disease. When registering the case, a set of variables is recorded. The data span the years 2003 to 2015 and are monthly records. Minor accidents, those with working disability of up to two days are dropped because they are not relevant as no daily cash benefits apply and the person is able to fully work again. The initial data set consists of 2'182'267 accidents and contains 38'735 records with at least one missing variable. As the percentage of the missing records are

rather low they are removed from the data. Finally, there are 2'143'532 observations out of which 17'385 accidents led to disability pensions in the data set.

Table 3.1: Variable Descriptions

Variable	Description
Costs for medical treatment	Costs for medical treatment were cumulated over a period of 12 months. In Section 3.5 we show alternative cumulations.
Daily cash benefits (in days)	Days of daily allowances were cumulated over a period of 12 months. In Section 3.5 we show alternative cumulations.
Daily cash benefits	Wage replacement of 80% during the time of absence.
Age	Age at the time of the accident.
Tenure	Amount of years, the worker was employed at the given firm.
Insured salary	The insured salary indicates the salary of the insured at the time of the accident.
Employees per firm	Number of full time employees per firm in a given year. It is a proxy for firm size.
Economic activity	Economic activity of the firm in which the patient was working at the time of the accident. It is an information based on the NOGA classification. Due to computational reasons, the activities are grouped by the first number of the NOGA code.
Injured bodyparts	The injured bodyparts are recorded in 99 different groups. Further information can be obtained in Appendix B1.
Injury type	There are 21 types of injuries in the records. Details are displayed in Appendix B1.
Gender	Male or female.
Insurance branch	Indicates whether the accident happened during work time or during leisure activities. Accidents of unemployed persons are excluded from the sample.

The explanatory variables, which are further described in Table 3.1, are the year of the accident, age at the time of the accident, injured bodyparts, gender, insurance branch, main economic activity of the firm (NOGA), cumulated costs for medical treatment and cumulated daily cash benefits of the case. Table 3.2 provides descriptive statistics of the entire sample. It is evident that the average costs are much higher for the cases ending in a DP. The dependent variable is a dummy variable indicating whether an accident becomes a disability pension at some later point of time. In the present study we focus on the classification of the accident. The amount of the disability pension is out of scope. An

Table 3.2: Descriptive Statistics

Variable	Mean	Std. Dev	Median	Min.	Max.
Accidents without DP (disability pension = 0)					
Insured Salary	63'122	25'131	63'900	10'001	148'200
Tenure	7	9	3	0	64
Age	38	13	37	12	94
Number of employees in firm	1'734	6'241	79	0	43'312
Daily cash benefits in days (12 months)	32.0	50.0	13.5	0.0	365.0
Daily cash benefits (12 months)	4'479	7'545	1'722	0	118'560
Treatment costs (12 months)	2'570	7'115	647	0	819'033
Occupational position: Employee / worker	0.8022	0.3983	1	0	1
Gender: Male	0.8307	0.3750	1	0	1
Injury type: Break	0.1185	0.3232	0	0	1
Work-related accident	0.4245	0.4943	0	0	1
NOGA: Manufacturing	0.2763	0.4472	0	0	1
NOGA: Construction	0.2445	0.4298	0	0	1
Accidents that lead to DP (disability pension = 1)					
Insured Salary	70'659	20'196	70'200	10'050	148'200
Tenure	9	11	5	0	67
Age	47	11	49	15	83
Number of employees in firm	1'267	5'578	45	0	43'312
Daily cash benefits in days (12 months)	268.0	98.3	305.0	0.0	365.0
Daily cash benefits (12 months)	40'260	18'894	42'347	0	118'560
Treatment costs (12 months)	41'945	75'104	16'686	0	963'770
Occupational position: Employee / worker	0.8156	0.3878	1	0	1
Gender: Male	0.8990	0.3013	1	0	1
Injury type: Break	0.2455	0.4304	0	0	1
Work-related accident	0.5642	0.4959	1	0	1
NOGA: Manufacturing	0.2396	0.4268	0	0	1
NOGA: Construction	0.3562	0.4789	0	0	1

accident can lead to a variety of pensions, such as survivors' pensions, integrity allowance, or helplessness allowances. The present study considers only disability pensions resulting out of an accident, where the injured person receives a replacement income.

3.3.2 Generation of training and test sets

A common way of creating a training and test sample is to split the sample into two parts. Usually, the former contains 75 to 80 percent of the observations and the latter 20 to 25 percent. Because only a few accidents result in a disability pension, their share is limited. Hence, the algorithms are likely to predict all cases with "no disability pension"

and the overall accuracy will be rather high but the classification rate for disability pensions will be close to zero. As a consequence, the model is trained in six different samples with each sample having a different share of disability pensions. The samples contain 1, 10, 20, 50, 75, and 90 percent disability pensions and are indicated in Table 3.3. Each sample has a different size because all the disability pensions were used to be able to train as good as possible. For the 1-percent-sample, a total of 250'000 accidents was selected because the computation time was excessively high. The samples are always generated from the initial large data set. Summary statistics for the different samples are provided in Appendix B1.

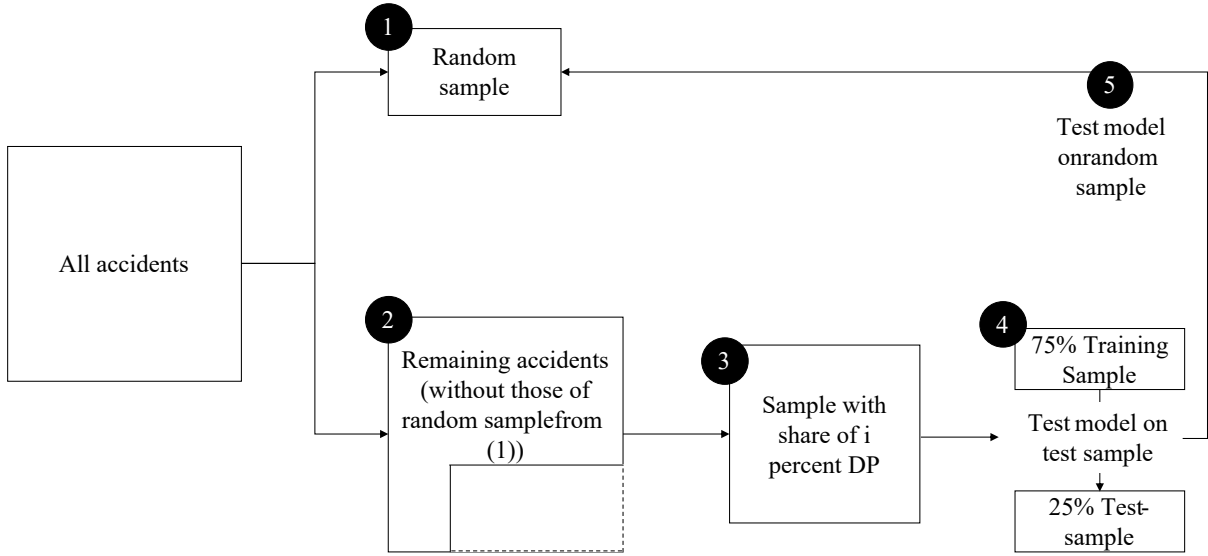
Table 3.3: Multiple samples with different shares of DP

Share of DP	Number of DP	Number of accidents without DP	Total sample size
90%	15'760	1'751	17'511
75%	15'760	5'253	21'014
50%	15'760	15'760	31'521
20%	15'760	63'042	78'802
10%	15'760	141'844	157'605
1%	2'500	247'500	250'000

Notes: Different samples that were used to train the corresponding models. The samples are a multiple of the number of the available disability pensions. Due to computational limits, the sample with 1 percent DP is limited to 250'000 observations.

Nevertheless, the algorithms will have to solve real-world problems. Hence, the different balances do not represent truly existing distributions of disability pensions. To deal with this issue, a random sample of 200'000 observations is drawn from the entire data set before training the algorithms. The procedure for sample generation is as follows (see also Figure 3.3): (1) draw a random sample of 200'000 observations, (2) create sample with remaining observations; (3) create sample with a given sample balance (with 90, 75, 50, 20, 10, 1 percent DP); (4) create a training and test sample, train the algorithms with training sample and predict disability pensions on test sample; (5) predict disability pensions on the alternative sample and test the results.

Figure 3.3: Generation of test sets



Notes: The procedure of the generation of test sets. A random sample is drawn in the beginning to test the trained model in a realistic environment. The models are trained in samples with diverging shares of DP.

3.3.3 Multiple disability pensions

A disability pension is a result of an earnings incapacity. This incapacity can be partial or full. It is possible that the same person can have multiple timely separated injuries, leading to different disabilities. In the data set, there are 386 persons that have more than one disability pension. However, the sum of all disability pensions cannot generate more than 80 percent of the pre-disability earnings. A new disability pension can only be determined as a result of another accident. These observations are kept in the sample because additional DP are the result of new accidents.

3.4 Empirical Analysis using Machine Learning

We apply supervised machine learning methods to predict disability pensions for accident insurance in Switzerland. Three different approaches are used: Lasso regression (Tibshirani, 1996) for logit models, random forests (Ho, 1995; Breiman, 2001), and an ensemble learner that combines and weighs different algorithms.

3.4.1 Lasso regression

In this section, we will discuss the lasso logit regression as a prediction algorithm. Lasso (Least Absolute Shrinkage and Selection Operator) is a regularized regression which penalizes the sum of absolute coefficients, i.e. the number of regressors considered in order to control the variance. Regularized regression is primarily applied as a measure of prediction. The main challenge is to find the appropriate penalty parameter (λ).

For the lasso regression, the balanced sample is split into two subsets: training and test sample. Our training sample contains 75 percent of the observations and is used to estimate the model parameters. The test sample contains 25 percent of the observations and is used for the out of sample prediction and performance evaluation. The question, whether an accident is likely to result in a disability pension is estimated as a function of multiple predictors.

As the goal is to solve a classification problem, the lasso estimate will be executed as a logit regression. As highlighted by Tibshirani (1996), one of the advantages of lasso is that it can set the coefficients of some covariates to zero and, thus, removes them from the model. Lasso requires an initial standardization of the covariates. This way, the penalty term is the same for all the regressors. Lasso logit solves the following problem:

$$\min_{(\beta_0, \beta) \in R^{p+1}} - \left[\frac{1}{N} \sum_{i=1}^N y_i (\beta_0 + x_i^T \beta) - \log(1 + e^{(\beta_0 + x_i^T \beta)}) \right] + \lambda \|\beta\|_1. \quad (3.1)$$

β_0 is the intercept, β stands for the slope coefficients on the predictor variables, x denotes the vector of predictors, i is an index for an observation in the data set, j is an index for a predictor, T is the number of predictors. λ is the penalty term (or tuning parameter), regulating the overall penalty.

The next step is to define the penalty term (λ). It is chosen by 15-fold cross validation. Hence, the data is split into 15 folds, 14 are used as a training set and one is used as a test set. After each run, the folds switch. Lambda is chosen such that it minimizes the

Gini-Index. The lasso procedure is run using the statistical software R, with the package "glmnet" (Friedman et al., 2009).

3.4.2 Random Forests

Classification and regression trees (CART) were introduced by Breiman et al. (1984). Classification trees belong to supervised machine learning techniques and consist of a sequence of binary decisions. The predictor space with the independent variables is divided into several distinct and nonoverlapping regions. At every node a decision is made, with the goal to separate a homogeneous group of outcomes. The most common outcome of observations in the same subregion is decisive to establish a classification for a given observation. These clusters are based on a set of splitting rules and can be displayed in a tree with nodes and leaves (terminal nodes). However, trees are generally easy to interpret but do not have the same level of predictive accuracy as other classification approaches. By aggregating many trees, e.g. through random forests, the predictive power can be improved (James et al., 2013).

In random forests, numerous trees are constructed through bootstrapping with replacement. Instead of taking all available predictors, only a subset of the predictor variables is chosen to predict the outcome at a specific split. As is the case in this research, there is a strong predictor, i.e. daily cash benefits. Under normal circumstances, that predictor will be the top split. Accordingly, the trees would all look similar. Random forests overcome this problem by forcing each split to pick a subset of the predictor variables and also by averaging over many trees. Hence, a large number of trees won't entail that strong predictor. Consequently, the trees are decorrelated and will show a lower variance. Random forests solve the issue of overfitting (Breiman, 2001). The procedures are run with the package "rpart" (Therneau and Atkinson, 1997) in R. The number of trees is restricted to 500.

3.4.3 Ensemble Method

With the advance of computational power, the afore mentioned approaches have become widely used. Furthermore, combinations of different approaches have become possible. The ensemble learner helps to increase the classification accuracy compared to single machine learning techniques by weighting predictions of several techniques. In this study, we will combine lasso logit, random forests, bagged classification trees, boosting, and neural networks. Estimation occurs through weighted averages of these approaches.

As is the case with random forests, both bagged trees and boosting belong to the family of tree methods. The trees for bagging (bootstrap aggregation) and boosting are constructed through bootstrapping. These new data sets are then split into different subsamples with prediction values. Unlike random forests, bagged trees use the whole set of variables to construct the trees and obtain predictions for disability pensions. Next, all predictions are averaged in order to get the final prediction. In boosting, a sequence of trees is grown by using the residuals of the first tree as outcome to build the successive tree. Neural nets fit a multilayer nonlinear model for predicting the outcome. As all these machine learning algorithms are nonparametric, no higher order or interaction terms are required.

The optimal weights of the above-mentioned algorithms are determined by cross-validation in the training sample. The ensemble method is executed by the "Super-Learner" (van der Laan et al., 2007) package in R.

3.5 Empirical Results

The previously described procedures are run with multiple samples, each containing a different share of disability pensions. The procedures, starting with the generation of the samples were repeated 50 times. Due to limited computation capacity, the procedures with the 1-percent-sample were repeated 10 times. The variables indicating costs are a cumulation of the first 12 months after the date of the accident. Hence, the algorithms predict the outcome of the accident after one year.

From the perspective of the insurance agency, incorrect classifications are not desirable. A feasible approach to reduce incorrect classifications is to move the probability threshold for a disability pension away from 0.5 towards 0.9. However, this approach decreases the likelihood of detecting disability pensions. Hence, there is a trade-off between the correct classification of "no DP" and disability pensions. In addition, because disability pensions are very scarce, we train and test the model in data sets with different shares of disability pensions. We create multiple data sets containing 90, 75, 50, 20, 10, and 1 percent disability pensions and test them in the corresponding test sample and in the random sample. The idea is to find an optimal value for the balance in the training sample and the probability that correctly classifies the cases.

Table 3.4: Performance of the algorithms

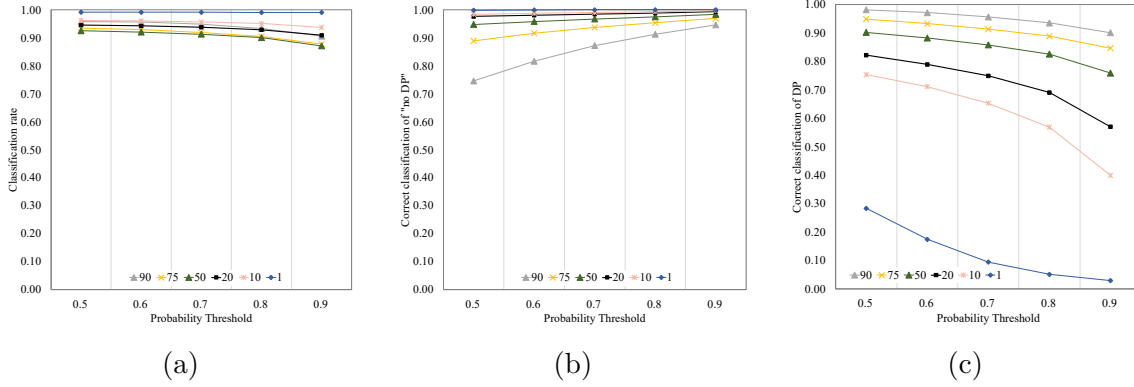
Share of DP in sample	Sample type	Algorithm	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
90	Test sample	Lasso Logit	95.80%	74.56%	98.14%
		Random Forest	96.70%	76.35%	98.96%
		Ensemble Learner	96.80%	78.58%	98.81%
	Random Sample	Lasso Logit	78.17%	78.12%	84.19%
		Random Forest	76.29%	76.10%	98.77%
		Ensemble Learner	78.65%	78.48%	98.90%
50	Test sample	Lasso Logit	92.48%	94.77%	90.18%
		Random Forest	93.60%	93.46%	93.73%
		Ensemble Learner	93.63%	93.56%	93.71%
	Random Sample	Lasso Logit	95.08%	95.19%	82.79%
		Random Forest	93.23%	93.23%	93.92%
		Ensemble Learner	93.57%	93.57%	93.78%
20	Test sample	Lasso Logit	94.51%	97.60%	82.16%
		Random Forest	94.98%	97.34%	85.58%
		Ensemble Learner	95.01%	97.12%	86.46%
	Random Sample	Lasso Logit	97.52%	97.68%	78.98%
		Random Forest	96.90%	96.98%	87.20%
		Ensemble Learner	97.15%	97.23%	87.37%
1	Test sample	Lasso Logit	99.12%	99.83%	28.35%
		Random Forest	99.11%	99.89%	21.75%
		Ensemble Learner	99.15%	99.85%	30.24%
	Random Sample	Lasso Logit	99.25%	99.83%	27.84%
		Random Forest	99.26%	99.90%	24.08%
		Ensemble Learner	99.27%	99.85%	28.91%

Notes: This table displays the results for the sample with 90, 50, 20 and 1 percent DP. The trained models are also tested on a random sample with the original share of DP, referred to as Random Sample. Threshold for classification of DP is at a probability of 0.5.

In Table 3.4, we show the classification rates of the machine learning algorithms for the samples containing 90, 50, 20 and 1 percent disability pensions. The decision threshold for a disability pension is at a probability of 50 percent. In addition to the test sample with a given share of disability pensions, a random sample containing the real share of disability pensions was drawn at the very beginning of each repetition, as described in Section 3.3.2. The models were also tested on the random sample. It is indicated that samples with higher shares of disability pensions have higher classification rates for the disability pensions. However, this does not apply for the classification of accidents that do not become disability pensions. This can be observed for all three algorithms. The overall correct classification of the cases increases with a decreasing share of disability pensions. Our goal is to have a high classification rate of disability pensions. In the samples with 90 percent DP, these values are above 98 percent for all three algorithms. In the sample with 50 percent DP, the classification rates for DP remain still above 90 percent. When looking at the other end of the table, namely the samples with 1 percent DP, the accuracy lies between 21.75 and 30.24 percent. The ensemble learner and random forests always outperform lasso in the samples with 90 and 50 percent DP. For the samples with 20 and 1 percent DP, the ensemble learner and lasso outperform random forests. With regard to the overall accuracy of the test samples, the ensemble learner always outperforms the other two algorithms.

Figure 3.4 shows the development of the classification rate over different training sets with different probability thresholds for lasso. The different graphs show results for different sample balances in the training sample sets as described in Table 3.4. For the overall classification rate (Plot 3.4a), the training set with a share of 90 percent disability pensions shows the best results. For the correct classification of accidents that do not result in disability pensions (will be named as "no DP"), it is the opposite (Plot 3.4b). There is a tradeoff between correctly predicting "no DP" and the accidents resulting in DP. The overall classification accuracy remains high for most of the combinations (Plot 3.4c). The overall classification rate is the highest in the training sample with 1 percent. This sample, however, is characterized by a relatively low classification rate of disability

Figure 3.4: Empirical Results



Notes: (a) shows the overall classification rate; (b) shows the correct classification of "no DP"; (c) shows the correct classification of DP. Development of error and classification rate over different training sets with different probability thresholds. Multiple training samples with a diversity of shares of disability pensions were used to train the model. Training samples with a share of 90, 75, 50, 20, 10, and 1 percent disability pensions are displayed.

pensions. The sample containing 90 percent disability pensions shows the highest values for a correct classification of DP. This rate drops when increasing the threshold for classification towards 0.9. Predictions of disability pensions with a high share of disability pensions in the training sample are more accurate than those with low shares of DP. If the classification threshold is at 0.5 the difference is about 55 percentage points between the sample with the highest and the lowest share of DP. With a classification threshold of 0.9 the gap is around 80 percentage points. Hence, a higher probability threshold does not improve the classification of disability pensions. It increases the overall classification rate. These findings are confirmed when considering the prediction accuracy of the random sample. The results of all samples and with different thresholds can be found in Appendices B2, B3 and B4. From the three methods that are applied in the present study, random forest and the ensemble learner bring forward the highest accuracy. However, the ensemble learner has a massively higher computational time. Consequently, an approach by random forest is preferred. With the goal being to accurately predict disability pensions, the most promising results are in the sample with a share of 20 percent disability pensions. An overall high accuracy and rather high prediction rate for DP are favorable. This way, the major part of the disability pensions is recognized at an early stage.

In Table 3.5 the most important variables from the random forest procedure are presented with an indication for the mean decrease in the Gini index. The most important predictors are the cost-related variables. Age, insured salary and firm size are important as well. Factors related to the injury quickly decrease in importance.

Table 3.5: Important variables (Random Forest)

Variable	Mean decrease in Gini index
Daily cash benefits in days (12 months)	3340
Daily cash benefits (12 months)	2822
Treatment costs (12 months)	1964
Age	456
Insured Salary	316
Number of employees in firm	250
Tenure	186
Injured body part: Shoulder	116
Non-work-related accident	81
Injury type: Break	69
Injured body part: Finger	52
NOGA: Construction	49
Injured body part: Knee	43

As a robustness check, the procedures are executed with cumulated costs for 6 and 24 months instead of 12 months. Accordingly, after 6 or 24 months, the cases can be predicted with different observation periods. The findings do not strongly deviate from the findings for 12 months. As expected, the prediction rate after 6 months is lower than that of 12 months. The classification rate increases when cumulating the costs for 24 months. The results are presented in the Appendices B2, B3 and B4.

3.6 Conclusion

Can an accident be predicted in such a way that we know that it's going turn out to be a disability pension? This question is evaluated in the present work by using machine learning techniques. A disability in the context of this paper is an earnings incapacity resulting out of an occupational or non-occupational accident. By taking a data set from the Swiss accident insurance fund, Suva, we apply multiple machine learning algorithms to predict the outcome of an accident after one year. The algorithms include lasso logit,

random forests and an ensemble learner (with lasso, bagging, boosting, random forests, neural networks). Measurement of the out-of-sample performance occurs in two ways. In a usual machine learning setting, the data set is split into two parts: training sample, with which the model is trained, and the test sample, on which the trained predictor is tested. Because the share of disability pensions is relatively low, an additional aspect is considered in our study. The algorithms are trained in multiple samples that contain different shares of disability pensions, namely 1, 10, 20, 50, 75 and 90 percent. Training occurs in the corresponding samples and is tested on the complementary test samples. Also, the models are tested on a randomly drawn sample with 200'000 observations with the true share of disability pensions. The results display an overall correct classification rate of above 90 percent for the samples containing 50, 75, and 90 percent of disability pensions. Likewise, the share of correct classifications of disability pensions is also above 90% for these samples. For the samples with a share of 20, 10, and 1 percent disability pensions, the overall classification rate is even higher, namely 95% and above. But these results are driven by the correct classification of accidents not leading to disability pensions. In the mentioned samples, the correct classification of disability pensions drops. For the 1-percent sample only around 30% of the disability pensions are correctly classified. The three algorithms performed similarly well, with random forest and the ensemble learner marginally outperforming lasso. The most promising approach seems to be the one with the sample that contains 20 percent disability pensions. The overall accuracy is high and the accuracy for disability pensions is still on a high level. These prediction rates point to a good tradeoff between the two groups.

The data that is available for this study is basic insurance data. Costs, information on the injured person and the firm are already good predictors for a basic prediction with a good quality. Further factors such as the objects that were involved in the accident as well as the description of the accident, which is required for all accidents that are reported to the insurance companies, can be integrated additionally. Furthermore, disability pensions are not the sole insurance benefit paid out after an accident. Prediction can be extended to benefits for medical care and reimbursement of expenses and daily cash benefits. Besides,

it can be applied to integrity allowance and helplessness allowance. The description of the accident could be analyzed by using a text analytics approach (Gentzkow et al., 2019). Moreover, the actual amount of the loss of earnings incapacity as well as the capital value of the disability pension could potentially be estimated in future projects.

Chapter 4

Impact of Winter Inactivity on the Recovery Duration of Temporary Construction Workers

4.1 Introduction

Hiring workers through temporary contracts comes with many advantages for employers. On the one hand, temporary contracts allow an instantaneous replacement of absent workers. On the other hand, productive peaks can be faced without the obligations that come with a permanent contract. Among construction firms, temporary workers are mostly hired during the highly productive periods. Temporary workers can be laid off rapidly, compared to workers with permanent contracts. But: Because an assignment can be of brief, these workers find themselves in situations with high job insecurity. Especially when assignment opportunities are missing, temporary workers are in a bad place financially. For workers that face an accident right before winter inactivity, accident insurance benefits might serve as a wage replacement when it is unlikely to find a new assignment after recovery.

The research question that is addressed in this study is: How does the upcoming "winter inactivity" in construction change the recovery time of temporary workers after an accident? The question is related to the likely case, that temporary workers need to find alternative ways of wage replacement when chances for obtaining new assignments are low. Given the rising share of temporary workers in Switzerland, this issue deserves increased attention. With some exceptions (e.g. Engellandt and Riphahn, 2005), there is a lack of research in the area of temporary workers for Switzerland.¹

Construction is one of the driving forces of the Swiss economy and makes up about 6.1% of the GDP. As a result, the sector receives much attention in the public. Within one year's cycle, construction activity starts in spring and continues until the beginning of winter. During the winter months, the activity level in construction decreases. Its course is best displayed in numbers of unemployed persons in the construction sector, as indicated in Figure 4.1. The present study exploits this cycle to examine the absence-behavior of temporary workers in construction who have accidents right before winter starts.

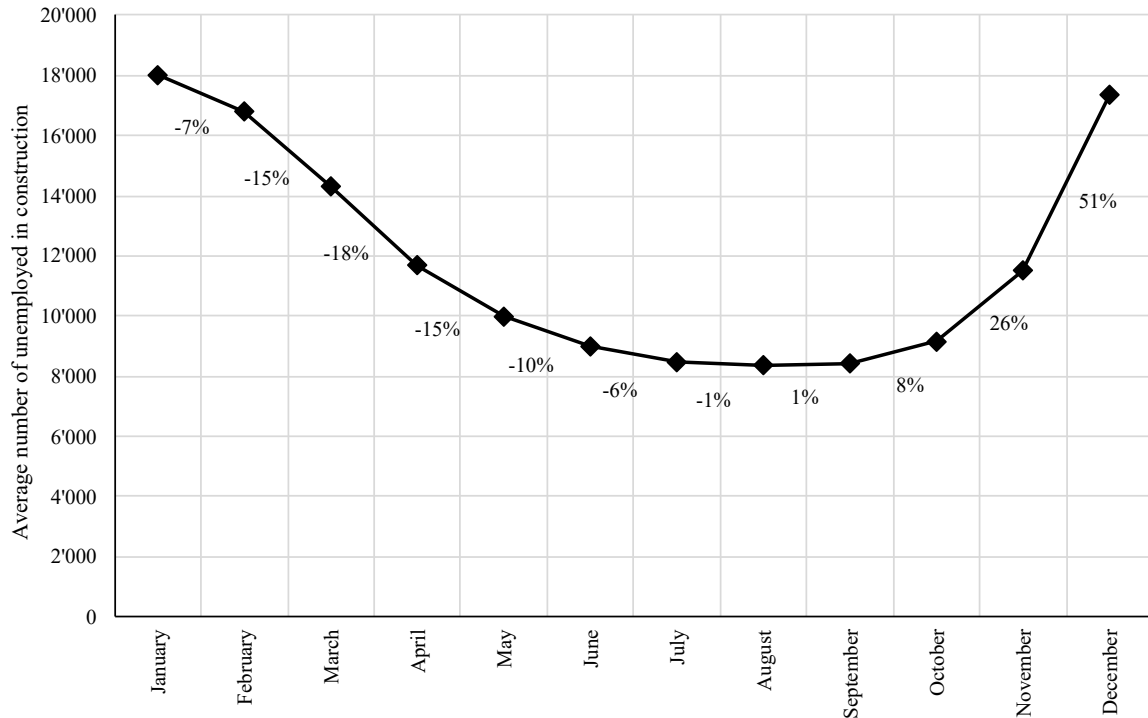
¹Although associations tied to temporary work provide statistical insight into temporary work in Switzerland.

Employees and employers use social insurance institutions to overcome unproductive periods. If workers cannot remain employed, they are likely to apply for unemployment benefits. Typically, workers with permanent contracts tend to have more complete contribution periods for unemployment insurance. They are rather eligible for full unemployment benefits. Temporary workers are even more exposed to seasonal fluctuations and might therefore apply for unemployment benefits too. Due to the character of temporary contracts, contribution periods turn out to be rather patchy. Hence, unemployment benefits do not apply in full. Apart from unemployment insurance, alternative forms of temporary wage replacement must be taken into consideration. For example, in the case of an accident, daily cash benefits amount to 80 percent of the salary until the worker has recovered.

In Switzerland, the share of temporary contracts has increased over the past decade. Both, employers and employees have various reasons for this type of contract. Firstly, employers may find it easier and more profitable to hire temporary staff. Leasing labor force reduces the incentive to think about social insurance and they are not on the payroll when orders drop. Secondly, for employees it is possible to find work and an income quickly and aspire a permanent employment.

There are two types of measures for accidents: The accident incidence rate and accident severity. In periods of high job insecurity, workers tend to underreport minor injuries, when it is possible to continue work (see e.g. Boone et al., 2011; Boone and van Ours, 2006; Leigh, 1985). The intuition behind it is that underreporting is caused by the concern of a loss of the current assignment. Accordingly, temporary workers almost permanently experience situations of job insecurity. Hence, minor injuries are rather not reported by temporary workers (see Palali and van Ours, 2017; Probst et al., 2013; Garcia-Serrano et al., 2010). Accident severity is captured by the extent of work absence after an accident which also depicts the recovery time. Previous findings on recovery time go both-ways. Using Spanish data, Garcia-Serrano et al. (2010) find that, after controlling for personal and job characteristics, temporary agency workers suffer less severe accidents than permanent contract workers. In a recent study with Italian data, Picchio

Figure 4.1: Average number of unemployed in the construction sector



Notes: The averages span the years from 2015 to 2018.

and van Ours (2017) show that temporary workers in general have more severe accidents. However, they cannot test the driving forces behind these results.

The present study extends previous work in two ways. First, it is placed in a specific setting, where the prevailing incentives push the behavior of temporary workers towards extending the absence spell and receiving daily cash benefits as a temporary wage replacement. Secondly, the data used in this study are provided by the Swiss accident insurance fund, Suva. The data set contains all accidents that occurred to construction workers with permanent and temporary contracts and has not been used before. It covers information on the accident, personal characteristics of the injured and on the employer. We apply a semiparametric difference-in-differences strategy by using permanent contract workers as the control group and the months before winter inactivity as the pre-treatment period. The workers of both contract types share the same seasonality and are likely to be working on the same construction sites. The findings suggest that in the beginning of winter inactivity, accident related absences are on average three days longer among temporary workers. As there might be underreporting (e.g. a bruised thumb might not

be reported by the temporary worker), we run robustness checks that control for accident severity, namely the costs for medical treatment. The effect slightly drops to a recovery time that is two days longer but still remains significant at the 10 percent level. In a further robustness check, observations without daily cash benefits are dropped. We find that the effect increases to five days and is significant at the 5 percent level.

The remainder of the paper is organized as follows. Section 4.2 discusses the relevant literature. Section 4.3 introduces the institutional background. The data is illustrated in Section 4.4. Section 4.5 covers the identification strategy, and the results are displayed in Section 4.6. Section 4.7 concludes the paper and discusses the findings.

4.2 Review of the relevant literature

The present study focuses on the incentive effects of absence spells in accident insurance during periods of high job insecurity. Therefore, a thorough understanding of the mechanisms surrounding medical absence leaves of workers are crucial. In this section we discuss previous research and the relationship between medical absence leaves and economic circumstances.

Leigh (1985) finds that sickness absence and business cycles have a negative correlation. There are three different concepts explaining these findings. The first concept argues with labor force composition effects. It focuses on the marginal worker who is more likely to be sick. Therefore, s/he will be unemployed more often, especially in recessions. During booms, chances of employment are high. But because the worker is sick more often, absence duration increases in that period. In addition, the marginal worker is hired in booms and has less time to gather work experience.

A second approach assumes moral hazard on the employee's side. This line of research focuses on the incentives and the utility of the worker. During recessions, the perceived risk of losing a job increases. The worker is afraid to report an accident because s/he could become unemployed. Hence, underreporting can potentially be observed. Previous findings confirm the presence of this mechanism, depending on certain circumstances, such

as the legal framework. With Swedish data, Johansson and Palme (1996) find that the unemployment rate has a significant negative impact on the absence duration of a worker. However, they separate the analysis for male and female workers and only find effects for the former. Boone and van Ours (2006) conduct their study with annual aggregate data from 16 OECD countries and find that the cyclical fluctuations in workplace accident rates are connected to the reporting behavior of workers. In another study, Boone et al. (2011) support this explanation with Austrian data on a micro level for minor accidents. Davies et al. (2009) come to the same conclusion for the UK.² Hesselius (2007) finds that workers with many sickness days are employed less quickly, which backs the potential concerns of workers.

The third concept is related to the employer incentives. During recessions, employers have an incentive to leave their employees at home and replace wage payments with other types of funding (Audas and Goddard, 2001), such as benefits from social insurances. While the former two approaches focus on procyclical behavior, the latter is based on countercyclical behavior.³

Low perceived job security is negatively related to the mental and physical wellbeing of an individual.⁴ By using an instrumental variable approach, Caroli and Godard (2016) find that job insecurity is a factor that actually causes poor health. Pirani and Salvini (2015) have a stronger focus on temporary workers and report that temporary employment is a driving factor of poor health. However, this topic has also been researched with an emphasis on incentives and moral hazard. When perceiving insecure signals, workers might alter their behavior. Underreporting minor accidents in situations of job insecurity is found to be a common behavioral pattern (see e.g. Probst et al., 2013; Blekesaune, 2012; Khan and Rehnberg, 2009). Hence, if a worker hurts his/her finger and is still able to work, s/he might not report it, because of fear of job loss. More specifically, temporary work contracts are a source of job insecurity. During booms, firms hire more temporary

²In Shapiro and Stiglitz, 1984, this is referred to as the "worker disciplining effect".

³For empirical research attempting to untangle these effects see also Markussen et al., 2011; Fahr and Frick, 2007; Askildsen et al., 2005; Thalmaier, 1999.

⁴For further research see e.g. Ferrie, 2001; Bohle et al., 2001; Murphy and Athanasou, 1999; Pearlin, 1989.

workers and during recessions, they are the first ones to be laid off.

