Whiplash Claims and Moral Hazard

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Abstract:

Although whiplash is a common cause of disability, there is usually no demonstrable pathology and this leaves scope for moral hazard in claims for loss of earnings. Using weekly data about temporary disability, prescription drug purchases and the use of health services during 1996-2007, we examine the effects of a Danish 2002 reform that extended the period where whiplash claimants could get compensation for temporary loss of earnings when claiming permanent loss of earnings capacity. We find that the reform increased temporary disability by about 18 percent without a matching increase in drug purchases or the use of health services.

Keywords: Whiplash claims, compensation reform, moral hazard

JEL codes: I13, I18, I38

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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% of all traffic injuries, Holm et al. (2008). Whiplash victims can immediately, or some days after the collision, experience a range of symptoms including neck pain, back pain, neck weakness, back weakness, 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% continue to describe themselves as not recovered at one year, Cassidy et al. (2007). Most often, there is no demonstrable pathology such as torn ligaments or fractures, and this has led to considerable debate about the validity of symptoms beyond the usual expected healing time for a soft-tissue injury, Virani et al. (2001).

The lack of demonstrable pathologies creates a situation where the symptomatic claimant is potentially at odds with an insurer, who has been told by medical experts that they can find no demonstrable pathological explanation for the ongoing disability. This creates a scope for moral hazard, where the symptom intensity, if affected by the level of compensation, can potentially contribute to explaining claiming behavior. The importance of moral hazard in health insurance markets and its implications for the optimal design of insurance policies in

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1 The economic literature, see for example Einav, Finkelstein, and Levin (2010), discusses two types of moral hazard in relation to insurance claims. First, financial compensation in the event of an injury can lead the insured to exercise less care in preventing WADs. This is labeled *ex ante* moral hazard. Second, compensation may lead insured persons to make claims for WADs that do in fact not exist or to exaggerate the extent of actual WADs. This is an incentive effect and is labeled *ex post* moral hazard. WADs are most often associated with rear-end car crashes, and previous evidence, Cassidy et al. (2000), has shown that the vast majority of WADs are caused by being struck by another vehicle implying that most WAD claimants are victims of collisions. It is therefore not likely that *ex ante* moral hazard is a massive issue in the case of WADs. *Ex post* moral hazard, on the other hand, is particularly likely to be relevant for injuries that are hard to diagnose such as WADs, and this is what we shall focus on.
general and for whiplash claims, Ebrahim et al. (2013), is well-recognized, but the empirical importance of it is of ongoing debate, and little is known about the specific role of compensation-seeking behavior in whiplash claims. In this paper we examine the effect of increasing compensation for whiplash claims for loss of earnings on temporary disability, permanent disability and prescription drug use in the Danish population.

It is inherently difficult to summarize the extent of whiplash incidence and claims because WAD comprises a wide range of symptoms that are difficult to diagnose, and people who file whiplash related claims are initially recorded under different diagnoses, or not at all. However, Chappui and Soltermann (2008) report that across ten European countries 40% of all traffic insurance claims with bodily injury involve minor cervical spine injuries. This number varies greatly across countries, and in Great Britain the fraction is as high as 76% amounting for about 430,000 whiplash type claims annually. In Canada, a population-based study of traffic injuries reported that more than 80% of claims were for WAD, Cassidy et al. (2000). There are no comparable numbers for the US, as far as we are aware of, but Quinlan et al. (2004) report that some 900,000 people with neck strain/sprain injury were treated in US hospital emergency departments in 2000, and they concluded that this is the most frequent motor vehicle related injury in the US. Not only is the frequency of WAD significant, but it also appears that neck and spine related soft tissue claims expenditures are 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 in Great Britain has increased by 60% from 2006 to 2010, even though the number of traffic collisions had 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 been 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. There are no comparable reports for the US, but Brook et al. (2009) report that the total US national health expenditures related to adults with spine problems increased by 65% from 1997-2005, which is more rapid than overall health expenditures. Based on many indicators it seems safe to conclude that the incidence of whiplash-type claims and health expenditures is significant and has been increasing, at least relatively, in many countries over the past 10 to 15 years.

