

What Happens When Compensation for Whiplash Claims Is Made More Generous?

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ABSTRACT

We examine the effect of a Danish reform in 2002 that increased compensation for permanent loss of earnings capacity and extended the period when whiplash claimants could get compensation for temporary loss of earnings. The first is subject to extensive state verification by the government while the second is not. Using weekly data about disability, drug purchases and use of health services during 1996-2007, we find that the reform increased the proportion on temporary disability by about 18 percent without a matching increase in drug purchases or the use of health services. We find no effect of compensation for permanent loss of earnings capacity.

Keywords: Whiplash claims, compensation reform, moral hazard

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1. Introduction

Whiplash is an injury mechanism that involves sudden acceleration followed by deceleration of the cervical spine, typically caused by a rear-end vehicle collision. It is the most common traffic injury, accounting for up to 80 percent of all traffic injuries, Holm et al. (2008). The incidence of whiplash-type claims and health expenditures is significant, and they have increased in many countries over the past 10 to 15 years, either in absolute terms or relative to the number of people injured in motor vehicle collisions.¹

Whiplash victims can immediately, or several days after the collision, experience a range of symptoms including neck pain, back pain, neck stiffness, back stiffness, vision disorders, dizziness, headaches, memory problems, or other subtle neurological symptoms. These symptoms are collectively known as whiplash associated disorders (WAD, Spitzer et al., 1995). The existence of temporary symptoms is well documented, and most people who are injured by whiplash recover, although about 30 percent continue to describe themselves as not recovered at one year (Cassidy et al., 2007). Most often, whiplash has no demonstrable pathology such as torn ligaments or fractures, leading to considerable debate about the validity of symptoms beyond the usual expected healing time for a soft-tissue injury (Virani et al., 2001).

¹ Chappui and Soltermann (2008) report that across ten European countries 40 percent of all traffic insurance claims with bodily injury involve minor cervical spine injuries. This number varies greatly across countries. In the United Kingdom the percentage is as high as 76 percent, amounting to about 430,000 whiplash-type claims annually. In Canada, a population-based study of traffic injuries reported that more than 80 percent of claims were for WAD (Cassidy et al., 2000). Despite no comparable numbers for the United States, Quinlan et al. (2004) report that about 900,000 people with neck strain/sprain injury were treated in US hospital emergency rooms in 2000, and concluded that this motor vehicle-related injury is the most frequent in the United States. Not only is the frequency of WAD significant, but neck- and spine-related soft tissue claims expenditures are also increasing. Chappui and Soltermann (2008) note that insurance costs associated with minor cervical spine injuries have increased in Europe over the past decade, and the Ministry of Justice (2012) of the United Kingdom documented that the number of whiplash related claims has increased by 60 percent from 2006 to 2010, even though the number of traffic collisions declined over the same period. In Denmark, our data source, the number of whiplash claims reported to a central government agency dealing with them, the National Bureau of Industrial Injuries, has stayed constant at 1,300-1,600 claims per year between 2000 and 2011, while the number of people injured in motor vehicle collisions has declined from 6,516 to 2,766 over the same period. Despite no comparable reports for the United States, Brook et al. (2009) report that the total U.S. national health expenditures related to adults with spine problems increased by 65 percent from 1997-2005, more rapidly than for overall health expenditures.

Cassidy et al. (2000) have shown that the vast majority of WAD victims are struck by another vehicle, implying that most WAD claimants do not intentionally expose themselves to car crashes. However, the lack of demonstrable pathologies creates a situation in which policyholders can exaggerate the extent of WAD *after* the accident has happened, to take advantage of the generosity of the compensation. In extreme cases it can even be fraud (Picard, 2013). This type of behavior is called “*ex post* moral hazard”. The importance of moral hazard in health insurance markets and its implications for the optimal design of insurance policies in general is well recognized (Dionne, 2013a), as is that moral hazard can play a role for whiplash claims (Ebrahim et al., 2013). However, little is known about the precise empirical importance of compensation-seeking behavior in whiplash claims. In this paper we examine the effects on temporary disability, permanent disability and prescription drug use, of increasing the generosity of compensation for whiplash claims.

We use a quasi-experimental design to examine the effect of a Danish 2002 reform that increased compensation for permanent loss of earnings capacity and extended the period when whiplash claimants could receive compensation for temporary loss of earnings. We measure the effect of the reform on the duration of absence from work, the use of public transfer programs and the use of prescription drugs and health services. We document the effect of the reform on claimant behavior by analyzing a very detailed unique data set with weekly information about the use of public transfers covering the period 1996-2007 for people making claims in 2000-2004, i.e. both before and after the reform. This data set exists because Denmark has a *public* system for evaluating whiplash claims.

The data can be linked at the individual level to a host of other public administrative register data with information about payments and prescription drug use, among other things. This data is collected from administrative records that form the basis for actual transfer payments that are audited and of very high quality. Denmark is the only country where researchers can

merge information about whiplash claims with administrative records about health and labor market outcomes. These data and the existence of a significant compensation reform offer a unique opportunity to learn about whiplash claiming behavior.

The characteristics of the data are crucial in three ways. First, people with poor *pre*-whiplash health are more likely to be adversely affected by a whiplash and to claim compensation (Wenzel et al., 2012). The data set allows us to characterize claimants in terms of a large number of relevant variables, such as disability, income, prescription drug use, hospitalization, and health-care consultations, all observed *before* the whiplash. Because we can credibly assume that people do not intentionally expose themselves to car crashes², we can effectively treat the whiplash as a random event (conditional on characteristics observed before the whiplash). Doing so enables us to examine both how claimants are characterized relative to the general population and how the composition of claimants changes when the compensation reform is implemented. Second, the longitudinal dimension of the data allows us to follow the claimants over an extended period, from one year before the whiplash, to up to seven years after. Thus we are able to learn about both the short- and the long-term effects of the compensation change. Third, the weekly updating of the data is critical, as it allows us to (graphically) pinpoint the exact time in the post-whiplash period where behavior changes and thus to link this change tightly to the change in compensation.

We find that selection into claiming for an injury is very important. Relative to a random sample of Danes, those claiming compensation were more likely to be female and to have lower income, more sickness absence, more prescription drug use, and more contacts with the health system before suffering whiplash. However, we find no evidence that the characteristics of claimants changed after the reform. One part of the reform extended the period when whiplash claimants could receive compensation for temporary loss of earnings.

² Cassidy et al. (2000) show that whiplash claimants are *not* at fault in the vast majority of incidences generating a whiplash.

We find that this reform increased the proportion on temporary disability by up to 18 percent in the first 76 weeks after the whiplash. The increase is heterogeneous across the sample, increasing with age, education and earnings, and the financial buffer available. The increase in temporary disability is not associated with a matching increase in the use of prescription drugs or the use of health services, such as GPs, specialists, chiropractors, or physiotherapists, suggesting that the disability effect is not rooted in poorer actual health.

The reform also changed compensation of permanent loss of earnings capacity. We find no evidence that the duration of disability increased when compensation did. Compensation for permanent loss of earnings capacity is only awarded after extensive examinations by health professionals, whereas compensation for temporary loss of earnings is not. Our results are consistent with existing theoretical and empirical knowledge about situations with scope for *ex post* moral hazard (Dionne, 2013b; Picard, 2013). The use of insurance increases with the generosity of compensation when there is no state verification, but does not when there is state verification. We calculate the cost of the reform, in terms of foregone earnings, to be about 53,000DKK (~8,000USD) per claimant on average.

Our analysis is connected with a number of past studies. Cassidy et al. (2000) have shown that after removing the possibility for compensation for pain and suffering in the Canadian province of Saskatchewan in 1995, there was a reduction in the number of insurance claims and more rapid recovery of those that submitted claims. Their results suggest that the economic costs, and benefits associated with the compensation system influence the propensity for claiming compensation and the recovery. Theirs is the only study focusing explicitly on the importance of changes in compensation for recovery.³

³ Cameron et al. (2008) examine the effects of a law change in New South Wales, Australia that both removed compensation for pain and suffering and introduced treatment guidelines. They found that self-reported health improved as a result of the reform.