Our study focuses on absence spells as a result of an accident. The effect of temporary jobs on accident severity or accident probability has been studied in previous research papers. Guadelupe (2003) finds that temporary workers have a higher accident probability than workers with permanent contracts in Spain. She excludes a compositional effect. By using a difference-in-differences approach, Palali and van Ours (2017) show that temporary workers are less likely to report an accident, compared to workers with a permanent contract. They find also country-specific effects for Italy and Spain. However, when job characteristics (Hernanz and Toharia, 2006) or working conditions (Amuedo-Dorantes, 2002) are controlled for, these effects seem to vanish.

Accident probability can simply be influenced by the worker, at least for minor incidents. S/he can choose whether or not to report a minor accident, such as a thumb Contusion. Therefore, previous studies have focused on accident severity. Garcia-Serrano et al. (2010) work with Spanish data on work-related accidents. By applying logistic regressions and a data count model, they study the probability of severe and fatal accidents as well as the number of lost working days. The data allows them to distinguish between three forms of contracts: Workers hired by agencies, temporary workers hired by firms and workers with permanent contracts. Their results suggest that workers hired by agencies have a lower accident probability and absence duration compared to the other two groups, when controlling for individual, job and accident characteristics.

Using a broad data set from Italy, Picchio and van Ours (2017) find that temporary workers have more severe accident than their peers. They apply a difference-in-difference analysis and use commuting accidents as control group on workplace accidents. Their case is based on the assumption that the differences in the severity of a workplace accident between temporary and permanent workers are caused by the distinct exposure to workplace hazards. Hence, they exploit commuting accidents to detect underreporting behavior of temporary workers, because commuting accidents usually do not point to differences in risk exposure. Their findings indicate that temporary workers, when confronted with an accident, face more severe accidents. One explanation might be the tenure: More experi-

enced workers are more likely to execute a given task by being more cautious. However, they are not able to actually test the underlying causes. In the present study, we are able to capture a specific setting, where the behavior and the relevant motives are prevalent.

4.3 Institutional background

This section will provide insight into accident insurance and temporary contracts in Switzerland. Further, potential benefit shifting mechanisms between unemployment insurance and accident insurance and the corresponding incentives are explained.

4.3.1 Accident insurance, unemployment insurance and benefit shifting mechanisms

Accident insurance is compulsory for all employed persons in Switzerland.⁵ It protects workers against the consequences of accidents and occupational illnesses. Employers have the obligation to insure their employees against the consequences of accidents for both, occupational and non-occupational accidents. The accident insurance market in Switzerland consists of approximately 30 insurance carriers. The Swiss accident insurance fund, Suva, has a partial monopoly on a defined set of industries employing blue collar workers and insures about half of the entire Swiss work force. The other carriers insure the remaining, white collar, workers and are in competition with each other.

Firms of certain industries cannot choose their insurance carrier when it comes to accident insurance.⁶ Two of these industries are construction and temporary staffing, which are subject to the present study. The insurance contract is standardized and covers the financial consequences of an injury, whether it happened on the job or not, workers are insured in both cases. Insurance coverage entails benefits for medical care, daily cash benefits and disability pensions. Daily cash benefits are a form of wage replacement. If the injured person is incapable of working, daily cash benefits will be paid out. The work

⁵There is also accident insurance of the unemployed, and an optional insurance for the self-employed. But these insurance branches are not subject of the present study.

⁶These industries are defined in the Swiss Accident Insurance Act. Original: Unfallversicherungsgesetz (UVG).

inability is confirmed by a medical certificate, which is handed out by a physician. The injured person is entitled to 80% of the insured salary. Payments of daily cash benefits begin on the third day after the occurrence of the accident. They are paid out until the injured person has fully recovered, a disability pension is paid, or the insured person dies.

Unemployment insurance (UI) is an additional mandatory social insurance in Switzerland. To be eligible for benefits from unemployment insurance, workers need to have contributed at least 12 months within the last two years before making UI claims. Contributions are directly deducted from a worker's salary. The maximum duration of unemployment benefits is two years.⁷ Benefits are paid out after a waiting period of five days. The waiting period for temporary workers is one day. The replacement rate is 80 percent of the insured salary. Under certain circumstances a replacement rate of 70 percent might apply.⁸ The Swiss UI also knows a bad weather allowance.⁹ It provides protection for industries that depend on stable weather conditions, e.g. construction, forestry and some others. Bad weather allowance does not require prior contributions. The maximum benefit period is six months over two years. This part of unemployment insurance is rarely used, because there are only 400 employees affected by that. However, employees hired by staff hiring agencies are not covered by bad weather allowance.

Because daily cash benefits are paid out until the recovery of the injured person, a moral hazard problem arises. Winter inactivity forces employers to lay off their staff and the temporary workers. While workers with permanent contracts remain employed, temporary workers will end up without work. Because eligibility for UI benefits is not always given, temporary workers are incentivized to influence accident reporting and the duration of the sickness spell. As indicated in Section 4.2 section, absence duration after an accident is not necessarily linked to accident severity. There are several reasons why temporary workers are not eligible for unemployment insurance. A temporary work assignment can range from a couple of weeks to a couple of years. In most cases, one

⁷Some exceptions apply for self-employed workers, workers close to retirement age, and workers who are raising children, and prior students.

⁸This is the case for workers that do not have to care for children under the age of 25, and those, who receive more than 140 Swiss Francs in daily unemployment benefits

⁹Original: Schlechtwetterentschädigung

single commitment lasts less than a year. Therefore, temporary workers might not be able to contribute enough to receive full unemployment benefits. Furthermore, accident insurance benefits are paid out for a much longer period than the maximum of two years in unemployment insurance. Another important factor could be that psychologically, it "feels" better to receive benefits from the accident insurance than to receive unemployment benefits and might be socially more acceptable.

4.3.2 Temporary vs. permanent contracts

Temporary contracts can come in different forms. Firms can hire workers for a limited amount of time directly. Another form is when the temporary workers is hired by a recruitment agency. In this case, there are three parties involved: the worker, the firm, which is seeking labour force, and the recruitment agency. Hereby, it is the recruitment agency who is the employer and leases the workforce to firms. In Switzerland, there is a collective bargaining agreement which establishes certain ground rules, such as a minimum wage, social security benefits and vocational training. Every single assignment contains a starting and an end date. For a temporary worker, it is possible to get a permanent contract after the temporary assignment. But the temporary contract can be extended over many years without limitations. Also, the rules for notice periods are written down in the collective bargaining agreement. For assignments of 1 to 3 months, it is 2 days, assignments of 4 to 6 months, 8 days; for 7 or more months it is one exact month. In contrast, the Swiss Code of obligations¹⁰, foresees a standard notice period of one month in the first year of employment. The income of temporary workers depends on the workload. But workload is not guaranteed. Hence, temporary workers do not have the same workplace protection compared to workers with permanent contracts. In terms of effort, Engellandt and Riphahn (2005) indicate that in Switzerland, temporary workers show higher effort than workers with a permanent contract. The authors argue that temporary workers want to position themselves as good workers, which increases chances to get a permanent contract.

¹⁰Original: Obligationenrecht (OR).

4.3.3 Construction sector in Switzerland

The activity level in construction is closely linked to the seasons. The main activity starts in spring and goes on until the end of autumn. Due to natural limitations, such as snow, winter is the period with the lowest construction activity. In times of lower activity, workers might stay home and reduce the overtime that was accumulated during the peak season. Alternatively, firms might send their employees off to unemployment insurance and rehire them after the winter months. For workers with a complete contribution period, this approach works, and the wage replacement is on the highest level.

There are many reasons why construction companies hire temporary staff from recruitment agencies. They can overcome order peaks and the contractual flexibility makes it possible to lay off labor force without financial consequences. The salary of the temporary worker is paid by the recruitment agency, along with all social security costs. Hence, the construction company solely pays a fixed hourly rate. Within a few days' notice, the temporary contract worker can be laid off. When construction activity is high, it will be probable to find a new assignment for the worker. However, during periods of low construction activity, it will be much harder.

If the workload of a given company is limited, workers with a permanent contract will still receive their salary for some time. Moreover, they might take some training during periods of lower activity or compensate for overtime that was accumulated during the high season. Permanent contract workers have an overall better job protection because of a higher notice period. Because the work relationship is generally more stable, also the contribution period for unemployment benefits is rather unproblematic. Entitlement to unemployment benefits in Switzerland depends mainly on the contribution period. To receive unemployment benefits, a contribution time of twelve months within the last two years is required. Furthermore, the earnings replacement rate in the unemployment insurance is only in some cases equal to the one from accident insurance, otherwise it is 70%. Unemployment benefits will amount to 80% if the insured has child maintenance obligations, if the insured salary does not exceed 3'797 Swiss Francs. Given the nature of the contract, temporary workers are more likely to change between unemployment and

temporary employment. Thus, when winter inactivity approaches, the workload depends on the construction site and the amount of permanent contract workers that are already working there.

4.4 Data

To answer the research question, this study uses data from Suva. This unique data set covers all accidents in the corresponding industries. Hence, the full set of accidents is available for the two industries that are in the center of this study. The data covers occupational accidents as well as non-occupational accidents and span the years 2015 to 2018.

When an injury happens, the worker informs the firm s/he is working for. Thereafter, the firm reports the accident to the insurance company. Accidents with a recovery time of up to two days are considered as minor injuries, because daily cash benefits do not apply. Accidents with a recovery time exceeding two days are eligible for daily cash benefits. The estimated recovery period needs to be confirmed by a physician. Workers have an incentive to report an accident, because there is no deductible for the treatment of accidents. This is in contrast to the health insurance, where deductibles apply.

Every accident is registered with a set of information on the accident itself, the injured person and the firm. Accident information contains date, time and place of the accident, costs for medical treatment, daily cash benefit payments, injured body part, injury type, and insurance branch (occupational or non-occupational). Moreover, individual characteristics of the injured persons include age and gender.

The data allows us to distinguish between accidents of permanent workers in construction and workers leased by a recruiting agency who are active in construction. The data does not identify temporary workers who were directly hired by the construction firm. There are 106'047 accidents from workers with permanent contracts and 82'144 accidents of temporary workers. However, there is no information on persons that did not have an accident.

Table 4.1 reports descriptive statistics for the relevant covariates organized by contract type. The duration of the absence spells is expressed by the variable "Daily cash benefits in days", which is the outcome variable. Temporary workers have on average longer absence spells than permanent workers. This is the aspect where the worker presumably has the strongest lever on the recovery process. Treatment costs are an indicator for accident severity. However, they can be hardly influenced by the injured persons. The only possibility to do so is to organize additional doctor's appointments. That's why the variable displays the cumulated costs of the first three months after the accident. The two groups do not show substantial differences in treatment costs. Injured body parts and injury types are comparable among the two groups. The body parts with the most injuries in construction are fingers, eye, ankle and knees. Whereas bruises, cuts, sprains, breakages represent the most common types of injuries. Because occupational risk in construction is high, there are more occupational than non-occupational accidents. Temporary workers usually have the position of employee. The share workers residing outside of Switzerland is much higher for temporary workers. Furthermore, the geographical distribution of the contracts is different for the two groups. Summary statistics of all variables can be found in Appendix C1.

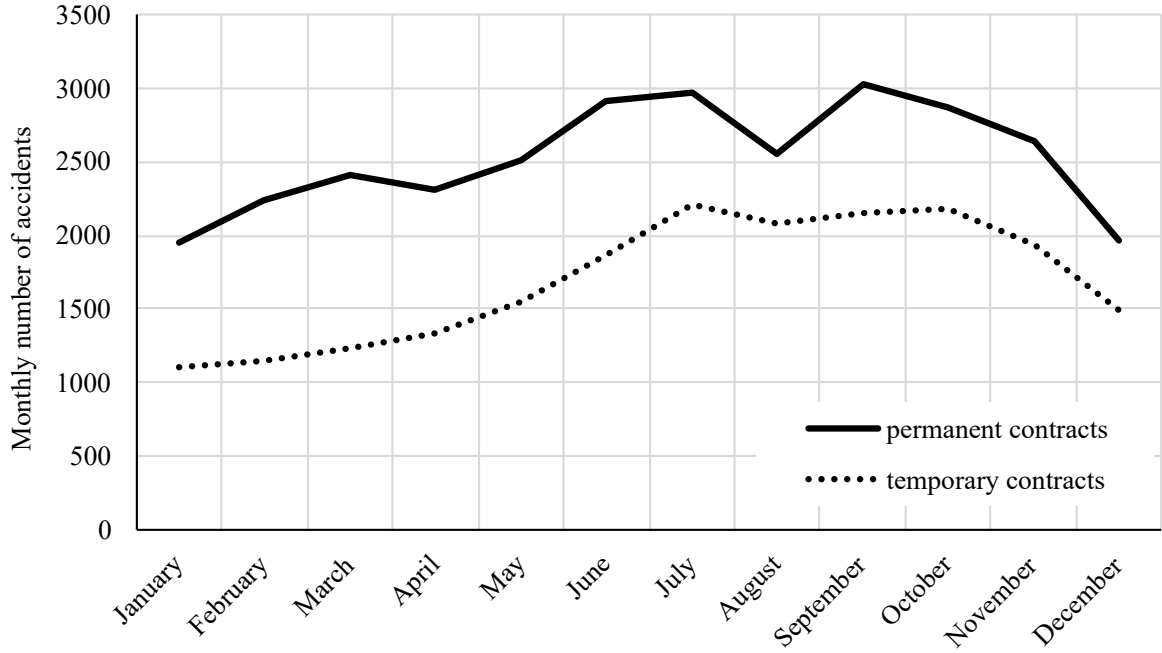
In the years 2015 to 2018, there have been 188'191 reported accidents of temporary agency workers and permanent workers in construction. Daily cash benefits represent the number of days paid out by the insurance within the first twelve months after the accident. The average number of monthly accidents is displayed in Figure 4.2. During the summer vacation, the number of accidents declines. Not because the risk in the construction industry decreases, but because workers go on vacation. Also, the absolute number of accidents are an indicator for the activity level in a given industry.

Table 4.1: Descriptive statistics for accidents of permanent and temporary workers

Variables	Permanent contract	Temporary contract
Daily cash benefits in days (12 months)	24	30
Treatment costs (3 months)	592	579
Age	39	35
Tenure	6.81	0.65
Injured body part: Skull	0.03	0.03
Injured body part: Eye	0.12	0.10
Injured body part: Back	0.05	0.05
Injured body part: Chest	0.04	0.03
Injured body part: Shoulder	0.06	0.05
Injured body part: Wrist	0.04	0.06
Injured body part: Metacarpus	0.04	0.05
Injured body part: Finger	0.15	0.15
Injured body part: Knee	0.09	0.09
Injured body part: Lower leg	0.05	0.03
Injured body part: Ankle	0.09	0.10
Injured body part: Middle foot	0.04	0.04
Injury type: Fracture	0.09	0.08
Injury type: Inflammation	0.03	0.04
Injury type: Contusion	0.18	0.19
Injury type: Bruise	0.07	0.06
Injury type: Crack	0.06	0.05
Injury type: Cut	0.12	0.13
Injury type: Sprain/twist	0.09	0.08
Injury type: Strain	0.04	0.03
Work-related accident	0.64	0.63
Occupational position: Higher cadre	0.04	0.00
Occupational position: Middle cadre	0.05	0.00
Occupational position: Employee / worker	0.84	0.98
Occupational position: Apprentice	0.05	0.00
Resident Country: Switzerland	0.93	0.85
Resident Country: Germany	0.01	0.02
Resident Country: France	0.02	0.09
Resident Country: Italy	0.04	0.03
Canton: Zürich	0.15	0.17
Canton: Bern	0.12	0.07
Canton: Luzern	0.06	0.03
Canton: Fribourg	0.04	0.03
Canton: Solothurn	0.02	0.03
Canton: Basel-Stadt	0.01	0.07
Canton: St. Gallen	0.06	0.07
Canton: Graubünden	0.05	0.01
Canton: Aargau	0.08	0.06
Canton: Thurgau	0.03	0.02
Canton: Tessin	0.07	0.03
Canton: Waadt	0.08	0.16
Canton: Wallis	0.06	0.02
Canton: Neuenburg	0.01	0.04
Canton: Genf	0.03	0.11
Observations	106'047	82'144

Notes: Descriptive statistics showing means of the selected variables accross the two groups.

Figure 4.2: Average number of accidents per month



Notes: Averages span the years from 2015 to 2018. The graphic shows values for construction workers with permanent contracts and construction workers with temporary contracts.

4.5 Identification

This section looks at the identification strategy for the underlying research question. Do temporary workers have longer lasting absence spells for accidents, right before winter inactivity? The outcome variable of interest is the number of days of daily cash benefits that were paid out by the insurance company. Causal inference about the effect of temporary contracts requires estimating how long these workers would be absent if they had not had temporary contracts. To illustrate the approach of the present study, the potential-outcome notation is used (Imbens and Woolridge, 2009). Accordingly, D denotes the binary indicator of treatment status (temporary versus permanent contract), $d \in \{0,1\}$. $d = 1$ in case of a temporary contract, $d = 0$ for permanent contracts. The periods, t , are equivalent to the months of a calendar year. The outcome variable Y_t^d is the potential number of absence days for a value d in period t . Y_t is the amount of daily cash benefits in days in period t . As we want to know whether temporary workers have

longer absence spells during winter activity, we are interested in the average treatment effect on the treated (ATET), which are the temporary workers, in period t :

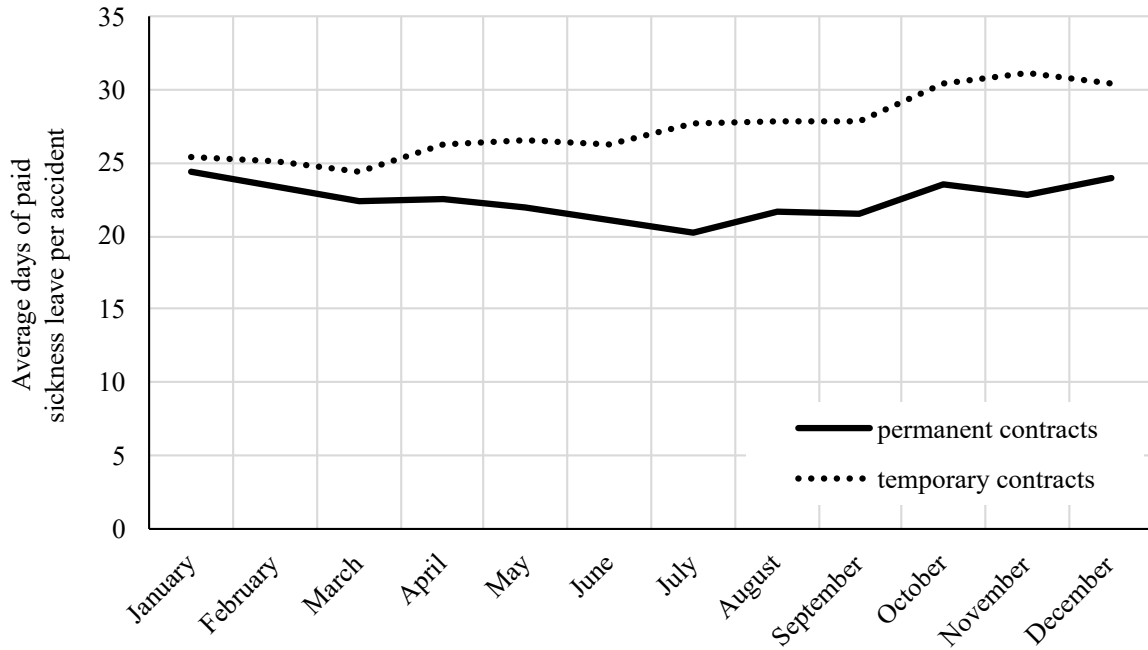
$$ATE_t = E(Y_t^1 - Y_t^0 | D = 1) \quad (4.1)$$

The potential outcome framework indicates the key factor of causal inference problems. Namely, it states what would have happened to temporary workers during winter inactivity, if they had permanent contracts. This is also known as counterfactual outcome, which is not observed. For this reason, it is necessary to include a control group. The closest observable population to temporary workers in construction are construction workers with permanent contracts. Both groups work in the same sector and often even on the same construction sites, sharing the same seasonality. They are an ideal control group for a quasi-experimental design. Suitable strategies and credible assumptions are required to identify a treatment effect. Given the present setting and the available data, a difference-in-differences (DiD) approach is reasonable.

Lechner (2011) discusses the DiD strategy and several developments that are relevant for its application. In a DiD approach, the key identifying assumption is the so-called common trend assumption. The intuition behind it is that both, control and treatment groups, have parallel time trends in the mean potential outcome under non-treatment. The pre-treatment period is used to test for the parallel trend. For the present study it means that the daily benefit payments for accidents of temporary workers and those of permanent workers share the same trends during the months prior to winter inactivity. However, they don't need to be on equal levels. The plausibility for the common trend assumption cannot be tested formally. Therefore, a visual inspection of the parallel trend is the first measure to take. Figure 4.3 shows the average duration of sickness spells for accidents of temporary and permanent workers. It is visible that the plain average of absence days is higher for workers with temporary contracts. Nevertheless, the two groups do not share parallel trends in terms of absence days.

A visual inspection does not indicate a parallel trend. The descriptive statistics in Table 4.1 show that the covariates are not equally distributed among the two groups. Es-

Figure 4.3: Average days of paid sickness leave per accident within a year's cycle



Notes: Averages span the years from 2015 to 2018. The graphic shows values for construction workers with permanent contracts and construction workers with temporary contracts.

pecially when it comes to characteristics, such as age, tenure, geographical differences and occupational position. The common trend assumption can be tested by including covariates, as Huber (2019) points out. Abadie (2005) proposes a semiparametric difference-in-differences estimator that addresses the imbalance of characteristics between control and treatment group by the inverse probability of treatment and allows the use of covariates. This approach, however assumes that the covariates maintain equal distributions within treatment states. The approach that we use in this study allows changes in the distribution of the covariates over time, given treatment. The identification result is indicated in Equation 4.2. It identifies the effect on the treated in the post-treatment period (Huber, 2019). To run the analysis, the procedure "didweight" of the "causalweight" package (Bodory and Huber, 2018) is used in the statistical software R. There is a binary treatment with one pre- and post-treatment period. It allows controlling for covariates of the two groups and is based on inverse probability weighting (IPW) by propensity scores for being observed in a specific treatment group and time period. Observations with too

extreme propensity scores will have a very large weight. To overcome this, a trimming rule is implemented in the used procedure. All the observations with a probability to be treated of above 0.95 will be discarded. Estimation is based on the sample analogue of the following expression for the population:

$$E \left[\left\{ \frac{D \cdot T}{\Pi} - \frac{D \cdot (1 - T) \cdot \rho_{1,1}(X)}{\rho_{1,0}(X) \cdot \Pi} - \left(\frac{(1 - D) \cdot T \cdot \rho_{1,1}(X)}{\rho_{0,1}(X) \cdot \Pi} - \frac{(1 - D) \cdot (1 - T) \cdot \rho_{1,1}(X)}{\rho_{0,0}(X) \cdot \Pi} \right) \right\} \cdot Y \right] \quad (4.2)$$

where D is the treatment status and takes the value 1 for temporary contracts and 0 otherwise. T is the period, where 1 represents the post-treatment period and 0 the pre-treatment period. Π stands for the probability of being treated in the post-treatment period. $\rho_{d,t}(X)$ indicates the probability of being in treated (d) in period t, given covariates X . The propensity scores for each observation are estimated by probit.

There is one issue with a potential selection problem. As shown in Section 4.2, under unfavorable economic conditions workers tend to underreport accidents because they fear to lose their job. This could lead to underreporting in the data set, e.g. in case of a bruised thumb, the worker might be tempted to not report the accident if winter inactivity is near. Whereas it is impossible in construction to go to work with a broken leg. This issue will be dealt with in Section 4.6. We will run robustness tests by adding treatment costs. Furthermore, we will exclude accidents without daily cash benefits.

This study uses the construction industry as an example for differences between temporary workers and permanent workers. It is a very unique setting, because both types of workers actually operate on the same construction sites and under comparable conditions. Both groups share equal seasonal trends. That's why the construction workers with permanent contracts are an the most credible control group for workers with temporary contracts in construction.

4.6 Results

4.6.1 Main results

The measure of interest is the amount of days a worker is absent from work because of an accident. Calendar months represent the periods of interest. The pre-treatment period is the month of October. Moving towards winter inactivity, temporary workers that are injured during November will recover from the accident and are likely to not find any work, because the construction sites are closed. Construction workers with permanent contracts are protected from not being laid off immediately after returning from a medical leave. In contrast to that, the temporary worker is not protected and might have to go into unemployment insurance. As temporary workers tend to have different work assignments with many gaps, chances are that they might not be entitled to UI benefits. Furthermore, UI benefits can be even less attractive than daily cash benefits from the accident insurance, as the former have a replacement rate of only 70% in many cases and the latter have a replacement rate of 80%. In sum, temporary construction workers tend to have stronger incentives to take advantage of a medical leave caused by an accident compared to permanent workers.

To test the plausibility of the common trend in mean potential outcomes under non-treatment in the post-treatment period, one may run placebo tests in the pre-treatment periods (Huber, 2019). If the results in these periods are not significant, it points to the plausibility of the common trend assumption. Periods that are linked to summer vacation, namely July and August are not considered. Many workers are on summer vacation and hence, are situated in a completely different environment than under normal circumstances. January and February are not used for effect estimation either, because these two months represent the transition from winter inactivity to the high productivity season in spring. With winter inactivity starting in November, accidents that happen during this period are the ones that have little or no hope of returning to work after the recovery. Hence, October serves as the last month before winter inactivity kicks in. Thus, October is the baseline period and November is the outcome period. Additionally,

to observe the development of the accidents, December is added to the estimation period.

Table 4.2 displays the main results. We start off with a baseline estimation without any covariates, which is shown in Column (1) of Table 4.2. As shown in Section 4.5, the assumptions for a baseline difference-in-difference estimation do not hold. The results of the semiparametric DiD estimation including covariates are exhibited in Column (2) of Table 4.2. In general, the size of the placebo effects is not that small, but hardly anything is significant. We do not find statistical evidence for the violation of the common trend assumption. The effect from March to April stands out as it is rather large compared to the other periods. A possible explanation could be that there is an inflow of new workers into the profession as construction activity is increasing. These workers are less experienced and don't know about the potential dangers on a construction site. Accidents of temporary workers in November exceed those of permanent workers by three days of absence spell. Hence, accidents that happen right before winter inactivity tend to have a longer recovery duration.

Table 4.2: Results of the DiD estimation

	Pre-treatment period	Treatment period	(1)	(2)
Placebo-test	February	March	-0.813	-0.847
	[12'126]	[13'084]	(1.539)	(1.567)
	March	April	3.004	2.246
	[13'084]	[13'211]	(1.562)*	(1.493)
	April	May	-1.304	-1.056
	[13'211]	[14'471]	(1.446)	(1.494)
	May	June	0.255	-0.037
	[14'471]	[17'953]	(1.351)	(1.340)
DiD Estimate	September	October	0.265	0.399
	[18'772]	[18'479]	(1.235)	(1.232)
	October	November	2.643	2.829
	[18'479]	[17'172]	(1.342)**	(1.326)**
	October	December	0.490	1.425
	[18'479]	[12'722]	(-1.404)	(-1.407)

*Notes: The standard errors are obtained by applying 1000 bootstrap repetitions. Standard errors are indicated in parenthesis. The number of observations for each period is provided in brackets. ***, **, and * stand for a significance level of 1%, 5%, resp. 10%*

4.6.2 Robustness checks

A number of studies provide evidence that temporary workers have different incentives for reporting accidents, especially for underreporting accidents because they are concerned about losing their job. With the present data set, accident probabilities cannot be estimated, because it only contains the accidents along with the corresponding information. The workers that have no accidents are not in the data set. Therefore, we want to account for the issue of underreporting in the robustness checks. One measure is to include the treatment costs of the first couple of months to the covariates. Treatment costs are all costs related to medical examinations, operations and all measures of the healing process. Similar accidents bear similar costs and absence leave. Thus, two similar accidents should have comparable treatment costs. With moral hazard, a worker might tend to stay home for a longer time, if the incentives are in place. But the costs for medical appointments should be on similar levels. Consequently, we will rerun the regressions and add the squared treatment costs. The variable 'Treatment Costs' is generated by summing up the treatment costs of the first three resp. six months after the accident. This is because for an accident, a sizeable part of the treatment costs applies at the beginning. While an absence spell can be partly influenced by the injured worker, treatment costs can only be influenced if additional appointments are made. In addition, workers with longer absence spells will visit physicians more often, which itself generates higher costs over time. The results of the robustness tests are displayed in Table 4.3. Column (1) represents the estimation with the squared sum of three months of treatment costs, while Column (2) shows the estimate with six months. The effect for November slightly decreases but remains significant at the 10% level. If we look at the cumulation for six months of treatment costs, the results remain comparable.

A second approach to account for underreporting of accidents, is to solely consider accidents with medical absence spells. Namely, accidents with at least three days of work disability. In case of an accident, the worker can still choose not to visit the physician. This accounts only for minor accidents, e.g. a pinched thumb. If the worker has a heavier accident, e.g. a broken leg s/he will be unable to return to work for some time. In

Table 4.3: Robustness tests

	Pre-treatment period	Treatment period	(1)	(2)	(3)
Placebo-test	February	March	0.48 (1.381)	0.888 (1.295)	-1.744 (2.411)
	March	April	1.939 (1.323)	1.524 (1.291)	1.952 (2.342)
	April	May	-1.977 (1.247)	-1.453 (1.344)	-3.588 (2.256)
	May	June	0.806 (1.183)	0.912 (1.192)	1.339 (2.031)
	September	October	0.236 (1.185)	-0.012 (1.183)	0.209 (1.873)
DiD Estimate	October	November	2.114 (1.166)*	2.351 (1.152)**	4.862 (2.01)**
	October	December	0.647 (1.265)	0.739 (1.268)	0.824 (2.115)

*Notes: The standard errors are obtained by applying 1000 bootstrap repetitions. Standard errors are indicated in parenthesis. ***, **, and * stand for a significance level of 1%, 5%, resp. 10%*

the latter case, a physician is required to verify that the patient is unable to work and has to hand out a corresponding certificate indicating the duration of the absence spell. Because daily cash benefits start from the third day of an absence, accidents without sickness spells are excluded from the sample. The results can be obtained in Column (3) of Table 4.3.¹¹ The robustness tests show that workers who must stay home after an accident, tend to stay home for approximately five days longer.

Cross-border commuters might have different incentives than workers living in Switzerland, because of special regulations. In case of unemployment, they receive unemployment benefits from their resident countries. In an additional analysis, accidents of this subgroup are excluded from the sample. The effect is stronger for workers that are living in Switzerland and the difference in absence duration augments to four days. Appendix C2 exhibits the corresponding results.

Our findings indicate the presence of moral hazard for temporary workers who have accidents in the beginning of winter inactivity. The average absence spell shows a longer duration of three days on average. These findings are confirmed by robustness checks, where we control for treatment costs in order to react to possible underreporting. Furthermore, we exclude non-Swiss residents as there are different policies for cross-border

¹¹For this specification, the sample changes. The descriptive statistics are reported in Appendix C1.

workers with regards to compensation in terms of accidents and temporary work inability. Our findings suggest that the effect is even stronger when focusing only on Swiss residents. To better understand the incentivisation, more information is necessary. As a first policy recommendation, we would recommend to gather more information on the construction company to which temporary worker is assigned to. That is because absent temporary workers are usually replaced with other workers. There are no parties involved that are awaiting the return of the temporary worker. When workers with a permanent contract are absent, the employer usually also takes care of the personal situation and counts on the return of the worker. In short, these workers have "caretakers". Temporary workers are in a different situation and are practically left to themselves. Hence, increasing the flow of information might speed up the process of reintegration. Furthermore, there should be information available on the contribution to the unemployment insurance. These information enable a better comprehension of the situation of these temporary workers with accidents. The remaining players do not have incentives to extend the absence spell of an accident. As the employer, the temporary work agency faces higher premiums with increased daily cash benefits. The construction company that acquires additional temporary workforce is not affected at all by the absence of these workers.

4.7 Conclusion

This study investigates the effect of winter inactivity on the recovery duration after accidents of temporary construction workers. It provides insight into an area that has not received much attention in previous research. The data set entails comprehensive information on all accidents by permanent and temporary construction workers in Switzerland in the years 2015 to 2018.

Temporary workers find themselves in different situations than permanent workers. While the latter are protected in many ways, temporary workers do not enjoy a high level of job protection in numerous industrialized countries. In the case of Switzerland,

temporary workers have only limited job protection. Within a week's notice, one can be dismissed of the current workplace. Therefore, job insecurity is one of the main factors leading to altering behavior in accident reporting or return to work. In construction, temporary workers strive to get a permanent contract. But what happens when it is foreseeable that after an injury, it is merely impossible to actually get a new assignment? Right before winter inactivity kicks in, how do the incentives change and what impact does it have on the return to work behavior? It is this case that we research in the present study.

To estimate the effect of being a temporary worker when injured at the beginning of winter inactivity on the duration of the absence spell, we apply a semiparametric difference-in-differences analysis with covariates. Construction workers with permanent contracts are hereby used as the control group. The common trend assumption is tested by running placebo tests in the periods preceding winter inactivity. The placebo tests do not provide statistical evidence for a violation of the common trend assumption, once accident characteristics and personal characteristics are controlled for. On average, temporary workers tend to have absence spells that last three days longer for accidents that happen in the month of November. In the robustness tests, we control for treatment costs. The results slightly change but remain on a comparable level. As cross-border workers are subject to different regulations than Swiss residents, we exclude this subgroup. This robustness test indicates an increase of the absence spell to four days. We recommend to gather additional information surrounding the accident and the injured person as a first step. It is important to know to which firm the temporary worker was assigned to. Furthermore, temporary workers do not have employers waiting for their return. They are simply replaced by other workers. Increasing the communication between the injured, the temporary agency and the workforce-buyer could help to speed up the recovery process.

Future research needs to find ways to account for accident probability and accident severity in a more detailed fashion. Picchio and van Ours (2017) suggest that temporary workers might be assigned to more dangerous tasks. Hence, additional data on detailed job and personal characteristics might help to research the situation of temporary work-

ers more broadly. Individuals are in a net of social insurance with multiple institutions at work. They try to maximise their utility. Further research requires a more comprehensive approach by combining data sets of the relevant insurance carriers. In this case, more detailed information on the further path of the individuals, such as receipt of unemployment benefits, health insurance, welfare benefits could help to better understand the underlying incentives.