We use a quasi-experimental design to quantify the importance of (ex post) moral hazard in whiplash claims by examining the effect of a significant increase in the compensation for temporary loss of earnings and permanently reduced earnings capacity, that was implemented in Denmark in 2002, on the duration of absence from work, the use of public transfer schemes and on prescription drug use and use of health services of whiplash claimants. We document the effect of the reform on claiming behavior by analyzing a very detailed and truly unique data set with weekly information about the use of public fund transfers covering the period 1996-2007 for people making claims in the period 2000-2004, i.e. before and after the reform. These data exist because Denmark has a public system to evaluate whiplash claims. The data can be linked at the person level to a host of other public administrative register data with information about payments and prescription drug use, among other things. The data are collected from administrative records that form the basis for actual transfer payments that are audited, and the data are therefore of high quality. As far as we know Denmark is the only place in the world where it is possible to merge information about whiplash claims with administrative records about health and labor market outcomes and the existence of a significant compensation reform offers a unique opportunity to learn about moral hazard behavior.
The characteristics of the data are crucial in several dimensions. Persons 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, observed \textit{before} exposure to the whiplash injury. The majority of persons who are affected by whiplash are not at fault for the collisions, Cassidy et al. (2000), and being able to describe claimants in terms of their pre-whiplash characteristics allows us to characterize differences in health and other characteristics that are not related to the whiplash event and to verify whether pre-whiplash characteristics and trends in temporary disability are similar across claimants before and after the compensation reform. In this way we can credibly verify that our findings are not driven by the comparison of claimants with different pre-whiplash health risks, i.e. differences in health states that are not related to the whiplash. Furthermore, the longitudinal dimension of the data allows us to follow the claimants over an extended time period, from up to four years before, to up to seven years after the whiplash. Thus, we are able to learn about both the short and the long-term effects of the compensation change. Finally, 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 thereby 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, to have lower income, more sickness absence, more prescription drug use, and more contacts with the health system prior to suffering whiplash. However, we find no evidence that the characteristics of claimants changed after the compensation changes. Turning to the effect of the change in the level of compensation, we find that the frequency of temporary disability
increases by up to 18 percent in the first 76 weeks after the whiplash after the reform. The increase is heterogeneous across the sample increasing with age, education and earnings, and the financial buffer available. Remarkably, 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, specialist, chiropractors and physiotherapists suggesting 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 scheme is subject to extensive screening of the claimants, and we find no evidence that duration of disability increases when compensation increased in this scheme.

Cassidy et al. (2000) have shown that after removing the possibility for compensation for pain and suffering in the Canadian province Saskatchewan in 1995, there was a reduction in the number of insurance claims and more rapid recovery of those that did claim. Their results suggest that the economic costs and benefits associated with the compensation system influence the propensity to claim compensation. This is, to our knowledge, the only existing study focusing explicitly on the importance of changes in compensation for recovery. The present study goes beyond that in several ways. 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 are unchanged in the same period. We also document the selection into claiming, that the compensation reform does not change claim selection, and that pre-whiplash trends in temporary disability are similar for persons claiming before and after the compensation reform, something not documented by Cassidy et al. (2000). This highlights the value of having access to pre-whiplash records as historical data, and allows us to assess and

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2 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.
construct comparisons of people with similar \textit{ex ante} health risk profiles. Finally, Leth-Petersen and Pons Rotger (2009) found that a significant fraction of whiplash claimants in Denmark, those with less severe injury, do not experience permanent reductions in earnings 2-5 years after the whiplash. This is consistent with the hypothesis that \textit{ex post} moral hazard could play a role for this group, but it does not explicitly identify moral hazard as is done in the present paper.