The present study goes beyond Cassidy et al. in three ways. First, we exploit the high frequency of observations in our data to show that temporary disability increases up to week 76 after whiplash injury and that prescription drug use and other health-related outcomes remain unchanged during that period. Second, we document that the compensation reform does not change claimant selection, and that pre-whiplash trends in temporary disability are similar for persons claiming before and after the compensation reform, something that Cassidy et al. (2000) did not document. Third, Leth-Petersen and Pons Rotger (2009) found that a significant fraction of whiplash claimants in Denmark, those with less severe injuries, do not experience permanent reductions in earnings 2-5 years after the whiplash. While this finding is consistent with the hypothesis that *ex post* moral hazard could play a role for this group, it does not explicitly identify the response to a change in the compensation as we do in this paper.

This study also relates to the literature studying the role of compensation for claims related to workplace injuries in which claims for temporary disability and permanent loss of earning capacity are subject to the same verification issues that this paper covers. Generally, these studies find that changing compensation affects the frequency of absenteeism, the number of claims, and the duration of absence from work (e.g., Krueger, 1990; Moore and Viscusi, 1990; Worrall and Butler, 1990; Meyer, Viscusi, and Durbin, 1995; Bolduc et al., 2002; Henreksson and Persson, 2003; Neuhauser and Raphael, 2004; Johansson and Palme, 2005; Puhani and Sonderhof, 2010).

Butler et al. (2013) and Dionne (2013b) provide recent and more complete reviews of this literature. However, apart from Bolduc et al. (2002) and Dionne and St. Michel (1991), these studies often do not distinguish between *ex ante* and *ex post* moral hazard. This arguably relates to the fact that health related work absenteeism is not tied to a specific diagnosis, leaving controlling for *ex ante* health risks difficult. Nevertheless, the distinction is

important because *ex ante* and *ex post* moral hazard often require different solutions. *Ex post* moral hazard is typically associated with subjective injuries that require extensive auditing. WAD constitutes a good example of a subjective injury. Our study contributes to this literature by focusing on a specific type of disorder that is not workplace-related, can credibly control for the *ex ante* health risk, where *ex post* moral hazard is likely to be particularly imminent, and where the number of claims is significant and increasing.

The next section provides more detail about whiplash and the compensation reform that we examine. Section 3 describes the data. Section 4 presents the results, and section 5 concludes.

2. Whiplash associated disorders and the compensation reform

The Danish damage liability act gives access to compensation for permanent injury, permanently lost earnings capacity, and temporary loss of income. Financial stakes for claims involving loss of earnings capacity and foregone earnings are far bigger than claims involving permanent injury. We focus on lost earning capacity claims, as this is the type for which our data has the best coverage.

Compensation for private claims involving permanent reduction in earnings capacity has two parts, including compensation for temporary loss of earnings and compensation for permanent loss of earnings capacity. Compensation for loss of earnings capacity applies when the estimated loss is 15 percent or higher. Before July 2002 compensation for loss of earnings capacity was computed as six times the annual earnings of the 12 months immediately preceding the whiplash multiplied by the degree of lost earnings capacity. The level of annual earnings applied for this calculation is capped, so that compensation for loss of earnings capacity cannot exceed six times this amount. The cap was 620,000 DKK (~90,000 USD) just before the reform, so that the maximum compensation obtainable was

3.72 million DKK (~540,000 USD). Compensation is reduced by 8.5 percent for each year that the injured claimant was older than 55 years when the injury occurred. Compensation for loss of earnings capacity is paid as a lump-sum transfer when the case is closed. If an individual thinks that he or she has been undercompensated, the case may be reopened upon the claimant's request.

However, no monitoring of the actual earnings capacity of the compensated claimant follows, and the compensation law does not establish a mechanism for correcting a situation of overcompensation. This lack of monitoring and the impossibility of the insurers' reopening an overvalued case provides an incentive for all claimants, whether compensated or not, to exploit all of their actual earnings capacity once the case has been closed. Thus the observed long-term outcomes are more likely to reveal the individual's actual state of health.

The possibility of obtaining compensation for temporary loss of earnings arises because the degree of lost earnings capacity cannot be immediately assessed. After the whiplash occurs, the individual generally experiences a drop in earnings capacity in the months immediately following. Approximately three months later, the health of the injured reaches a stable level, called the "stationary point". The level of lost earnings capacity cannot be assessed until the stationary point has been reached. Compensation for temporary loss of earnings concerns loss of earnings in the period from between the whiplash event and the stationary point.

The compensation system was reformed on July 1, 2002 (Røn, 2003). The reform increased the capitalization factor from six to ten. Compensation for loss of earnings capacity was still subject to the cap on the maximum level of earnings that could be compensated. The reform also introduced a different age-adjustment, reducing compensation by 1 percent for each year the injured claimant was older than 29 when the injury occurred. Finally, the reform affected the compensation for temporary loss of earnings. Before July 1, 2002, compensation for temporary loss of earnings was given from the point of the whiplash injury

up to the stationary point. From July 1, 2002, compensation for temporary loss of earnings was now awarded up to the point where the final assessment of loss of earnings capacity is completed. As the median stationary point is typically reached after 13 weeks, whereas the median final assessment of permanent loss of earnings capacity is 144 weeks, this change increased compensation for temporary loss of earnings significantly for claimants assessed by the National Board of Industrial Injuries (NBII). Table 1 summarizes the changes in the compensation.

Table 1. Overview over the compensation reform

Age	Injured before July 1, 2002	Injured from July 1, 2002
20-29	TC=up to stationary point PC=6·min(earnings;620,000)·LEC	TC=up to LEC assessment point PC=10· min(earnings;620,000) ·LEC
30-54	TC=up to stationary point PC=6·min(earnings;620,000) ·LEC	TC=up to LEC assessment point PC=(10·min(earnings;620,000)·LEC)· (1-(67-age) ·1%)
55-67	TC=up to stationary point PC=(6·min(earnings;620,000)·LEC)· (1-(67-age)·8.5%)	TC=up to LEC assessment point PC=(10·min(earnings;620,000)·LEC)· (1-(67-age) ·1%)

Note: TC: compensation for temporary loss of earnings. PC: compensation for permanent loss of earnings. LEC: lost earnings capacity.

Compensation for temporary loss of earnings is obtained through private insurance, typically that of the person at fault. Because there are often no objective pathologies, the insurance company and the claimant may disagree about the intensity of symptoms. One way of mitigating *ex post* moral hazard behavior is to extensively audit claims, and the Danish authorities do so through the national evaluation scheme administrated by the NBII.

The NBII has established an assessment system through which, upon request from insurance companies or claimants, they provide an impartial statement on the health effects and occupational consequences of a private personal injury, including WAD. The NBII independently collects information about the case and the health of the claimant, including information from other government institutions about the use of transfer programs and earnings, and from the health system (i.e., from GPs, specialists, and hospitals). In many cases, the NBII also takes the initiative to collect new assessments from specialists. These assessments include the degree of permanent injury (i.e., the direct health effects of the injury) and of lost earnings capacity (i.e., the permanent loss of earnings caused by the injury).

The statement made by the NBII is advisory: If the parties involved do not agree with the NBII statement, the case may be tried in court. The NBII statement covers only the permanent loss of earnings capacity, not health reasons for staying out of work while the case is pending. Thus the NBII functions as an auditing device that tries to correct for possible moral hazard behavior in relation to permanent claims, but not in relation to compensation for temporary loss of earnings.

Table 2 displays the number of whiplash claims involving permanent loss of earnings capacity for the period 2000-2004 as assessed by the NBII. It shows that the number of assessed claims stays more or less constant over the period, perhaps increasing slightly in 2002-2003, but returning to the original level by 2004. These variations are relatively small, suggesting that the change in selection into a lost earning capacity claim following the reform is not dramatic. Section 4 presents extensive checks showing that our results are not driven by a change in the selection into a lost earning capacity claim.

Table 2. Number of claims for loss of earnings capacity recorded at the NBII

Year	2000	2001	2002	2003	2004
Number of Claims	1,080	1,017	1,199	1,135	1,066

Source: NBII

3. Data

We construct the data set by merging various administrative registers to the whiplash claim records of the National Board of Industrial Injuries (NBII) for the period January 2000-December 2004. It comprises whiplash claims incurred two and a half years before and after the compensation reform. These records are merged at the individual level to a host of other administrative registers covering a period that ranges from one year before the whiplash and up to seven years after the whiplash. Thus, for each claimant we have a time series covering nine years. Because claims are made at different points during 2000-2004, the time series will be centered at different calendar points within this window.