Bibliography

- Abadie, A. (2005). Semiparametric difference-in-differences estimators. *The Review of Economic Studies*, 72(1), 1-19.
- Abbring, J. H., Chiappori, P. A., & Pinquet, J. (2003). Moral hazard and dynamic insurance data. *Journal of the European Economic Association*, 1(4), 767-820.
- Amuedo-Dorantes, C. (2002). Work safety in the context of temporary employment: the Spanish experience. *ILR Review*, 55(2), 262-285.
- Arrow, K. J. (1963). Uncertainty and the welfare economics of medical care. *American Economic Review* 53(5), 941–973.
- Askildsen, J. E., E. Bratberg and O.A. Nielsen (2005): Unemployment, Labor Force Composition and Sickness Absence: A Panel Data Study. *Health Economics*, 14, 1087-1101.
- Athey, S., & Imbens, G. W. (2019). Machine learning methods that economists should know about. *Annual Review of Economics*, 11.
- Audas, R., Goddard, J. (2001): Absenteeism, seasonality and the business cycle. *J. Econ. Bus.* 53, 405–419.
- Autor, D., Duggan, M., (2003). The Rise in the Disability Rolls and the Decline in Unemployment. *Quarterly Journal of Economics*, 118(1), 157-206.
- Bauder, R. A., Khoshgoftaar, T. M., Richter, A., & Herland, M. (2016). Predicting medical provider specialties to detect anomalous insurance claims. In 2016 IEEE 28th

- international conference on tools with artificial intelligence (ICTAI) (pp. 784-790). IEEE.
- Benitez-Silva, H., Disney, R., & Jiménez-Martín, S. (2010). Disability, capacity for work and the business cycle: an international perspective. *Economic Policy*, 25(63), 483-536.
- Blekesaune, M. (2012). Job insecurity and sickness absence: correlations between attrition and absence in 36 occupational groups. *Scandinavian journal of public health*, 40(7), 668-673.
- Bodory, H., & Huber, M. (2018). The causalweight package for causal inference in R. Université de Fribourg.
- Böheim, R., & Leoni T. (2011). Firms' moral hazard in sickness absences', IZA discussion papers 6005 . <http://ftp.iza.org/dp6005.pdf>.
- Böheim, R., & Leoni, T. (2014). Firms' Sickness Costs and Workers' Sickness Absences (Working Paper 20305). National Bureau of Economic Research.
- Bohle, P., Quinlan, M., & Mayhew, C. (2001). The health and safety effects of job insecurity: An evaluation of the evidence.
- Boone, J., & Van Ours, J. C. (2006). Are recessions good for workplace safety?. *Journal of Health economics*, 25(6), 1069-1093.
- Boone, J., Van Ours, J. C., Wuellrich, J. P., & Zweimüller, J. (2011). Recessions are bad for workplace safety. *Journal of health economics*, 30(4), 764-773.
- Breiman, L. (2001). Random forests. *Machine learning*, 45(1), 5-32.
- Breiman, L., J. H. Friedman, R. A. Olshen, and C. G. Stone (1984). *Classification and Regression Trees*. Wadsworth International Group, Belmont, California, USA.
- Bütler, M., Deuchert, E., Lechner, M., Staubli, S., & Thiemann, P. (2015). Financial work incentives for disability benefit recipients: lessons from a randomised field experiment. *IZA journal of labor policy*, 4(1), 18.

- Butler, R. J., Gardner, H. H., & Kleinman, N. L. (2013). Workers' compensation: occupational injury insurance's influence on the workplace. In *Handbook of insurance*, 449-469. Springer New York.
- Calonico, S., Cattaneo, M. D., and Titiunik, R. (2014). Robust Nonparametric Confidence Intervals for Regression-Discontinuity Designs. *Econometrica* 82(6): 2295-2326.
- Calonico, S., M. D. Cattaneo, and M. H. Farrell. (2018). On the Effect of Bias Estimation on Coverage Accuracy in Nonparametric Inference. *Journal of the American Statistical Association*, forthcoming.
- Calonico, S., Cattaneo, M. D., Farrell, M.H., and Titiunik, R. (2018). Regression Discontinuity Designs using Covariates. *Review of Economics and Statistics*, forthcoming.
- Cardon, J. H., Hendel, I. (2001). Asymmetric information in health insurance: evidence from the National Medical Expenditure Survey. *RAND Journal of Economics*, 408-427.
- Caroli, E., & Godard, M. (2016). Does job insecurity deteriorate health?. *Health economics*, 25(2), 131-147.
- Chelius, J. R, Smith, R. S. (1983). Experience-rating and injury prevention. In: Worrall JD (ed) *Safety and the workforce*, ILR Press, Ithaca, NY, 128–137.
- Chiappori, P. A., Durand, F., & Geoffard, P. Y. (1998). Moral hazard and the demand for physician services: First lessons from a French natural experiment. *European economic review*, 42(3-5), 499-511.
- Chiappori, P. A., & Salanie, B. (2000). Testing for asymmetric information in insurance markets. *Journal of political Economy*, 108(1), 56-78.
- Crook, J., Milner, R., Schultz, I. Z., & Stringer, B. (2002). Determinants of occupational disability following a low back injury: a critical review of the literature. *Journal of occupational rehabilitation*, 12(4), 277-295.
- Davies, R., Jones, P., & Nuñez, I. (2009). The impact of the business cycle on occupational injuries in the UK. *Social science & medicine*, 69(2), 178-182.

- Dionne, G. (1984). Search and insurance. *International Economic Review* 25, 357–367
- Dionne, G. (2013). *Handbook of insurance*. Springer, New York, NY.
- Dionne, G., Vanasse, C. (1992). Automobile insurance ratemaking in the presence of asymmetrical information. *Journal of Applied Econometrics*, 7(2), 149-165.
- Dionne, G., Michaud, P. C., & Dahchour, M. (2013). Separating moral hazard from adverse selection and learning in automobile insurance: longitudinal evidence from France. *Journal of the European Economic Association*, 11(4), 897-917.
- Dua, P., & Bais, S. (2014). Supervised learning methods for fraud detection in health-care insurance. In *Machine learning in healthcare informatics* (pp. 261-285). Springer, Berlin, Heidelberg.
- Engelland, A., & Riphahn, R. T. (2005). Temporary contracts and employee effort. *Labour economics*, 12(3), 281-299.
- EU-OSHA. European Agency for Safety and Health at Work (2019). The value of occupational safety and health and the societal costs of work-related injuries and diseases.
- Internet Link: https://osha.europa.eu/sites/default/files/publications/documents/Value%20of%20OSH_and_societal_cost_workrelated%20injuries_and_diseases.pdf, accessed on 30. August 2020.
- Fagart, M. C., Picard, P. (1999). Optimal insurance under random auditing. *The GENEVA Papers on Risk and Insurance-Theory*, 24(1), 29-54.
- Fahr, R., & Frick, B. (2007). On the inverse relationship between unemployment and absenteeism: evidence from natural experiments and worker heterogeneity.
- Federal Social Insurance Office FSIO (2020). Overview of social security in Switzerland. <https://www.bsv.admin.ch/dam/bsv/en/dokumente/int/uebersichten/uebersicht-ueber-die-schweizerische-soziale-sicherheit-stand-1-1-2017.pdf.download.pdf/Overview>

%20of%20Swiss%20Social%20Security%20-%20as%20of%201%201%202020.pdf,

14. August 2020.

- Ferrie, J. E. (2001). Is job insecurity harmful to health?. *Journal of the royal society of medicine*, 94(2), 71-76.
- Friedman J, Hastie T, Tibshirani R (2009). glmnet: Lasso and Elastic-Net Regularized Generalized Linear Models. R package version 2.0-18, URL <http://CRAN.R-project.org/package=glmnet>., 04.08.2019.
- Garcia-Serrano, C., Hernanz, V., & Toharia, L. (2010). Mind the gap, please! The effect of temporary help agencies on the consequences of work accidents. *Journal of Labor Research*, 31(2), 162-182.
- Gentzkow, M., Kelly, B., & Taddy, M. (2019). Text as data. *Journal of Economic Literature*, 57(3), 535-74.
- Guadalupe, M. (2003). The hidden costs of fixed term contracts: the impact on work accidents. *Labour economics*, 10(3), 339-357.
- Hahn, J., Todd, P., & Van der Klaauw, W. (2001). Identification and estimation of treatment effects with a regression discontinuity design. *Econometrica*, 69(1), 201-209.
- Hendel, I., & Lizzeri, A. (2003). The role of commitment in dynamic contracts: Evidence from life insurance. *The Quarterly Journal of Economics*, 118(1), 299-328.
- Hernanz, V., & Toharia, L. (2006). Do temporary contracts increase work accidents? A microeconomic comparison between Italy and Spain. *Labour*, 20(3), 475-504.
- Hesselius, P. (2007). Does sickness absence increase the risk of unemployment? *The Journal of Socio-Economics*, 36(2), 288-310.
- Ho, T. K. (1995). Random decision forests. In *Proceedings of 3rd international conference on document analysis and recognition* (Vol. 1, pp. 278-282). IEEE.

- Hölmstrom, B. (1979). Moral hazard and observability. *The Bell journal of economics*, 74-91.
- Holly, A., Gardiol, L., Domenighetti, G., & Bisig, B. (1998). An econometric model of health care utilization and health insurance in Switzerland. *European economic review*, 42(3), 513-522.
- Huber, M. (2019). An introduction to flexible methods for policy evaluation. arXiv preprint arXiv:1910.00641.
- Imbens, G. W., & Wooldridge, J. M. (2009). Recent developments in the econometrics of program evaluation. *Journal of economic literature*, 47(1), 5-86.
- Israel, M. (2004). Do we drive more safely when accidents are more expensive? Identifying moral hazard from experience rating schemes (No. 0043). CSIO working paper/Northwestern University, Center for the Study of Industrial Organization.
- James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An introduction to statistical learning*. New York: Springer.
- Johansson, P., & Palme, M. (1996). Do economic incentives affect work absence? Empirical evidence using Swedish micro data. *Journal of Public Economics*, 59(2), 195-218.
- Khan, J., & Rehnberg, C. (2009). Perceived job security and sickness absence: a study on moral hazard. *The European Journal of Health Economics*, 10(4), 421-428.
- Knardahl, S., Johannessen, H. A., Sterud, T., Härmä, M., Rugulies, R., Seitsamo, J., & Borg, V. (2017). The contribution from psychological, social, and organizational work factors to risk of disability retirement: a systematic review with meta-analyses. *BMC Public Health*, 17(1), 176.
- Kose, I., Gokturk, M., & Kilic, K. (2015). An interactive machine-learning-based electronic fraud and abuse detection system in healthcare insurance. *Applied Soft Computing*, 36, 283-299.

- Kralj, B. (1994). Employer responses to workers' compensation insurance experience rating. *Relations industrielles/Industrial Relations*, 49(1), 41-61.
- Krueger, A. (1990). "Incentive Effects of Workers' compensation Insurance," *Journal of Public Economics* 41, 73-99.
- Kumar, M., Ghani, R., & Mei, Z. S. (2010). Data mining to predict and prevent errors in health insurance claims processing. In *Proceedings of the 16th ACM SIGKDD international conference on Knowledge discovery and data mining* (pp. 65-74).
- Lanoie, P. (1992). The impact of occupational safety and health regulation on the risk of workplace accidents: Quebec: 1983–87. *Journal of Human Resources* 27(4):643–660.
- Lechner, M. (2011). The estimation of causal effects by difference-in-difference methods. *Foundations and Trends® in Econometrics*, 4(3), 165-224.
- Lee, D. S., Lemieux, T. (2010). Regression discontinuity designs in economics. *Journal of Economic Literature*, 48(2), 281-355.
- Leigh, J.P. (1985): The effects of unemployment and business cycle on absenteeism. *J. Econ. Bus.* 37(2), 159–170.
- Lengwiler, M. (2006). *Risikopolitik im Sozialstaat: die schweizerische Unfallversicherung 1870-1970* (Vol. 69). Böhlau Verlag Köln Weimar.
- Loubergé, H. (2013). *Developments in Risk and Insurance Economics: The Past 40 Years*. In: Dionne G. (eds) *Handbook of Insurance*. Springer, New York, NY
- 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.
- Manning, W. G., Newhouse, J. P., Duan, N., Keeler, E. B., & Leibowitz, A. (1987). Health insurance and the demand for medical care: evidence from a randomized experiment. *American Economic Review*, 251-277.

- Markussen, S., Røed, K., Røgeberg, O. J., & Gaure, S. (2011). The anatomy of absenteeism. *Journal of health economics*, 30(2), 277-292.
- McCrary, J. (2008). Manipulation of the running variable in the regression discontinuity design: A density test. *Journal of Econometrics*, 142(2), 698-714.
- McKinsey & Company (2017). Artificial Intelligence. The Next Digital Frontier? Discussion paper.
<https://www.mckinsey.com/~/media/mckinsey/industries/advanced%20electronics/our%20insights/how%20artificial%20intelligence%20can%20deliver%20real%20value%20to%20companies/mgi-artificial-intelligence-discussion-paper.ashx>,
 14 August 2020.
- Mueller, A., Rothstein, J., Von Wachter, T. (2013). Unemployment insurance and disability insurance in the Great Recession. No. odrc13-10. National Bureau of Economic Research.
- Müller, T., & Boes, S. (2020). Disability insurance benefits and labor supply decisions: evidence from a discontinuity in benefit awards. *Empirical economics*, 58(5), 2513-2544.
- Mullainathan, S., & Spiess, J. (2017). Machine learning: an applied econometric approach. *Journal of Economic Perspectives*, 31(2), 87-106.
- Murphy, G. C., & Athanasou, J. A. (1999). The effect of unemployment on mental health. *Journal of Occupational and organizational Psychology*, 72(1), 83-99.
- OECD (2010). *Sickness, Disability and Work: Breaking the barriers – A synthesis of findings across OECD countries*. Paris: OECD, 2010.
- Palali, A., & van Ours, J. C. (2017). Workplace accidents and workplace safety: on under-reporting and temporary jobs. *Labour*, 31(1), 1-14.
- Parsons, C. (2002). Liability rules, compensation systems and safety at work in Europe. *The Geneva Papers on Risk and Insurance-Issues and Practice*, 27(3), 358-382.

- Pauly, M. V. (1974). Overinsurance and public provision of insurance: The roles of moral hazard and adverse selection. *The Quarterly Journal of Economics* 88(1), 44–62.
- Pearlin, L. I. (1989). The sociological study of stress. *Journal of health and social behavior*, 241-256.
- Picchio, M., & Van Ours, J. C. (2017). Temporary jobs and the severity of workplace accidents. *Journal of safety research*, 61, 41-51.
- Pirani, E., & Salvini, S. (2015). Is temporary employment damaging to health? A longitudinal study on Italian workers. *Social Science & Medicine*, 124, 121-131.
- Probst, T. M., Barbaranelli, C., & Petitta, L. (2013). The relationship between job insecurity and accident under-reporting: A test in two countries. *Work & Stress*, 27(4), 383-402.
- Rostenstein, E. (2019). Rehabilitation before pension? A longitudinal study sheds light on Swiss disability insurance reforms. In: *LIVES Impact* (ISSN: 2297-6124). No 11 - October 2019. Weblink: <https://lives-nccr.ch/en/newsletter/rehabilitation-pension-n3817>, visited on: 22.06.2020.
- Rothschild, M., & Stiglitz, J. (1976). Equilibrium in competitive insurance markets: An essay on the economics of imperfect information. *The Quarterly Journal of Economics*, 629-649.
- Rubin, D. B. (1974). Estimating causal effects of treatments in randomized and nonrandomized studies. *Journal of educational Psychology*, 66(5), 688.
- Rubinstein, A., Yaari, M. E. (1983). Repeated insurance contracts and moral hazard. *Journal of Economic Theory* 30, 74–97.
- Ruser, J. W. (1985). Workers' compensation insurance, experience-rating, and occupational injuries. *Rand Journal of Economics* 16(4), 487–503
- Schultz, I. Z., & Gatchel, R. J. (Eds.). (2015). *Handbook of return to work: From research to practice* (Vol. 1). Springer.

- Shapiro, C., & Stiglitz, J. E. (1984). Equilibrium unemployment as a worker discipline device. *The American Economic Review*, 74(3), 433-444.
- Shavell, S. (1979). On moral hazard and insurance. In *Foundations of Insurance Economics*, 280-301. Springer Netherlands.
- Spence, M., Zeckhauser, R. (1971). Insurance, information and individual action. *American Economic Review* 61, 380–387.
- Steiger O., Andermatt P. (2009) Einflüsse auf die Rentenzahlen. In *Fünffjahresbericht UVG 2003-2007* (pp. 55-57).
- Tibshirani, R. (1996). Regression shrinkage and selection via the lasso. *Journal of the Royal Statistical Society: Series B (Methodological)*, 58(1), 267-288.
- Thalmaier, A. (1999). Bestimmungsgründe von Fehlzeiten: welche Rolle spielt die Arbeitslosigkeit? (No. 62). IZA Discussion Papers.
- Therneau, T. M., & Atkinson, E. J. (1997). An introduction to recursive partitioning using the RPART routines.
- Thomason, T., & Pozzebon, S. (2002). Determinants of firm workplace health and safety and claims management practices. *ILR Review*, 55(2), 286-307.
- Turner, J. A., Franklin, G., & Turk, D. C. (2000). Predictors of chronic disability in injured workers: a systematic literature synthesis. *American journal of industrial medicine*, 38(6), 707-722.
- Unfallstatistik UVG (2019). Unfallstatistik UVG 2019. Koordinationsgruppe für die Statistik der Unfallversicherung UVG (KSUV), Luzern. <https://unfallstatistik.ch/d/publik/unfstat/pdf/Ts19.pdf>, 14 August 2020.
- van der Laan, M. J., Polley, E. C., & Hubbard, A. E. (2007). Super learner. *Statistical applications in genetics and molecular biology*, 6(1).

- Varian, H. R. (2014). Big data: New tricks for econometrics. *Journal of Economic Perspectives*, 28(2), 3-28.
- Wang, Y., & Xu, W. (2018). Leveraging deep learning with LDA-based text analytics to detect automobile insurance fraud. *Decision Support Systems*, 105, 87-95.
- Westergård-Nielsen, N., & Pertold, F. (2012). Firm insurance and sickness absence of employees. IZA Discussion Paper No. 6782.
- Worrall, J. D., Butler, R. J. (1988). Experience rating matters. In: Borba PS, Appel D (eds) *Workers' compensation insurance pricing: current programs and proposed reforms*, Kluwer Academic Publishers, Boston, MA, pp 81–94
- Wuthrich, M. V., & Buser, C. (2019). Data analytics for non-life insurance pricing. *Swiss Finance Institute Research Paper*, (16-68).
- Ziebarth, N. R. (2018). Social insurance and health. In *Health Econometrics*. Emerald Publishing Limited.

Appendices

Appendix

A Appendix 1

A1 Description of different rates

Table A1: Glossary of different expressions used in this paper

Exression	Description
A firm's or group's risk rate	The actual calculated risk rate for a group or for a firm.
Manual rate	The rate according to the tariff schedule.
Net premium	The premium actually paid at the end of the year. It is the product of a firms individual net risk rate (including eventual bonus or malus) and the payroll of a given year.
Base premium	It is the product of summed payroll of the past six years and the manual rate of the year of insurance. The base premium is solely utilized to assign firms to the pricing plans.

A2 Regulatory boundaries of the Bonus-Malus

Suva has developed a standardized tariff schedule with 150 level, each level representing a certain rate. The calculated risk rates for firms or groups will be rounded to one of the rates in the tariff schedule. The schedule starts on level one with 0.0200% and goes up in five percent steps to level 150, with a premium of 4.5000%. Example: If the actual risk rate of a group is 3.7400% then the manual rate will be the one that is the closest to the risk rate, namely level 100 with a rate of 3.7600%.

Within the Bonus/Malus plan, every firm has a different weight for a bonus or malus. Depending on the weight, a firm's own records will have a higher or lower impact on the final risk rate. Weight is a function of a firm's size. ¹²

For a single accident, the claims for short term benefits are capped at totally 38'000 Swiss Francs per case. For long term benefits this cap is at 380'000 Swiss Francs.

The annual bonus or malus is capped at three levels in the tariff schedule. The maximum bonus or malus is a deviation of 14 levels from the manual rate of the risk group. Let's illustrate this with an example, which is summarized in Figure A1. Suppose

¹²Can be over multiple years, still attributed to one year.

Figure A1: Tariff details

Level	Manual Rate	
6	0.0255%	Minimum manual rate with bonus for firm A: -14 levels
...		
16	0.0416%	
17	0.0437%	Minimum manual rate with bonus within one year for firm A: -3 levels
18	0.0458%	
19	0.0481%	
20	0.0505%	Required risk rate for group A is 0.0501% which is attributed to level 20
21	0.0531%	
22	0.0557%	
23	0.0585%	Maximum manual rate with malus within one year for firm A: +3 levels
24	0.0614%	
...		
34	0.1001%	Maximum manual rate with malus for firm A: +14 levels

Notes: Tariff schedule of Suva along with example for a firm in a given risk group. Maximum bonus or malus are indicated.

group A has a required risk rate of exactly 0.0501%. The closest manual rate in the tariff schedule is level 20. Let's assume firm A is part of Group A and in the Bonus/Malus plan and now, for the first year has better accident records its peers. It has a bonus of 0.0101%, leading to a required risk rate of 0.4000%. According to the annual cap, firm A will in fact have a bonus of maximum 3 levels.

A3 Description of outcome variables

Table A2: Description of outcome variables

Variable	Description
Number of accidents per FTE	Indicates the number of accidents divided by the number of full time employees for a given observation. The information on FTEs is not reported by the firm. It is rather an official estimation done by SSUV on the ground of the firm's regularly reported payroll and the reported salary of an insured person in case of an accident.
Daily benefits per case with DB	Number of days that a firm is reimbursed for, divided by the number of cases that lead to daily benefit payments.
Daily benefits in days per case	Number of days that a firm is reimbursed for, divided by the number of accidents of a firm.
Cases with DB payments per FTE	Number of cases that lead to daily benefits divided by the number of FTE.
Daily benefit payments per case	Number of daily benefit payments divided by the total number of cases per firm. The costs are cumulated for 24 months after the accident and attributed to the year of the accident.
Costs per 1000 Swiss Francs of payroll	Sum of daily benefit payments in Swiss Francs and the costs for medical treatment divided by the payroll of a given firm. The costs are cumulated for 24 months after the accident and attributed to the year of the accident.
Costs for medical treatment per case	Costs for medical treatment divided by the number of cases. These costs are difficult to manipulate. It is the cost for doctor's appointment, medical devices or medication. Thus, it cannot be influenced by the firm. The costs are cumulated for 24 months after the accident and attributed to the year of the accident.
Total days of DB	The total amount of daily benefits of an observation.
Total number of cases	The total amount of accidents of an observation.
Total number of DB cases	The total amount of cases leading to daily benefit payments of an observation.

A4 Removing observations

The following types of observations have been removed from the initial dataset.

Table A3: Description of outcome variables

Type of observation	Description
Mergers and acquisitions	Firms that show a merger are summed up for the pre-merger period. Mergers and acquisitions are not per se separated in the dataset. Firms that were part of a merge retroactively take on the aggregated values.
Group premium	Firms that are part of large holdings find themselves in plans that correspond to the size of the holding structure. Hence, any outcome variable of these firms would be biased.
Firms with overridden pricing plans	Firms with special treatment (e.g. employment programs for special institutes) will never be priced with the Bonus/Malus rate plan. They are actually never-takers in the context of the fuzzy RDD.
Payroll below 50'000 Swiss Francs	Observations with an annual payroll of less than 50'000 Swiss Francs are removed as well. I assume that this amount is in the lower bound of a salary for at least one full time employee
FTE = 0	Since the number of FTE is estimated, there are still observations that have an FTE of zero but still show a salary. For the construction of our output variables it is required that this value is greater than zero.
Base premium is 0 or missing	Observations where the base premium is zero or missing are excluded from the sample. This is due to missing data in the dataset.
Firms with full experience rating	We exclude all observations that are not priced not assigned to the manual rate or Bonus/Malus plan.

Furthermore also the corresponding accidents have to be adjusted. Our sample has a total of 1'485'966 cases. Some of the accident records show negative payments. This is due to false assignment to the insurance branch, or because there are multiple accident numbers representing one case. This amounts to a total of 1'475'919 accidents that are considered in our sample.

Overall, cases leading to a disability pension are excluded because these kinds of cases are rare and bear very high costs. This would create outliers that influence the variables of interest, namely total costs and cases with daily benefits.

A5 Placebo test for covariates at threshold

Table A4: Placebo test for covariates at threshold

UX:

Variable	Robust estimation	Standard error	Bandwidth	# of obs. below	# of obs above
Region: Western/South-CH	0.00	0.0410	8136	43962	31246
Year 2008	0.03	0.0278	13802	86723	48284
Year 2009	-0.02	0.0269	14901	96922	51310
Year 2010	0.01	0.0281	13691	85722	47976
Year 2011	-0.01	0.0284	11113	64820	40646
Year 2012	-0.01	0.0267	15235	100103	52179
Year 2013	0.01	0.0296	10367	59236	38399
Year 2014	-0.01	0.0302	11409	67040	41510
Year 2015	0.00	0.0118	10242	118986	56896
Industry: Manufacture of fibre cement and other articles of concrete, plaster and cement	0.00	0.0025	9288	51590	34951
Industry: Ceramics and glass	0.00	0.0047	8158	44130	31324
Industry: Metallurgy	-0.01**	0.0025	7321	38663	28552
Industry: Steel and metal construction	0.00	0.0201	8211	44443	31484
Industry: Manufacture of machinery and equipment n.e.c.	0.00	0.0217	7401	39183	28810
Industry: Repair and installation of land vehicles, machinery and equipment	0.00	0.0376	5046	25056	20605
Industry: Bodywork: Repair and maintenance of ships and boats, aircraft and spacecraft, bodywork	0.02	0.0163	9238	51256	34799
Industry: Manufacture of instruments and appliances for measuring, testing and navigation; watches and clocks	-0.01	0.0163	7103	37230	27839
Industry: Manufacture of basic iron and steel and of ferro-alloys	0.00	0.0086	9755	54830	36417
Industry: Surface treatment	0.00	0.0059	12437	75094	44543
Industry: Sawmilling and planing of wood	-0.01	0.0066	7725	41269	29894
Industry: Builders' carpentry and joinery	-0.09***	0.0319	5478	27539	22226
Industry: Manufacture of plastics in primary forms	0.02*	0.0089	14401	92173	49946

Variable	Robust estimation	Standard error	Bandwidth	# of obs. below	# of obs above
Industry: Processing of paper, paper products and plastics	0.00	0.0043	11357	66656	41368
Industry: Printing and reproduction of recorded media	0.00	0.0094	8366	45432	32024
Industry: Interior decoration, orthopedy technics, leather fabrication	-0.01	0.0050	8959	49263	33915
Industry: Manufacture of textiles	0.00	0.0034	9791	55070	36526
Industry: Washing and (dry-)cleaning of textile and fur products	0.00	0.0035	6432	33051	25591
Industry: Manufacture of basic pharmaceutical products and other pharmaceutical products	0.01**	0.0037	9491	53000	35606
Industry: Manufacture of chemicals and chemical products	0.00	0.0059	7881	42267	30393
Industry: Processing and preserving of meat and production of meat products	0.00	0.0016	7328	38715	28569
Industry: Manufacture of food products	0.00	0.0054	13487	84013	47403
Industry: Cigarette and cigar production	0.00	0.0010	13997	88487	48840
Industry: Cutting, shaping and finishing of stone	0.00	0.0038	13101	80756	46383
Industry: Construction of buildings	0.01	0.0267	9057	49955	34201
Industry: Forestry and logging	-0.02*	0.0105	8904	48892	33749
Industry: Plastering and painting	0.02	0.0250	7273	38336	28415
Industry: Roofing activities	-0.01	0.0113	6843	35609	26980
Industry: Laying of floor coverings	0.01	0.0106	13337	82735	47020
Industry: General cleaning of buildings, Facility services	0.02	0.0148	9623	53896	36007
Industry: Services to buildings and landscape activities	0.04	0.0252	9167	50733	34538
Industry: Assembly plants	0.00	0.0015	11538	68041	41905
Industry: Floor and wall covering	0.00	0.0159	9087	50158	34294
Industry: Rail transport, water transport	0.00	0.0039	10419	59586	38547
Industry: Passenger transport by cableways, funiculars and ski-tows	0.00	0.0057	8045	43342	30952
Industry: Freight and passenger transport by road	0.04	0.0278	5463	27420	22182
Industry: Passenger air transport, airports, maintenance of air vehicles	-0.01	0.0060	10180	57866	37807
Industry: Warehousing and storage, trade	0.00	0.0155	9661	54159	36134
Industry: Recycling	0.00	0.0046	9431	52567	35408

Variable	Robust estimation	Standard error	Bandwidth	# of obs. below	# of obs above
Industry: Manufacture of beverages	0.00	0.0079	8970	49340	33943
Industry: Electricity, gas, steam and air-conditioning supply	0.00	0.0050	15872	106234	53872
Industry: Net construction and net maintenance, electricity	-0.01	0.0217	6947	36265	27310
Industry: Offices	0.00	0.0034	7663	40857	29690
Industry: Architectural and engineering activities and related technical consultancy	0.01	0.0203	4605	22649	18950
Industry: Personnel placement	0.00	0.0074	10014	56661	37243
Industry: Social institutions and training workshops	-0.01***	0.0054	11405	67013	41501
Industry: Other	0.00	0.0002	5217	26010	21281
Full Time Employees	0.01	0.9825	9440	52649	35444

*Notes: Estimates are based on local linear regression within the indicated windows. Optimal bandwidth is chosen by one common MSE-optimal bandwidth selector across both sides of the threshold for the RD treatment effect estimator. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.*

A6 Extended analysis with polynomial local regressions without and with covariates

Table A5: Extended analysis with polynomial local regressions without and with covariates

(a) Linear estimation with triangular kernel without covariates

	Accidents per FTE	DB case DB	per of accident	DB per accident	DB cases per FTE	DB (in CHF) per case	DB (in 1000 CHF of payroll	per of	Share of DB cases	DB days (to- tal)	in (to- tal)	Number of acci- dents	Number of DB cases
	(1)	(2)	(3)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(9)	(10)
Robust Estimate	0.00 (9.83)	-0.57 (9.83)	-0.97 (5.10)	-0.97 (5.10)	0.01 (0.01)	-969.37 (1890.30)	1.87 (2.15)	420.01 (512.96)	0.05 (3.73)	0.05 (0.09)	0.00 (0.03)	0.05 (0.09)	0.00 (0.03)
Bandwidth	8'023	7'261	7'173	7'173	10'709	5'734	13'547	9'796	10'586	12'118	15'583	12'118	15'583
# of obs. below	43'194	9'250	19'066	19'066	61'699	7'128	84'464	27'052	60'759	72'452	103'403	72'452	103'403
# of obs. above	30'868	8'056	16'009	16'009	39'408	6'467	47'582	21'141	39'035	43'582	53'122	43'582	53'122
Covariates	No	No	No	No	No	No	No	No	No	No	No	No	No
Polynome	-	-	-	-	-	-	-	-	-	-	-	-	-
Kernel	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular

(b) Quadratic estimation with triangular kernel without covariates

	Accidents per FTE	DB case DB	per of accident	DB per accident	DB cases per FTE	DB (in CHF) per case	DB (in 1000 CHF of payroll	per of	Share of DB cases	DB days (to- tal)	in (to- tal)	Number of acci- dents	Number of DB cases
	(1)	(2)	(3)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(9)	(10)
Robust Estimate	0.00 (0.04)	-0.07 (11.26)	-1.29 (5.89)	-1.29 (5.89)	0.01 (0.03)	-1'164.01 (1965.13)	2.56 (17.81)	300.60 (710.57)	-15.11 (23.97)	-0.04 (0.15)	-0.01 (0.07)	-0.04 (0.15)	-0.01 (0.07)
Bandwidth	11'715	14'247	14'550	14'550	12'609	11'891	17'647	13'682	12'433	12'234	13'756	12'234	13'756
# of obs. below	69'350	19'513	42'957	42'957	76'536	15'908	125'535	39'935	75'053	73'360	86'299	73'360	86'299
# of obs. above	42'412	15'001	29'952	29'952	45'000	12'804	58'338	28'389	44'523	43'915	48'138	43'915	48'138
Covariates	No	No	No	No	No	No	No	No	No	No	No	No	No
Polynome	2	2	2	2	2	2	2	2	2	2	2	2	2
Kernel	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular

Table A5: Extended analysis with polynomial local regressions without and with covariates

(c) Cubic estimation with triangular kernel without covariates

[illegible]

(d) Linear estimation with triangular kernel with covariates

[illegible]

Table A5: Extended analysis with polynomial local regressions without and with covariates

(e) Quadratic estimation with triangular kernel with covariates

	Accidents per FTE	DB case DB	per of accident	DB per accident	DB cases per FTE	DB (in CHF) per case	DB (in 1000 CHF of payroll	per of	Share of DB cases	DB days (to- tal)	in	Number of acci- dents	Number of DB cases
	(1)	(2)	(3)	(3)	(4)	(5)	(6)	(6)	(7)	(8)	(8)	(9)	(10)
Robust Estimate	0.00 (0.02)	-2.07 (10.13)	-2.26 (5.21)	-2.26 (5.21)	0.01 (0.01)	-1'664.81 (1828.93)	0.66 (3.53)	0.66 (3.53)	375.98 (671.85)	-2.97 (5.33)	-2.97 (5.33)	0.02 (0.13)	0.00 (0.07)
# of obs. below	69'350	19'513	42'957	42'957	76'536	15'908	125'535	125'535	39'935	75'053	75'053	73'360	86'299
# of obs. above	42'412	15'001	29'952	29'952	45'000	12'804	58'338	58'338	28'389	44'523	44'523	43'915	48'138
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Polynome	2	2	2	2	2	2	2	2	2	2	2	2	2
Kernel	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular

(f) Cubic estimation with triangular kernel with covariates

	Accidents per FTE	DB case DB	per of accident	DB per accident	DB cases per FTE	DB (in CHF) per case	DB (in 1000 CHF of payroll	per of	Share of DB cases	DB days (to- tal)	in	Number of acci- dents	Number of DB cases
	(1)	(2)	(3)	(3)	(4)	(5)	(6)	(6)	(7)	(8)	(8)	(9)	(10)
Robust Estimate	0.00 (0.02)	-4.22 (12.09)	-4.20 (6.11)	-4.20 (6.11)	0.01 (0.01)	-1'703.33 (2028.20)	-0.11 (4.80)	-0.11 (4.80)	346.92 (755.72)	-3.09 (5.59)	-3.09 (5.59)	-0.05 (0.14)	-0.02 (0.07)
Standard Error													
# of obs. below	87'866	19'855	44'698	44'698	96'569	19'477	144'076	144'076	49'956	105'161	105'161	86'805	101'655
# of obs. above	48'624	15'205	30'832	30'832	51'223	14'979	61'889	61'889	33'262	53'581	53'581	48'302	52'629
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Polynome	3	3	3	3	3	3	3	3	3	3	3	3	3
Kernel	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular

Notes: Estimates are based on local linear regression within the indicated windows. Optimal bandwidth is chosen by one common MSE-optimal bandwidth selector across both sides of the threshold for the RD treatment effect estimator. Robust standard errors are in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