This study also relates to a number of studies trying to sort out the importance of moral hazard behavior in compensation for reduced earnings capacity following work place related injuries and in relation to short term sickness absence. Generally, these studies find that changing compensation affects the frequency of absenteeism/the number of claims and the duration of absence from work, Krueger (1990), Moore and Viscusi (1990), Worrall and Butler (1990), Meyer, Viscusi, and Durbin (1995), Bolduc \textit{et al.} (2002), Henreksson and Persson (2003), Neuhauser and Raphael (2004), Johansson and Palme (2005), Puhani and Sonderhoft (2010). Apart from Bolduc \textit{et al.} (2002) these studies do not distinguish between \textit{ex ante} and \textit{ex post} moral hazard. This arguably relates to the fact that health related work absenteeism is not tied to a specific diagnosis, leaving it difficult to control for \textit{ex ante} health risks. The distinction is, however, important because they often require different solutions. \textit{Ex post} moral hazard is typically associated with hard-to-diagnose injuries that require extensive auditing. WAD are a good example of hard-to-diagnose injuries. Our study contributes (among other things) by focusing on a specific type disorder that is not workplace related, where we can credibly control for the \textit{ex ante} health risk, and where \textit{ex post} moral hazard is likely to be particularly imminent.

In the next section we provide more detail about whiplash and the compensation reform that is examined. In section 3, the data are described. Section 4 presents the results, and section 5 concludes the paper.
2. **Whiplash associated disorders and the compensation reform**

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

Compensation for private claims involving permanent reduction in earnings capacity has two parts, including compensation for temporary loss of earnings and another concerning compensation for permanent loss of earnings capacity. Compensation for loss of earnings capacity applies when the estimated loss is 15% or more. 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, times 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 just before the reform, so that the maximum compensation obtainable was 3.72 million DKK. Compensation is reduced by 8.5% for each year 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. There is, however, no monitoring of the actual earnings capacity of the compensated claimant hereafter, and the compensation law does not establish a mechanism to correct a situation of overcompensation. This lack of monitoring and the fact that it is not possible for the insurer to reopen the case if it has been overvalued, provides an incentive for all claimants, whether they have been compensated or not, to exploit all of their actual earnings capacity once the
case has been closed, and the observed long-run outcomes are thus likely to reveal the true health state.

The possibility to obtain compensation for temporary loss of earnings arises because the degree of lost earnings capacity cannot be assessed immediately. After the whiplash occurs the individual generally experiences a drop in earnings capacity in the months immediately following the whiplash. Some 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 when the whiplash happens and until the stationary point.

**Table 1. Overview over the compensation reform**

<table>
<thead>
<tr>
<th>Age</th>
<th>Injured before July 1, 2002</th>
<th>Injured from July 1, 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>TC=up to stationary point</td>
<td>TC=up to LEC assessment point</td>
</tr>
<tr>
<td></td>
<td>PC=6×\min(earnings;620,000)×LEC</td>
<td>PC=10×\min(earnings;620,000)×LEC</td>
</tr>
<tr>
<td>30-54</td>
<td>TC=up to stationary point</td>
<td>TC=up to LEC assessment point</td>
</tr>
<tr>
<td></td>
<td>PC=6×\min(earnings;620,000)×LEC</td>
<td>PC=(10×\min(earnings;620,000)×LEC)×(1-(67-age)×1%)</td>
</tr>
<tr>
<td>55-67</td>
<td>TC=up to stationary point</td>
<td>TC=up to LEC assessment point</td>
</tr>
<tr>
<td></td>
<td>PC=(6×\min(earnings;620,000)×LEC)×(1-(67-age)×8.5%)</td>
<td>PC=(10×\min(earnings;620,000)×LEC)×(1-(67-age)×1%)</td>
</tr>
</tbody>
</table>


The compensation system was reformed as of 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 where compensation is
reduced by 1% 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 and up to the stationary point. From July 1, 2002 compensation for temporary loss of earnings was changed so that compensation was now awarded up to the point where the final assessment of loss of earnings capacity is completed. This increased compensation for temporary loss of earnings significantly for claimants who are assessed by the National Board of Industrial Injuries (NBII) because the median stationary point is typically reached after 13 weeks whereas the median final assessment of permanent loss of earnings capacity is 144 weeks. Table 1 summarizes the changes in the compensation.