The insurance company is responsible for covering temporary loss of earnings while the case is pending. However, claimants are required to exhaust the possibilities for obtaining public transfers (e.g., sickness benefits or social assistance) while the case is pending, and the insurance company then covers the difference between foregone earnings and public transfers. Thus we can measure the consequences of the change in compensation for temporary loss of earnings by tracking the uptake of public transfers. To do so we rely heavily on the DREAM register⁴ (the longitudinal database of the Ministry of Employment on public transfer income) containing weekly information about transfers from any public transfer program. The DREAM register is known to be of high quality for measuring sick leave spells (Stapelfeldt et al., 2012).

⁴ DREAM is a Danish acronym for “Den Registerbaserede Evaluering Af Marginaliseringsomfanget”. The main outcome used in the analysis is temporary disability, including sickness benefits (code 890-899), rehabilitation benefits (code 760-767), and social assistance (code 730-748).

We also consider the effect of the whiplash claims on drug use. To do so, we include information from a complete register of purchases of prescription drugs, with every prescription drug purchase recorded by purchase date. While we also combine the whiplash records with registers containing information about hospitalizations and the use of general practitioners and specialists, this information is available only annually. Finally, we combine the whiplash records with records from the income-tax register, giving annual information about earnings, income, and wealth, and with records from other registers giving information about education, family composition, age, and other variables.

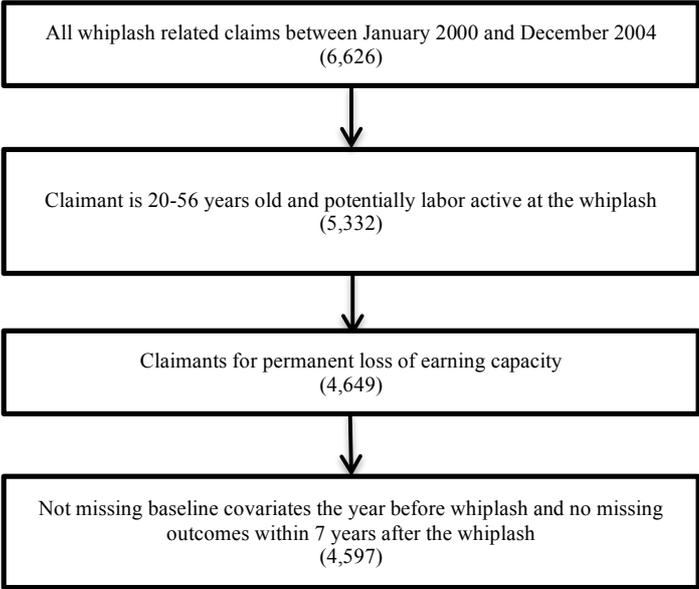
The same information is obtained for a 2 percent random sample of the Danish population, amounting to 105,093 persons. We excluded anyone with an injury recorded in the NBII register from this control group sample. To be able to compare individuals in this sample with whiplash claimants around the time of the whiplash event, we randomly allocate control subjects to an injury week within the 2000-2004 window. Thus we can make comparisons between claimants and control units observed in the same calendar time window. We include observations covering the period from one year before to seven years after the randomly allocated whiplash week, so that the data structure of the control group matches that of the claimant group.

We are interested in measuring the effect of the compensation on the propensity for staying out of work. To conduct analyses of the effect of the compensation reform, we make a few sample selections from the NBII register. The NBII register contains 6,626 whiplash claimants in the period 2000-2004. Firstly, we include only whiplash claimants in the age group 20-56 years at the time of the injury and who were potentially active in the labor market at that time. Thus, we exclude persons on permanent disability, early retirement and older claimants, to avoid interference with the retirement decision. The sample includes

students because, within a 7-year horizon, many are likely to be active in the labor market. This leaves us with 5,332 persons making whiplash claims.

Second, we exclude claims that were not related to loss of earnings capacity, further reducing the sample to 4,649 claimants. Third, we require that covariate information be present in the year leading up to the whiplash injury, and that outcome information is also available up to 7 years after the whiplash. This final selection left a sample of 4,597 claimants. Figure 1 summarizes the sample selection process.

Figure 1. Sample selection protocol



Insurance companies make more than 80 percent of all requests for assessments made by the NBII. As in other countries, no universal method for counting the number of whiplash cases exists in Denmark, so we do not know exactly how comprehensive the coverage of the NBII

database is.⁵ From conversations with people in the insurance industry, we have learned that the NBII assessments are requested primarily in cases that involve claims about permanent injury and permanently reduced earnings capacity — the claims that we study. Some cases are resolved directly between the insurance company and the claimant without the involvement of the NBII. The cases presented to the NBII are typically those in which the insurance company and the claimant disagree. As the potential for disagreement is bigger when there is no demonstrable pathological diagnosis, the NBII database tends to include cases where the scope for moral hazard is bigger.

In addition to being the most comprehensive database with information on whiplash claims, our data set has many other outstanding features. It contains a large number of pre-whiplash characteristics, including the use of health services, prescription drugs, and disability benefits. Thus, we can give a detailed description of pre-whiplash health for assessing and controlling for differences in *ex ante* health risk between the whiplash claimants and the general population. Our database also holds detailed information about temporary disability over a very long period, thereby enabling us to assess both the exact time at which economic incentives change behavior and the effects on both the short- and the long-term horizons.

Table 3 presents summary statistics for whiplash claimants making claims before and after the compensation reform was introduced on July 1, 2002, along with standardized differences compared to the random sample from the population for selected variables. It shows that women are more likely to make a claim, and that claimants have less education and lower earnings before the whiplash than the average of the population.

⁵ From 2000-2004, the police recorded 25,278 persons injured in motor vehicle collisions. The number of whiplash cases contained in the NBII database corresponds to about 25 percent of these.

Table 3. Summary statistics for claimants before and after the introduction of the compensation reform, July 1 2002.

Baseline covariates ¹	Pre-reform claims		Post-reform claims	
	Mean of claimants	Standardized difference to random sample ²	Mean of claimants	Standardized difference to random sample
Age	36.29	-19.0	35.66	-30.2
Female	0.67	37.9	0.66	32.6
Partner	0.72	-25.1	0.69	-33.2
Vocational training	0.39	0.6	0.41	4.3
Short education	0.05	-3.7	0.04	-6.0
Medium education	0.11	-3.7	0.11	-7.9
Long education	0.03	-17.8	0.02	-23.8
Earnings (1,000 DKK)	170.08	-23.7	167.82	-35.7
Liquid assets / disposable income	1.84	0.5	1.82	-5.8
Individual unemployment	0.04	3.2	0.06	12.9
Local unemployment	0.05	-4.6	0.05	-7.8
Visits to general practitioner	0.95	39.5	0.95	36.3
Temporary disability benefits (weeks)	6.72	21.7	8.30	32.3
Musculoskeletal system diseases	0.07	14.6	0.09	18.3
Pregnancy, childbirth, and the puerperium	0.05	5.7	0.07	11.5
Abnormal clinical and laboratory findings	0.04	11.3	0.05	12.7
Injury, poisoning, and other external consequences	0.18	18.5	0.18	19.6
Health status and health services contact	0.16	15.2	0.18	18.5
Pain medicine (weeks)	1.03	18.4	1.15	22.3
Psycholeptic medicine (weeks)	0.65	10.2	0.77	12.9
Other medicine (weeks)	4.01	33.8	3.97	32.7
Number of whiplash claimants	2,235		2,362	
Number of control units	51,152		53,941	
Ratio treated/control sample	0.04		0.04	