A7 Examination of different industries

Table A6: Multiple industries

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Manufacture of fibre cement and other articles of concrete, plaster and cement	Accidents per FTE	-0.04	0.22	68'057	69	109
	DB per case of DB	71.21	114.39	114'969	6	57
	DB per accident	-625.41**	283.46	77'619	13	68
	DB cases per FTE	-0.01	0.15	51'246	69	88
	DB (in CHF) per case	4684.55	19531.19	124'694	6	60
	DB per 1000 CHF of payroll	4.90	14.34	45'886	69	69
	Share of DB cases	-190570**	78246.18	96'687	13	72
	DB in days (total)	-15.68	28.05	56'751	69	97
	Number of accidents	-0.59	0.79	69'066	69	113
	Number of DB cases	-0.50	0.57	65'669	69	108
Ceramics and glass	Accidents per FTE	-0.08	0.30	11'183	208	149
	DB per case of DB	55.72	71.41	26'820	128	141
	DB per accident	158.99	102.79	14'612	127	126
	DB cases per FTE	0.00	0.19	12'219	226	167
	DB (in CHF) per case	8073.96	10487.04	27'347	129	143
	DB per 1000 CHF of payroll	5.37	56.60	9'983	185	131
	Share of DB cases	4879.47	3161.75	16'845	139	135
	DB in days (total)	73.33	59.22	12'185	225	166
	Number of accidents	0.22	1.34	12'675	233	169
	Number of DB cases	-0.07	0.75	11'525	212	154
Metallurgy	Accidents per FTE	-0.06	0.06	57'562	238	195
	DB per case of DB	-62.00	63.71	135'703	30	132
	DB per accident	-7.27	23.14	134'912	64	224
	DB cases per FTE	-0.04	0.04	63'826	238	210
	DB (in CHF) per case	-14732.87	12975.72	134'535	30	131
	DB per 1000 CHF of payroll	-10.81	10.17	65'321	239	215
	Share of DB cases	-1569.31	2514.37	123'309	64	215
	DB in days (total)	-17.20	17.50	61'050	239	200
	Number of accidents	-0.36	0.55	46'251	239	178
	Number of DB cases	-0.05	0.23	48'615	239	180

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Steel and metal construction	Accidents per FTE	-0.10	0.12	7'356	1'836	1'476
	DB per case of DB	11.64	21.06	14'215	914	780
	DB per accident	1.38	9.99	10'630	1'505	1'304
	DB cases per FTE	0.03	0.05	8'321	2'130	1'648
	DB (in CHF) per case	3108.84	3164.75	14'513	938	800
	DB per 1000 CHF of payroll	2.75	7.04	9'305	2'438	1'831
	Share of DB cases	52.25	840.13	8'832	1'230	1'084
	DB in days (total)	-3.28	12.78	8'526	2'197	1'693
	Number of accidents	-0.29	0.48	8'298	2'124	1'642
	Number of DB cases	0.07	0.17	9'467	2'497	1'854
Manufacture of machinery and equipment n.e.c.	Accidents per FTE	-0.05	0.07	10'707	3'481	2'227
	DB per case of DB	-24.00	61.13	10'494	780	647
	DB per accident	-26.87	42.64	8'250	1'428	1'148
	DB cases per FTE	-0.02	0.02	12'611	4'349	2'531
	DB (in CHF) per case	-7963.24	10181.60	10'901	813	667
	DB per 1000 CHF of payroll	-5.72	5.53	5'928	1'701	1'365
	Share of DB cases	-2282.13	2731.88	11'945	2'167	1'601
	DB in days (total)	-40.81	26.50	6'837	2'002	1'515
	Number of accidents	-1.25	1.20	8'160	2'474	1'761
	Number of DB cases	-0.49	0.44	9'212	2'860	1'973
Repair and installation of land vehicles, machinery and equipment	Accidents per FTE	0.00	0.04	13'397	8'274	3'399
	DB per case of DB	52.36***	20.29	14'952	2'044	1'128
	DB per accident	14.58	9.56	13'685	4'883	2'453
	DB cases per FTE	-0.01	0.02	12'749	7'611	3'292
	DB (in CHF) per case	4777.17	2985.88	15'817	2'212	1'174
	DB per 1000 CHF of payroll	6.43	4.97	9'121	4'573	2'579
	Share of DB cases	1865.46	2059.49	11'939	4'019	2'221
	DB in days (total)	20.03**	9.76	13'482	8'373	3'415
	Number of accidents	-0.13	0.38	11'686	6'571	3'090
	Number of DB cases	-0.09	0.12	14'922	9'975	3'647

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Bodywork: Repair and maintenance of ships and boats, aircraft and spacecraft, bodywork	Accidents per FTE	0.02	0.09	10'007	1'955	1'206
	DB per case of DB	12.90	35.88	13'737	510	404
	DB per accident	-5.28	16.84	9'370	908	719
	DB cases per FTE	0.00	0.05	9'770	1'891	1'183
	DB (in CHF) per case	618.49	6114.28	10'913	390	324
	DB per 1000 CHF of payroll	0.22	9.22	9'389	1'802	1'153
	Share of DB cases	1249.20	995.17	11'530	1'150	853
	DB in days (total)	-10.15	18.81	9'554	1'838	1'163
	Number of accidents	-0.30	0.61	10'004	1'956	1'206
	Number of DB cases	-0.30	0.31	9'451	1'817	1'156
Manufacture of instruments and appliances for measuring, testing and navigation; watches and clocks	Accidents per FTE	0.00	0.02	9'774	1'654	938
	DB per case of DB	-32.79	35.65	8'947	353	264
	DB per accident	-17.28	19.54	7'357	625	466
	DB cases per FTE	0.01	0.01	9'912	1'697	945
	DB (in CHF) per case	-3062.53	4764.79	10'347	443	307
	DB per 1000 CHF of payroll	-0.52	1.37	11'280	2'050	1'061
	Share of DB cases	-249.34	1507.61	9'701	892	594
	DB in days (total)	2.06	13.70	8'573	1'378	845
	Number of accidents	0.95**	0.45	10'076	1'738	957
	Number of DB cases	0.33	0.25	9'217	1'517	896
Manufacture of basic iron and steel and of ferro-alloys	Accidents per FTE	0.09	0.16	7'717	318	279
	DB per case of DB	-17.29	32.85	37'338	383	405
	DB per accident	-31.86*	16.31	21'972	620	463
	DB cases per FTE	0.07	0.10	6'614	272	249
	DB (in CHF) per case	-2450.13	4137.03	34'217	383	374
	DB per 1000 CHF of payroll	-4.19	7.30	7'635	314	278
	Share of DB cases	-4984.61	4093.86	13'656	348	331
	DB in days (total)	-9.49	27.76	7'230	298	269
	Number of accidents	0.85	1.55	8'285	337	293
	Number of DB cases	0.46	0.81	7'179	296	269

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Surface treatment	Accidents per FTE	-0.09	0.09	12'830	270	292
	DB per case of DB	2.08	34.13	61'830	92	252
	DB per accident	-4.73	15.36	36'920	202	313
	DB cases per FTE	0.05	0.04	16'000	326	338
	DB (in CHF) per case	3096.06	4843.89	54'923	92	239
	DB per 1000 CHF of payroll	10.70	7.13	13'444	285	300
	Share of DB cases	-1613.38	2191.22	32'116	202	281
	DB in days (total)	51.30	34.25	12'943	276	294
	Number of accidents	-0.02	0.55	14'063	297	306
	Number of DB cases	0.34	0.34	11'743	242	269
Sawmilling and planing of wood	Accidents per FTE	8.96***	2.95	8'577	341	300
	DB per case of DB	76.80	89.71	29'243	177	201
	DB per accident	153.70	116.00	17'830	252	242
	DB cases per FTE	3.36***	1.24	9'112	371	314
	DB (in CHF) per case	15313.18	11910.12	28'921	175	199
	DB per 1000 CHF of payroll	-316.20**	122.79	9'507	383	327
	Share of DB cases	-23256.63*	12583.75	18'826	268	251
	DB in days (total)	-154.11	192.58	11'674	479	370
	Number of accidents	18.74***	7.13	9'334	380	325
	Number of DB cases	13.92***	5.08	9'032	365	313
Builders' carpentry and joinery	Accidents per FTE	-0.01	0.06	8'084	3'182	2'298
	DB per case of DB	6.92	32.25	8'712	1'013	835
	DB per accident	1.59	11.37	8'501	2'001	1'589
	DB cases per FTE	-0.01	0.03	10'020	4'209	2'767
	DB (in CHF) per case	1760.77	6120.33	7'915	904	742
	DB per 1000 CHF of payroll	-2.11	6.90	7'604	2'945	2'177
	Share of DB cases	2526.53	1653.41	13'653	3'485	2'396
	DB in days (total)	1.34	9.10	11'738	5'229	3'163
	Number of accidents	0.45	0.33	8'405	3'344	2'391
	Number of DB cases	0.04	0.15	10'175	4'307	2'799

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Manufacture of plastics in primary forms	Accidents per FTE	-0.05	0.24	10'205	530	421
	DB per case of DB	9.05	34.36	32'283	290	358
	DB per accident	4.45	18.29	23'642	533	498
	DB cases per FTE	-0.02	0.14	9'984	519	415
	DB (in CHF) per case	2591.57	4335.89	30'652	290	336
	DB per 1000 CHF of payroll	11.05	17.63	11'575	615	462
	Share of DB cases	1857.28	2474.25	15'595	344	356
	DB in days (total)	113.85	97.93	13'562	757	524
	Number of accidents	-1.13	3.25	9'260	481	395
	Number of DB cases	-0.22	1.35	9'938	518	414
Processing of paper, paper products and plastics	Accidents per FTE	-0.34***	0.10	28'537	297	156
	DB per case of DB	411.36***	118.32	65'675	65	129
	DB per accident	285.27**	126.82	43'530	112	148
	DB cases per FTE	-0.42***	0.12	25'588	244	143
	DB (in CHF) per case	49513.37***	15779.25	68'782	65	130
	DB per 1000 CHF of payroll	15.22	14.31	28'522	297	156
	Share of DB cases	11854.03**	5103.55	44'775	112	150
	DB in days (total)	286.82	176.92	26'220	251	145
	Number of accidents	-13.57***	2.83	23'834	215	130
	Number of DB cases	-28.63***	5.54	20'612	182	111
Printing and reproduction of recorded media	Accidents per FTE	0.06	0.09	6'420	374	217
	DB per case of DB	64.00**	30.26	18'343	235	154
	DB per accident	44.23	33.05	7'741	245	129
	DB cases per FTE	0.06	0.04	6'358	368	217
	DB (in CHF) per case	6519.39	5042.52	18'472	238	154
	DB per 1000 CHF of payroll	11.43	9.60	8'341	518	268
	Share of DB cases	1933.25	2091.67	8'038	256	134
	DB in days (total)	52.88	39.45	7'535	456	245
	Number of accidents	1.71	1.43	6'722	393	222
	Number of DB cases	0.58	0.57	7'614	461	246

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Interior decoration, orthopedy technics, leather fabrication	Accidents per FTE	-0.01	0.07	7'679	171	68
	DB per case of DB	-10.79	23.17	18'234	94	36
	DB per accident	-30.33	23.03	9'255	91	39
	DB cases per FTE	-0.02	0.04	11'605	323	100
	DB (in CHF) per case	-2926.77	3234.72	15'963	73	35
	DB per 1000 CHF of payroll	-1.93	2.67	8'625	198	74
	Share of DB cases	-3624.55	2713.20	8'204	81	34
	DB in days (total)	-27.56	21.16	7'805	176	69
	Number of accidents	-0.33	0.66	15'819	539	126
	Number of DB cases	-0.12	0.35	13'891	439	114
Manufacture of textiles	Accidents per FTE	0.00	0.14	9'905	168	98
	DB per case of DB	-69.14	73.80	65'084	91	99
	DB per accident	12.01	25.73	37'400	214	155
	DB cases per FTE	0.07	0.11	8'794	142	83
	DB (in CHF) per case	-9576.53	9907.58	72'575	91	117
	DB per 1000 CHF of payroll	31.68	27.98	9'368	153	91
	Share of DB cases	-28.04	1556.57	40'955	214	164
	DB in days (total)	90.99	71.57	10'866	201	103
	Number of accidents	0.75	1.33	12'963	253	119
	Number of DB cases	0.86	0.63	15'881	318	134
Washing and (dry-) cleaning of textile and fur products	Accidents per FTE	0.01	0.06	11'973	120	52
	DB per case of DB	27.33	27.26	33'085	99	41
	DB per accident	54.66***	19.69	15'414	54	24
	DB cases per FTE	0.05	0.05	10'029	88	42
	DB (in CHF) per case	2548.18	3017.29	32'971	99	41
	DB per 1000 CHF of payroll	-4.28	3.59	3'682	28	14
	Share of DB cases	1632.31*	961.62	16'089	60	27
	DB in days (total)	-11.97	25.35	5'490	39	26
	Number of accidents	0.06	0.76	11'430	108	47
	Number of DB cases	0.54	0.74	6'708	48	31

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Manufacture of basic pharmaceutical products and other pharmaceutical products	Accidents per FTE	0.05	0.05	18'588	239	129
	DB per case of DB	26.66	34.07	41'306	77	113
	DB per accident	20.79	12.70	33'762	193	169
	DB cases per FTE	0.09*	0.05	16'442	204	119
	DB (in CHF) per case	5481.85	4178.00	44'911	77	122
	DB per 1000 CHF of payroll	7.56*	4.20	21'041	279	146
	Share of DB cases	2277.55**	958.87	31'260	193	150
	DB in days (total)	23.09	19.67	17'614	219	124
	Number of accidents	-0.18	1.18	20'446	269	145
	Number of DB cases	1.45**	0.71	15'987	200	114
Manufacture of chemicals and chemical products	Accidents per FTE	-0.01	0.08	10'707	251	195
	DB per case of DB	15.46	28.65	52'936	120	150
	DB per accident	6.48	13.40	38'619	270	260
	DB cases per FTE	0.02	0.05	10'523	246	192
	DB (in CHF) per case	3825.13	4988.32	54'351	120	154
	DB per 1000 CHF of payroll	6.16	5.22	15'375	355	258
	Share of DB cases	-197.20	1357.91	40'212	270	264
	DB in days (total)	6.67	23.89	11'841	274	212
	Number of accidents	0.14	0.72	14'214	324	242
	Number of DB cases	-0.02	0.34	14'976	341	257
Processing and preserving of meat and production of meat products	Accidents per FTE	-0.56*	0.32	149'142	53	72
	DB per case of DB	-10.19	21.80	149'423	14	30
	DB per accident	-16.73	15.37	123'333	21	46
	DB cases per FTE	-0.42	0.29	156'480	53	74
	DB (in CHF) per case	-1632.88	2527.13	147'900	14	30
	DB per 1000 CHF of payroll	-22.41	16.11	134'470	53	72
	Share of DB cases	-381.38	823.10	129'971	21	46
	DB in days (total)	-16.65	66.26	108'084	53	71
	Number of accidents	-2.13	2.27	127'789	53	72
	Number of DB cases	-1.55	1.71	139'017	53	72

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Manufacture of food products	Accidents per FTE	0.02	0.04	33'417	629	467
	DB per case of DB	99.60**	50.78	57'676	102	282
	DB per accident	16.48	21.30	55'624	190	458
	DB cases per FTE	-0.02	0.02	33'567	629	467
	DB (in CHF) per case	16076.94**	7477.56	56'476	102	278
	DB per 1000 CHF of payroll	1.96	3.72	35'114	629	481
	Share of DB cases	300.59	2468.10	61'353	190	476
	DB in days (total)	18.27	20.92	32'908	629	464
	Number of accidents	0.07	0.50	31'182	629	446
	Number of DB cases	-0.46	0.28	29'560	611	428
Cutting, shaping and finishing of stone	Accidents per FTE	-0.22	0.56	7'936	97	67
	DB per case of DB	90.49***	31.18	41'863	92	109
	DB per accident	32.14*	17.57	33'991	196	153
	DB cases per FTE	0.15	0.20	8'004	97	67
	DB (in CHF) per case	16820.32***	5918.96	39'281	92	105
	DB per 1000 CHF of payroll	10.48	20.49	14'630	220	128
	Share of DB cases	2116.52	2015.95	41'917	196	186
	DB in days (total)	105.01***	39.12	16'613	263	145
	Number of accidents	2.93	2.06	12'077	163	101
	Number of DB cases	2.30	1.67	10'151	133	86
Construction of buildings	Accidents per FTE	-0.06	0.06	8'915	4'447	3'490
	DB per case of DB	8.00	8.74	23'280	4'110	2'884
	DB per accident	5.74	6.81	16'708	4'577	3'380
	DB cases per FTE	-0.04	0.04	11'146	5'860	4'246
	DB (in CHF) per case	1245.66	1385.92	22'566	3'942	2'794
	DB per 1000 CHF of payroll	14.25	15.50	10'261	5'278	3'967
	Share of DB cases	-40.30	659.31	17'980	4'976	3'614
	DB in days (total)	4.36	12.66	10'395	5'358	4'021
	Number of accidents	-0.03	0.29	8'747	4'351	3'440
	Number of DB cases	-0.10	0.16	9'757	4'955	3'795

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Forestry and logging	Accidents per FTE	-0.03	0.20	12'697	935	657
	DB per case of DB	82.89	57.21	8'337	111	110
	DB per accident	39.17	32.37	7'982	232	219
	DB cases per FTE	-0.11	0.14	8'347	582	446
	DB (in CHF) per case	5884.56	6826.92	8'244	110	109
	DB per 1000 CHF of payroll	9.82	27.08	8'564	594	457
	Share of DB cases	2903.97	3216.18	9'540	273	257
	DB in days (total)	21.91	24.26	9'900	700	516
	Number of accidents	0.03	0.35	13'963	1'035	729
	Number of DB cases	-0.03	0.21	11'962	878	624
Plastering and painting	Accidents per FTE	0.21*	0.11	7'861	3'184	2'284
	DB per case of DB	-17.47	40.49	13'733	1'251	909
	DB per accident	-28.09	44.47	8'249	1'196	987
	DB cases per FTE	0.09	0.07	8'270	3'394	2'384
	DB (in CHF) per case	-4656.95	7638.07	13'013	1'179	880
	DB per 1000 CHF of payroll	9.42	30.85	8'678	3'607	2'476
	Share of DB cases	-1536.85	4216.61	9'135	1'360	1'078
	DB in days (total)	-4.46	28.52	8'992	3'768	2'561
	Number of accidents	0.35	0.34	10'432	4'486	2'892
	Number of DB cases	0.16	0.27	8'670	3'603	2'475
Roofing activities	Accidents per FTE	-0.28	0.24	10'252	566	546
	DB per case of DB	25.64	32.66	33'567	349	397
	DB per accident	20.68	21.67	22'914	481	486
	DB cases per FTE	-0.12	0.18	8'609	472	483
	DB (in CHF) per case	-1140.18	3105.76	32'508	349	380
	DB per 1000 CHF of payroll	9.40	18.92	13'546	777	677
	Share of DB cases	3152.92	2020.21	23'714	494	511
	DB in days (total)	-7.43	30.35	12'100	687	617
	Number of accidents	-0.82	0.59	13'621	781	678
	Number of DB cases	-0.42	0.52	10'497	580	557

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Laying of floor coverings	Accidents per FTE	0.06	0.09	10'394	995	621
	DB per case of DB	-15.92	20.24	8'680	197	163
	DB per accident	0.45	13.51	12'870	523	414
	DB cases per FTE	0.09	0.06	11'677	1'157	701
	DB (in CHF) per case	-2053.41	2999.45	8'118	181	157
	DB per 1000 CHF of payroll	11.42	11.04	10'417	997	623
	Share of DB cases	-901.41	931.18	12'681	519	407
	DB in days (total)	16.20	15.11	12'747	1'314	753
	Number of accidents	0.28	0.36	11'774	1'175	709
	Number of DB cases	0.26	0.24	10'815	1'045	641
General cleaning of buildings, Facility services	Accidents per FTE	-0.07	0.05	9'186	1'299	932
	DB per case of DB	-144.48	111.41	8'301	308	260
	DB per accident	-209.67*	112.45	5'933	361	323
	DB cases per FTE	-0.11**	0.04	6'773	903	733
	DB (in CHF) per case	-15815.94	17818.67	8'343	308	260
	DB per 1000 CHF of payroll	-50.66	32.38	8'483	1'182	883
	Share of DB cases	-7333.31	5230.07	6'206	376	337
	DB in days (total)	-93.70**	47.34	8'478	1'181	883
	Number of accidents	-0.34	0.34	9'875	1'409	981
	Number of DB cases	-0.51**	0.22	10'507	1'516	1'027
Services to buildings and landscape activities	Accidents per FTE	0.06	0.06	9'972	5'157	3'585
	DB per case of DB	-100.45**	43.70	6'280	770	746
	DB per accident	-29.75**	14.98	6'270	1'608	1'499
	DB cases per FTE	0.02	0.03	12'240	6'647	4'221
	DB (in CHF) per case	-15652.63*	9151.22	6'125	752	735
	DB per 1000 CHF of payroll	-8.15	6.21	9'947	5'141	3'583
	Share of DB cases	-2173.91**	912.53	7'081	1'838	1'702
	DB in days (total)	-24.01	16.59	6'083	2'928	2'296
	Number of accidents	0.56*	0.31	10'679	5'614	3'775
	Number of DB cases	0.15	0.15	11'239	5'975	3'953

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Assembly plants	Accidents per FTE	178.16	115.94	7'853	14	9
	DB per case of DB	110.76*	58.73	22'169	19	5
	DB per accident	82.40	100.20	18'963	20	8
	DB cases per FTE	187.78**	85.50	9'019	16	9
	DB (in CHF) per case	16428.48*	9605.73	20'720	16	5
	DB per 1000 CHF of payroll	1286.38**	559.89	10'456	19	10
	Share of DB cases	12356.86	15625.19	20'308	20	8
	DB in days (total)	477.99*	266.42	12'541	22	11
	Number of accidents	38.29	58.85	5'924	11	8
	Number of DB cases	13.42	22.28	5'412	9	8
Floor and wall covering	Accidents per FTE	0.26	0.21	10'398	1'756	1'203
	DB per case of DB	-22.10	39.37	17'778	625	458
	DB per accident	-24.09	33.42	11'336	675	570
	DB cases per FTE	0.03	0.15	9'178	1'531	1'080
	DB (in CHF) per case	-2451.68	6962.40	16'862	590	437
	DB per 1000 CHF of payroll	-37.78	47.07	11'963	2'075	1'318
	Share of DB cases	-2451.96	3728.75	8'548	509	445
	DB in days (total)	-12.59	34.04	11'906	2'062	1'313
	Number of accidents	0.48	0.53	12'009	2'081	1'320
	Number of DB cases	0.08	0.40	10'070	1'679	1'172
Rail transport, water transport	Accidents per FTE	1.06*	0.59	14'474	172	139
	DB per case of DB	-9.80	59.92	119'572	75	152
	DB per accident	3.28	24.60	95'179	154	202
	DB cases per FTE	0.26	0.16	14'719	178	140
	DB (in CHF) per case	-4621.83	6398.65	119'092	75	152
	DB per 1000 CHF of payroll	0.14	5.66	19'682	269	171
	Share of DB cases	-274.34	952.79	71'986	154	171
	DB in days (total)	42.95	36.51	24'678	374	190
	Number of accidents	2.47**	1.08	19'612	265	170
	Number of DB cases	1.06*	0.58	22'252	313	183

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Passenger transport by cableways, funiculars and ski-tows	Accidents per FTE	0.05	0.13	15'321	264	197
	DB per case of DB	30.79	30.61	58'736	91	210
	DB per accident	4.82	13.13	43'234	205	286
	DB cases per FTE	-0.11	0.09	15'145	261	195
	DB (in CHF) per case	7209.37	4473.07	55'984	91	203
	DB per 1000 CHF of payroll	-1.19	6.99	15'569	268	202
	Share of DB cases	223.47	1674.73	46'777	205	304
	DB in days (total)	56.18	59.23	16'114	279	209
	Number of accidents	0.72	0.70	21'240	487	254
	Number of DB cases	0.31	0.57	18'419	373	227
Freight and passenger transport by road	Accidents per FTE	-0.01	0.03	13'523	4'749	2'692
	DB per case of DB	42.20**	19.49	15'763	1'090	742
	DB per accident	26.25*	14.32	11'437	1'335	1'046
	DB cases per FTE	0.00	0.03	10'408	3'413	2'159
	DB (in CHF) per case	3353.57	2305.41	17'886	1'265	849
	DB per 1000 CHF of payroll	6.26	5.47	11'300	3'809	2'315
	Share of DB cases	2131.46	2717.84	16'358	1'999	1'418
	DB in days (total)	25.22**	12.48	10'838	3'587	2'234
	Number of accidents	0.20	0.17	11'105	3'719	2'276
	Number of DB cases	0.14	0.11	12'508	4'309	2'528
Passenger air transport, airports, maintenance of air vehicles	Accidents per FTE	-0.04	0.14	11'628	213	118
	DB per case of DB	200.01	169.93	48'283	62	44
	DB per accident	86.87	59.19	47'641	194	96
	DB cases per FTE	0.10	0.09	11'897	221	120
	DB (in CHF) per case	40372.30	37177.95	47'658	62	43
	DB per 1000 CHF of payroll	10.38**	4.46	17'578	407	152
	Share of DB cases	14676.24	8925.47	45'075	194	91
	DB in days (total)	10.85	27.41	12'691	243	127
	Number of accidents	-1.21	1.27	11'257	204	115
	Number of DB cases	0.18	0.69	8'229	131	95

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Warehousing and storage, trade	Accidents per FTE	0.03	0.06	10'330	1'716	1'152
	DB per case of DB	18.18	16.27	27'886	968	664
	DB per accident	12.41	16.07	13'080	943	761
	DB cases per FTE	0.01	0.04	9'071	1'460	1'046
	DB (in CHF) per case	4357.87	2999.71	26'694	917	635
	DB per 1000 CHF of payroll	0.35	5.80	12'454	2'232	1'334
	Share of DB cases	1141.96	1489.14	12'553	887	732
	DB in days (total)	4.24	17.93	10'947	1'859	1'209
	Number of accidents	0.65	0.57	8'782	1'399	1'020
	Number of DB cases	0.25	0.28	9'348	1'518	1'074
Recycling	Accidents per FTE	-0.07	0.14	15'184	204	170
	DB per case of DB	-36.06	63.60	44'508	134	119
	DB per accident	-29.75	43.70	38'619	245	186
	DB cases per FTE	-0.04	0.09	16'474	231	174
	DB (in CHF) per case	-4269.32	8471.47	45'812	134	120
	DB per 1000 CHF of payroll	-14.01	13.13	20'378	326	201
	Share of DB cases	-2326.73	2520.81	39'690	245	193
	DB in days (total)	15.39	32.40	14'693	198	164
	Number of accidents	-0.19	0.84	16'085	221	173
	Number of DB cases	0.01	0.55	15'782	217	172
Manufacture of beverages	Accidents per FTE	-0.02	0.10	9'035	424	274
	DB per case of DB	-22.53	34.84	31'108	268	185
	DB per accident	66.48	44.92	9'669	175	133
	DB cases per FTE	0.01	0.06	8'753	409	266
	DB (in CHF) per case	-1600.25	5313.80	33'566	268	196
	DB per 1000 CHF of payroll	6.71	8.55	9'084	426	275
	Share of DB cases	2969.41	2645.39	15'502	294	210
	DB in days (total)	28.02	22.94	7'072	297	220
	Number of accidents	-0.43	0.74	8'762	410	266
	Number of DB cases	0.04	0.41	8'971	419	273

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Electricity, gas, steam and air-conditioning supply	Accidents per FTE	-0.24	0.27	10'641	228	156
	DB per case of DB	71.84*	38.48	29'020	138	151
	DB per accident	64.32*	37.37	19'678	229	209
	DB cases per FTE	0.08	0.18	8'432	180	123
	DB (in CHF) per case	16650.99*	8761.44	28'028	134	143
	DB per 1000 CHF of payroll	35.47	23.42	16'018	372	243
	Share of DB cases	8540.73*	4817.88	16'827	198	177
	DB in days (total)	206.55	138.97	11'727	255	174
	Number of accidents	-1.11	1.93	11'245	245	166
	Number of DB cases	1.17	1.42	9'460	197	140
Power grid construction and maintenance, electricity	Accidents per FTE	0.24***	0.07	5'595	1'532	1'165
	DB per case of DB	-110.63***	40.79	6'942	580	491
	DB per accident	-45.51**	20.23	6'751	1'229	982
	DB cases per FTE	0.07*	0.04	7'881	2'306	1'558
	DB (in CHF) per case	-15993**	6371.83	7'185	610	517
	DB per 1000 CHF of payroll	-3.16	4.25	12'672	3'941	2'393
	Share of DB cases	-2974.34*	1601.77	9'806	1'870	1'400
	DB in days (total)	-20.43	17.97	11'433	3'491	2'185
	Number of accidents	1.80***	0.69	6'450	1'790	1'319
	Number of DB cases	0.31	0.34	9'812	2'966	1'901
Offices	Accidents per FTE	-0.01	0.01	8'279	73	61
	DB per case of DB	-357.62	380.68	15'212	11	12
	DB per accident	-62.01	62.67	12'421	30	30
	DB cases per FTE	0.00	0.01	2'730	27	16
	DB (in CHF) per case	-69091.02	72162.59	16'684	12	15
	DB per 1000 CHF of payroll	-1.58	1.78	11'885	114	82
	Share of DB cases	1571.51	8536.25	8'656	23	19
	DB in days (total)	-31.89	40.37	9'775	88	74
	Number of accidents	-0.05	0.35	11'727	114	82
	Number of DB cases	-0.19	0.15	11'004	103	78

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Architectural and engineering activities and related technical consultancy	Accidents per FTE	0.00	0.02	8'338	1'159	555
	DB per case of DB	-4.10	22.39	11'885	245	120
	DB per accident	-3.20	4.49	9'710	661	298
	DB cases per FTE	0.00	0.01	4'486	508	334
	DB (in CHF) per case	-1011.73	4184.35	10'237	208	107
	DB per 1000 CHF of payroll	-2.72*	1.61	3'272	366	251
	Share of DB cases	-365.58	611.56	6'326	349	205
	DB in days (total)	-2.14	5.05	9'298	1'401	609
	Number of accidents	0.02	0.19	12'364	2'267	752
	Number of DB cases	-0.08	0.07	11'213	1'928	700
Personnel placement	Accidents per FTE	0.01	0.05	17'510	880	392
	DB per case of DB	22.56	15.29	98'522	513	568
	DB per accident	5.74	7.01	90'258	929	726
	DB cases per FTE	-0.03	0.03	22'303	1'380	450
	DB (in CHF) per case	2061.06	2040.17	104'045	513	596
	DB per 1000 CHF of payroll	-5.12	3.32	20'176	1'114	424
	Share of DB cases	-37.22	391.99	76'419	929	662
	DB in days (total)	-38.12	36.81	16'621	792	376
	Number of accidents	-0.69	1.17	17'897	904	398
	Number of DB cases	-0.67	0.63	16'877	812	380
Social institutions and training workshops	Accidents per FTE	-0.07	0.10	9'055	206	129
	DB per case of DB	3.79	16.99	9'811	143	97
	DB per accident	3.57	7.26	10'552	223	142
	DB cases per FTE	-0.01	0.05	7'826	174	116
	DB (in CHF) per case	-1440.51	2604.97	9'551	142	94
	DB per 1000 CHF of payroll	0.16	1.78	10'365	240	148
	Share of DB cases	400.90	905.57	9'878	202	133
	DB in days (total)	-1.78	61.87	12'012	288	167
	Number of accidents	-0.18	6.17	12'009	288	167
	Number of DB cases	-0.69	2.19	10'048	226	141

Industry	Variable	Robust estimation	Std. Error	Bandwidth	# of obs below	# of obs above
Other industry	Accidents per FTE	0.06	0.08	23'098	491	413
	DB per case of DB	9.68	49.63	61'716	81	191
	DB per accident	14.67	24.21	39'082	170	314
	DB cases per FTE	-0.03	0.04	27'566	559	471
	DB (in CHF) per case	2682.20	8048.49	61'332	81	190
	DB per 1000 CHF of payroll	8.61	15.27	24'339	512	433
	Share of DB cases	13.32	1995.79	38'019	170	306
	DB in days (total)	-0.59	22.81	26'343	543	455
	Number of accidents	0.44	0.48	24'326	512	433
	Number of DB cases	0.00	0.22	25'919	537	451

Notes: Estimates are based on local linear regression within the indicated windows. Optimal bandwidth is chosen by one common MSE-optimal bandwidth selector across both sides of the threshold for the RD treatment effect estimator. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B Appendix 2