¹ All variables are measured before the whiplash. Short higher education is defined as 2-3 years of education after high school at an occupational academy. Medium higher education denotes 3-4.5 years of education at a profession university. Long higher education is 5-6 years of university education. Individual unemployment denotes whether the primary labor market state of the individual the year before whiplash was unemployment. Local unemployment denotes the average unemployment rate of the county of residence of the individual before whiplash. Visits to general practitioner is a dummy variable indicating if the subject has visited a GP/physiotherapist/specialist the year preceding the year of whiplash. Temporary disability benefits indicates the number of weeks within 52 weeks before the whiplash where the person receives temporary sickness benefit for at least 3 weeks, rehabilitation or social assistance without job activation before the injury date. "Musculoskeletal system diseases" is a dummy indicating a diagnosis under codes M00-M99 in the ICD-10 (v2010) classification. Pregnancy, childbirth and the puerperium indicates a diagnosis under codes O00-O99 in the ICD-10 (v2010) classification. "Abnormal clinical and laboratory findings" indicates a diagnosis under codes R00-R99 in the ICD-10 (v2010) classification. Injury, poisoning and other external consequences is a dummy for a diagnosis under codes S00-T98 in the ICD-10 (v2010) classification. Health status and health services contact indicates a diagnosis under codes Z00-Z99 in the ICD-10 (v2010) classification. Pain medicine indicates the number of weeks where the individual had purchased anti-inflammatory, antirheumatic products; topical products for joint and muscular pain, muscle relaxants or analgesics. Psycholeptic medicine indicates the number of weeks with purchases of drugs under the groups N05 and N06A in the Anatomical Therapeutic Chemical Classification System within the last 52 weeks. Other medicine indicates the number of weeks with purchases of medicine other than pain or Psycholeptic medicine within the last 52 weeks.

² The standardized differences are calculated as $(\bar{X}_1 - \bar{X}_0) / \sqrt{(s_1^2 + s_2^2) / 2}$, where \bar{X}_1 denotes the sample mean of the covariate among whiplash claimants, \bar{X}_0 denotes the sample mean of the covariate among the 2 percent of Danish population, s_1^2 denotes the sample variance of the covariate among whiplash claimants, and s_2^2 denotes the sample variance of the covariate among 2 percent of the Danish population.

Remarkably, claimants clearly already have poorer health before they are exposed to the whiplash event, a point emphasized previously by Leth-Petersen and Rotger (2009), Jöud et al. (2013) and Carstensen et al. (2015). They also have more temporary disability and more contacts with the health system. Finally, claimants purchase more prescription drugs than the average person in the population, even before they are exposed to the whiplash. Interestingly, drug purchases among claimants are not concentrated only on drugs directly related to musculoskeletal disorders, such as pain medicine. They also purchase psycholeptic drugs, medication producing a calming effect, and other types of drugs, consistent with the findings of Myrtveit et al. (2013).

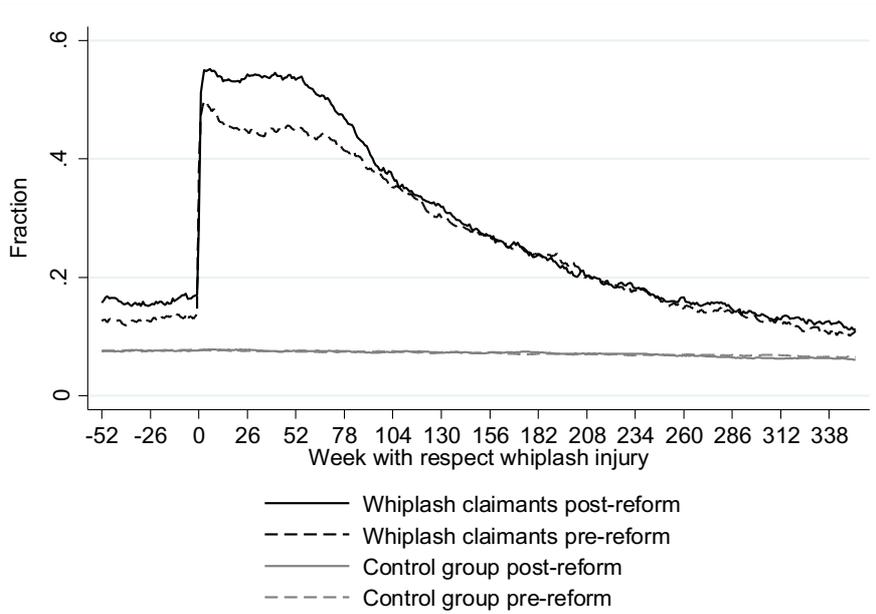
Comparing differences between claimants and the random population sample before and after the reform reveals no differences, showing that the claimant composition did not change across the reform period in terms of the characteristics listed in Table 3. That the assessment system is voluntary creates the possibility for two types of selection into our dataset. Insurance companies may change their propensity for making requests to the NBII, and claimants may change their propensity for applying for compensation for loss of earnings capacity. That we see no differences between pre- and post-reform covariates suggests that the composition of claimants has not changed from before to after the reform. In section 4 we present additional robustness checks to make sure that our results are not driven by a change in the propensity of insurance companies for making requests of the NBII.

As a final piece of descriptive evidence, Figure 2 compares the evolution of temporary disability for all 4,597 whiplash claimants and for the random sample, where both control and whiplash claimants are grouped by whether the claim is made before or after the compensation reform. The graph shows the average temporary disability for all whiplash claimants in the 52 weeks before the injury through 338 weeks after the injury. The graph

clearly shows that the proportion on temporary disability is higher for whiplash claimants than for the general population, even before the whiplash event occurred. About 15 percent of claimants are on temporary disability prior to the whiplash event, compared to 7 percent of the general population. This percentage increases dramatically for claimants after the injury, with an immediate post-injury effect of about 13 weeks, after which disability declines somewhat and levels at week 52. Disability then steadily declines and reaches the pre-whiplash level after about 300 weeks (i.e., about six years, after the whiplash event). This pattern suggests that claimants recover completely from the whiplash in the long term, a pattern consistent with the findings of Leth-Petersen and Rotger (2009). However, six years on disability is a considerable time.

Comparing temporary disability for claimants claiming before July 1 2002, with those claiming after, a slightly higher proportion of post-reform claimants have temporary disability before the whiplash event than that in pre-reform claimants. The real difference, however, appears after the whiplash, where post-reform claimants have a clearly higher level of temporary disability up to about 100 weeks after the whiplash. The reform increased compensation for temporary loss of earnings (e.g., foregone earnings) while the assessment of loss of permanent loss of earnings capacity is pending, and the pattern in Figure 2 is consistent with this finding.

Figure 2. Fraction on temporary disability for whiplash claimants and for the random sample before and after the compensation reform



Note: Temporary disability is defined as a weekly dummy indicator for receiving temporary sickness benefit, rehabilitation, or social assistance without activation for at least 3 weeks.

4. Results

We now turn to estimating the effect of the compensation reform, which we do essentially by comparing the curves in Figure 2. We subtract the level of temporary disability of the control group from the level of the claimant group and then compare this difference between claimants who are exposed to a whiplash before July 1, 2002, and claimants who are exposed to a whiplash after that date. Formally, we quantify the effect by estimating the following difference-in-difference model:

$$\tau_{it} = \beta_{0t} + \beta_{1t} D_i^{Post} + \beta_{2t} W_i + \beta_{3t} (D_i^{Post} \times W_i) + \beta_{4t} X_i^{Pre} + u_{it} \quad (1)$$

where τ_{it} is the outcome measured for person i at time t , where t is an indicator of the week running from -52 to 352 weeks after the whiplash, i.e., from one year before to seven years after. In the main analysis τ_{it} is a dummy indicator taking the value one if individual i is on temporary disability in week t . β_{0t} captures movements in temporary disability that are common for all persons in the sample. D_i^{Post} is a dummy variable taking the value 1 if person i has been exposed to a whiplash after 1 July 2002, the date of the introduction of the higher compensation. β_{1t} is the associated parameter capturing movements in temporary disability that are specific to persons who either belong to the post-reform control group or to the group of people claiming compensation after the reform.

W_i is a dummy variable taking the value 1 if person i has been exposed to a whiplash. For control group observations, this variable will always take the value zero. β_{2t} is the associated parameter vector measuring how whiplash claimants generally deviate from people who submit no claims, irrespective of the time at which the whiplash event occurs. Figure 2 clearly showed that a higher proportion of whiplash claimants had temporary disability, both before and after the whiplash event, when compared to the random sample from the population, and this effect is captured by the β_{2t} . The third term is the interaction between the dummy variables D_i^{Post} and W_i . The associated parameter vector, β_{3t} is the effect on temporary disability among claimants exposed to a whiplash after the introduction of the higher compensation.

Finally, X_i^{Pre} is a vector of pre-whiplash characteristics including those in Table 3.⁶ All parameters are t -specific. In practice this feature is obtained by running OLS regressions independently week-by-week.⁷ The estimator effectively calculates how the temporary

⁶ It turns out that our results do not depend on controlling for this vector of control variables.

⁷ Because the outcome is binary, the model is a linear probability model, which has known disadvantages because it has no confining predicted probabilities within the $[0;1]$ interval. However, it has the advantage that it is very simple to estimate given that we estimate a very large number of parameters. We have also estimated

disability for whiplash claimants who claimed compensation after the reform differs from the temporary disability for whiplash claimants claiming before the reform. Furthermore, temporary disability for both pre-reform and post-reform claimants is compared to the temporary disability in a random sample from the population. Thus, equation (1) is effectively a triple differences-in-differences estimator.

Given the appropriateness of the specification of equation (1), β_{3t} can be interpreted as the causal effect of the compensation reform on temporary disability (and other outcomes). The underlying premise is that the whiplash event quasi-randomizes individuals into a situation where they can exploit private information about their true state of health under two different compensation levels. In terms of our application, this notion implies that whiplash claimants are assumed to follow the same trend in temporary disability as the control group had they not been exposed to a whiplash. While this assumption is not directly testable, under this hypothesis one should expect the development in temporary disability to be similar in the pre-whiplash period — something we can test with our data.

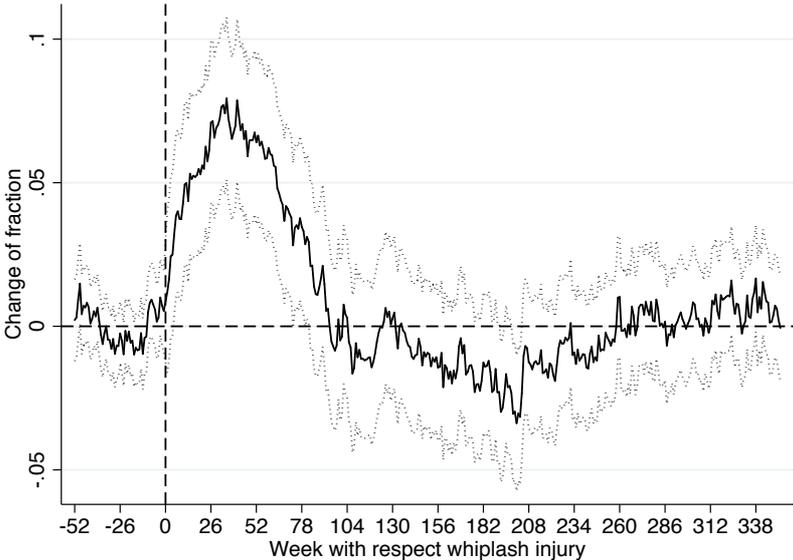
Figure 3 presents baseline estimates of β_{3t} .⁸ The graph shows that whiplash claimants under the new compensation regime have significantly higher temporary disability up to 76 weeks after the whiplash. However, the point estimate is positive up to about 90 weeks after the whiplash. The effect of the reform is biggest at 40-50 weeks after the whiplash, reaching about 7.5 percentage points. The level of temporary disability among pre-reform claimants

the model using a Logit estimator and found that the results closely resembled the results presented here. The results are reported in a supplement to this paper (Cassidy et al, 2016). We have also estimated the effect of the reform using a matching estimator. Matching estimators take into account imbalances in covariates between the treatment and control groups. Results from this exercise are similar to the results reported in figure 3, and they are reported in the supplement (Cassidy et al., 2016). Finally, we have tested the importance of estimating the equations independently for each period. We have shown that the results remain unchanged when we estimate β_{3t} in a specification that allows taking full advantage of the longitudinal dimension of the data where we control for individual level fixed effects and standard errors are clustered at the individual level.

⁸ In order to construct Figure 3 we have estimated 404 regressions, each with 50 parameters, totalling 20,200 parameters. The full set of parameter estimates is available from the authors upon request.

is about 42 percent, and the level of temporary disability thus increased with about 18 percent as a consequence of the compensation reform.

Figure 3. Estimated effect of reform on temporary disability for whiplash claimants



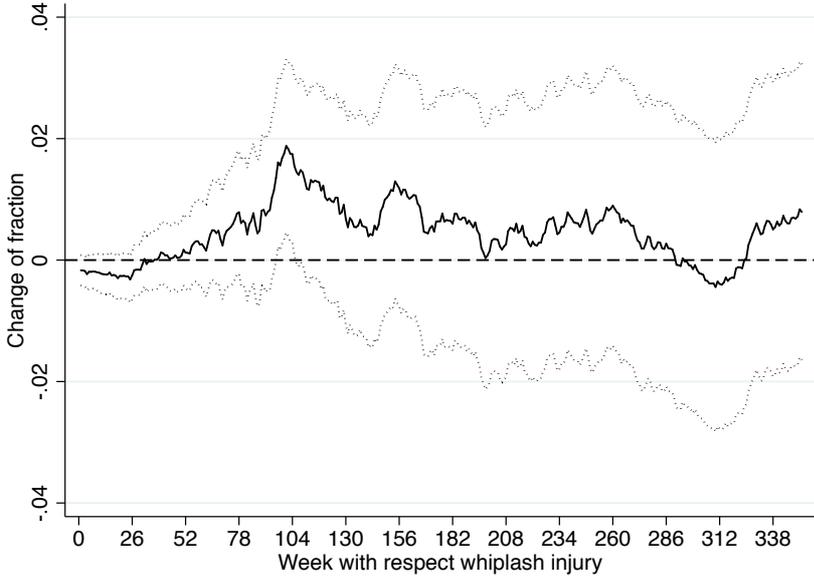
Note: Temporary disability is defined as a weekly dummy indicator for receiving temporary sickness benefit, rehabilitation or social assistance without activation for at least 3 weeks. The full line is the estimated effect, i.e. $\widehat{\beta}_{3t}$ from equation (1), and dotted lines are 95% confidence intervals. The dashed lines mark the zero-level on both axes.

The reform changed compensation for both temporary loss of income and compensation for permanent loss of earnings capacity. Although compensation for temporary loss of earnings is not screened, compensation for permanent loss of earnings capacity is subject to extensive screening and verification by the NBII, and our results are consistent with this differential monitoring. The scope for rent-seeking behavior is bigger for compensation for temporary loss of earnings than for compensation for loss of earnings capacity. We find no differences in the level of temporary disability in the pre-whiplash period. This finding is consistent

with the notion that the reform did not change the composition of the claimant group⁹, nor the composition of requests by insurance companies to the NBII.

One possible explanation for the drop in temporary disability could be that claimants exit to permanent disability pension programs. To assess this possibility, we re-estimate equation (1) by using an indicator for receiving permanent disability pension as the dependent variable. The result appears in Figure 4. The pre-whiplash level is the same, as we have selected out of our sample people who already were on the permanent disability program before the whiplash. We find no sign that the increase in temporary disability pension shown in Figure 3 is followed by transits to permanent disability schemes.