B1 Descriptive statistics of the samples used

B1.1 Overall sample

Observations with DP (N=17'385)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	70'659	20'196	70'200	10'050	148'200
Tenure	9	11	5	0	67
Age	47	11	49	15	83
Number of employees in firm	1'267	5'578	45	0	43'312
Daily cash benefits in days (6 months)	126	53	141	0	188
Daily cash benefits in days (12 months)	268	98	305	0	365
Daily cash benefits in days (24 months)	484	199	511	1	730
Daily cash benefits (6 months)	18'982	10'050	19'917	0	59'280
Daily cash benefits (12 months)	40'260	18'894	42'347	0	118'560
Daily cash benefits (24 months)	72'564	36'187	72'908	124	220'277
Treatment costs (6 months)	23'287	43'314	8'275	0	468'151
Treatment costs (12 months)	41'945	75'104	16'686	0	963'770
Treatment costs (24 months)	60'247	98'796	30'796	0	1'268'214
Unemployed	11'512	6'250	9'811	36	25'001
Occupational position: Higher cadre	0.04	0.21	0	0	1
Occupational position: Middle cadre	0.03	0.17	0	0	1
Occupational position: Employee / worker	0.82	0.39	1	0	1
Occupational position: Trained	0.05	0.22	0	0	1
Occupational position: Unskilled	0.02	0.15	0	0	1
Occupational position: Apprentice	0.01	0.11	0	0	1
Occupational position: Volunteer, Intern	0.00	0.04	0	0	1
Occupational position: Traveller, representative	0.00	0.01	0	0	1
Occupational position: unknown	0.02	0.14	0	0	1
Gender: Male	0.90	0.30	1	0	1
Gender: Female	0.10	0.30	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.39	0.49	0	0	1
Region: Western CH	0.31	0.46	0	0	1
Injury type: Bite	0.00	0.03	0	0	1
Injury type: Fracture	0.25	0.43	0	0	1
Injury type: Inflammation	0.01	0.11	0	0	1
Injury type: Contusion	0.08	0.28	0	0	1
Injury type: Bruise	0.04	0.19	0	0	1
Injury type: Crack	0.07	0.25	0	0	1
Injury type: Cut	0.02	0.15	0	0	1
Injury type: Shot	0.00	0.03	0	0	1
Injury type: Swelling	0.01	0.08	0	0	1
Injury type: Abrasion	0.00	0.04	0	0	1
Injury type: Compression of the spine	0.01	0.08	0	0	1
Injury type: Stitch	0.00	0.04	0	0	1
Injury type: Separation/separation	0.01	0.10	0	0	1
Injury type: Incineration	0.00	0.06	0	0	1
Injury type: Sprain/twist	0.03	0.18	0	0	1
Injury type: Poisoning	0.00	0.02	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.03	0.16	0	0	1
Injury type: Other injury	0.41	0.49	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injury type: Foreign matter	0.00	0.06	0	0	1
Injury type: Dislocation	0.02	0.13	0	0	1
Injured body part: Skull	0.06	0.24	0	0	1
Injured body part: Face	0.01	0.08	0	0	1
Injured body part: Eye	0.01	0.09	0	0	1
Injured body part: Nose	0.00	0.03	0	0	1
Injured body part: Ear	0.00	0.03	0	0	1
Injured body part: Teeth	0.00	0.02	0	0	1
Injured body part: Pine	0.00	0.02	0	0	1
Injured body part: Neck	0.00	0.05	0	0	1
Injured body part: Back	0.06	0.24	0	0	1
Injured body part: Chest	0.01	0.11	0	0	1
Injured body part: Cervical spine	0.01	0.12	0	0	1
Injured body part: Thoracic spine	0.01	0.08	0	0	1
Injured body part: Lumbar spine	0.01	0.10	0	0	1
Injured body part: Shoulder	0.20	0.40	0	0	1
Injured body part: Upper arm	0.04	0.19	0	0	1
Injured body part: Elbows	0.02	0.13	0	0	1
Injured body part: Forearm	0.02	0.14	0	0	1
Injured body part: Wrist	0.06	0.24	0	0	1
Injured body part: Metacarpus	0.03	0.16	0	0	1
Injured body part: Finger	0.04	0.20	0	0	1
Injured body part: Several areas of the upper extremities	0.01	0.09	0	0	1
Injured body part: Basins	0.01	0.11	0	0	1
Injured body part: Hip joint	0.01	0.09	0	0	1
Injured body part: Coccyx	0.00	0.04	0	0	1
Injured body part: Bar	0.00	0.01	0	0	1
Injured body part: Genitalia	0.00	0.01	0	0	1
Injured body part: Belly	0.00	0.03	0	0	1
Injured body part: Thigh	0.01	0.12	0	0	1
Injured body part: Knee	0.12	0.33	0	0	1
Injured body part: Lower leg	0.05	0.21	0	0	1
Injured body part: Ankle	0.06	0.24	0	0	1
Injured body part: Middle foot	0.03	0.18	0	0	1
Injured body part: Toes	0.00	0.05	0	0	1
Injured body part: Several areas of the lower extremities	0.01	0.08	0	0	1
Injured body part: Internal injury	0.01	0.08	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.01	0.08	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.02	0	0	1
Injured body part: Kidney	0.00	0.01	0	0	1
Injured body part: Bubble	0.00	0.01	0	0	1
Injured body part: Polyblesse	0.07	0.25	0	0	1
Injured body part: Death	0.00	0.01	0	0	1
Injured body part: Shock	0.00	0.04	0	0	1
Injured body part: Whole body (systemic effect)	0.01	0.11	0	0	1
Injured body part: open	0.00	0.04	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.04	0	0	1
Work-related accident	0.56	0.50	1	0	1
Non-work-related accident	0.44	0.50	0	0	1
NOGA: Agriculture, forestry and fishing	0.00	0.07	0	0	1
NOGA: Mining and quarrying	0.01	0.07	0	0	1
NOGA: Manufacturing	0.24	0.43	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.08	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.10	0	0	1
NOGA: Construction	0.36	0.48	0	0	1
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.09	0.29	0	0	1
NOGA: Transportation and storage	0.09	0.28	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.07	0	0	1
NOGA: Financial and insurance activities	0.01	0.09	0	0	1
NOGA: Real estate activities	0.01	0.08	0	0	1
NOGA: Professional, scientific and technical activities	0.02	0.16	0	0	1
NOGA: Administrative and support service activities	0.11	0.31	0	0	1
NOGA: Public administration and defence; compulsory social security	0.03	0.16	0	0	1
NOGA: Education	0.01	0.07	0	0	1
NOGA: Human health and social work activities	0.01	0.10	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.02	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1

Observations without DP (N=2126147)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	63'122	25'131	63'900	10'001	148'200
Tenure	7	9	3	0	64
Age	38	13	37	12	94
Number of employees in firm	1'734	6'241	79	0	43'312
Daily cash benefits in days (6 months)	27	34	13	0	188
Daily cash benefits in days (12 months)	32	50	14	0	365
Daily cash benefits in days (24 months)	35	66	14	1	730
Daily cash benefits (6 months)	3'732	5'314	1'618	0	59'280
Daily cash benefits (12 months)	4'479	7'545	1'722	0	118'560
Daily cash benefits (24 months)	4'940	9'752	1'760	0	237'120
Treatment costs (6 months)	1'970	5'015	588	0	450'585
Treatment costs (12 months)	2'570	7'115	647	0	819'033
Treatment costs (24 months)	2'958	8'966	663	0	2'132'922
Unemployed	12'011	6'497	11'306	36	25'001
Occupational position: Higher cadre	0.03	0.17	0	0	1
Occupational position: Middle cadre	0.03	0.18	0	0	1
Occupational position: Employee / worker	0.80	0.40	1	0	1
Occupational position: Trained	0.02	0.16	0	0	1
Occupational position: Unskilled	0.01	0.12	0	0	1
Occupational position: Apprentice	0.07	0.26	0	0	1
Occupational position: Volunteer, Intern	0.00	0.06	0	0	1
Occupational position: Traveller, representative	0.00	0.02	0	0	1
Occupational position: unknown	0.02	0.13	0	0	1
Gender: Male	0.83	0.38	1	0	1
Gender: Female	0.17	0.38	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.40	0.49	0	0	1
Region: Western CH	0.30	0.46	0	0	1
Injury type: Bite	0.00	0.06	0	0	1
Injury type: Fracture	0.12	0.32	0	0	1
Injury type: Inflammation	0.02	0.14	0	0	1
Injury type: Contusion	0.13	0.34	0	0	1
Injury type: Bruise	0.06	0.24	0	0	1
Injury type: Crack	0.08	0.26	0	0	1
Injury type: Cut	0.08	0.28	0	0	1
Injury type: Shot	0.00	0.02	0	0	1
Injury type: Swelling	0.01	0.11	0	0	1
Injury type: Abrasion	0.01	0.09	0	0	1
Injury type: Compression of the spine	0.01	0.11	0	0	1
Injury type: Stitch	0.01	0.08	0	0	1
Injury type: Separation/separation	0.00	0.05	0	0	1
Injury type: Incineration	0.01	0.10	0	0	1
Injury type: Sprain/twist	0.08	0.27	0	0	1
Injury type: Poisoning	0.00	0.03	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.05	0.21	0	0	1
Injury type: Other injury	0.30	0.46	0	0	1
Injury type: Foreign matter	0.01	0.11	0	0	1
Injury type: Dislocation	0.02	0.15	0	0	1
Injured body part: Skull	0.03	0.16	0	0	1
Injured body part: Face	0.01	0.11	0	0	1
Injured body part: Eye	0.02	0.13	0	0	1
Injured body part: Nose	0.00	0.07	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Ear	0.00	0.04	0	0	1
Injured body part: Teeth	0.00	0.04	0	0	1
Injured body part: Pine	0.00	0.04	0	0	1
Injured body part: Neck	0.01	0.08	0	0	1
Injured body part: Back	0.05	0.22	0	0	1
Injured body part: Chest	0.04	0.20	0	0	1
Injured body part: Cervical spine	0.02	0.13	0	0	1
Injured body part: Thoracic spine	0.00	0.05	0	0	1
Injured body part: Lumbar spine	0.00	0.06	0	0	1
Injured body part: Shoulder	0.07	0.26	0	0	1
Injured body part: Upper arm	0.02	0.13	0	0	1
Injured body part: Elbows	0.02	0.14	0	0	1
Injured body part: Forearm	0.02	0.13	0	0	1
Injured body part: Wrist	0.05	0.22	0	0	1
Injured body part: Metacarpus	0.06	0.23	0	0	1
Injured body part: Finger	0.14	0.35	0	0	1
Injured body part: Several areas of the upper extremities	0.00	0.07	0	0	1
Injured body part: Basins	0.00	0.07	0	0	1
Injured body part: Hip joint	0.01	0.07	0	0	1
Injured body part: Coccyx	0.01	0.08	0	0	1
Injured body part: Bar	0.00	0.04	0	0	1
Injured body part: Genitalia	0.00	0.03	0	0	1
Injured body part: Belly	0.00	0.04	0	0	1
Injured body part: Thigh	0.02	0.13	0	0	1
Injured body part: Knee	0.13	0.33	0	0	1
Injured body part: Lower leg	0.04	0.19	0	0	1
Injured body part: Ankle	0.12	0.33	0	0	1
Injured body part: Middle foot	0.05	0.22	0	0	1
Injured body part: Toes	0.02	0.15	0	0	1
Injured body part: Several areas of the lower extremities	0.00	0.05	0	0	1
Injured body part: Internal injury	0.00	0.04	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.00	0.03	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.01	0	0	1
Injured body part: Kidney	0.00	0.02	0	0	1
Injured body part: Bubble	0.00	0.00	0	0	1
Injured body part: Polyblesse	0.01	0.12	0	0	1
Injured body part: Death	0.00	0.00	0	0	1
Injured body part: Shock	0.00	0.03	0	0	1
Injured body part: Whole body (systemic effect)	0.00	0.06	0	0	1
Injured body part: open	0.00	0.03	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.02	0	0	1
Work-related accident	0.42	0.49	0	0	1
Non-work-related accident	0.58	0.49	1	0	1
NOGA: Agriculture, forestry and fishing	0.01	0.07	0	0	1
NOGA: Mining and quarrying	0.00	0.05	0	0	1
NOGA: Manufacturing	0.28	0.45	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.10	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.09	0	0	1
NOGA: Construction	0.24	0.43	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.12	0.33	0	0	1
NOGA: Transportation and storage	0.10	0.30	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.10	0	0	1
NOGA: Financial and insurance activities	0.01	0.10	0	0	1
NOGA: Real estate activities	0.01	0.08	0	0	1
NOGA: Professional, scientific and technical activities	0.04	0.18	0	0	1
NOGA: Administrative and support service activities	0.10	0.30	0	0	1
NOGA: Public administration and defence; compulsory social security	0.04	0.19	0	0	1
NOGA: Education	0.01	0.09	0	0	1
NOGA: Human health and social work activities	0.02	0.12	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.03	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1

B1.2 Sample with 90 percent disability pensions

Observations with DP (N=15760)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	70'665	20'202	70'200	10'050	148'200
Tenure	9	11	5	0	67
Age	47	11	49	15	83
Number of employees in firm	1'266	5'575	45	0	43'312
Daily cash benefits in days (6 months)	126	53	141	0	188
Daily cash benefits in days (12 months)	268	98	305	0	365
Daily cash benefits in days (24 months)	484	199	511	1	730
Daily cash benefits (6 months)	18'982	10'052	19'923	0	59'280
Daily cash benefits (12 months)	40'258	18'898	42'344	0	118'560
Daily cash benefits (24 months)	72'552	36'200	72'889	124	220'277
Treatment costs (6 months)	23'289	43'298	8'273	0	468'151
Treatment costs (12 months)	41'949	75'116	16'684	0	963'770
Treatment costs (24 months)	60'262	98'825	30'768	0	1'268'214
Unemployed	11'511	6'249	9'811	36	25'001
Occupational position: Higher cadre	0.04	0.21	0	0	1
Occupational position: Middle cadre	0.03	0.17	0	0	1
Occupational position: Employee / worker	0.82	0.39	1	0	1
Occupational position: Trained	0.05	0.22	0	0	1
Occupational position: Unskilled	0.02	0.15	0	0	1
Occupational position: Apprentice	0.01	0.11	0	0	1
Occupational position: Volunteer, Intern	0.00	0.04	0	0	1
Occupational position: Traveller, representative	0.00	0.01	0	0	1
Occupational position: unknown	0.02	0.14	0	0	1
Gender: Male	0.90	0.30	1	0	1
Gender: Female	0.10	0.30	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.39	0.49	0	0	1
Region: Western CH	0.31	0.46	0	0	1
Injury type: Bite	0.00	0.03	0	0	1
Injury type: Fracture	0.25	0.43	0	0	1
Injury type: Inflammation	0.01	0.11	0	0	1
Injury type: Contusion	0.08	0.28	0	0	1
Injury type: Bruise	0.04	0.19	0	0	1
Injury type: Crack	0.07	0.25	0	0	1
Injury type: Cut	0.02	0.15	0	0	1
Injury type: Shot	0.00	0.03	0	0	1
Injury type: Swelling	0.01	0.08	0	0	1
Injury type: Abrasion	0.00	0.04	0	0	1
Injury type: Compression of the spine	0.01	0.08	0	0	1
Injury type: Stitch	0.00	0.04	0	0	1
Injury type: Separation/separation	0.01	0.10	0	0	1
Injury type: Incineration	0.00	0.06	0	0	1
Injury type: Sprain/twist	0.03	0.18	0	0	1
Injury type: Poisoning	0.00	0.02	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.03	0.16	0	0	1
Injury type: Other injury	0.41	0.49	0	0	1
Injury type: Foreign matter	0.00	0.06	0	0	1
Injury type: Dislocation	0.02	0.13	0	0	1
Injured body part: Skull	0.06	0.24	0	0	1
Injured body part: Face	0.01	0.08	0	0	1
Injured body part: Eye	0.01	0.09	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Nose	0.00	0.03	0	0	1
Injured body part: Ear	0.00	0.03	0	0	1
Injured body part: Teeth	0.00	0.02	0	0	1
Injured body part: Pine	0.00	0.02	0	0	1
Injured body part: Neck	0.00	0.05	0	0	1
Injured body part: Back	0.06	0.24	0	0	1
Injured body part: Chest	0.01	0.11	0	0	1
Injured body part: Cervical spine	0.01	0.12	0	0	1
Injured body part: Thoracic spine	0.01	0.08	0	0	1
Injured body part: Lumbar spine	0.01	0.10	0	0	1
Injured body part: Shoulder	0.20	0.40	0	0	1
Injured body part: Upper arm	0.04	0.19	0	0	1
Injured body part: Elbows	0.02	0.13	0	0	1
Injured body part: Forearm	0.02	0.14	0	0	1
Injured body part: Wrist	0.06	0.24	0	0	1
Injured body part: Metacarpus	0.03	0.16	0	0	1
Injured body part: Finger	0.04	0.20	0	0	1
Injured body part: Several areas of the upper extremities	0.01	0.09	0	0	1
Injured body part: Basins	0.01	0.11	0	0	1
Injured body part: Hip joint	0.01	0.09	0	0	1
Injured body part: Coccyx	0.00	0.04	0	0	1
Injured body part: Bar	0.00	0.01	0	0	1
Injured body part: Genitalia	0.00	0.01	0	0	1
Injured body part: Belly	0.00	0.03	0	0	1
Injured body part: Thigh	0.01	0.12	0	0	1
Injured body part: Knee	0.12	0.33	0	0	1
Injured body part: Lower leg	0.05	0.21	0	0	1
Injured body part: Ankle	0.06	0.24	0	0	1
Injured body part: Middle foot	0.03	0.18	0	0	1
Injured body part: Toes	0.00	0.05	0	0	1
Injured body part: Several areas of the lower extremities	0.01	0.08	0	0	1
Injured body part: Internal injury	0.01	0.08	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.01	0.08	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.02	0	0	1
Injured body part: Kidney	0.00	0.01	0	0	1
Injured body part: Bubble	0.00	0.01	0	0	1
Injured body part: Polyblesse	0.07	0.25	0	0	1
Injured body part: Death	0.00	0.01	0	0	1
Injured body part: Shock	0.00	0.04	0	0	1
Injured body part: Whole body (systemic effect)	0.01	0.11	0	0	1
Injured body part: open	0.00	0.04	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.04	0	0	1
Work-related accident	0.56	0.50	1	0	1
Non-work-related accident	0.44	0.50	0	0	1
NOGA: Agriculture, forestry and fishing	0.00	0.07	0	0	1
NOGA: Mining and quarrying	0.01	0.07	0	0	1
NOGA: Manufacturing	0.24	0.43	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.08	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.10	0	0	1
NOGA: Construction	0.36	0.48	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.09	0.29	0	0	1
NOGA: Transportation and storage	0.09	0.28	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.07	0	0	1
NOGA: Financial and insurance activities	0.01	0.09	0	0	1
NOGA: Real estate activities	0.01	0.08	0	0	1
NOGA: Professional, scientific and technical activities	0.02	0.16	0	0	1
NOGA: Administrative and support service activities	0.11	0.31	0	0	1
NOGA: Public administration and defence; compulsory social security	0.03	0.16	0	0	1
NOGA: Education	0.01	0.07	0	0	1
NOGA: Human health and social work activities	0.01	0.10	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.02	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1
NOGA: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.00	0	0	0

Observations without DP (N=1751)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	63'152	25'078	64'006	10'004	148'200
Tenure	7	9	3	0	62
Age	38	13	37	14	90
Number of employees in firm	1'720	6'208	80	0	43'312
Daily cash benefits in days (6 months)	27	35	13	0	188
Daily cash benefits in days (12 months)	32	50	14	0	365
Daily cash benefits in days (24 months)	35	65	14	1	730
Daily cash benefits (6 months)	3'733	5'309	1'618	0	59'280
Daily cash benefits (12 months)	4'477	7'495	1'730	0	96'394
Daily cash benefits (24 months)	4'923	9'559	1'765	0	178'079
Treatment costs (6 months)	1'932	4'595	588	0	208'804
Treatment costs (12 months)	2'543	6'771	646	0	515'378
Treatment costs (24 months)	2'920	8'278	662	0	725'143
Unemployed	12'048	6'511	12'191	36	25'001
Occupational position: Higher cadre	0.03	0.17	0	0	1
Occupational position: Middle cadre	0.04	0.18	0	0	1
Occupational position: Employee / worker	0.80	0.40	1	0	1
Occupational position: Trained	0.02	0.16	0	0	1
Occupational position: Unskilled	0.01	0.12	0	0	1
Occupational position: Apprentice	0.07	0.26	0	0	1
Occupational position: Volunteer, Intern	0.00	0.06	0	0	1
Occupational position: Traveller, representative	0.00	0.02	0	0	1
Occupational position: unknown	0.02	0.13	0	0	1
Gender: Male	0.83	0.38	1	0	1
Gender: Female	0.17	0.38	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.40	0.49	0	0	1
Region: Western CH	0.30	0.46	0	0	1
Injury type: Bite	0.00	0.06	0	0	1
Injury type: Fracture	0.12	0.32	0	0	1
Injury type: Inflammation	0.02	0.14	0	0	1
Injury type: Contusion	0.13	0.34	0	0	1
Injury type: Bruise	0.06	0.24	0	0	1
Injury type: Crack	0.08	0.26	0	0	1
Injury type: Cut	0.09	0.28	0	0	1
Injury type: Shot	0.00	0.02	0	0	1
Injury type: Swelling	0.01	0.11	0	0	1
Injury type: Abrasion	0.01	0.09	0	0	1
Injury type: Compression of the spine	0.01	0.11	0	0	1
Injury type: Stitch	0.01	0.08	0	0	1
Injury type: Separation/separation	0.00	0.06	0	0	1
Injury type: Incineration	0.01	0.10	0	0	1
Injury type: Sprain/twist	0.08	0.26	0	0	1
Injury type: Poisoning	0.00	0.03	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.05	0.21	0	0	1
Injury type: Other injury	0.30	0.46	0	0	1
Injury type: Foreign matter	0.01	0.11	0	0	1
Injury type: Dislocation	0.02	0.14	0	0	1
Injured body part: Skull	0.03	0.17	0	0	1
Injured body part: Face	0.01	0.11	0	0	1
Injured body part: Eye	0.02	0.13	0	0	1
Injured body part: Nose	0.00	0.07	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Ear	0.00	0.04	0	0	1
Injured body part: Teeth	0.00	0.04	0	0	1
Injured body part: Pine	0.00	0.04	0	0	1
Injured body part: Neck	0.01	0.08	0	0	1
Injured body part: Back	0.05	0.22	0	0	1
Injured body part: Chest	0.04	0.20	0	0	1
Injured body part: Cervical spine	0.02	0.13	0	0	1
Injured body part: Thoracic spine	0.00	0.05	0	0	1
Injured body part: Lumbar spine	0.00	0.06	0	0	1
Injured body part: Shoulder	0.07	0.26	0	0	1
Injured body part: Upper arm	0.02	0.13	0	0	1
Injured body part: Elbows	0.02	0.14	0	0	1
Injured body part: Forearm	0.02	0.14	0	0	1
Injured body part: Wrist	0.05	0.22	0	0	1
Injured body part: Metacarpus	0.05	0.23	0	0	1
Injured body part: Finger	0.15	0.35	0	0	1
Injured body part: Several areas of the upper extremities	0.00	0.07	0	0	1
Injured body part: Basins	0.00	0.07	0	0	1
Injured body part: Hip joint	0.01	0.07	0	0	1
Injured body part: Coccyx	0.01	0.07	0	0	1
Injured body part: Bar	0.00	0.04	0	0	1
Injured body part: Genitalia	0.00	0.03	0	0	1
Injured body part: Belly	0.00	0.04	0	0	1
Injured body part: Thigh	0.02	0.13	0	0	1
Injured body part: Knee	0.12	0.33	0	0	1
Injured body part: Lower leg	0.04	0.20	0	0	1
Injured body part: Ankle	0.12	0.33	0	0	1
Injured body part: Middle foot	0.05	0.22	0	0	1
Injured body part: Toes	0.02	0.16	0	0	1
Injured body part: Several areas of the lower extremities	0.00	0.05	0	0	1
Injured body part: Internal injury	0.00	0.04	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.00	0.03	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.01	0	0	1
Injured body part: Kidney	0.00	0.02	0	0	1
Injured body part: Bubble	0.00	0.00	0	0	1
Injured body part: Polyblesse	0.01	0.12	0	0	1
Injured body part: Death	0.00	0.00	0	0	1
Injured body part: Shock	0.00	0.03	0	0	1
Injured body part: Whole body (systemic effect)	0.00	0.06	0	0	1
Injured body part: open	0.00	0.03	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.02	0	0	1
Work-related accident	0.43	0.49	0	0	1
Non-work-related accident	0.57	0.49	1	0	1
NOGA: Agriculture, forestry and fishing	0.01	0.07	0	0	1
NOGA: Mining and quarrying	0.00	0.05	0	0	1
NOGA: Manufacturing	0.28	0.45	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.10	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.09	0	0	1
NOGA: Construction	0.24	0.43	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.12	0.33	0	0	1
NOGA: Transportation and storage	0.10	0.30	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.10	0	0	1
NOGA: Financial and insurance activities	0.01	0.10	0	0	1
NOGA: Real estate activities	0.01	0.07	0	0	1
NOGA: Professional, scientific and technical activities	0.03	0.18	0	0	1
NOGA: Administrative and support service activities	0.10	0.30	0	0	1
NOGA: Public administration and defence; compulsory social security	0.04	0.19	0	0	1
NOGA: Education	0.01	0.09	0	0	1
NOGA: Human health and social work activities	0.02	0.12	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.03	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1
NOGA: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.00	0	0	0

B1.3 Sample with 75 percent disability pensions

Observations with DP (N=15760)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	70'665	20'202	70'200	10'050	148'200
Tenure	9	11	5	0	67
Age	47	11	49	15	83
Number of employees in firm	1'266	5'575	45	0	43'312
Daily cash benefits in days (6 months)	126	53	141	0	188
Daily cash benefits in days (12 months)	268	98	305	0	365
Daily cash benefits in days (24 months)	484	199	511	1	730
Daily cash benefits (6 months)	18'982	10'052	19'923	0	59'280
Daily cash benefits (12 months)	40'258	18'898	42'344	0	118'560
Daily cash benefits (24 months)	72'552	36'200	72'889	124	220'277
Treatment costs (6 months)	23'289	43'298	8'273	0	468'151
Treatment costs (12 months)	41'949	75'116	16'684	0	963'770
Treatment costs (24 months)	60'262	98'825	30'768	0	1'268'214
Unemployed	11'511	6'249	9'811	36	25'001
Occupational position: Higher cadre	0.04	0.21	0	0	1
Occupational position: Middle cadre	0.03	0.17	0	0	1
Occupational position: Employee / worker	0.82	0.39	1	0	1
Occupational position: Trained	0.05	0.22	0	0	1
Occupational position: Unskilled	0.02	0.15	0	0	1
Occupational position: Apprentice	0.01	0.11	0	0	1
Occupational position: Volunteer, Intern	0.00	0.04	0	0	1
Occupational position: Traveller, representative	0.00	0.01	0	0	1
Occupational position: unknown	0.02	0.14	0	0	1
Gender: Male	0.90	0.30	1	0	1
Gender: Female	0.10	0.30	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.39	0.49	0	0	1
Region: Western CH	0.31	0.46	0	0	1
Injury type: Bite	0.00	0.03	0	0	1
Injury type: Fracture	0.25	0.43	0	0	1
Injury type: Inflammation	0.01	0.11	0	0	1
Injury type: Contusion	0.08	0.28	0	0	1
Injury type: Bruise	0.04	0.19	0	0	1
Injury type: Crack	0.07	0.25	0	0	1
Injury type: Cut	0.02	0.15	0	0	1
Injury type: Shot	0.00	0.03	0	0	1
Injury type: Swelling	0.01	0.08	0	0	1
Injury type: Abrasion	0.00	0.04	0	0	1
Injury type: Compression of the spine	0.01	0.08	0	0	1
Injury type: Stitch	0.00	0.04	0	0	1
Injury type: Separation/separation	0.01	0.10	0	0	1
Injury type: Incineration	0.00	0.06	0	0	1
Injury type: Sprain/twist	0.03	0.18	0	0	1
Injury type: Poisoning	0.00	0.02	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.03	0.16	0	0	1
Injury type: Other injury	0.41	0.49	0	0	1
Injury type: Foreign matter	0.00	0.06	0	0	1
Injury type: Dislocation	0.02	0.13	0	0	1
Injured body part: Skull	0.06	0.24	0	0	1
Injured body part: Face	0.01	0.08	0	0	1
Injured body part: Eye	0.01	0.09	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Nose	0.00	0.03	0	0	1
Injured body part: Ear	0.00	0.03	0	0	1
Injured body part: Teeth	0.00	0.02	0	0	1
Injured body part: Pine	0.00	0.02	0	0	1
Injured body part: Neck	0.00	0.05	0	0	1
Injured body part: Back	0.06	0.24	0	0	1
Injured body part: Chest	0.01	0.11	0	0	1
Injured body part: Cervical spine	0.01	0.12	0	0	1
Injured body part: Thoracic spine	0.01	0.08	0	0	1
Injured body part: Lumbar spine	0.01	0.10	0	0	1
Injured body part: Shoulder	0.20	0.40	0	0	1
Injured body part: Upper arm	0.04	0.19	0	0	1
Injured body part: Elbows	0.02	0.13	0	0	1
Injured body part: Forearm	0.02	0.14	0	0	1
Injured body part: Wrist	0.06	0.24	0	0	1
Injured body part: Metacarpus	0.03	0.16	0	0	1
Injured body part: Finger	0.04	0.20	0	0	1
Injured body part: Several areas of the upper extremities	0.01	0.09	0	0	1
Injured body part: Basins	0.01	0.11	0	0	1
Injured body part: Hip joint	0.01	0.09	0	0	1
Injured body part: Coccyx	0.00	0.04	0	0	1
Injured body part: Bar	0.00	0.01	0	0	1
Injured body part: Genitalia	0.00	0.01	0	0	1
Injured body part: Belly	0.00	0.03	0	0	1
Injured body part: Thigh	0.01	0.12	0	0	1
Injured body part: Knee	0.12	0.33	0	0	1
Injured body part: Lower leg	0.05	0.21	0	0	1
Injured body part: Ankle	0.06	0.24	0	0	1
Injured body part: Middle foot	0.03	0.18	0	0	1
Injured body part: Toes	0.00	0.05	0	0	1
Injured body part: Several areas of the lower extremities	0.01	0.08	0	0	1
Injured body part: Internal injury	0.01	0.08	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.01	0.08	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.02	0	0	1
Injured body part: Kidney	0.00	0.01	0	0	1
Injured body part: Bubble	0.00	0.01	0	0	1
Injured body part: Polyblesse	0.07	0.25	0	0	1
Injured body part: Death	0.00	0.01	0	0	1
Injured body part: Shock	0.00	0.04	0	0	1
Injured body part: Whole body (systemic effect)	0.01	0.11	0	0	1
Injured body part: open	0.00	0.04	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.04	0	0	1
Work-related accident	0.56	0.50	1	0	1
Non-work-related accident	0.44	0.50	0	0	1
NOGA: Agriculture, forestry and fishing	0.00	0.07	0	0	1
NOGA: Mining and quarrying	0.01	0.07	0	0	1
NOGA: Manufacturing	0.24	0.43	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.08	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.10	0	0	1
NOGA: Construction	0.36	0.48	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.09	0.29	0	0	1
NOGA: Transportation and storage	0.09	0.28	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.07	0	0	1
NOGA: Financial and insurance activities	0.01	0.09	0	0	1
NOGA: Real estate activities	0.01	0.08	0	0	1
NOGA: Professional, scientific and technical activities	0.02	0.16	0	0	1
NOGA: Administrative and support service activities	0.11	0.31	0	0	1
NOGA: Public administration and defence; compulsory social security	0.03	0.16	0	0	1
NOGA: Education	0.01	0.07	0	0	1
NOGA: Human health and social work activities	0.01	0.10	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.02	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1
NOGA: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.00	0	0	0

Observations without DP (N=5'253)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	63'147	25'154	63'981	10'001	148'200
Tenure	7	9	3	0	64
Age	38	13	37	13	90
Number of employees in firm	1'727	6'217	80	0	43'312
Daily cash benefits in days (6 months)	27	34	13	0	188
Daily cash benefits in days (12 months)	32	50	14	0	365
Daily cash benefits in days (24 months)	35	66	14	1	730
Daily cash benefits (6 months)	3'729	5'314	1'618	0	59'280
Daily cash benefits (12 months)	4'477	7'549	1'724	0	117'624
Daily cash benefits (24 months)	4'941	9'781	1'760	0	217'369
Treatment costs (6 months)	1'955	5'101	587	0	450'585
Treatment costs (12 months)	2'559	7'436	645	0	691'900
Treatment costs (24 months)	2'950	9'670	660	0	1'625'863
Unemployed	12'014	6'504	11'306	36	25'001
Occupational position: Higher cadre	0.03	0.17	0	0	1
Occupational position: Middle cadre	0.03	0.18	0	0	1
Occupational position: Employee / worker	0.80	0.40	1	0	1
Occupational position: Trained	0.02	0.15	0	0	1
Occupational position: Unskilled	0.01	0.12	0	0	1
Occupational position: Apprentice	0.07	0.26	0	0	1
Occupational position: Volunteer, Intern	0.00	0.06	0	0	1
Occupational position: Traveller, representative	0.00	0.02	0	0	1
Occupational position: unknown	0.02	0.13	0	0	1
Gender: Male	0.83	0.38	1	0	1
Gender: Female	0.17	0.38	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.40	0.49	0	0	1
Region: Western CH	0.29	0.46	0	0	1
Injury type: Bite	0.00	0.06	0	0	1
Injury type: Fracture	0.12	0.32	0	0	1
Injury type: Inflammation	0.02	0.14	0	0	1
Injury type: Contusion	0.13	0.34	0	0	1
Injury type: Bruise	0.06	0.24	0	0	1
Injury type: Crack	0.08	0.26	0	0	1
Injury type: Cut	0.09	0.28	0	0	1
Injury type: Shot	0.00	0.02	0	0	1
Injury type: Swelling	0.01	0.11	0	0	1
Injury type: Abrasion	0.01	0.09	0	0	1
Injury type: Compression of the spine	0.01	0.11	0	0	1
Injury type: Stitch	0.01	0.08	0	0	1
Injury type: Separation/separation	0.00	0.06	0	0	1
Injury type: Incineration	0.01	0.10	0	0	1
Injury type: Sprain/twist	0.08	0.27	0	0	1
Injury type: Poisoning	0.00	0.03	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.05	0.21	0	0	1
Injury type: Other injury	0.29	0.46	0	0	1
Injury type: Foreign matter	0.01	0.11	0	0	1
Injury type: Dislocation	0.02	0.15	0	0	1
Injured body part: Skull	0.03	0.16	0	0	1
Injured body part: Face	0.01	0.11	0	0	1
Injured body part: Eye	0.02	0.13	0	0	1
Injured body part: Nose	0.00	0.07	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Ear	0.00	0.04	0	0	1
Injured body part: Teeth	0.00	0.05	0	0	1
Injured body part: Pine	0.00	0.04	0	0	1
Injured body part: Neck	0.01	0.08	0	0	1
Injured body part: Back	0.05	0.22	0	0	1
Injured body part: Chest	0.04	0.20	0	0	1
Injured body part: Cervical spine	0.02	0.13	0	0	1
Injured body part: Thoracic spine	0.00	0.05	0	0	1
Injured body part: Lumbar spine	0.00	0.06	0	0	1
Injured body part: Shoulder	0.07	0.26	0	0	1
Injured body part: Upper arm	0.02	0.13	0	0	1
Injured body part: Elbows	0.02	0.14	0	0	1
Injured body part: Forearm	0.02	0.13	0	0	1
Injured body part: Wrist	0.05	0.22	0	0	1
Injured body part: Metacarpus	0.05	0.23	0	0	1
Injured body part: Finger	0.14	0.35	0	0	1
Injured body part: Several areas of the upper extremities	0.01	0.07	0	0	1
Injured body part: Basins	0.00	0.07	0	0	1
Injured body part: Hip joint	0.01	0.07	0	0	1
Injured body part: Coccyx	0.01	0.07	0	0	1
Injured body part: Bar	0.00	0.04	0	0	1
Injured body part: Genitalia	0.00	0.03	0	0	1
Injured body part: Belly	0.00	0.04	0	0	1
Injured body part: Thigh	0.02	0.13	0	0	1
Injured body part: Knee	0.13	0.33	0	0	1
Injured body part: Lower leg	0.04	0.20	0	0	1
Injured body part: Ankle	0.12	0.33	0	0	1
Injured body part: Middle foot	0.05	0.22	0	0	1
Injured body part: Toes	0.02	0.15	0	0	1
Injured body part: Several areas of the lower extremities	0.00	0.05	0	0	1
Injured body part: Internal injury	0.00	0.04	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.00	0.03	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.01	0	0	1
Injured body part: Kidney	0.00	0.02	0	0	1
Injured body part: Bubble	0.00	0.00	0	0	1
Injured body part: Polyblesse	0.01	0.12	0	0	1
Injured body part: Death	0.00	0.00	0	0	1
Injured body part: Shock	0.00	0.03	0	0	1
Injured body part: Whole body (systemic effect)	0.00	0.06	0	0	1
Injured body part: open	0.00	0.03	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.02	0	0	1
Work-related accident	0.43	0.49	0	0	1
Non-work-related accident	0.57	0.49	1	0	1
NOGA: Agriculture, forestry and fishing	0.01	0.07	0	0	1
NOGA: Mining and quarrying	0.00	0.05	0	0	1
NOGA: Manufacturing	0.28	0.45	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.10	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.09	0	0	1
NOGA: Construction	0.24	0.43	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.12	0.33	0	0	1
NOGA: Transportation and storage	0.10	0.30	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.10	0	0	1
NOGA: Financial and insurance activities	0.01	0.10	0	0	1
NOGA: Real estate activities	0.01	0.07	0	0	1
NOGA: Professional, scientific and technical activities	0.03	0.18	0	0	1
NOGA: Administrative and support service activities	0.10	0.30	0	0	1
NOGA: Public administration and defence; compulsory social security	0.04	0.19	0	0	1
NOGA: Education	0.01	0.09	0	0	1
NOGA: Human health and social work activities	0.02	0.12	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.03	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1
NOGA: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.00	0	0	1