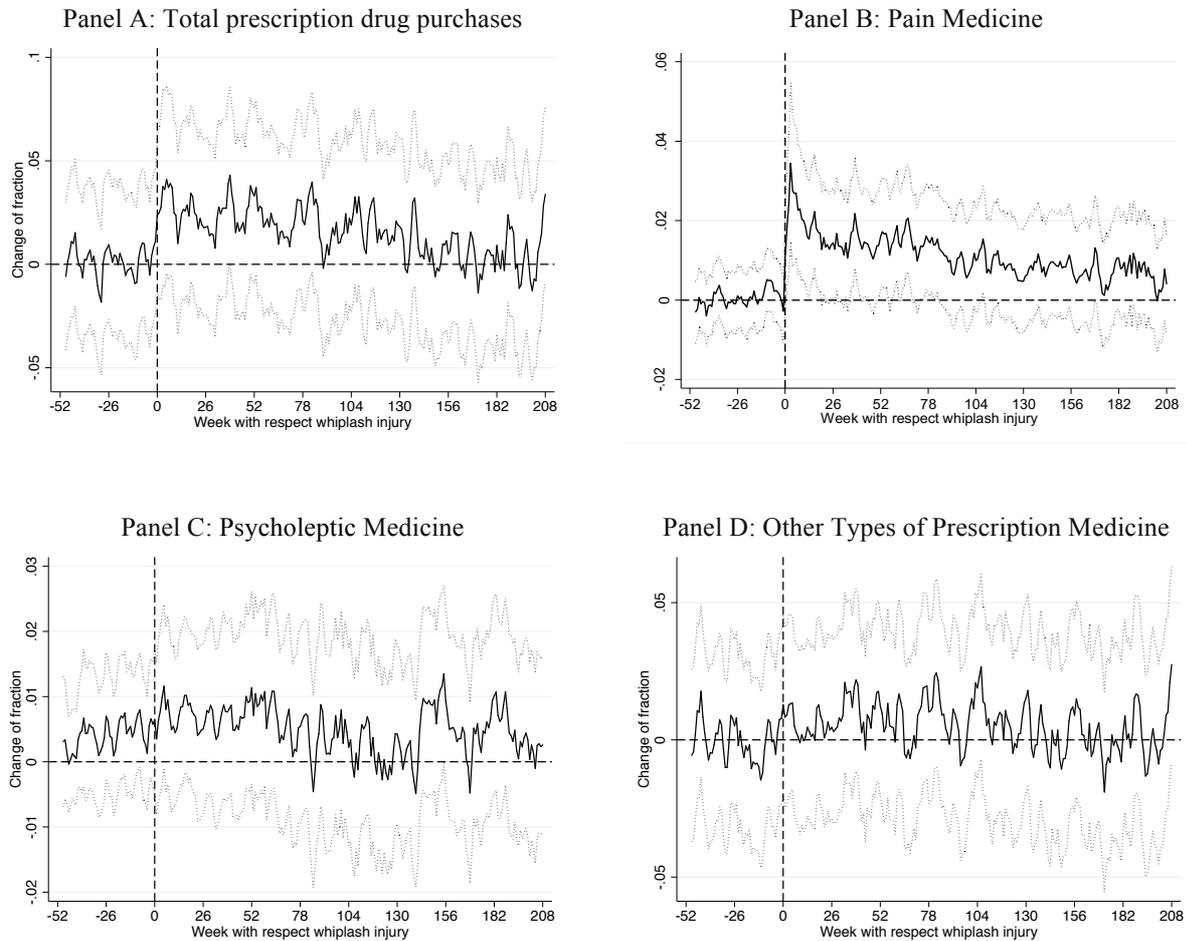
Figure 4. Estimated effect of reform on permanent disability for whiplash claimants



Note: Permanent disability is defined as a weekly dummy indicator for receiving permanent disability pension. The full line is the estimated effect, i.e. $\widehat{\beta}_{3t}$ from equation (1), and the dotted lines are 95% confidence intervals. The dashed line marks the zero-level on the x axis.

⁹ This effect was emphasized by Neuhauser et al. (2004) in the context of workers compensation.

Figure 5. Estimated effect of reform on the frequency of prescription drug purchases for whiplash claimants



Note: We estimate effects by applying equation (1), where the dependent variable is a dummy indicator for having bought prescription drugs in a given period. Estimated effects are four-week averages, and the four-week average is plotted against the final week in the four-week period. The full line is the estimated effect, i.e., $\widehat{\beta}_{3t}$ from equation (1), and the dotted lines are 95% confidence intervals. Panel A presents estimates for all prescription drug purchases, while panels B-D break total drug purchases down into pain drugs (Panel B), psycholeptic drugs (Panel C) and other drugs (panel D). Prescription pain drugs include anti-inflammatory, antirheumatic products, topical products for joint and muscular pain, muscle relaxants and analgesics. Psycholeptic drugs include barbiturates, benzodiazepines, nonbenzodiazepines, phenothiazines, opiates/opioids, carbamates, ethanol, 2-methyl-2-butanol, cannabinoids, some antidepressants, neuroleptics, and some anticonvulsants.

In Figure 5 we investigate whether the increase in temporary disability shown in Figure 3 is associated with an increase in the purchase of prescription drugs. Effects are estimated using the same methodology used for estimating Figure 3, except that the dependent variable is now a dummy indicator for having purchased prescription drugs in a given period. Weekly

prescription drug purchases are very volatile for identifying any effect, either visibly or statistically, and the estimated effects using data at the weekly frequency are not reported. Therefore, we have aggregated the weekly outcomes to four-week periods and plotted the estimated average four-week effects where the four-week average is plotted against the final week in the four-week period.

Panel A shows the estimated effect for total prescription drug purchases while panel B-D breaks total drug purchases down into pain drugs (Panel B), Psycholeptic drugs (Panel C) and other drugs (panel D). Panel A shows that identifying any change in the purchase of prescription drugs is not possible for whiplash claimants following the reform. In panel B we consider only prescription pain drugs, the class of medicine most directly targeting potential WAD.

Despite a slight increase in the purchase of pain drugs as a consequence of the reform, this effect is significant only in the phase immediately following the whiplash. Moreover, in the first 78 weeks after the whiplash, where the fraction on temporary disability increases 5-7 percentage points, the fraction of claimants using pain drugs increases 1-1.5 percentage points, and the effect is not uniformly significant in this period. In other words, the increase in the fraction using pain drugs cannot account for the increase in temporary disability reported in Figure 3. Panel C isolates the purchase of psycholeptic drugs, medications that produce a calming effect, and Panel D considers remaining prescription drugs. In neither case do we see any indication that the reform is associated with increased prescription drug purchases at any point around the whiplash event.

We also have access to other health-related metrics, including the use of services from GPs, physiotherapists, chiropractors, and specialized practitioners, although these measures are available only on an annual basis. To assess whether the compensation reform has impacted

the use of any of these services, we estimated equation (1) on data covering the period from one year before the whiplash to four years after the whiplash.¹⁰

The results, in Table 4, show that the reform was not associated with any change in the use of these services, thus agreeing with the results concerning prescription drug use. In summary, we find that the reform was not associated with any increase in the use of prescription drugs or health services that can explain the increase in temporary disability shown in Figure 3.

Table 4. Estimated effect of the reform on visits to general and specialized practitioner for whiplash claimants

Year	GP		Physiotherapist		Chiropractor		Other specialized practitioner		Any specialized practitioner	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
-1	0.00	0.00	0.00	0.01	-0.01	0.01	0.01	0.01	0.00	0.01
1	-0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01	-0.01	0.01
2	-0.01	0.01	-0.01	0.01	0.01	0.01	0.02	0.01	0.00	0.01
3	-0.01	0.01	-0.03*	0.01	-0.01	0.01	0.01	0.01	0.01	0.01
4	0.00	0.01	-0.02	0.01	-0.01	0.01	0.00	0.01	-0.01	0.01
Number of observations					109,690					

Notes: (1) Year denotes the year when the outcome is measured with respect to the year of the whiplash injury. (2) General Practitioner is a dummy variable indicating if the subject has visited the GP. (3) Physiotherapist is a dummy indicating if the individual has visited a physiotherapist. (4) Chiropractor is a variable indicating if the subject has visited a chiropractor. (5) Other specialized practitioner is a dummy variable indicating whether the individual has visited a specialized practitioner other than a physiotherapist or a chiropractor. (6) Any Specialized Practitioner indicates whether the subject has visited any type of specialized practitioner. * indicates significance at the 10% level.

What are the characteristics of those who change behavior?

The evidence from Figure 3 suggests that the reform increased temporary disability from week 0 to week 76 after the whiplash. We now explore the characteristics of the individuals responsible for this increase. We do so by running regression (2)

¹⁰ In these analyses we are able to analyze a period covering only up to four years after the whiplash because these records are not updated or made available for research purposes as quickly as the registers for disability.

$$\begin{aligned} \#weeks_i^{1-76} = & \alpha_0 + \alpha_1 X_i + \alpha_2 D_i^{Post} + \alpha_3 W_i + \alpha_4 (D_i^{Post} \times X_i) \\ & + \alpha_5 (D_i^{Post} \times W_i) + \alpha_6 (X_i \times W_i) + \alpha_7 (D_i^{Post} \times W_i \times X_i) \end{aligned} \quad (2)$$

$\#weeks_i^{1-76} = \sum_{t=1}^{76} (\tau_{it} - \tau_{i,-t})$. $\tau_{it} = 1$ if individual i is on temporary disability in period t and the dependent variable measures the number of weeks on temporary disability between week 0 and week 76 after the whiplash less the number of weeks on temporary disability in the 76 weeks preceding the whiplash. We look at the change in the number of weeks on temporary disability from before to after the whiplash event in order to get a more precise measure of the individual increase in temporary disability. X_i is a vector of pre-whiplash characteristics including the characteristics listed in Table 3, and D_i^{Post} is a dummy variable taking the value 1 if person i has been exposed to a whiplash after July 1, 2002, the date of the introduction of the new compensation scheme. W_i is a dummy variable taking the value 1 if person i has been exposed to a whiplash. α_7 is the parameter of interest, showing what pre-whiplash characteristics are associated with the post-reform increase in temporary disability within week 76 after the whiplash. Since we censor the number of weeks on temporary disability at 76 weeks, we estimate equation (2) using a Tobit estimator with a censoring point at 76. Estimates of α_7 appear in Table 5.

The tendency to extend the time on temporary disability is positively correlated with age, being male, and having a short education (compared to having no education beyond the compulsory level). The time spent on temporary disability is positively associated with pre-whiplash earnings, consistent with the notion that the improved possibility of receiving compensation for temporary loss of earnings gave the largest nominal increase in coverage for people with high incomes.

Table 5. Characteristics of claimants correlated with the post-reform increase in temporary disability

Baseline covariate ¹⁾	Coefficient	Standard error
Age	0.10 **	0.04
Female	-3.04 ***	0.89
Partner	-1.44	0.89
Vocational training	1.61 *	0.89
Short education	9.46 ***	1.97
Medium education	1.71	1.39
Long education	1.64	2.46
Earnings (1.000 DKK)	0.01 *	0.00
Liquid assets/Disposable income	0.26 ***	0.09
Individual unemployment	-4.31 **	1.92
Local unemployment	55.60	34.49
Visits to general practitioner	1.06	1.87
Temporary disability benefits (weeks)	-0.08 **	0.03
Musculoskeletal system diseases	-1.47	1.55
Pregnancy, childbirth, and the puerperium	-2.21	1.98
Abnormal clinical and laboratory findings	-4.98 **	1.97
Injury, poisoning, and other external consequences	-1.02	1.06
Health status and health services contact	-0.40	1.23
Pain medicine (weeks)	0.19	0.15
Psycholeptic medicine (weeks)	-0.23 **	0.10
Other medicine (weeks)	0.07	0.15
Number of observations	109,340	

Notes: See notes to Table 3. The dependent variable measures the number of weeks that the claimant is on temporary disability within week 76 after the whiplash less the number of weeks on temporary disability during the 76 weeks preceding the whiplash. Equation (2) is estimated using a Tobit estimator with a censoring point at 76. The table reports estimates of α_7 from equation (2). Standard errors are robust to heteroskedasticity. *** indicates significance at the 1% level. ** indicates significance at the 5% level. * indicates significance at the 10% level.

The number of weeks on temporary disability is negatively associated with the duration of unemployment before the whiplash. For people to exert moral hazard, they should not be truly limited in their ability to work following the whiplash, and they should not be affected by liquidity constraints.¹¹ To control for the importance of liquidity constraints, we have

¹¹ This is a well-established result from the literature on optimal unemployment insurance (Chetty, 2008).

included a variable measuring liquid assets as a proportion of disposable income among the regressors. This measure is often used in savings studies as a proxy for being affected by liquidity constraints (e.g., Zeldes, 1989; and Leth-Petersen, 2010). The estimate indicates that the propensity for extending temporary disability is positively related to the amount of liquidity available, consistent with some part of the response being driven by people being affected by liquidity constraints.

Nevertheless, after controlling for liquidity constraints, we still find that other characteristics are associated with the increase in the number of weeks on temporary disability. Table 5 shows that the level of temporary disability realized before the whiplash event is negatively related to the propensity for extending temporary disability after the whiplash, as a consequence of the reform. Similarly, all pre-whiplash health indicators are negatively related to the propensity for extending the duration of temporary disability as a consequence of the reform. In other words, the marginal person who extends temporary disability following the reform is less fragile, in terms of pre-whiplash characteristics, than the average person on temporary disability.

Robustness checks

That the NBII assessment system is voluntary implies that any difference that we observe between pre- and post-reform claimant behavior can potentially be related to both a change in the behavior of the claimants and to insurance companies referring different types of cases to the NBII after the reform. Insurance companies face a significant increase in insurance costs due to the reform because the period during which they are obligated to cover loss of earnings is extended significantly. Yet the reform also creates an incentive for people to increase their propensity for submitting claims because the possibility of receiving compensation is improved. *A priori* it is not clear whether these forces are important or what their relative importance is, if indeed they are significant. We have already shown some

evidence suggesting that the composition of the claimant group did not change across the reform period. The evidence in Table 3 suggests that the composition of the claimant group did not change, and the pre-whiplash effects estimated in Figures 3 and 5 and Table 4 all suggest no change in the selection.

To further assess whether our results are impacted by selection into the NBII database, we conducted two robustness checks. First, our database records who made the request to NBII. If the reform induced a change in the propensity for insurance companies to send assessment requests to the NBII, then we would expect to see a sharp break in the number of cases referred to the NBII and/or a break in the fraction of requests made by insurance companies at the point of the reform.

Figure 6. Fraction of referrals from insurance companies by injury date

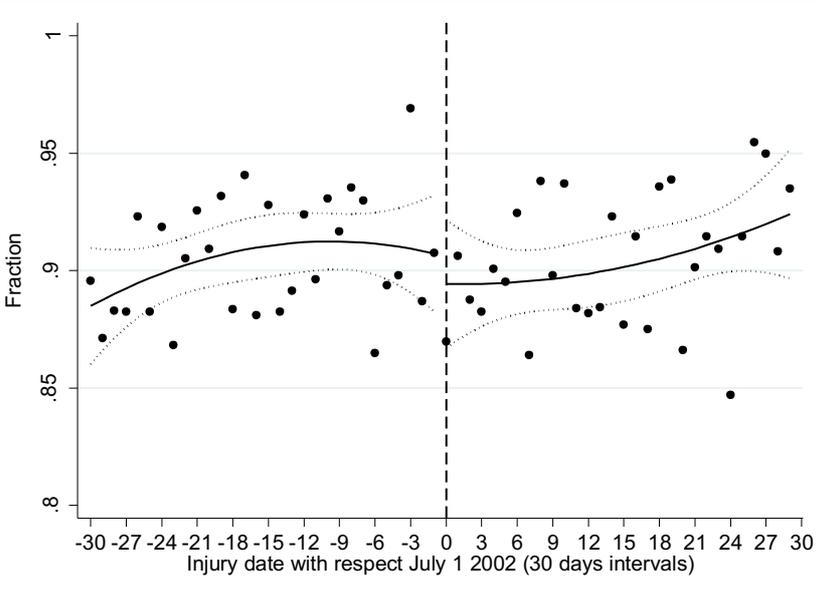


Table 2 showed that the number of cases assessed by the NBII involving loss of earnings capacity increased slightly in 2002 and 2003, but decreased again in 2004; overall the changes in the number of applications were relatively small during that period. In Figure 6, we have binned the number of requests at a monthly frequency around the reform and

superimposed a polynomial regression with confidence intervals at each side of the reform point. If there is a break in the fraction of requests made by insurance companies, then the two regression lines would not align. The figure shows that insurance companies make 90 percent of all requests to the NBII. It also shows that the fraction of claims made by insurance companies from 30 months before the reform to 30 months after the reform is roughly constant. In particular, we find no break in the fraction of requests made by insurance companies, as would be expected had insurance companies changed their propensity for sending requests as a consequence of the reform.¹²

If a whiplash is a truly random event (given the observed characteristics that we condition on), and if insurance companies change the composition of cases referred to the NBII towards cases where the true health condition is either more or less serious than in the pre-reform period, then our previous analysis would not reveal a true behavioral effect, but rather an effect of a change in the true health state of the applicants.