B1.4 Sample with 50 percent disability pensions

Observations with DP (N=15760)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	70'665	20'202	70'200	10'050	148'200
Tenure	9	11	5	0	67
Age	47	11	49	15	83
Number of employees in firm	1'266	5'575	45	0	43'312
Daily cash benefits in days (6 months)	126	53	141	0	188
Daily cash benefits in days (12 months)	268	98	305	0	365
Daily cash benefits in days (24 months)	484	199	511	1	730
Daily cash benefits (6 months)	18'982	10'052	19'923	0	59'280
Daily cash benefits (12 months)	40'258	18'898	42'344	0	118'560
Daily cash benefits (24 months)	72'552	36'200	72'889	124	220'277
Treatment costs (6 months)	23'289	43'298	8'273	0	468'151
Treatment costs (12 months)	41'949	75'116	16'684	0	963'770
Treatment costs (24 months)	60'262	98'825	30'768	0	1'268'214
Unemployed	11'511	6'249	9'811	36	25'001
Occupational position: Higher cadre	0.04	0.21	0	0	1
Occupational position: Middle cadre	0.03	0.17	0	0	1
Occupational position: Employee / worker	0.82	0.39	1	0	1
Occupational position: Trained	0.05	0.22	0	0	1
Occupational position: Unskilled	0.02	0.15	0	0	1
Occupational position: Apprentice	0.01	0.11	0	0	1
Occupational position: Volunteer, Intern	0.00	0.04	0	0	1
Occupational position: Traveller, representative	0.00	0.01	0	0	1
Occupational position: unknown	0.02	0.14	0	0	1
Gender: Male	0.90	0.30	1	0	1
Gender: Female	0.10	0.30	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.39	0.49	0	0	1
Region: Western CH	0.31	0.46	0	0	1
Injury type: Bite	0.00	0.03	0	0	1
Injury type: Fracture	0.25	0.43	0	0	1
Injury type: Inflammation	0.01	0.11	0	0	1
Injury type: Contusion	0.08	0.28	0	0	1
Injury type: Bruise	0.04	0.19	0	0	1
Injury type: Crack	0.07	0.25	0	0	1
Injury type: Cut	0.02	0.15	0	0	1
Injury type: Shot	0.00	0.03	0	0	1
Injury type: Swelling	0.01	0.08	0	0	1
Injury type: Abrasion	0.00	0.04	0	0	1
Injury type: Compression of the spine	0.01	0.08	0	0	1
Injury type: Stitch	0.00	0.04	0	0	1
Injury type: Separation/separation	0.01	0.10	0	0	1
Injury type: Incineration	0.00	0.06	0	0	1
Injury type: Sprain/twist	0.03	0.18	0	0	1
Injury type: Poisoning	0.00	0.02	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.03	0.16	0	0	1
Injury type: Other injury	0.41	0.49	0	0	1
Injury type: Foreign matter	0.00	0.06	0	0	1
Injury type: Dislocation	0.02	0.13	0	0	1
Injured body part: Skull	0.06	0.24	0	0	1
Injured body part: Face	0.01	0.08	0	0	1
Injured body part: Eye	0.01	0.09	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Nose	0.00	0.03	0	0	1
Injured body part: Ear	0.00	0.03	0	0	1
Injured body part: Teeth	0.00	0.02	0	0	1
Injured body part: Pine	0.00	0.02	0	0	1
Injured body part: Neck	0.00	0.05	0	0	1
Injured body part: Back	0.06	0.24	0	0	1
Injured body part: Chest	0.01	0.11	0	0	1
Injured body part: Cervical spine	0.01	0.12	0	0	1
Injured body part: Thoracic spine	0.01	0.08	0	0	1
Injured body part: Lumbar spine	0.01	0.10	0	0	1
Injured body part: Shoulder	0.20	0.40	0	0	1
Injured body part: Upper arm	0.04	0.19	0	0	1
Injured body part: Elbows	0.02	0.13	0	0	1
Injured body part: Forearm	0.02	0.14	0	0	1
Injured body part: Wrist	0.06	0.24	0	0	1
Injured body part: Metacarpus	0.03	0.16	0	0	1
Injured body part: Finger	0.04	0.20	0	0	1
Injured body part: Several areas of the upper extremities	0.01	0.09	0	0	1
Injured body part: Basins	0.01	0.11	0	0	1
Injured body part: Hip joint	0.01	0.09	0	0	1
Injured body part: Coccyx	0.00	0.04	0	0	1
Injured body part: Bar	0.00	0.01	0	0	1
Injured body part: Genitalia	0.00	0.01	0	0	1
Injured body part: Belly	0.00	0.03	0	0	1
Injured body part: Thigh	0.01	0.12	0	0	1
Injured body part: Knee	0.12	0.33	0	0	1
Injured body part: Lower leg	0.05	0.21	0	0	1
Injured body part: Ankle	0.06	0.24	0	0	1
Injured body part: Middle foot	0.03	0.18	0	0	1
Injured body part: Toes	0.00	0.05	0	0	1
Injured body part: Several areas of the lower extremities	0.01	0.08	0	0	1
Injured body part: Internal injury	0.01	0.08	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.01	0.08	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.02	0	0	1
Injured body part: Kidney	0.00	0.01	0	0	1
Injured body part: Bubble	0.00	0.01	0	0	1
Injured body part: Polyblesse	0.07	0.25	0	0	1
Injured body part: Death	0.00	0.01	0	0	1
Injured body part: Shock	0.00	0.04	0	0	1
Injured body part: Whole body (systemic effect)	0.01	0.11	0	0	1
Injured body part: open	0.00	0.04	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.04	0	0	1
Work-related accident	0.56	0.50	1	0	1
Non-work-related accident	0.44	0.50	0	0	1
NOGA: Agriculture, forestry and fishing	0.00	0.07	0	0	1
NOGA: Mining and quarrying	0.01	0.07	0	0	1
NOGA: Manufacturing	0.24	0.43	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.08	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.10	0	0	1
NOGA: Construction	0.36	0.48	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.09	0.29	0	0	1
NOGA: Transportation and storage	0.09	0.28	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.07	0	0	1
NOGA: Financial and insurance activities	0.01	0.09	0	0	1
NOGA: Real estate activities	0.01	0.08	0	0	1
NOGA: Professional, scientific and technical activities	0.02	0.16	0	0	1
NOGA: Administrative and support service activities	0.11	0.31	0	0	1
NOGA: Public administration and defence; compulsory social security	0.03	0.16	0	0	1
NOGA: Education	0.01	0.07	0	0	1
NOGA: Human health and social work activities	0.01	0.10	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.02	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1
NOGA: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.00	0	0	0

Observations without DP (N=15'760)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	63'107	25'110	63'925	10'001	148'200
Tenure	7	9	3	0	64
Age	38	13	37	13	93
Number of employees in firm	1'733	6'239	79	0	43'312
Daily cash benefits in days (6 months)	27	34	13	0	188
Daily cash benefits in days (12 months)	32	50	14	0	365
Daily cash benefits in days (24 months)	35	66	14	1	730
Daily cash benefits (6 months)	3'723	5'298	1'619	0	59'280
Daily cash benefits (12 months)	4'465	7'520	1'723	0	118'560
Daily cash benefits (24 months)	4'930	9'762	1'761	0	217'369
Treatment costs (6 months)	1'965	5'069	587	0	450'585
Treatment costs (12 months)	2'566	7'267	646	0	741'324
Treatment costs (24 months)	2'958	9'194	662	0	1'625'863
Unemployed	12'015	6'496	11'306	36	25'001
Occupational position: Higher cadre	0.03	0.17	0	0	1
Occupational position: Middle cadre	0.03	0.18	0	0	1
Occupational position: Employee / worker	0.80	0.40	1	0	1
Occupational position: Trained	0.02	0.15	0	0	1
Occupational position: Unskilled	0.01	0.12	0	0	1
Occupational position: Apprentice	0.07	0.26	0	0	1
Occupational position: Volunteer, Intern	0.00	0.06	0	0	1
Occupational position: Traveller, representative	0.00	0.02	0	0	1
Occupational position: unknown	0.02	0.13	0	0	1
Gender: Male	0.83	0.37	1	0	1
Gender: Female	0.17	0.37	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.40	0.49	0	0	1
Region: Western CH	0.30	0.46	0	0	1
Injury type: Bite	0.00	0.06	0	0	1
Injury type: Fracture	0.12	0.32	0	0	1
Injury type: Inflammation	0.02	0.14	0	0	1
Injury type: Contusion	0.13	0.34	0	0	1
Injury type: Bruise	0.06	0.24	0	0	1
Injury type: Crack	0.08	0.26	0	0	1
Injury type: Cut	0.09	0.28	0	0	1
Injury type: Shot	0.00	0.02	0	0	1
Injury type: Swelling	0.01	0.11	0	0	1
Injury type: Abrasion	0.01	0.09	0	0	1
Injury type: Compression of the spine	0.01	0.11	0	0	1
Injury type: Stitch	0.01	0.08	0	0	1
Injury type: Separation/separation	0.00	0.05	0	0	1
Injury type: Incineration	0.01	0.10	0	0	1
Injury type: Sprain/twist	0.08	0.26	0	0	1
Injury type: Poisoning	0.00	0.03	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.05	0.21	0	0	1
Injury type: Other injury	0.30	0.46	0	0	1
Injury type: Foreign matter	0.01	0.11	0	0	1
Injury type: Dislocation	0.02	0.15	0	0	1
Injured body part: Skull	0.03	0.16	0	0	1
Injured body part: Face	0.01	0.11	0	0	1
Injured body part: Eye	0.02	0.13	0	0	1
Injured body part: Nose	0.00	0.07	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Ear	0.00	0.04	0	0	1
Injured body part: Teeth	0.00	0.04	0	0	1
Injured body part: Pine	0.00	0.04	0	0	1
Injured body part: Neck	0.01	0.08	0	0	1
Injured body part: Back	0.05	0.22	0	0	1
Injured body part: Chest	0.04	0.20	0	0	1
Injured body part: Cervical spine	0.02	0.13	0	0	1
Injured body part: Thoracic spine	0.00	0.05	0	0	1
Injured body part: Lumbar spine	0.00	0.06	0	0	1
Injured body part: Shoulder	0.07	0.26	0	0	1
Injured body part: Upper arm	0.02	0.13	0	0	1
Injured body part: Elbows	0.02	0.14	0	0	1
Injured body part: Forearm	0.02	0.13	0	0	1
Injured body part: Wrist	0.05	0.22	0	0	1
Injured body part: Metacarpus	0.06	0.23	0	0	1
Injured body part: Finger	0.14	0.35	0	0	1
Injured body part: Several areas of the upper extremities	0.01	0.07	0	0	1
Injured body part: Basins	0.00	0.07	0	0	1
Injured body part: Hip joint	0.01	0.07	0	0	1
Injured body part: Coccyx	0.01	0.08	0	0	1
Injured body part: Bar	0.00	0.04	0	0	1
Injured body part: Genitalia	0.00	0.03	0	0	1
Injured body part: Belly	0.00	0.04	0	0	1
Injured body part: Thigh	0.02	0.13	0	0	1
Injured body part: Knee	0.13	0.33	0	0	1
Injured body part: Lower leg	0.04	0.19	0	0	1
Injured body part: Ankle	0.12	0.33	0	0	1
Injured body part: Middle foot	0.05	0.22	0	0	1
Injured body part: Toes	0.02	0.15	0	0	1
Injured body part: Several areas of the lower extremities	0.00	0.05	0	0	1
Injured body part: Internal injury	0.00	0.04	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.00	0.03	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.01	0	0	1
Injured body part: Kidney	0.00	0.02	0	0	1
Injured body part: Bubble	0.00	0.00	0	0	1
Injured body part: Polyblesse	0.01	0.12	0	0	1
Injured body part: Death	0.00	0.00	0	0	1
Injured body part: Shock	0.00	0.03	0	0	1
Injured body part: Whole body (systemic effect)	0.00	0.06	0	0	1
Injured body part: open	0.00	0.03	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.02	0	0	1
Work-related accident	0.42	0.49	0	0	1
Non-work-related accident	0.58	0.49	1	0	1
NOGA: Agriculture, forestry and fishing	0.01	0.07	0	0	1
NOGA: Mining and quarrying	0.00	0.05	0	0	1
NOGA: Manufacturing	0.28	0.45	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.10	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.09	0	0	1
NOGA: Construction	0.24	0.43	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.12	0.33	0	0	1
NOGA: Transportation and storage	0.10	0.30	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.10	0	0	1
NOGA: Financial and insurance activities	0.01	0.10	0	0	1
NOGA: Real estate activities	0.01	0.07	0	0	1
NOGA: Professional, scientific and technical activities	0.03	0.18	0	0	1
NOGA: Administrative and support service activities	0.10	0.30	0	0	1
NOGA: Public administration and defence; compulsory social security	0.04	0.19	0	0	1
NOGA: Education	0.01	0.09	0	0	1
NOGA: Human health and social work activities	0.02	0.13	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.03	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1
NOGA: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.00	0	0	1

B1.5 Sample with 20 percent disability pensions

Observations with DP (N=15'760)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	70'665	20'202	70'200	10'050	148'200
Tenure	9	11	5	0	67
Age	47	11	49	15	83
Number of employees in firm	1'266	5'575	45	0	43'312
Daily cash benefits in days (6 months)	126	53	141	0	188
Daily cash benefits in days (12 months)	268	98	305	0	365
Daily cash benefits in days (24 months)	484	199	511	1	730
Daily cash benefits (6 months)	18'982	10'052	19'923	0	59'280
Daily cash benefits (12 months)	40'258	18'898	42'344	0	118'560
Daily cash benefits (24 months)	72'552	36'200	72'889	124	220'277
Treatment costs (6 months)	23'289	43'298	8'273	0	468'151
Treatment costs (12 months)	41'949	75'116	16'684	0	963'770
Treatment costs (24 months)	60'262	98'825	30'768	0	1'268'214
Unemployed	11'511	6'249	9'811	36	25'001
Occupational position: Higher cadre	0.04	0.21	0	0	1
Occupational position: Middle cadre	0.03	0.17	0	0	1
Occupational position: Employee / worker	0.82	0.39	1	0	1
Occupational position: Trained	0.05	0.22	0	0	1
Occupational position: Unskilled	0.02	0.15	0	0	1
Occupational position: Apprentice	0.01	0.11	0	0	1
Occupational position: Volunteer, Intern	0.00	0.04	0	0	1
Occupational position: Traveller, representative	0.00	0.01	0	0	1
Occupational position: unknown	0.02	0.14	0	0	1
Gender: Male	0.90	0.30	1	0	1
Gender: Female	0.10	0.30	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.39	0.49	0	0	1
Region: Western CH	0.31	0.46	0	0	1
Injury type: Bite	0.00	0.03	0	0	1
Injury type: Fracture	0.25	0.43	0	0	1
Injury type: Inflammation	0.01	0.11	0	0	1
Injury type: Contusion	0.08	0.28	0	0	1
Injury type: Bruise	0.04	0.19	0	0	1
Injury type: Crack	0.07	0.25	0	0	1
Injury type: Cut	0.02	0.15	0	0	1
Injury type: Shot	0.00	0.03	0	0	1
Injury type: Swelling	0.01	0.08	0	0	1
Injury type: Abrasion	0.00	0.04	0	0	1
Injury type: Compression of the spine	0.01	0.08	0	0	1
Injury type: Stitch	0.00	0.04	0	0	1
Injury type: Separation/separation	0.01	0.10	0	0	1
Injury type: Incineration	0.00	0.06	0	0	1
Injury type: Sprain/twist	0.03	0.18	0	0	1
Injury type: Poisoning	0.00	0.02	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.03	0.16	0	0	1
Injury type: Other injury	0.41	0.49	0	0	1
Injury type: Foreign matter	0.00	0.06	0	0	1
Injury type: Dislocation	0.02	0.13	0	0	1
Injured body part: Skull	0.06	0.24	0	0	1
Injured body part: Face	0.01	0.08	0	0	1
Injured body part: Eye	0.01	0.09	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Nose	0.00	0.03	0	0	1
Injured body part: Ear	0.00	0.03	0	0	1
Injured body part: Teeth	0.00	0.02	0	0	1
Injured body part: Pine	0.00	0.02	0	0	1
Injured body part: Neck	0.00	0.05	0	0	1
Injured body part: Back	0.06	0.24	0	0	1
Injured body part: Chest	0.01	0.11	0	0	1
Injured body part: Cervical spine	0.01	0.12	0	0	1
Injured body part: Thoracic spine	0.01	0.08	0	0	1
Injured body part: Lumbar spine	0.01	0.10	0	0	1
Injured body part: Shoulder	0.20	0.40	0	0	1
Injured body part: Upper arm	0.04	0.19	0	0	1
Injured body part: Elbows	0.02	0.13	0	0	1
Injured body part: Forearm	0.02	0.14	0	0	1
Injured body part: Wrist	0.06	0.24	0	0	1
Injured body part: Metacarpus	0.03	0.16	0	0	1
Injured body part: Finger	0.04	0.20	0	0	1
Injured body part: Several areas of the upper extremities	0.01	0.09	0	0	1
Injured body part: Basins	0.01	0.11	0	0	1
Injured body part: Hip joint	0.01	0.09	0	0	1
Injured body part: Coccyx	0.00	0.04	0	0	1
Injured body part: Bar	0.00	0.01	0	0	1
Injured body part: Genitalia	0.00	0.01	0	0	1
Injured body part: Belly	0.00	0.03	0	0	1
Injured body part: Thigh	0.01	0.12	0	0	1
Injured body part: Knee	0.12	0.33	0	0	1
Injured body part: Lower leg	0.05	0.21	0	0	1
Injured body part: Ankle	0.06	0.24	0	0	1
Injured body part: Middle foot	0.03	0.18	0	0	1
Injured body part: Toes	0.00	0.05	0	0	1
Injured body part: Several areas of the lower extremities	0.01	0.08	0	0	1
Injured body part: Internal injury	0.01	0.08	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.01	0.08	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.02	0	0	1
Injured body part: Kidney	0.00	0.01	0	0	1
Injured body part: Bubble	0.00	0.01	0	0	1
Injured body part: Polyblesse	0.07	0.25	0	0	1
Injured body part: Death	0.00	0.01	0	0	1
Injured body part: Shock	0.00	0.04	0	0	1
Injured body part: Whole body (systemic effect)	0.01	0.11	0	0	1
Injured body part: open	0.00	0.04	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.04	0	0	1
Work-related accident	0.56	0.50	1	0	1
Non-work-related accident	0.44	0.50	0	0	1
NOGA: Agriculture, forestry and fishing	0.00	0.07	0	0	1
NOGA: Mining and quarrying	0.01	0.07	0	0	1
NOGA: Manufacturing	0.24	0.43	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.08	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.10	0	0	1
NOGA: Construction	0.36	0.48	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.09	0.29	0	0	1
NOGA: Transportation and storage	0.09	0.28	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.07	0	0	1
NOGA: Financial and insurance activities	0.01	0.09	0	0	1
NOGA: Real estate activities	0.01	0.08	0	0	1
NOGA: Professional, scientific and technical activities	0.02	0.16	0	0	1
NOGA: Administrative and support service activities	0.11	0.31	0	0	1
NOGA: Public administration and defence; compulsory social security	0.03	0.16	0	0	1
NOGA: Education	0.01	0.07	0	0	1
NOGA: Human health and social work activities	0.01	0.10	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.02	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1
NOGA: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.00	0	0	0

Observations without DP (N=63'042)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	63'102	25'126	63'890	10'001	148'200
Tenure	7	9	3	0	64
Age	38	13	37	12	93
Number of employees in firm	1'735	6'246	79	0	43'312
Daily cash benefits in days (6 months)	27	34	13	0	188
Daily cash benefits in days (12 months)	32	50	14	0	365
Daily cash benefits in days (24 months)	35	66	14	1	730
Daily cash benefits (6 months)	3'728	5'312	1'615	0	59'280
Daily cash benefits (12 months)	4'475	7'549	1'719	0	118'560
Daily cash benefits (24 months)	4'940	9'778	1'758	0	237'120
Treatment costs (6 months)	1'971	5'060	588	0	450'585
Treatment costs (12 months)	2'575	7'205	647	0	819'033
Treatment costs (24 months)	2'966	9'184	663	0	2'132'922
Unemployed	12'016	6'498	11'306	36	25'001
Occupational position: Higher cadre	0.03	0.17	0	0	1
Occupational position: Middle cadre	0.03	0.18	0	0	1
Occupational position: Employee / worker	0.80	0.40	1	0	1
Occupational position: Trained	0.02	0.16	0	0	1
Occupational position: Unskilled	0.01	0.12	0	0	1
Occupational position: Apprentice	0.07	0.26	0	0	1
Occupational position: Volunteer, Intern	0.00	0.06	0	0	1
Occupational position: Traveller, representative	0.00	0.02	0	0	1
Occupational position: unknown	0.02	0.13	0	0	1
Gender: Male	0.83	0.37	1	0	1
Gender: Female	0.17	0.37	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.40	0.49	0	0	1
Region: Western CH	0.30	0.46	0	0	1
Injury type: Bite	0.00	0.06	0	0	1
Injury type: Fracture	0.12	0.32	0	0	1
Injury type: Inflammation	0.02	0.14	0	0	1
Injury type: Contusion	0.13	0.34	0	0	1
Injury type: Bruise	0.06	0.24	0	0	1
Injury type: Crack	0.08	0.26	0	0	1
Injury type: Cut	0.08	0.28	0	0	1
Injury type: Shot	0.00	0.02	0	0	1
Injury type: Swelling	0.01	0.11	0	0	1
Injury type: Abrasion	0.01	0.09	0	0	1
Injury type: Compression of the spine	0.01	0.11	0	0	1
Injury type: Stitch	0.01	0.08	0	0	1
Injury type: Separation/separation	0.00	0.05	0	0	1
Injury type: Incineration	0.01	0.10	0	0	1
Injury type: Sprain/twist	0.08	0.27	0	0	1
Injury type: Poisoning	0.00	0.03	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.05	0.21	0	0	1
Injury type: Other injury	0.30	0.46	0	0	1
Injury type: Foreign matter	0.01	0.11	0	0	1
Injury type: Dislocation	0.02	0.15	0	0	1
Injured body part: Skull	0.03	0.16	0	0	1
Injured body part: Face	0.01	0.11	0	0	1
Injured body part: Eye	0.02	0.13	0	0	1
Injured body part: Nose	0.00	0.07	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Ear	0.00	0.04	0	0	1
Injured body part: Teeth	0.00	0.04	0	0	1
Injured body part: Pine	0.00	0.04	0	0	1
Injured body part: Neck	0.01	0.08	0	0	1
Injured body part: Back	0.05	0.22	0	0	1
Injured body part: Chest	0.04	0.20	0	0	1
Injured body part: Cervical spine	0.02	0.13	0	0	1
Injured body part: Thoracic spine	0.00	0.05	0	0	1
Injured body part: Lumbar spine	0.00	0.06	0	0	1
Injured body part: Shoulder	0.07	0.26	0	0	1
Injured body part: Upper arm	0.02	0.13	0	0	1
Injured body part: Elbows	0.02	0.14	0	0	1
Injured body part: Forearm	0.02	0.13	0	0	1
Injured body part: Wrist	0.05	0.22	0	0	1
Injured body part: Metacarpus	0.06	0.23	0	0	1
Injured body part: Finger	0.14	0.35	0	0	1
Injured body part: Several areas of the upper extremities	0.00	0.07	0	0	1
Injured body part: Basins	0.00	0.07	0	0	1
Injured body part: Hip joint	0.01	0.07	0	0	1
Injured body part: Coccyx	0.01	0.08	0	0	1
Injured body part: Bar	0.00	0.04	0	0	1
Injured body part: Genitalia	0.00	0.03	0	0	1
Injured body part: Belly	0.00	0.04	0	0	1
Injured body part: Thigh	0.02	0.13	0	0	1
Injured body part: Knee	0.13	0.33	0	0	1
Injured body part: Lower leg	0.04	0.19	0	0	1
Injured body part: Ankle	0.12	0.33	0	0	1
Injured body part: Middle foot	0.05	0.22	0	0	1
Injured body part: Toes	0.02	0.15	0	0	1
Injured body part: Several areas of the lower extremities	0.00	0.05	0	0	1
Injured body part: Internal injury	0.00	0.04	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.00	0.03	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.01	0	0	1
Injured body part: Kidney	0.00	0.02	0	0	1
Injured body part: Bubble	0.00	0.00	0	0	1
Injured body part: Polyblesse	0.01	0.12	0	0	1
Injured body part: Death	0.00	0.00	0	0	1
Injured body part: Shock	0.00	0.03	0	0	1
Injured body part: Whole body (systemic effect)	0.00	0.06	0	0	1
Injured body part: open	0.00	0.03	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.02	0	0	1
Work-related accident	0.42	0.49	0	0	1
Non-work-related accident	0.58	0.49	1	0	1
NOGA: Agriculture, forestry and fishing	0.01	0.07	0	0	1
NOGA: Mining and quarrying	0.00	0.05	0	0	1
NOGA: Manufacturing	0.28	0.45	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.10	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.09	0	0	1
NOGA: Construction	0.24	0.43	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.12	0.33	0	0	1
NOGA: Transportation and storage	0.10	0.30	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.10	0	0	1
NOGA: Financial and insurance activities	0.01	0.10	0	0	1
NOGA: Real estate activities	0.01	0.07	0	0	1
NOGA: Professional, scientific and technical activities	0.04	0.18	0	0	1
NOGA: Administrative and support service activities	0.10	0.30	0	0	1
NOGA: Public administration and defence; compulsory social security	0.04	0.19	0	0	1
NOGA: Education	0.01	0.09	0	0	1
NOGA: Human health and social work activities	0.02	0.12	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.03	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1
NOGA: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.00	0	0	1

B1.6 Sample with 10 percent disability pensions

Observations with DP (N=15'760)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	70'665	20'202	70'200	10'050	148'200
Tenure	9	11	5	0	67
Age	47	11	49	15	83
Number of employees in firm	1'266	5'575	45	0	43'312
Daily cash benefits in days (6 months)	126	53	141	0	188
Daily cash benefits in days (12 months)	268	98	305	0	365
Daily cash benefits in days (24 months)	484	199	511	1	730
Daily cash benefits (6 months)	18'982	10'052	19'923	0	59'280
Daily cash benefits (12 months)	40'258	18'898	42'344	0	118'560
Daily cash benefits (24 months)	72'552	36'200	72'889	124	220'277
Treatment costs (6 months)	23'289	43'298	8'273	0	468'151
Treatment costs (12 months)	41'949	75'116	16'684	0	963'770
Treatment costs (24 months)	60'262	98'825	30'768	0	1'268'214
Unemployed	11'511	6'249	9'811	36	25'001
Occupational position: Higher cadre	0.04	0.21	0	0	1
Occupational position: Middle cadre	0.03	0.17	0	0	1
Occupational position: Employee / worker	0.82	0.39	1	0	1
Occupational position: Trained	0.05	0.22	0	0	1
Occupational position: Unskilled	0.02	0.15	0	0	1
Occupational position: Apprentice	0.01	0.11	0	0	1
Occupational position: Volunteer, Intern	0.00	0.04	0	0	1
Occupational position: Traveller, representative	0.00	0.01	0	0	1
Occupational position: unknown	0.02	0.14	0	0	1
Gender: Male	0.90	0.30	1	0	1
Gender: Female	0.10	0.30	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.39	0.49	0	0	1
Region: Western CH	0.31	0.46	0	0	1
Injury type: Bite	0.00	0.03	0	0	1
Injury type: Fracture	0.25	0.43	0	0	1
Injury type: Inflammation	0.01	0.11	0	0	1
Injury type: Contusion	0.08	0.28	0	0	1
Injury type: Bruise	0.04	0.19	0	0	1
Injury type: Crack	0.07	0.25	0	0	1
Injury type: Cut	0.02	0.15	0	0	1
Injury type: Shot	0.00	0.03	0	0	1
Injury type: Swelling	0.01	0.08	0	0	1
Injury type: Abrasion	0.00	0.04	0	0	1
Injury type: Compression of the spine	0.01	0.08	0	0	1
Injury type: Stitch	0.00	0.04	0	0	1
Injury type: Separation/separation	0.01	0.10	0	0	1
Injury type: Incineration	0.00	0.06	0	0	1
Injury type: Sprain/twist	0.03	0.18	0	0	1
Injury type: Poisoning	0.00	0.02	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.03	0.16	0	0	1
Injury type: Other injury	0.41	0.49	0	0	1
Injury type: Foreign matter	0.00	0.06	0	0	1
Injury type: Dislocation	0.02	0.13	0	0	1
Injured body part: Skull	0.06	0.24	0	0	1
Injured body part: Face	0.01	0.08	0	0	1
Injured body part: Eye	0.01	0.09	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Nose	0.00	0.03	0	0	1
Injured body part: Ear	0.00	0.03	0	0	1
Injured body part: Teeth	0.00	0.02	0	0	1
Injured body part: Pine	0.00	0.02	0	0	1
Injured body part: Neck	0.00	0.05	0	0	1
Injured body part: Back	0.06	0.24	0	0	1
Injured body part: Chest	0.01	0.11	0	0	1
Injured body part: Cervical spine	0.01	0.12	0	0	1
Injured body part: Thoracic spine	0.01	0.08	0	0	1
Injured body part: Lumbar spine	0.01	0.10	0	0	1
Injured body part: Shoulder	0.20	0.40	0	0	1
Injured body part: Upper arm	0.04	0.19	0	0	1
Injured body part: Elbows	0.02	0.13	0	0	1
Injured body part: Forearm	0.02	0.14	0	0	1
Injured body part: Wrist	0.06	0.24	0	0	1
Injured body part: Metacarpus	0.03	0.16	0	0	1
Injured body part: Finger	0.04	0.20	0	0	1
Injured body part: Several areas of the upper extremities	0.01	0.09	0	0	1
Injured body part: Basins	0.01	0.11	0	0	1
Injured body part: Hip joint	0.01	0.09	0	0	1
Injured body part: Coccyx	0.00	0.04	0	0	1
Injured body part: Bar	0.00	0.01	0	0	1
Injured body part: Genitalia	0.00	0.01	0	0	1
Injured body part: Belly	0.00	0.03	0	0	1
Injured body part: Thigh	0.01	0.12	0	0	1
Injured body part: Knee	0.12	0.33	0	0	1
Injured body part: Lower leg	0.05	0.21	0	0	1
Injured body part: Ankle	0.06	0.24	0	0	1
Injured body part: Middle foot	0.03	0.18	0	0	1
Injured body part: Toes	0.00	0.05	0	0	1
Injured body part: Several areas of the lower extremities	0.01	0.08	0	0	1
Injured body part: Internal injury	0.01	0.08	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.01	0.08	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.02	0	0	1
Injured body part: Kidney	0.00	0.01	0	0	1
Injured body part: Bubble	0.00	0.01	0	0	1
Injured body part: Polyblesse	0.07	0.25	0	0	1
Injured body part: Death	0.00	0.01	0	0	1
Injured body part: Shock	0.00	0.04	0	0	1
Injured body part: Whole body (systemic effect)	0.01	0.11	0	0	1
Injured body part: open	0.00	0.04	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.04	0	0	1
Work-related accident	0.56	0.50	1	0	1
Non-work-related accident	0.44	0.50	0	0	1
NOGA: Agriculture, forestry and fishing	0.00	0.07	0	0	1
NOGA: Mining and quarrying	0.01	0.07	0	0	1
NOGA: Manufacturing	0.24	0.43	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.08	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.10	0	0	1
NOGA: Construction	0.36	0.48	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.09	0.29	0	0	1
NOGA: Transportation and storage	0.09	0.28	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.07	0	0	1
NOGA: Financial and insurance activities	0.01	0.09	0	0	1
NOGA: Real estate activities	0.01	0.08	0	0	1
NOGA: Professional, scientific and technical activities	0.02	0.16	0	0	1
NOGA: Administrative and support service activities	0.11	0.31	0	0	1
NOGA: Public administration and defence; compulsory social security	0.03	0.16	0	0	1
NOGA: Education	0.01	0.07	0	0	1
NOGA: Human health and social work activities	0.01	0.10	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.02	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1
NOGA: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.00	0	0	0