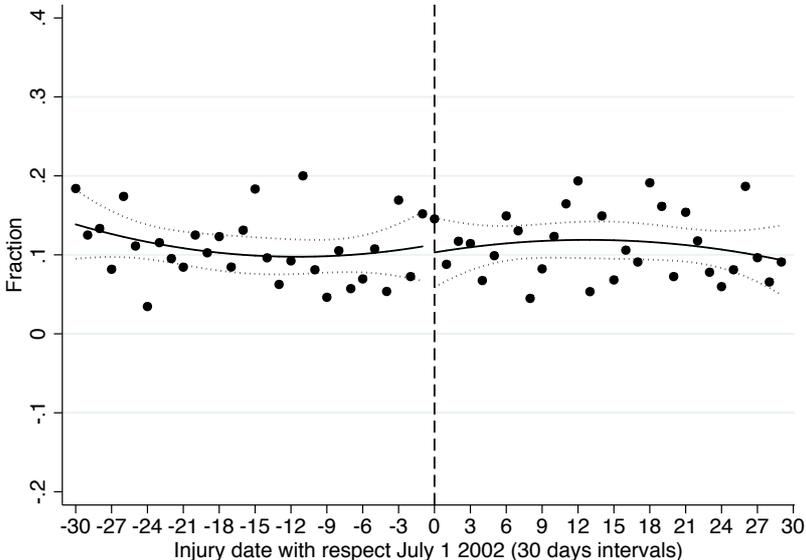
As another check that no sharp change has occurred in the type of cases referred to the NBII around the point of the reform, we investigate how long-term outcomes vary with the timing of the whiplash. Compensation for loss of earnings capacity is paid as a lump-sum transfer when the case is closed. If an individual thinks that he or she has been undercompensated, the case may be reopened at the claimant's request. However, no monitoring of the actual earnings capacity of the compensated claimant takes place and the compensation law does not establish a mechanism for correcting a situation of overcompensation. This lack of monitoring and the impossibility for the insurer to reopen an overvalued case provides an incentive for all claimants, whether they have been compensated or not, to exploit all of their

¹² To formally test whether there is a break in the insurance company referral propensity we estimate the following regression, $y_i = \beta_0 + \beta_1 D_i^{POST} + \beta_2 BIN_i + \beta_3 BIN_i^2 + \beta_4 BIN_i \times D_i^{POST} + \beta_5 BIN_i^2 \times D_i^{POST} + u_i$, where y is the fraction of referrals, D_i^{POST} is a dummy variable taking the value 1 if the person under consideration claims compensation after the reform. BIN counts the number of 30-day periods from the date of the reform. The hypothesis of no break in referrals is: $H_0: \beta_1 = 0$. The t -statistic is $t=-0.03$ (p -value=0.979), and we do not reject the null hypothesis of no break.

actual earnings capacity once the case has been closed. Thus, the observed long-term outcomes are likely to reveal the claimants' true state of health.¹³ If the reform influenced the type of cases that ended up in the NBII database, then we would expect to see a change in the true health state around the time of the reform.

To investigate this possibility, we plot the temporary disability rate among claimants at 352 weeks, i.e., about 6.5 years after the whiplash, against the week that the whiplash happened. We can thus see whether there is a discrete change in the true state of health around the time of the reform. Figure 7 plots the average temporary disability rate in week 352 after the whiplash against the month when the whiplash occurred, where the x-axis is centered at the point of the reform, and superimposes a polynomial regression based on the underlying microdata, together with 95 percent confidence intervals. The figure shows that there is no break in the long-term temporary disability rate around the time of the reform.

Figure 7. Fraction on temporary disability 352 weeks after the whiplash injury by injury date



¹³ Leth-Petersen and Rotger (2009) exploited this institutional set-up to identify the effect of experiencing a whiplash on the long-term labor market performance of whiplash claimants.

What are the costs?

The reform increased the generosity of compensation for whiplash claims. We find that it had a significant effect on temporary disability. We do not find significant effects on drug use, or on the number of visits to general and specialized practitioners, and we do not find any effect on permanent disability. These results indicate that the major effect of the reform is on foregone earnings. This finding resonates with that of the Swedish Whiplash Commission (2005), which found that the majority of costs associated with whiplash claims relates to compensation for loss of income. However, our paper shows that the societal costs can be attributed to the average whiplash claimant, not only to those individuals ending with long-term or permanent work disability.

To assess the magnitude of foregone earnings following the 2002 Danish reform, we calculate the effect of the reform on earnings by using annual data from the income tax register. To assess the total foregone earnings, we calculate the cumulative earnings loss following the reform for up to four years after the whiplash. We limit the horizon to four years because it is the horizon for which we have income tax records for the full sample. We calculate the estimates using the same methodology used for estimating the results reported in Figure 3.

The results are presented in Table 6. They show that the effect accumulates rapidly for the first three years and levels off at about 53,000 DKK (~8,000 USD) four years after the whiplash. Assuming that earnings losses do not accumulate beyond four years, we can aggregate the estimated effect over the 2,362 people who are claiming after the reform. The total effect is about 125 million DKK (~18.3 million USD). This is likely to be conservative, as we have not included the large costs for employers from reduced output, costs associated with treatment outside the public system, costs for legal aid, and psychosocial costs (i.e., subjective costs to the individual that are inherently difficult to measure).

Table 6. Estimated average cumulative effect of the reform on earnings

	Years after the whiplash									
	0		1		2		3		4	
Coefficient	-7,600	**	-19,038	***	-34,470	***	-47,619	***	-52,754	***
Standard error	3,424		6,976		10,810		15,068		19,792	

Notes: *** indicates significance at the 1% level. ** indicates significance at the 5% level.

5. Conclusion

Learning about claimant behavior after whiplash injury is important because whiplash is the most common traffic injury and can result in prolonged disability. Furthermore, the magnitude of insurance claims related to whiplash is significant and has been increasing in recent years. Whiplash claimants typically have no detectible or objective pathology to account for their symptoms, so that the only assessment of severity is how claimants subjectively feel about their injuries, something that is hard to qualify. This situation leaves a scope for *ex post* moral hazard to occur in whiplash claims.

This paper quantifies the effects of a 2002 Danish reform that increased compensation for permanent loss of earnings capacity and extended the period wherein whiplash claimants could receive compensation for temporary loss of earnings. We measure the effect of the reform on the duration of absence from work, the use of public transfer programs, and the use of prescription drugs and health services.

Our analysis is based on a dataset with records about whiplash claims collected from a unique public assessment system. These records are merged with data about the receipt of weekly public transfers and the daily purchase of prescription drugs for a period ranging from one year before the whiplash injury to seven years after it. The weekly data on temporary disability benefits along with the compensation reform allows us to (graphically) pinpoint the exact time at which the effects of increasing the generosity of compensation on

work absence occurs. The dataset provides a clean example where economic incentives change, but where *ex ante* health risks are constant, an almost ideal set-up for documenting health-related moral hazard behavior.

The results from this study show that the propensity for being on temporary disability increases with the generosity of the compensation. Specifically, the fraction on temporary disability increased, on average, up to 7.5 percentage points within the first year after the whiplash. Compared to the level of temporary disability, this amounts to a relative increase of about 18 percent. The increase is heterogeneous across the sample and increases with age, education, and earnings. Remarkably, the increase in temporary disability is not accompanied by an increase in the use of prescription drugs matching the temporary disability, and there is no increase in the use of health services, such as GPs, specialists, chiropractors, or physiotherapists. This finding suggests that the disability effect is not rooted in poorer actual health.

The reform also changed compensation of permanent loss of earnings capacity. However, this part of the compensation is subject to extensive screening of the claimants, and we find no evidence that the duration of disability increases when compensation for permanent loss of earnings increased. We calculate the cost of the reform in terms of foregone earnings at about 53,000 DKK (~8,000 USD) per claimant on average.

The results from this study show that temporary disability increases when compensation is made more generous and when there is no extensive screening check in place. This suggests that rent-seeking behavior is relevant to take into account when designing compensation systems for whiplash claims, and more broadly for health related claims, where there are no clearly detectable pathologies.

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