Observations without DP (N=141'844)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	63'113	25'126	63'892	10'001	148'200
Tenure	7	9	3	0	64
Age	38	13	37	12	94
Number of employees in firm	1'734	6'241	79	0	43'312
Daily cash benefits in days (6 months)	27	34	13	0	188
Daily cash benefits in days (12 months)	32	50	14	0	365
Daily cash benefits in days (24 months)	35	66	14	1	730
Daily cash benefits (6 months)	3'731	5'311	1'617	0	59'280
Daily cash benefits (12 months)	4'479	7'544	1'723	0	118'560
Daily cash benefits (24 months)	4'942	9'765	1'760	0	237'120
Treatment costs (6 months)	1'970	5'030	588	0	450'585
Treatment costs (12 months)	2'571	7'104	647	0	819'033
Treatment costs (24 months)	2'960	9'020	663	0	2'132'922
Unemployed	12'012	6'498	11'306	36	25'001
Occupational position: Higher cadre	0.03	0.17	0	0	1
Occupational position: Middle cadre	0.03	0.18	0	0	1
Occupational position: Employee / worker	0.80	0.40	1	0	1
Occupational position: Trained	0.02	0.16	0	0	1
Occupational position: Unskilled	0.01	0.12	0	0	1
Occupational position: Apprentice	0.07	0.26	0	0	1
Occupational position: Volunteer, Intern	0.00	0.06	0	0	1
Occupational position: Traveller, representative	0.00	0.02	0	0	1
Occupational position: unknown	0.02	0.13	0	0	1
Gender: Male	0.83	0.37	1	0	1
Gender: Female	0.17	0.37	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.40	0.49	0	0	1
Region: Western CH	0.30	0.46	0	0	1
Injury type: Bite	0.00	0.06	0	0	1
Injury type: Fracture	0.12	0.32	0	0	1
Injury type: Inflammation	0.02	0.14	0	0	1
Injury type: Contusion	0.13	0.34	0	0	1
Injury type: Bruise	0.06	0.24	0	0	1
Injury type: Crack	0.08	0.26	0	0	1
Injury type: Cut	0.08	0.28	0	0	1
Injury type: Shot	0.00	0.02	0	0	1
Injury type: Swelling	0.01	0.11	0	0	1
Injury type: Abrasion	0.01	0.09	0	0	1
Injury type: Compression of the spine	0.01	0.11	0	0	1
Injury type: Stitch	0.01	0.08	0	0	1
Injury type: Separation/separation	0.00	0.05	0	0	1
Injury type: Incineration	0.01	0.10	0	0	1
Injury type: Sprain/twist	0.08	0.27	0	0	1
Injury type: Poisoning	0.00	0.03	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.05	0.21	0	0	1
Injury type: Other injury	0.30	0.46	0	0	1
Injury type: Foreign matter	0.01	0.11	0	0	1
Injury type: Dislocation	0.02	0.15	0	0	1
Injured body part: Skull	0.03	0.16	0	0	1
Injured body part: Face	0.01	0.11	0	0	1
Injured body part: Eye	0.02	0.13	0	0	1
Injured body part: Nose	0.00	0.07	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Ear	0.00	0.04	0	0	1
Injured body part: Teeth	0.00	0.04	0	0	1
Injured body part: Pine	0.00	0.04	0	0	1
Injured body part: Neck	0.01	0.08	0	0	1
Injured body part: Back	0.05	0.22	0	0	1
Injured body part: Chest	0.04	0.20	0	0	1
Injured body part: Cervical spine	0.02	0.13	0	0	1
Injured body part: Thoracic spine	0.00	0.05	0	0	1
Injured body part: Lumbar spine	0.00	0.06	0	0	1
Injured body part: Shoulder	0.07	0.26	0	0	1
Injured body part: Upper arm	0.02	0.13	0	0	1
Injured body part: Elbows	0.02	0.14	0	0	1
Injured body part: Forearm	0.02	0.13	0	0	1
Injured body part: Wrist	0.05	0.22	0	0	1
Injured body part: Metacarpus	0.06	0.23	0	0	1
Injured body part: Finger	0.14	0.35	0	0	1
Injured body part: Several areas of the upper extremities	0.00	0.07	0	0	1
Injured body part: Basins	0.00	0.07	0	0	1
Injured body part: Hip joint	0.01	0.07	0	0	1
Injured body part: Coccyx	0.01	0.08	0	0	1
Injured body part: Bar	0.00	0.04	0	0	1
Injured body part: Genitalia	0.00	0.03	0	0	1
Injured body part: Belly	0.00	0.04	0	0	1
Injured body part: Thigh	0.02	0.13	0	0	1
Injured body part: Knee	0.13	0.33	0	0	1
Injured body part: Lower leg	0.04	0.19	0	0	1
Injured body part: Ankle	0.12	0.33	0	0	1
Injured body part: Middle foot	0.05	0.22	0	0	1
Injured body part: Toes	0.02	0.15	0	0	1
Injured body part: Several areas of the lower extremities	0.00	0.05	0	0	1
Injured body part: Internal injury	0.00	0.04	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.00	0.03	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.01	0	0	1
Injured body part: Kidney	0.00	0.02	0	0	1
Injured body part: Bubble	0.00	0.00	0	0	1
Injured body part: Polyblesse	0.01	0.12	0	0	1
Injured body part: Death	0.00	0.00	0	0	1
Injured body part: Shock	0.00	0.03	0	0	1
Injured body part: Whole body (systemic effect)	0.00	0.06	0	0	1
Injured body part: open	0.00	0.03	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.02	0	0	1
Work-related accident	0.42	0.49	0	0	1
Non-work-related accident	0.58	0.49	1	0	1
NOGA: Agriculture, forestry and fishing	0.01	0.07	0	0	1
NOGA: Mining and quarrying	0.00	0.05	0	0	1
NOGA: Manufacturing	0.28	0.45	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.10	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.09	0	0	1
NOGA: Construction	0.24	0.43	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.12	0.33	0	0	1
NOGA: Transportation and storage	0.10	0.30	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.10	0	0	1
NOGA: Financial and insurance activities	0.01	0.10	0	0	1
NOGA: Real estate activities	0.01	0.08	0	0	1
NOGA: Professional, scientific and technical activities	0.04	0.18	0	0	1
NOGA: Administrative and support service activities	0.10	0.30	0	0	1
NOGA: Public administration and defence; compulsory social security	0.04	0.19	0	0	1
NOGA: Education	0.01	0.09	0	0	1
NOGA: Human health and social work activities	0.02	0.12	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.03	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1
NOGA: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.00	0	0	1

B1.7 Sample with 1 percent disability pensions

Observations with DP (N=2'500)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	70'095	19'853	69'721	10'397	148'200
Tenure	9	11	5	0	56
Age	47	11	49	16	81
Number of employees in firm	1'325	5'703	48	0	43'312
Daily cash benefits in days (6 months)	126	53	141	0	188
Daily cash benefits in days (12 months)	267	99	304	0	365
Daily cash benefits in days (24 months)	484	199	509	1	730
Daily cash benefits (6 months)	18'827	9'927	19'669	0	59'280
Daily cash benefits (12 months)	39'802	18'688	41'960	0	118'560
Daily cash benefits (24 months)	71'889	35'803	72'074	234	220'277
Treatment costs (6 months)	23'373	43'487	8'214	0	468'151
Treatment costs (12 months)	41'851	75'002	16'757	0	856'951
Treatment costs (24 months)	59'710	98'241	30'252	0	1'224'595
Unemployed	11'611	6'297	9'811	36	25'001
Occupational position: Higher cadre	0.04	0.20	0	0	1
Occupational position: Middle cadre	0.03	0.16	0	0	1
Occupational position: Employee / worker	0.81	0.39	1	0	1
Occupational position: Trained	0.05	0.23	0	0	1
Occupational position: Unskilled	0.03	0.17	0	0	1
Occupational position: Apprentice	0.01	0.10	0	0	1
Occupational position: Volunteer, Intern	0.00	0.04	0	0	1
Occupational position: Traveller, representative	0.00	0.00	0	0	0
Occupational position: unknown	0.02	0.14	0	0	1
Gender: Male	0.89	0.31	1	0	1
Gender: Female	0.11	0.31	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.39	0.49	0	0	1
Region: Western CH	0.32	0.47	0	0	1
Injury type: Bite	0.00	0.03	0	0	1
Injury type: Fracture	0.24	0.43	0	0	1
Injury type: Inflammation	0.01	0.11	0	0	1
Injury type: Contusion	0.08	0.27	0	0	1
Injury type: Bruise	0.04	0.19	0	0	1
Injury type: Crack	0.07	0.26	0	0	1
Injury type: Cut	0.02	0.15	0	0	1
Injury type: Shot	0.00	0.04	0	0	1
Injury type: Swelling	0.01	0.08	0	0	1
Injury type: Abrasion	0.00	0.04	0	0	1
Injury type: Compression of the spine	0.01	0.09	0	0	1
Injury type: Stitch	0.00	0.04	0	0	1
Injury type: Separation/separation	0.01	0.10	0	0	1
Injury type: Incineration	0.00	0.06	0	0	1
Injury type: Sprain/twist	0.03	0.18	0	0	1
Injury type: Poisoning	0.00	0.02	0	0	1
Injury type: Chemical burn	0.00	0.00	0	0	0
Injury type: Strain	0.03	0.17	0	0	1
Injury type: Other injury	0.42	0.49	0	0	1
Injury type: Foreign matter	0.00	0.05	0	0	1
Injury type: Dislocation	0.02	0.13	0	0	1
Injured body part: Skull	0.06	0.24	0	0	1
Injured body part: Face	0.01	0.07	0	0	1
Injured body part: Eye	0.01	0.09	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Nose	0.00	0.02	0	0	1
Injured body part: Ear	0.00	0.04	0	0	1
Injured body part: Teeth	0.00	0.01	0	0	1
Injured body part: Pine	0.00	0.02	0	0	1
Injured body part: Neck	0.00	0.04	0	0	1
Injured body part: Back	0.06	0.24	0	0	1
Injured body part: Chest	0.01	0.11	0	0	1
Injured body part: Cervical spine	0.01	0.12	0	0	1
Injured body part: Thoracic spine	0.01	0.08	0	0	1
Injured body part: Lumbar spine	0.01	0.10	0	0	1
Injured body part: Shoulder	0.20	0.40	0	0	1
Injured body part: Upper arm	0.04	0.19	0	0	1
Injured body part: Elbows	0.02	0.14	0	0	1
Injured body part: Forearm	0.02	0.14	0	0	1
Injured body part: Wrist	0.06	0.23	0	0	1
Injured body part: Metacarpus	0.03	0.16	0	0	1
Injured body part: Finger	0.04	0.20	0	0	1
Injured body part: Several areas of the upper extremities	0.01	0.07	0	0	1
Injured body part: Basins	0.01	0.10	0	0	1
Injured body part: Hip joint	0.01	0.09	0	0	1
Injured body part: Coccyx	0.00	0.04	0	0	1
Injured body part: Bar	0.00	0.02	0	0	1
Injured body part: Genitalia	0.00	0.01	0	0	1
Injured body part: Belly	0.00	0.03	0	0	1
Injured body part: Thigh	0.02	0.12	0	0	1
Injured body part: Knee	0.12	0.33	0	0	1
Injured body part: Lower leg	0.04	0.20	0	0	1
Injured body part: Ankle	0.06	0.23	0	0	1
Injured body part: Middle foot	0.03	0.18	0	0	1
Injured body part: Toes	0.00	0.06	0	0	1
Injured body part: Several areas of the lower extremities	0.01	0.07	0	0	1
Injured body part: Internal injury	0.01	0.08	0	0	1
Injured body part: Heart	0.00	0.00	0	0	0
Injured body part: Lungs	0.01	0.07	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.02	0	0	1
Injured body part: Kidney	0.00	0.01	0	0	1
Injured body part: Bubble	0.00	0.01	0	0	1
Injured body part: Polyblesse	0.07	0.25	0	0	1
Injured body part: Death	0.00	0.01	0	0	1
Injured body part: Shock	0.00	0.04	0	0	1
Injured body part: Whole body (systemic effect)	0.01	0.11	0	0	1
Injured body part: open	0.00	0.04	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.03	0	0	1
Work-related accident	0.56	0.50	1	0	1
Non-work-related accident	0.44	0.50	0	0	1
NOGA: Agriculture, forestry and fishing	0.01	0.07	0	0	1
NOGA: Mining and quarrying	0.00	0.07	0	0	1
NOGA: Manufacturing	0.24	0.43	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.09	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.09	0	0	1
NOGA: Construction	0.34	0.47	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.10	0.30	0	0	1
NOGA: Transportation and storage	0.09	0.29	0	0	1
NOGA: Accommodation and food service activities	0.00	0.03	0	0	1
NOGA: Information and communication	0.00	0.06	0	0	1
NOGA: Financial and insurance activities	0.01	0.08	0	0	1
NOGA: Real estate activities	0.01	0.09	0	0	1
NOGA: Professional, scientific and technical activities	0.02	0.15	0	0	1
NOGA: Administrative and support service activities	0.11	0.31	0	0	1
NOGA: Public administration and defence; compulsory social security	0.03	0.16	0	0	1
NOGA: Education	0.01	0.07	0	0	1
NOGA: Human health and social work activities	0.01	0.10	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.01	0	0	1
NOGA: Other service activities	0.00	0.06	0	0	1
NOGA: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.00	0	0	0

Observations without DP (N=247'500)

Variable	Mean	Std. Dev.	Median	Min.	Max.
Insured Salary	63'123	25'084	63'901	10'004	148'200
Tenure	7	9	3	0	115
Age	38	13	37	12	92
Number of employees in firm	1'727	6'220	80	0	43'312
Daily cash benefits in days (6 months)	27	34	13	0	188
Daily cash benefits in days (12 months)	32	50	14	0	365
Daily cash benefits in days (24 months)	35	66	14	1	730
Daily cash benefits (6 months)	3'733	5'318	1'613	0	59'280
Daily cash benefits (12 months)	4'479	7'546	1'716	0	118'560
Daily cash benefits (24 months)	4'939	9'755	1'753	0	217'369
Treatment costs (6 months)	1'980	5'153	588	0	362'853
Treatment costs (12 months)	2'580	7'119	648	0	593'497
Treatment costs (24 months)	2'964	8'783	663	0	961'406
Unemployed	12'019	6'493	11'306	36	25'001
Occupational position: Higher cadre	0.03	0.17	0	0	1
Occupational position: Middle cadre	0.03	0.18	0	0	1
Occupational position: Employee / worker	0.80	0.40	1	0	1
Occupational position: Trained	0.02	0.15	0	0	1
Occupational position: Unskilled	0.01	0.12	0	0	1
Occupational position: Apprentice	0.07	0.26	0	0	1
Occupational position: Volunteer, Intern	0.00	0.07	0	0	1
Occupational position: Traveller, representative	0.00	0.02	0	0	1
Occupational position: unknown	0.02	0.13	0	0	1
Gender: Male	0.83	0.38	1	0	1
Gender: Female	0.17	0.38	0	0	1
Region: Eastern CH	0.30	0.46	0	0	1
Region: Central CH	0.40	0.49	0	0	1
Region: Western CH	0.30	0.46	0	0	1
Injury type: Bite	0.00	0.06	0	0	1
Injury type: Fracture	0.12	0.32	0	0	1
Injury type: Inflammation	0.02	0.14	0	0	1
Injury type: Contusion	0.13	0.34	0	0	1
Injury type: Bruise	0.06	0.24	0	0	1
Injury type: Crack	0.08	0.26	0	0	1
Injury type: Cut	0.08	0.28	0	0	1
Injury type: Shot	0.00	0.02	0	0	1
Injury type: Swelling	0.01	0.11	0	0	1
Injury type: Abrasion	0.01	0.09	0	0	1
Injury type: Compression of the spine	0.01	0.11	0	0	1
Injury type: Stitch	0.01	0.08	0	0	1
Injury type: Separation/separation	0.00	0.05	0	0	1
Injury type: Incineration	0.01	0.10	0	0	1
Injury type: Sprain/twist	0.08	0.26	0	0	1
Injury type: Poisoning	0.00	0.03	0	0	1
Injury type: Chemical burn	0.00	0.03	0	0	1
Injury type: Strain	0.05	0.21	0	0	1
Injury type: Other injury	0.29	0.46	0	0	1
Injury type: Foreign matter	0.01	0.11	0	0	1
Injury type: Dislocation	0.02	0.15	0	0	1
Injured body part: Skull	0.03	0.16	0	0	1
Injured body part: Face	0.01	0.11	0	0	1
Injured body part: Eye	0.02	0.13	0	0	1
Injured body part: Nose	0.00	0.07	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
Injured body part: Ear	0.00	0.04	0	0	1
Injured body part: Teeth	0.00	0.04	0	0	1
Injured body part: Pine	0.00	0.04	0	0	1
Injured body part: Neck	0.01	0.08	0	0	1
Injured body part: Back	0.05	0.22	0	0	1
Injured body part: Chest	0.04	0.20	0	0	1
Injured body part: Cervical spine	0.02	0.13	0	0	1
Injured body part: Thoracic spine	0.00	0.05	0	0	1
Injured body part: Lumbar spine	0.00	0.06	0	0	1
Injured body part: Shoulder	0.07	0.26	0	0	1
Injured body part: Upper arm	0.02	0.13	0	0	1
Injured body part: Elbows	0.02	0.14	0	0	1
Injured body part: Forearm	0.02	0.13	0	0	1
Injured body part: Wrist	0.05	0.22	0	0	1
Injured body part: Metacarpus	0.06	0.23	0	0	1
Injured body part: Finger	0.14	0.35	0	0	1
Injured body part: Several areas of the upper extremities	0.00	0.07	0	0	1
Injured body part: Basins	0.00	0.07	0	0	1
Injured body part: Hip joint	0.00	0.07	0	0	1
Injured body part: Coccyx	0.01	0.08	0	0	1
Injured body part: Bar	0.00	0.04	0	0	1
Injured body part: Genitalia	0.00	0.03	0	0	1
Injured body part: Belly	0.00	0.04	0	0	1
Injured body part: Thigh	0.02	0.13	0	0	1
Injured body part: Knee	0.13	0.33	0	0	1
Injured body part: Lower leg	0.04	0.19	0	0	1
Injured body part: Ankle	0.12	0.33	0	0	1
Injured body part: Middle foot	0.05	0.22	0	0	1
Injured body part: Toes	0.02	0.15	0	0	1
Injured body part: Several areas of the lower extremities	0.00	0.05	0	0	1
Injured body part: Internal injury	0.00	0.04	0	0	1
Injured body part: Heart	0.00	0.01	0	0	1
Injured body part: Lungs	0.00	0.03	0	0	1
Injured body part: Liver	0.00	0.01	0	0	1
Injured body part: Spleen	0.00	0.02	0	0	1
Injured body part: Kidney	0.00	0.02	0	0	1
Injured body part: Bubble	0.00	0.00	0	0	1
Injured body part: Polyblesse	0.01	0.12	0	0	1
Injured body part: Death	0.00	0.00	0	0	1
Injured body part: Shock	0.00	0.03	0	0	1
Injured body part: Whole body (systemic effect)	0.00	0.06	0	0	1
Injured body part: open	0.00	0.03	0	0	1
Injured body part: unfixed/not coded BK	0.00	0.02	0	0	1
Work-related accident	0.42	0.49	0	0	1
Non-work-related accident	0.58	0.49	1	0	1
NOGA: Agriculture, forestry and fishing	0.01	0.07	0	0	1
NOGA: Mining and quarrying	0.00	0.05	0	0	1
NOGA: Manufacturing	0.28	0.45	0	0	1
NOGA: Electricity, gas, steam and air-conditioning supply	0.01	0.10	0	0	1
NOGA: Water supply; Sewerage, waste management and remediation activities	0.01	0.09	0	0	1
NOGA: Construction	0.24	0.43	0	0	1

Variable	Mean	Std. Dev.	Median	Min.	Max.
NOGA: Wholesale and retail trade; repair of motor vehicles and motorcycles	0.12	0.33	0	0	1
NOGA: Transportation and storage	0.10	0.30	0	0	1
NOGA: Accommodation and food service activities	0.00	0.05	0	0	1
NOGA: Information and communication	0.01	0.10	0	0	1
NOGA: Financial and insurance activities	0.01	0.10	0	0	1
NOGA: Real estate activities	0.01	0.07	0	0	1
NOGA: Professional, scientific and technical activities	0.04	0.18	0	0	1
NOGA: Administrative and support service activities	0.10	0.30	0	0	1
NOGA: Public administration and defence; compulsory social security	0.04	0.19	0	0	1
NOGA: Education	0.01	0.09	0	0	1
NOGA: Human health and social work activities	0.02	0.12	0	0	1
NOGA: Arts, entertainment and recreation	0.00	0.03	0	0	1
NOGA: Other service activities	0.00	0.07	0	0	1
NOGA: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.01	0	0	1

B2 Results Lasso

Table B15: Results of Lasso (Test Sample)

Share of DP	Months	Probability	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
90	6	0.5	94.18%	58.20%	98.14%
90	6	0.6	94.02%	67.24%	96.97%
90	6	0.7	93.28%	75.82%	95.20%
90	6	0.8	91.44%	83.41%	92.32%
90	6	0.9	86.98%	90.40%	86.60%
90	12	0.5	95.80%	74.56%	98.14%
90	12	0.6	95.58%	81.59%	97.12%
90	12	0.7	94.79%	87.20%	95.63%
90	12	0.8	93.27%	91.24%	93.49%
90	12	0.9	90.54%	94.63%	90.09%
90	24	0.5	96.94%	83.95%	98.37%
90	24	0.6	96.47%	89.28%	97.26%
90	24	0.7	95.66%	92.56%	96.00%
90	24	0.8	94.41%	94.86%	94.36%
90	24	0.9	92.10%	96.83%	91.58%
75	6	0.5	90.50%	79.63%	94.15%
75	6	0.6	90.02%	84.59%	91.85%
75	6	0.7	88.81%	88.60%	88.88%
75	6	0.8	86.63%	91.88%	84.87%
75	6	0.9	81.47%	95.06%	76.91%
75	12	0.5	93.37%	88.86%	94.89%
75	12	0.6	92.84%	91.63%	93.25%
75	12	0.7	91.90%	93.68%	91.30%
75	12	0.8	90.46%	95.31%	88.83%
75	12	0.9	87.71%	96.90%	84.63%
75	24	0.5	95.15%	92.99%	95.87%
75	24	0.6	94.68%	94.64%	94.69%
75	24	0.7	93.86%	95.87%	93.18%
75	24	0.8	92.88%	96.89%	91.54%
75	24	0.9	90.83%	97.88%	88.47%
50	6	0.5	88.74%	90.51%	86.96%
50	6	0.6	88.31%	92.66%	83.94%
50	6	0.7	87.11%	94.50%	79.70%
50	6	0.8	84.68%	96.13%	73.20%
50	6	0.9	78.84%	97.89%	59.73%
50	12	0.5	92.48%	94.77%	90.18%
50	12	0.6	92.00%	95.80%	88.19%
50	12	0.7	91.26%	96.72%	85.79%
50	12	0.8	90.04%	97.49%	82.57%
50	12	0.9	87.11%	98.32%	75.87%
50	24	0.5	94.46%	96.61%	92.30%
50	24	0.6	94.06%	97.31%	90.79%
50	24	0.7	93.38%	97.87%	88.87%
50	24	0.8	92.18%	98.36%	85.98%
50	24	0.9	89.89%	98.83%	80.93%

Share of DP	Months	Probability	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
20	6	0.5	91.55%	96.08%	73.44%
20	6	0.6	91.12%	97.12%	67.12%
20	6	0.7	90.15%	98.04%	58.58%
20	6	0.8	88.31%	98.87%	46.04%
20	6	0.9	85.13%	99.58%	27.28%
20	12	0.5	94.51%	97.60%	82.16%
20	12	0.6	94.22%	98.04%	78.90%
20	12	0.7	93.73%	98.44%	74.91%
20	12	0.8	92.86%	98.81%	69.03%
20	12	0.9	90.84%	99.28%	57.03%
20	24	0.5	95.88%	98.43%	85.70%
20	24	0.6	95.56%	98.69%	83.04%
20	24	0.7	95.12%	98.92%	79.90%
20	24	0.8	94.46%	99.13%	75.78%
20	24	0.9	93.21%	99.36%	68.60%
10	6	0.5	94.14%	97.90%	60.26%
10	6	0.6	93.86%	98.57%	51.48%
10	6	0.7	93.31%	99.12%	40.98%
10	6	0.8	92.48%	99.55%	28.75%
10	6	0.9	91.41%	99.85%	15.39%
10	12	0.5	96.10%	98.40%	75.35%
10	12	0.6	95.95%	98.71%	71.11%
10	12	0.7	95.63%	99.00%	65.29%
10	12	0.8	95.06%	99.30%	56.89%
10	12	0.9	93.71%	99.68%	39.94%
10	24	0.5	96.98%	98.96%	79.19%
10	24	0.6	96.79%	99.13%	75.71%
10	24	0.7	96.53%	99.28%	71.75%
10	24	0.8	96.11%	99.43%	66.18%
10	24	0.9	95.35%	99.58%	57.21%
1	6	0.5	99.03%	99.99%	4.14%
1	6	0.6	99.03%	99.99%	3.17%
1	6	0.7	99.02%	99.99%	2.38%
1	6	0.8	99.02%	100.00%	1.73%
1	6	0.9	99.01%	100.00%	0.81%
1	12	0.5	99.12%	99.83%	28.35%
1	12	0.6	99.11%	99.93%	17.45%
1	12	0.7	99.07%	99.97%	9.49%
1	12	0.8	99.04%	99.99%	5.14%
1	12	0.9	99.03%	100.00%	2.98%
1	24	0.5	99.20%	99.75%	44.87%
1	24	0.6	99.20%	99.81%	38.15%
1	24	0.7	99.18%	99.87%	30.83%
1	24	0.8	99.16%	99.93%	22.19%
1	24	0.9	99.09%	99.98%	10.37%

Notes: Share of DP: The share of DP that is in the sample. Sample sizes are displayed in Table 3.3. Months refers to the period, the cost variables were cumulated after an accident. 6 months indicates the costs of the first six months after the accident, 12 and 24 months are analogous. Correct classification "no DP" indicates that correct classification of accidents that did not lead to disability pensions.

Table B16: Results of Lasso (Random Sample)

Share of DP	Months	Probability	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
90	6	0.5	64.30%	64.13%	84.20%
90	6	0.6	72.10%	72.01%	83.21%
90	6	0.7	79.19%	79.17%	81.59%
90	6	0.8	85.67%	85.72%	79.14%
90	6	0.9	91.63%	91.78%	74.31%
90	12	0.5	78.17%	78.12%	84.19%
90	12	0.6	84.19%	84.19%	83.28%
90	12	0.7	88.81%	88.87%	82.03%
90	12	0.8	92.37%	92.47%	80.17%
90	12	0.9	95.28%	95.43%	77.24%
90	24	0.5	86.35%	86.36%	84.32%
90	24	0.6	90.72%	90.78%	83.37%
90	24	0.7	93.53%	93.62%	82.22%
90	24	0.8	95.50%	95.62%	80.85%
90	24	0.9	97.10%	97.26%	78.62%
75	6	0.5	82.01%	82.01%	82.67%
75	6	0.6	86.44%	86.48%	80.63%
75	6	0.7	89.90%	90.00%	78.14%
75	6	0.8	92.79%	92.94%	74.59%
75	6	0.9	95.53%	95.76%	67.63%
75	12	0.5	90.30%	90.36%	83.31%
75	12	0.6	92.72%	92.81%	81.84%
75	12	0.7	94.48%	94.60%	80.15%
75	12	0.8	95.88%	96.03%	78.06%
75	12	0.9	97.18%	97.37%	74.37%
75	24	0.5	93.87%	93.95%	84.09%
75	24	0.6	95.30%	95.40%	83.07%
75	24	0.7	96.35%	96.47%	81.82%
75	24	0.8	97.22%	97.36%	80.31%
75	24	0.9	98.02%	98.19%	77.67%
50	6	0.5	91.11%	91.21%	79.97%
50	6	0.6	93.11%	93.24%	77.27%
50	6	0.7	94.72%	94.90%	73.42%
50	6	0.8	96.20%	96.43%	67.48%
50	6	0.9	97.70%	98.05%	55.11%
50	12	0.5	95.08%	95.19%	82.79%
50	12	0.6	96.06%	96.18%	81.02%
50	12	0.7	96.84%	96.99%	78.84%
50	12	0.8	97.53%	97.71%	75.80%
50	12	0.9	98.22%	98.45%	69.72%
50	24	0.5	96.82%	96.92%	84.65%
50	24	0.6	97.44%	97.56%	83.30%
50	24	0.7	97.92%	98.06%	81.48%
50	24	0.8	98.33%	98.49%	78.90%
50	24	0.9	98.71%	98.91%	74.21%

Share of DP	Months	Probability	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
20	6	0.5	96.05%	96.26%	70.60%
20	6	0.6	96.97%	97.23%	64.49%
20	6	0.7	97.75%	98.09%	56.53%
20	6	0.8	98.44%	98.89%	44.42%
20	6	0.9	98.99%	99.59%	26.44%
20	12	0.5	97.52%	97.68%	78.98%
20	12	0.6	97.93%	98.12%	75.85%
20	12	0.7	98.27%	98.49%	71.89%
20	12	0.8	98.59%	98.86%	66.26%
20	12	0.9	98.94%	99.31%	54.60%
20	24	0.5	98.35%	98.48%	82.19%
20	24	0.6	98.58%	98.74%	79.59%
20	24	0.7	98.78%	98.96%	76.58%
20	24	0.8	98.95%	99.17%	72.50%
20	24	0.9	99.11%	99.39%	65.75%
10	6	0.5	97.60%	97.90%	60.70%
10	6	0.6	98.18%	98.57%	51.84%
10	6	0.7	98.64%	99.11%	41.24%
10	6	0.8	98.97%	99.55%	28.99%
10	6	0.9	99.16%	99.85%	15.59%
10	12	0.5	98.23%	98.42%	75.53%
10	12	0.6	98.50%	98.72%	71.34%
10	12	0.7	98.73%	99.00%	65.52%
10	12	0.8	98.96%	99.31%	56.94%
10	12	0.9	99.19%	99.68%	40.00%
10	24	0.5	98.81%	98.97%	79.16%
10	24	0.6	98.94%	99.14%	75.67%
10	24	0.7	99.06%	99.28%	71.74%
10	24	0.8	99.15%	99.42%	66.21%
10	24	0.9	99.24%	99.58%	57.37%
1	6	0.5	99.20%	99.98%	3.77%
1	6	0.6	99.20%	99.99%	3.01%
1	6	0.7	99.20%	99.99%	2.22%
1	6	0.8	99.19%	100.00%	1.53%
1	6	0.9	99.19%	100.00%	0.79%
1	12	0.5	99.25%	99.83%	27.84%
1	12	0.6	99.25%	99.93%	17.24%
1	12	0.7	99.23%	99.97%	9.36%
1	12	0.8	99.21%	99.99%	5.37%
1	12	0.9	99.20%	99.99%	2.96%
1	24	0.5	99.30%	99.75%	44.46%
1	24	0.6	99.31%	99.81%	38.40%
1	24	0.7	99.31%	99.87%	30.73%
1	24	0.8	99.29%	99.93%	22.00%
1	24	0.9	99.25%	99.98%	10.17%

Notes: Share of DP: The share of DP that is in the sample. Sample sizes are displayed in Table 3.3. Months refers to the period, the cost variables were cumulated after an accident. 6 months indicates the costs of the first six months after the accident, 12 and 24 months are analogous. Correct classification "no DP" indicates that correct classification of accidents that did not lead to disability pensions.

B3 Results Random Forest

Table B17: Results of Random Forest (Test Sample)

Share of DP	Months	Probability	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
90	6	0.5	95.83%	67.97%	98.92%
90	6	0.6	95.80%	73.36%	98.28%
90	6	0.7	95.39%	78.65%	97.24%
90	6	0.8	93.69%	83.47%	94.83%
90	6	0.9	89.21%	89.44%	89.18%
90	12	0.5	96.70%	76.35%	98.96%
90	12	0.6	96.43%	80.60%	98.18%
90	12	0.7	96.05%	83.70%	97.42%
90	12	0.8	94.67%	88.63%	95.33%
90	12	0.9	91.70%	93.69%	91.48%
90	24	0.5	97.34%	82.32%	99.01%
90	24	0.6	97.14%	85.07%	98.47%
90	24	0.7	96.68%	87.94%	97.65%
90	24	0.8	96.09%	92.42%	96.49%
90	24	0.9	93.96%	94.83%	93.86%
75	6	0.5	92.84%	79.92%	97.08%
75	6	0.6	92.92%	84.27%	95.77%
75	6	0.7	91.75%	87.43%	93.17%
75	6	0.8	89.35%	90.86%	88.86%
75	6	0.9	82.62%	94.45%	78.73%
75	12	0.5	94.74%	87.16%	97.24%
75	12	0.6	94.42%	89.90%	95.91%
75	12	0.7	93.69%	92.56%	94.06%
75	12	0.8	92.06%	94.18%	91.37%
75	12	0.9	88.31%	96.53%	85.61%
75	24	0.5	95.66%	90.56%	97.34%
75	24	0.6	95.43%	92.60%	96.36%
75	24	0.7	94.93%	94.68%	95.01%
75	24	0.8	93.90%	96.11%	93.18%
75	24	0.9	91.52%	97.30%	89.62%
50	6	0.5	90.89%	89.04%	92.75%
50	6	0.6	90.32%	91.17%	89.47%
50	6	0.7	89.00%	93.41%	84.58%
50	6	0.8	86.21%	95.58%	76.80%
50	6	0.9	78.51%	97.89%	59.04%
50	12	0.5	93.60%	93.46%	93.73%
50	12	0.6	93.06%	94.73%	91.37%
50	12	0.7	92.43%	95.76%	89.09%
50	12	0.8	91.40%	96.90%	85.88%
50	12	0.9	87.78%	98.05%	77.48%
50	24	0.5	94.89%	95.01%	94.77%
50	24	0.6	94.73%	96.03%	93.44%
50	24	0.7	94.51%	96.81%	92.19%
50	24	0.8	93.83%	97.55%	90.10%
50	24	0.9	91.10%	98.27%	83.90%

Share of DP	Months	Probability	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
20	6	0.5	92.30%	95.59%	79.21%
20	6	0.6	91.94%	96.76%	72.79%
20	6	0.7	90.77%	97.85%	62.59%
20	6	0.8	88.79%	98.93%	48.45%
20	6	0.9	84.35%	99.80%	22.94%
20	12	0.5	94.98%	97.34%	85.58%
20	12	0.6	94.75%	97.76%	82.77%
20	12	0.7	94.35%	98.24%	78.91%
20	12	0.8	93.32%	98.83%	71.42%
20	12	0.9	89.57%	99.53%	49.97%
20	24	0.5	96.27%	97.89%	89.80%
20	24	0.6	96.18%	98.26%	87.92%
20	24	0.7	95.89%	98.61%	85.08%
20	24	0.8	95.12%	99.04%	79.57%
20	24	0.9	92.55%	99.49%	64.97%
10	6	0.5	94.39%	97.73%	64.21%
10	6	0.6	94.11%	98.56%	53.91%
10	6	0.7	93.36%	99.21%	40.54%
10	6	0.8	92.13%	99.69%	23.82%
10	6	0.9	90.67%	99.95%	6.94%
10	12	0.5	96.26%	98.18%	79.01%
10	12	0.6	96.13%	98.60%	73.87%
10	12	0.7	95.73%	99.02%	66.06%
10	12	0.8	94.75%	99.45%	52.27%
10	12	0.9	92.55%	99.84%	26.76%
10	24	0.5	97.21%	98.53%	85.21%
10	24	0.6	97.13%	98.83%	81.78%
10	24	0.7	96.89%	99.13%	76.72%
10	24	0.8	96.22%	99.43%	67.18%
10	24	0.9	94.22%	99.78%	44.05%
1	6	0.5	98.24%	99.86%	16.94%
1	6	0.6	98.15%	99.95%	8.08%
1	6	0.7	98.09%	99.99%	3.02%
1	6	0.8	98.05%	100.00%	0.69%
1	6	0.9	98.04%	100.00%	0.00%
1	12	0.5	99.11%	99.89%	21.75%
1	12	0.6	99.06%	99.97%	10.12%
1	12	0.7	99.02%	99.99%	2.71%
1	12	0.8	99.00%	100.00%	0.24%
1	12	0.9	99.00%	100.00%	0.00%
1	24	0.5	99.23%	99.81%	41.75%
1	24	0.6	99.18%	99.92%	26.53%
1	24	0.7	99.09%	99.97%	12.35%
1	24	0.8	99.02%	100.00%	2.55%
1	24	0.9	99.00%	100.00%	0.00%

Notes: Share of DP: The share of DP that is in the sample. Sample sizes are displayed in Table 3.3. Months refers to the period, the cost variables were cumulated after an accident. 6 months indicates the costs of the first six months after the accident, 12 and 24 months are analogous. Correct classification "no DP" indicates that correct classification of accidents that did not lead to disability pensions.

Table B18: Results of Random Forest (Random Sample)

Share of DP	Months	Probability	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
90	6	0.5	67.56%	67.30%	98.68%
90	6	0.6	73.16%	72.96%	98.01%
90	6	0.7	78.48%	78.32%	97.20%
90	6	0.8	83.74%	83.65%	95.30%
90	6	0.9	89.50%	89.50%	89.73%
90	12	0.5	76.29%	76.10%	98.77%
90	12	0.6	81.05%	80.91%	98.37%
90	12	0.7	85.42%	85.32%	97.38%
90	12	0.8	89.32%	89.27%	95.72%
90	12	0.9	93.23%	93.23%	92.23%
90	24	0.5	82.19%	82.05%	99.16%
90	24	0.6	85.84%	85.73%	98.64%
90	24	0.7	88.97%	88.89%	97.92%
90	24	0.8	91.81%	91.77%	96.75%
90	24	0.9	94.77%	94.77%	94.97%
75	6	0.5	80.00%	79.86%	96.87%
75	6	0.6	84.03%	83.94%	95.57%
75	6	0.7	87.59%	87.54%	93.26%
75	6	0.8	90.92%	90.94%	88.68%
75	6	0.9	94.61%	94.74%	79.16%
75	12	0.5	86.93%	86.84%	96.96%
75	12	0.6	89.81%	89.76%	96.00%
75	12	0.7	92.17%	92.15%	94.40%
75	12	0.8	94.32%	94.34%	91.57%
75	12	0.9	96.45%	96.53%	86.54%
75	24	0.5	90.61%	90.55%	97.53%
75	24	0.6	92.65%	92.62%	96.87%
75	24	0.7	94.36%	94.34%	95.84%
75	24	0.8	95.81%	95.83%	94.49%
75	24	0.9	97.25%	97.30%	91.15%
50	6	0.5	88.88%	88.85%	92.65%
50	6	0.6	91.34%	91.36%	89.28%
50	6	0.7	93.51%	93.58%	84.61%
50	6	0.8	95.55%	95.70%	76.87%
50	6	0.9	97.60%	97.92%	59.50%
50	12	0.5	93.23%	93.23%	93.92%
50	12	0.6	94.69%	94.71%	91.99%
50	12	0.7	95.83%	95.89%	89.43%
50	12	0.8	96.84%	96.93%	86.12%
50	12	0.9	97.98%	98.15%	76.93%
50	24	0.5	95.07%	95.07%	95.48%
50	24	0.6	96.04%	96.06%	94.40%
50	24	0.7	96.86%	96.89%	92.83%
50	24	0.8	97.59%	97.65%	90.33%
50	24	0.9	98.41%	98.53%	84.70%

Share of DP	Months	Probability	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
20	6	0.5	95.29%	95.41%	80.68%
20	6	0.6	96.45%	96.64%	73.99%
20	6	0.7	97.50%	97.79%	64.30%
20	6	0.8	98.38%	98.80%	49.50%
20	6	0.9	99.02%	99.68%	22.72%
20	12	0.5	96.90%	96.98%	87.20%
20	12	0.6	97.42%	97.53%	84.97%
20	12	0.7	97.96%	98.10%	81.03%
20	12	0.8	98.52%	98.74%	73.17%
20	12	0.9	99.04%	99.44%	52.08%
20	24	0.5	97.65%	97.70%	91.72%
20	24	0.6	98.02%	98.09%	89.78%
20	24	0.7	98.40%	98.50%	86.85%
20	24	0.8	98.77%	98.91%	82.38%
20	24	0.9	99.18%	99.45%	67.94%
10	6	0.5	97.47%	97.74%	64.57%
10	6	0.6	98.19%	98.55%	54.47%
10	6	0.7	98.73%	99.21%	40.93%
10	6	0.8	99.07%	99.69%	24.16%
10	6	0.9	99.19%	99.95%	6.81%
10	12	0.5	98.02%	98.18%	79.12%
10	12	0.6	98.40%	98.60%	74.15%
10	12	0.7	98.76%	99.02%	66.21%
10	12	0.8	99.07%	99.45%	52.51%
10	12	0.9	99.24%	99.84%	26.75%
10	24	0.5	98.43%	98.54%	85.19%
10	24	0.6	98.70%	98.84%	81.85%
10	24	0.7	98.95%	99.13%	76.70%
10	24	0.8	99.17%	99.43%	67.09%
10	24	0.9	99.32%	99.77%	44.15%
1	6	0.5	99.16%	99.87%	17.26%
1	6	0.6	99.18%	99.95%	9.75%
1	6	0.7	99.17%	99.99%	4.05%
1	6	0.8	99.15%	100.00%	0.59%
1	6	0.9	99.15%	100.00%	0.00%
1	12	0.5	99.26%	99.90%	24.08%
1	12	0.6	99.22%	99.97%	11.63%
1	12	0.7	99.17%	99.99%	2.99%
1	12	0.8	99.15%	100.00%	0.23%
1	12	0.9	99.15%	100.00%	0.00%
1	24	0.5	99.35%	99.82%	44.39%
1	24	0.6	99.32%	99.92%	29.07%
1	24	0.7	99.24%	99.97%	13.86%
1	24	0.8	99.18%	99.99%	3.82%
1	24	0.9	99.15%	100.00%	0.00%

Notes: Share of DP: The share of DP that is in the sample. Sample sizes are displayed in Table 3.3. Months refers to the period, the cost variables were cumulated after an accident. 6 months indicates the costs of the first six months after the accident, 12 and 24 months are analogous. Correct classification "no DP" indicates that correct classification of accidents that did not lead to disability pensions.

B4 Results ensemble learner

Table B19: Results of ensemble learner (Test Sample)

Share of DP	Months	Probability	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
90	6	0.5	95.83%	67.97%	98.92%
90	6	0.6	95.80%	73.36%	98.28%
90	6	0.7	95.39%	78.65%	97.24%
90	6	0.8	93.69%	83.47%	94.83%
90	6	0.9	89.21%	89.44%	89.18%
90	12	0.5	96.70%	76.35%	98.96%
90	12	0.6	96.43%	80.60%	98.18%
90	12	0.7	96.05%	83.70%	97.42%
90	12	0.8	94.67%	88.63%	95.33%
90	12	0.9	91.70%	93.69%	91.48%
90	24	0.5	97.34%	82.32%	99.01%
90	24	0.6	97.14%	85.07%	98.47%
90	24	0.7	96.68%	87.94%	97.65%
90	24	0.8	96.09%	92.42%	96.49%
90	24	0.9	93.96%	94.83%	93.86%
75	6	0.5	92.84%	79.92%	97.08%
75	6	0.6	92.92%	84.27%	95.77%
75	6	0.7	91.75%	87.43%	93.17%
75	6	0.8	89.35%	90.86%	88.86%
75	6	0.9	82.62%	94.45%	78.73%
75	12	0.5	94.74%	87.16%	97.24%
75	12	0.6	94.42%	89.90%	95.91%
75	12	0.7	93.69%	92.56%	94.06%
75	12	0.8	92.06%	94.18%	91.37%
75	12	0.9	88.31%	96.53%	85.61%
75	24	0.5	95.66%	90.56%	97.34%
75	24	0.6	95.43%	92.60%	96.36%
75	24	0.7	94.93%	94.68%	95.01%
75	24	0.8	93.90%	96.11%	93.18%
75	24	0.9	91.52%	97.30%	89.62%
50	6	0.5	90.89%	89.04%	92.75%
50	6	0.6	90.32%	91.17%	89.47%
50	6	0.7	89.00%	93.41%	84.58%
50	6	0.8	86.21%	95.58%	76.80%
50	6	0.9	78.51%	97.89%	59.04%
50	12	0.5	93.60%	93.46%	93.73%
50	12	0.6	93.06%	94.73%	91.37%
50	12	0.7	92.43%	95.76%	89.09%
50	12	0.8	91.40%	96.90%	85.88%
50	12	0.9	87.78%	98.05%	77.48%
50	24	0.5	94.89%	95.01%	94.77%
50	24	0.6	94.73%	96.03%	93.44%
50	24	0.7	94.51%	96.81%	92.19%
50	24	0.8	93.83%	97.55%	90.10%
50	24	0.9	91.10%	98.27%	83.90%

Share of DP	Months	Probability	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
20	6	0.5	92.30%	95.59%	79.21%
20	6	0.6	91.94%	96.76%	72.79%
20	6	0.7	90.77%	97.85%	62.59%
20	6	0.8	88.79%	98.93%	48.45%
20	6	0.9	84.35%	99.80%	22.94%
20	12	0.5	94.98%	97.34%	85.58%
20	12	0.6	94.75%	97.76%	82.77%
20	12	0.7	94.35%	98.24%	78.91%
20	12	0.8	93.32%	98.83%	71.42%
20	12	0.9	89.57%	99.53%	49.97%
20	24	0.5	96.27%	97.89%	89.80%
20	24	0.6	96.18%	98.26%	87.92%
20	24	0.7	95.89%	98.61%	85.08%
20	24	0.8	95.12%	99.04%	79.57%
20	24	0.9	92.55%	99.49%	64.97%
10	6	0.5	94.39%	97.73%	64.21%
10	6	0.6	94.11%	98.56%	53.91%
10	6	0.7	93.36%	99.21%	40.54%
10	6	0.8	92.13%	99.69%	23.82%
10	6	0.9	90.67%	99.95%	6.94%
10	12	0.5	96.26%	98.18%	79.01%
10	12	0.6	96.13%	98.60%	73.87%
10	12	0.7	95.73%	99.02%	66.06%
10	12	0.8	94.75%	99.45%	52.27%
10	12	0.9	92.55%	99.84%	26.76%
10	24	0.5	97.21%	98.53%	85.21%
10	24	0.6	97.13%	98.83%	81.78%
10	24	0.7	96.89%	99.13%	76.72%
10	24	0.8	96.22%	99.43%	67.18%
10	24	0.9	94.22%	99.78%	44.05%
1	6	0.5	98.24%	99.86%	16.94%
1	6	0.6	98.15%	99.95%	8.08%
1	6	0.7	98.09%	99.99%	3.02%
1	6	0.8	98.05%	100.00%	0.69%
1	6	0.9	98.04%	100.00%	0.00%
1	12	0.5	99.11%	99.89%	21.75%
1	12	0.6	99.06%	99.97%	10.12%
1	12	0.7	99.02%	99.99%	2.71%
1	12	0.8	99.00%	100.00%	0.24%
1	12	0.9	99.00%	100.00%	0.00%
1	24	0.5	99.23%	99.81%	41.75%
1	24	0.6	99.18%	99.92%	26.53%
1	24	0.7	99.09%	99.97%	12.35%
1	24	0.8	99.02%	100.00%	2.55%
1	24	0.9	99.00%	100.00%	0.00%

Notes: Share of DP: The share of DP that is in the sample. Sample sizes are displayed in Table 3.3. Months refers to the period, the cost variables were cumulated after an accident. 6 months indicates the costs of the first six months after the accident, 12 and 24 months are analogous. Correct classification "no DP" indicates that correct classification of accidents that did not lead to disability pensions.

Table B20: Results of ensemble learner (Random Sample)

Share of DP	Months	Probability	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
90	6	0.5	67.56%	67.30%	98.68%
90	6	0.6	73.16%	72.96%	98.01%
90	6	0.7	78.48%	78.32%	97.20%
90	6	0.8	83.74%	83.65%	95.30%
90	6	0.9	89.50%	89.50%	89.73%
90	12	0.5	76.29%	76.10%	98.77%
90	12	0.6	81.05%	80.91%	98.37%
90	12	0.7	85.42%	85.32%	97.38%
90	12	0.8	89.32%	89.27%	95.72%
90	12	0.9	93.23%	93.23%	92.23%
90	24	0.5	82.19%	82.05%	99.16%
90	24	0.6	85.84%	85.73%	98.64%
90	24	0.7	88.97%	88.89%	97.92%
90	24	0.8	91.81%	91.77%	96.75%
90	24	0.9	94.77%	94.77%	94.97%
75	6	0.5	80.00%	79.86%	96.87%
75	6	0.6	84.03%	83.94%	95.57%
75	6	0.7	87.59%	87.54%	93.26%
75	6	0.8	90.92%	90.94%	88.68%
75	6	0.9	94.61%	94.74%	79.16%
75	12	0.5	86.93%	86.84%	96.96%
75	12	0.6	89.81%	89.76%	96.00%
75	12	0.7	92.17%	92.15%	94.40%
75	12	0.8	94.32%	94.34%	91.57%
75	12	0.9	96.45%	96.53%	86.54%
75	24	0.5	90.61%	90.55%	97.53%
75	24	0.6	92.65%	92.62%	96.87%
75	24	0.7	94.36%	94.34%	95.84%
75	24	0.8	95.81%	95.83%	94.49%
75	24	0.9	97.25%	97.30%	91.15%
50	6	0.5	88.88%	88.85%	92.65%
50	6	0.6	91.34%	91.36%	89.28%
50	6	0.7	93.51%	93.58%	84.61%
50	6	0.8	95.55%	95.70%	76.87%
50	6	0.9	97.60%	97.92%	59.50%
50	12	0.5	93.23%	93.23%	93.92%
50	12	0.6	94.69%	94.71%	91.99%
50	12	0.7	95.83%	95.89%	89.43%
50	12	0.8	96.84%	96.93%	86.12%
50	12	0.9	97.98%	98.15%	76.93%
50	24	0.5	95.07%	95.07%	95.48%
50	24	0.6	96.04%	96.06%	94.40%
50	24	0.7	96.86%	96.89%	92.83%
50	24	0.8	97.59%	97.65%	90.33%
50	24	0.9	98.41%	98.53%	84.70%

Share of DP	Months	Probability	Overall correct classification	Correct classification of "no DP"	Correct classification of DP
20	6	0.5	95.29%	95.41%	80.68%
20	6	0.6	96.45%	96.64%	73.99%
20	6	0.7	97.50%	97.79%	64.30%
20	6	0.8	98.38%	98.80%	49.50%
20	6	0.9	99.02%	99.68%	22.72%
20	12	0.5	96.90%	96.98%	87.20%
20	12	0.6	97.42%	97.53%	84.97%
20	12	0.7	97.96%	98.10%	81.03%
20	12	0.8	98.52%	98.74%	73.17%
20	12	0.9	99.04%	99.44%	52.08%
20	24	0.5	97.65%	97.70%	91.72%
20	24	0.6	98.02%	98.09%	89.78%
20	24	0.7	98.40%	98.50%	86.85%
20	24	0.8	98.77%	98.91%	82.38%
20	24	0.9	99.18%	99.45%	67.94%
10	6	0.5	97.47%	97.74%	64.57%
10	6	0.6	98.19%	98.55%	54.47%
10	6	0.7	98.73%	99.21%	40.93%
10	6	0.8	99.07%	99.69%	24.16%
10	6	0.9	99.19%	99.95%	6.81%
10	12	0.5	98.02%	98.18%	79.12%
10	12	0.6	98.40%	98.60%	74.15%
10	12	0.7	98.76%	99.02%	66.21%
10	12	0.8	99.07%	99.45%	52.51%
10	12	0.9	99.24%	99.84%	26.75%
10	24	0.5	98.43%	98.54%	85.19%
10	24	0.6	98.70%	98.84%	81.85%
10	24	0.7	98.95%	99.13%	76.70%
10	24	0.8	99.17%	99.43%	67.09%
10	24	0.9	99.32%	99.77%	44.15%
1	6	0.5	99.16%	99.87%	17.26%
1	6	0.6	99.18%	99.95%	9.75%
1	6	0.7	99.17%	99.99%	4.05%
1	6	0.8	99.15%	100.00%	0.59%
1	6	0.9	99.15%	100.00%	0.00%
1	12	0.5	99.26%	99.90%	24.08%
1	12	0.6	99.22%	99.97%	11.63%
1	12	0.7	99.17%	99.99%	2.99%
1	12	0.8	99.15%	100.00%	0.23%
1	12	0.9	99.15%	100.00%	0.00%
1	24	0.5	99.35%	99.82%	44.39%
1	24	0.6	99.32%	99.92%	29.07%
1	24	0.7	99.24%	99.97%	13.86%
1	24	0.8	99.18%	99.99%	3.82%
1	24	0.9	99.15%	100.00%	0.00%

Notes: Share of DP: The share of DP that is in the sample. Sample sizes are displayed in Table 3.3. Months refers to the period, the cost variables were cumulated after an accident. 6 months indicates the costs of the first six months after the accident, 12 and 24 months are analogous. Correct classification "no DP" indicates that correct classification of accidents that did not lead to disability pensions.

C Appendix 3

C1 Descriptive Statistics

Workers with permanent contracts

Variable	Mean	Std. Dev.	Median	Min.	Max.	N	NMiss
Daily cash benefits in days (12 months)	24	56	3	0	365	106'047	0
Treatment costs (12 months)	1'102	6'962	0	0	561'530	106'047	0
Treatment costs (3 months)	592.01	3'021.39	0	0	253'150	106'047	0
Treatment costs (6 months)	865.54	4'934.05	0	0	302'997	106'047	0
Age	38.99	12.12	38	16	95	106'047	19
Tenure	6.81	8.01	4	0	78	106'047	961
Gender: Male	0.97	0.18	1	0	1	106'047	0
Gender: Female	0.03	0.18	0	0	1	106'047	0
Injured body part: Skull	0.03	0.16	0	0	1	106'047	0
Injured body part: Face	0.02	0.16	0	0	1	106'047	0
Injured body part: Eye	0.12	0.33	0	0	1	106'047	0
Injured body part: Nose	0.01	0.08	0	0	1	106'047	0
Injured body part: Ear	0.00	0.06	0	0	1	106'047	0
Injured body part: Teeth	0.02	0.13	0	0	1	106'047	0
Injured body part: Jaw	0.00	0.04	0	0	1	106'047	0
Injured body part: Neck	0.01	0.08	0	0	1	106'047	0
Injured body part: Back	0.05	0.21	0	0	1	106'047	0
Injured body part: Chest	0.04	0.20	0	0	1	106'047	0
Injured body part: Cervical spine	0.01	0.09	0	0	1	106'047	0
Injured body part: Thoracic spine	0.00	0.05	0	0	1	106'047	0
Injured body part: Lumbar spine	0.00	0.06	0	0	1	106'047	0
Injured body part: Shoulder	0.06	0.23	0	0	1	106'047	0
Injured body part: Upper arm	0.02	0.13	0	0	1	106'047	0
Injured body part: Elbows	0.02	0.14	0	0	1	106'047	0
Injured body part: Forearm	0.02	0.14	0	0	1	106'047	0
Injured body part: Wrist	0.04	0.20	0	0	1	106'047	0
Injured body part: Metacarpus	0.04	0.20	0	0	1	106'047	0
Injured body part: Finger	0.15	0.36	0	0	1	106'047	0
Injured body part: Several areas of the upper extremities	0.00	0.06	0	0	1	106'047	0
Injured body part: Basins	0.00	0.06	0	0	1	106'047	0
Injured body part: Hip joint	0.00	0.06	0	0	1	106'047	0
Injured body part: Coccyx	0.00	0.07	0	0	1	106'047	0
Injured body part: Bar	0.00	0.05	0	0	1	106'047	0
Injured body part: Genitalia	0.00	0.03	0	0	1	106'047	0
Injured body part: Belly	0.00	0.06	0	0	1	106'047	0
Injured body part: Thigh	0.02	0.14	0	0	1	106'047	0
Injured body part: Knee	0.09	0.29	0	0	1	106'047	0
Injured body part: Lower leg	0.05	0.21	0	0	1	106'047	0
Injured body part: Ankle	0.09	0.29	0	0	1	106'047	0
Injured body part: Middle foot	0.04	0.19	0	0	1	106'047	0
Injured body part: Toes	0.02	0.13	0	0	1	106'047	0
Injured body part: Several areas of the lower extremities	0.00	0.04	0	0	1	106'047	0
Injured body part: Internal injury	0.00	0.05	0	0	1	106'047	0
Injured body part: Heart	0.00	0.01	0	0	1	106'047	0

Variable	Mean	Std. Dev.	Median	Min.	Max.	N	NMiss
Injured body part: Lungs	0.00	0.03	0	0	1	106'047	0
Injured body part: Liver	0.00	0.01	0	0	1	106'047	0
Injured body part: Spleen	0.00	0.01	0	0	1	106'047	0
Injured body part: Kidney	0.00	0.02	0	0	1	106'047	0
Injured body part: Bubble	0.00	0.00	0	0	1	106'047	0
Injured body part: Polyblesse	0.00	0.05	0	0	1	106'047	0
Injured body part: Shock	0.00	0.03	0	0	1	106'047	0
Injured body part: Whole body (systemic effect)	0.00	0.06	0	0	1	106'047	0
Injured body part: open	0.00	0.04	0	0	1	106'047	0
Work-related accident	0.64	0.48	1	0	1	106'047	0
Non-work-related accident	0.36	0.48	0	0	1	106'047	0
Resident Country: Austria	0.00	0.03	0	0	1	106'047	0
Resident Country: Switzerland	0.93	0.25	1	0	1	106'047	0
Resident Country: Germany	0.01	0.08	0	0	1	106'047	0
Resident Country: France	0.02	0.14	0	0	1	106'047	0
Resident Country: Italy	0.04	0.19	0	0	1	106'047	0
Resident Country: Other	0.00	0.02	0	0	1	106'047	0
Occupational position: Higher cadre	0.04	0.21	0	0	1	106'047	505
Occupational position: Middle cadre	0.05	0.22	0	0	1	106'047	505
Occupational position: Em- ployee / worker	0.84	0.36	1	0	1	106'047	505
Occupational position: Ap- prentice	0.05	0.23	0	0	1	106'047	505
Occupational position: Volun- teer, Intern	0.00	0.07	0	0	1	106'047	505
Occupational position: un- known	0.00	0.07	0	0	1	106'047	505
Canton: Zürich	0.15	0.35	0	0	1	106'047	0
Canton: Bern	0.12	0.32	0	0	1	106'047	0
Canton: Luzern	0.06	0.24	0	0	1	106'047	0
Canton: Uri	0.01	0.09	0	0	1	106'047	0
Canton: Schwyz	0.03	0.17	0	0	1	106'047	0
Canton: Obwalden	0.01	0.10	0	0	1	106'047	0
Canton: Nidwalden	0.00	0.07	0	0	1	106'047	0
Canton: Glarus	0.01	0.11	0	0	1	106'047	0
Canton: Zug	0.02	0.13	0	0	1	106'047	0
Canton: Fribourg	0.04	0.20	0	0	1	106'047	0
Canton: Solothurn	0.02	0.16	0	0	1	106'047	0
Canton: Basel-Stadt	0.01	0.12	0	0	1	106'047	0
Canton: Basel-Land	0.02	0.15	0	0	1	106'047	0
Canton: Schaffhausen	0.01	0.08	0	0	1	106'047	0
Canton: Appenzell A. Rh.	0.01	0.07	0	0	1	106'047	0
Canton: Appenzell I. Rh.	0.00	0.04	0	0	1	106'047	0
Canton: St. Gallen	0.06	0.23	0	0	1	106'047	0
Canton: Graubünden	0.05	0.22	0	0	1	106'047	0
Canton: Aargau	0.08	0.27	0	0	1	106'047	0
Canton: Thurgau	0.03	0.16	0	0	1	106'047	0
Canton: Tessin	0.07	0.25	0	0	1	106'047	0
Canton: Waadt	0.08	0.27	0	0	1	106'047	0
Canton: Wallis	0.06	0.23	0	0	1	106'047	0
Canton: Neuenburg	0.01	0.12	0	0	1	106'047	0
Canton: Genf	0.03	0.18	0	0	1	106'047	0
Canton: Jura	0.01	0.09	0	0	1	106'047	0
Year 2015	0.26	0.44	0	0	1	106'047	0

Variable	Mean	Std. Dev.	Median	Min.	Max.	N	NMiss
Year 2016	0.25	0.43	0	0	1	106'047	0
Year 2017	0.25	0.43	0	0	1	106'047	0
Year 2018	0.25	0.43	0	0	1	106'047	0
Injury type: Bite	0.01	0.09	0	0	1	106'047	56
Injury type: Fracture	0.09	0.29	0	0	1	106'047	56
Injury type: Inflammation	0.03	0.18	0	0	1	106'047	56
Injury type: Contusion	0.18	0.38	0	0	1	106'047	56
Injury type: Bruise	0.07	0.26	0	0	1	106'047	56
Injury type: Crack	0.06	0.23	0	0	1	106'047	56
Injury type: Cut	0.12	0.32	0	0	1	106'047	56
Injury type: Shot	0.00	0.02	0	0	1	106'047	56
Injury type: Swelling	0.02	0.13	0	0	1	106'047	56
Injury type: Abrasion	0.01	0.12	0	0	1	106'047	56
Injury type: Compression of the spine	0.01	0.09	0	0	1	106'047	56
Injury type: Stitch	0.02	0.14	0	0	1	106'047	56
Injury type: Separation	0.00	0.05	0	0	1	106'047	56
Injury type: Incineration	0.01	0.10	0	0	1	106'047	56
Injury type: Sprain/twist	0.09	0.28	0	0	1	106'047	56
Injury type: Poisoning	0.00	0.04	0	0	1	106'047	56
Injury type: Chemical burn	0.00	0.05	0	0	1	106'047	56
Injury type: Strain	0.04	0.20	0	0	1	106'047	56
Injury type: Other injury	0.12	0.32	0	0	1	106'047	56
Injury type: Foreign matter	0.11	0.31	0	0	1	106'047	56
Injury type: Dislocation	0.02	0.14	0	0	1	106'047	56
Injury type: unknown	0.00	0.02	0	0	1	106'047	0

Workers with temporary contracts

Variable	Mean	Std. Dev.	Median	Min.	Max.	N	NMiss
Daily cash benefits in days (12 months)	30	66	5	0	365	82'144	0
Treatment costs (12 months)	1'153	8'003	0	0	649'770	82'144	0
Treatment costs (3 months)	579.09	3'158.59	0	0	217'611	82'144	0
Treatment costs (6 months)	869.93	5'727.27	0	0	399'236	82'144	0
Age	35.23	11.08	33	17	77	82'144	10
Tenure	0.65	1.68	0	0	36	82'144	1'454
Gender: Male	0.90	0.30	1	0	1	82'144	0
Gender: Female	0.10	0.30	0	0	1	82'144	0
Injured body part: Skull	0.03	0.18	0	0	1	82'144	0
Injured body part: Face	0.02	0.14	0	0	1	82'144	0
Injured body part: Eye	0.10	0.30	0	0	1	82'144	0
Injured body part: Nose	0.01	0.08	0	0	1	82'144	0
Injured body part: Ear	0.00	0.06	0	0	1	82'144	0
Injured body part: Teeth	0.01	0.11	0	0	1	82'144	0
Injured body part: Jaw	0.00	0.05	0	0	1	82'144	0
Injured body part: Neck	0.01	0.09	0	0	1	82'144	0
Injured body part: Back	0.05	0.23	0	0	1	82'144	0
Injured body part: Chest	0.03	0.17	0	0	1	82'144	0
Injured body part: Cervical spine	0.01	0.10	0	0	1	82'144	0
Injured body part: Thoracic spine	0.00	0.05	0	0	1	82'144	0
Injured body part: Lumbar spine	0.00	0.05	0	0	1	82'144	0
Injured body part: Shoulder	0.05	0.22	0	0	1	82'144	0
Injured body part: Upper arm	0.02	0.13	0	0	1	82'144	0
Injured body part: Elbows	0.02	0.14	0	0	1	82'144	0
Injured body part: Forearm	0.02	0.14	0	0	1	82'144	0
Injured body part: Wrist	0.06	0.23	0	0	1	82'144	0
Injured body part: Metacarpus	0.05	0.21	0	0	1	82'144	0
Injured body part: Finger	0.15	0.36	0	0	1	82'144	0
Injured body part: Several areas of the upper extremities	0.00	0.07	0	0	1	82'144	0
Injured body part: Basins	0.00	0.06	0	0	1	82'144	0
Injured body part: Hip joint	0.01	0.07	0	0	1	82'144	0
Injured body part: Coccyx	0.01	0.07	0	0	1	82'144	0
Injured body part: Bar	0.00	0.04	0	0	1	82'144	0
Injured body part: Genitalia	0.00	0.03	0	0	1	82'144	0
Injured body part: Belly	0.00	0.05	0	0	1	82'144	0
Injured body part: Thigh	0.02	0.13	0	0	1	82'144	0
Injured body part: Knee	0.09	0.29	0	0	1	82'144	0
Injured body part: Lower leg	0.03	0.18	0	0	1	82'144	0
Injured body part: Ankle	0.10	0.30	0	0	1	82'144	0
Injured body part: Middle foot	0.04	0.20	0	0	1	82'144	0
Injured body part: Toes	0.02	0.14	0	0	1	82'144	0
Injured body part: Several areas of the lower extremities	0.00	0.05	0	0	1	82'144	0
Injured body part: Internal injury	0.01	0.07	0	0	1	82'144	0
Injured body part: Heart	0.00	0.01	0	0	1	82'144	0
Injured body part: Lungs	0.00	0.04	0	0	1	82'144	0
Injured body part: Liver	0.00	0.00	0	0	1	82'144	0
Injured body part: Spleen	0.00	0.01	0	0	1	82'144	0
Injured body part: Kidney	0.00	0.02	0	0	1	82'144	0

Variable	Mean	Std. Dev.	Median	Min.	Max.	N	NMiss
Injured body part: Bubble	0.00	0.00	0	0	1	82'144	0
Injured body part: Polyblesse	0.00	0.05	0	0	1	82'144	0
Injured body part: Shock	0.00	0.03	0	0	1	82'144	0
Injured body part: Whole body (systemic effect)	0.01	0.07	0	0	1	82'144	0
Injured body part: open	0.00	0.05	0	0	1	82'144	0
Work-related accident	0.63	0.48	1	0	1	82'144	0
Non-work-related accident	0.37	0.48	0	0	1	82'144	0
Resident Country: Austria	0.00	0.07	0	0	1	82'144	0
Resident Country: Switzerland	0.85	0.35	1	0	1	82'144	0
Resident Country: Germany	0.02	0.14	0	0	1	82'144	0
Resident Country: France	0.09	0.28	0	0	1	82'144	0
Resident Country: Italy	0.03	0.17	0	0	1	82'144	0
Resident Country: Other	0.00	0.05	0	0	1	82'144	0
Occupational position: Higher cadre	0.00	0.06	0	0	1	82'144	837
Occupational position: Middle cadre	0.00	0.05	0	0	1	82'144	837
Occupational position: Em- ployee / worker	0.98	0.12	1	0	1	82'144	837
Occupational position: Ap- prentice	0.00	0.04	0	0	1	82'144	837
Occupational position: Volun- teer, Intern	0.00	0.06	0	0	1	82'144	837
Occupational position: un- known	0.00	0.06	0	0	1	82'144	837
Canton: Zürich	0.17	0.37	0	0	1	82'144	0
Canton: Bern	0.07	0.26	0	0	1	82'144	0
Canton: Luzern	0.03	0.18	0	0	1	82'144	0
Canton: Uri	0.00	0.06	0	0	1	82'144	0
Canton: Schwyz	0.01	0.11	0	0	1	82'144	0
Canton: Obwalden	0.00	0.04	0	0	1	82'144	0
Canton: Nidwalden	0.00	0.06	0	0	1	82'144	0
Canton: Glarus	0.00	0.00	0	0	1	82'144	0
Canton: Zug	0.03	0.17	0	0	1	82'144	0
Canton: Fribourg	0.03	0.17	0	0	1	82'144	0
Canton: Solothurn	0.03	0.16	0	0	1	82'144	0
Canton: Basel-Stadt	0.07	0.26	0	0	1	82'144	0
Canton: Basel-Land	0.02	0.14	0	0	1	82'144	0
Canton: Schaffhausen	0.00	0.03	0	0	1	82'144	0
Canton: Appenzell A. Rh.	0.00	0.01	0	0	1	82'144	0
Canton: Appenzell I. Rh.	0.00	0.01	0	0	1	82'144	0
Canton: St. Gallen	0.07	0.26	0	0	1	82'144	0
Canton: Graubünden	0.01	0.08	0	0	1	82'144	0
Canton: Aargau	0.06	0.24	0	0	1	82'144	0
Canton: Thurgau	0.02	0.14	0	0	1	82'144	0
Canton: Tessin	0.03	0.17	0	0	1	82'144	0
Canton: Waadt	0.16	0.36	0	0	1	82'144	0
Canton: Wallis	0.02	0.14	0	0	1	82'144	0
Canton: Neuenburg	0.04	0.19	0	0	1	82'144	0
Canton: Genf	0.11	0.32	0	0	1	82'144	0
Canton: Jura	0.01	0.08	0	0	1	82'144	0
Year 2015	0.23	0.42	0	0	1	82'144	0
Year 2016	0.23	0.42	0	0	1	82'144	0
Year 2017	0.25	0.43	0	0	1	82'144	0
Year 2018	0.29	0.45	0	0	1	82'144	0
Injury type: Bite	0.01	0.08	0	0	1	82'144	77

Variable	Mean	Std. Dev.	Median	Min.	Max.	N	NMiss
Injury type: Fracture	0.08	0.28	0	0	1	82'144	77
Injury type: Inflammation	0.04	0.19	0	0	1	82'144	77
Injury type: Contusion	0.19	0.40	0	0	1	82'144	77
Injury type: Bruise	0.06	0.23	0	0	1	82'144	77
Injury type: Crack	0.05	0.21	0	0	1	82'144	77
Injury type: Cut	0.13	0.34	0	0	1	82'144	77
Injury type: Shot	0.00	0.02	0	0	1	82'144	77
Injury type: Swelling	0.03	0.16	0	0	1	82'144	77
Injury type: Abrasion	0.01	0.11	0	0	1	82'144	77
Injury type: Compression of the spine	0.01	0.09	0	0	1	82'144	77
Injury type: Stitch	0.02	0.12	0	0	1	82'144	77
Injury type: Separation	0.00	0.05	0	0	1	82'144	77
Injury type: Incineration	0.01	0.11	0	0	1	82'144	77
Injury type: Sprain/twist	0.08	0.28	0	0	1	82'144	77
Injury type: Poisoning	0.00	0.04	0	0	1	82'144	77
Injury type: Chemical burn	0.00	0.05	0	0	1	82'144	77
Injury type: Strain	0.03	0.18	0	0	1	82'144	77
Injury type: Other injury	0.15	0.35	0	0	1	82'144	77
Injury type: Foreign matter	0.08	0.27	0	0	1	82'144	77
Injury type: Dislocation	0.02	0.13	0	0	1	82'144	77
Injury type: unknown	0.00	0.03	0	0	1	82'144	0

C2 Robustness Test with observations of workers residing in Switzerland

Table C3: Robustness Test with observations of workers residing in Switzerland

	Pre-treatment period	Treatment period	(1)
Placebo-test	February	March	-0.222
	[11'662]	[12'640]	(1.498)
	March	April	1.964
	[12'640]	[12'729]	(1.537)
	April	May	-0.163
	[12'729]	[13'355]	(1.507)
	May	June	-0.259
	[13'355]	[17'208]	(1.397)
	September	October	-0.276
	[17'864]	[17'342]	(1.189)
DiD Estimate	October	November	4.157
	[17'342]	[16'065]	(1.346)***
	October	December	1.565
	[17'342]	[11'779]	(1.437)

Notes: The standard errors are obtained by applying 1000 bootstrap repetitions. Standard errors are indicated in parenthesis. The number of observations for each period is provided in brackets. ***, **, and * stand for a significance level of 1%, 5%, resp. 10%