Compensation for temporary loss of earnings is obtained through a private insurance, typically the insurance of the person who is at fault. Because there are often no objective pathologies the insurance company and the claimant disagree about the intensity of symptoms. One way to mitigate *ex post* moral hazard behavior is to extensively audit claims, and the Danish authorities do this through the national evaluation scheme administrated by the NBII. The NBII has established an assessment system where, upon request from insurance companies or claimants, they will provide an impartial statement on the health effects and occupational consequences of a private personal injury, including WAD. The NBII will independently collect information about the case and about the health of the claimant, including information from other government institutions about the use of transfer schemes and earnings, and from the health system (i.e., from GPs, specialists and hospitals). In many cases the NBII will also take the initiative to collect new assessments from specialists. These include an assessment of the degree of permanent injury (i.e., the direct health effects of the injury) and an assessment of the degree of lost earnings capacity (i.e., the permanent loss of earnings caused by the injury). The statement made by the NBII is
advisory, and if the parties involved do not agree with the statement made by the NBII, the case may be tried in a court of law. The NBII only prepares a statement about the permanent loss of earnings capacity, and not about health reasons for staying out of work while the case is pending. In this way the NBII can be viewed 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 that is assessed by the NBII. It shows that the number of claims assessed by the NBII is more or less constant over the period, and 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 in to the scheme following the reform is not dramatic. In section 4 we shall make extensive checks that our results are not driven by a change in the selection in to the scheme.

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Claims</td>
<td>1080</td>
<td>1017</td>
<td>1199</td>
<td>1135</td>
<td>1066</td>
</tr>
</tbody>
</table>

Source: NBII

### 3. Data

The data set is constructed 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, comprising whiplash claims incurred two and a half years before and after the compensation reform. These records are merged at the person level to a host of other
administrative registers covering a period that ranges from two years before the whiplash and up to seven years after the whiplash, so that the data set consisting of claimants constitutes a balanced panel.

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, for example sickness benefits or social assistance, while the case is pending, and the insurance company then covers the difference between foregone earnings and public transfers. This implies that we can measure the consequences of the change in compensation for temporary loss of earnings by tracking the uptake of public transfers. To do this we shall rely heavily on the so-called DREAM register containing weekly information about transfers from any public transfer scheme. Specifically, 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). The DREAM register is known to be of high quality, Stapelfeldt et al. (2012). We also consider the effect of the whiplash claims on drug use. To do this, we include information from a complete register of purchases of prescription drugs, where any prescription drug purchased is recorded along with the exact purchase date. We also combine the whiplash records with registers containing information about hospitalizations and the use of general practitioners and specialists, but this information is only available at an annual frequency. 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% random sample of the Danish population, amounting to 105,093 persons, that was not recorded in the NBII register. We use this sample as a control group, and in order to be able to compare individuals in this sample with whiplash claimants
around the time of the whiplash event, we allocate control subjects to a random injury week within the 2000-2004 window, such that we will be able to measure outcomes for claimants and controls relative to the point in time of the injury week. We include observations covering the period from two years before to seven years after the randomly allocated whiplash week so that the data structure of the control group matches that of the group of whiplash claimants.

**Figure 1. Sample selection protocol**

All whiplash related claims between January 2000 and December 2004 (6,626)

Claimant is 20-56 years old and potentially labor active at the whiplash (5,332)

Claimants for permanent loss of earning capacity (4,649)

Not missing baseline covariates the year before whiplash and no missing outcomes within 7 years after the whiplash (4,597)

We are interested in measuring the effect of the compensation on the propensity to stay out of work. For conducting 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 interval 20-56 at the time of the injury and who were potentially active in the labor market at the point of the whiplash. In this way we exclude persons on permanent disability and early retirement, but also older claimants to avoid interference with the retirement decision. The
sample includes students because, within a 7 years horizon, many of them are likely to be active on the labor market. This leaves us with 5,332 persons making whiplash claims. Secondly, we excluded claims that were not related to loss of earnings capacity and this reduced the sample to 4,649 claimants. Finally, we required that covariate information not be missing 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. The sample selection process is summarized in Figure 1.

The NBII assessment system is voluntary, and requests to give an impartial statement can be made by either insurance companies or claimants. Insurance companies make more than 80% of all requests for assessments made by the NBII. As in other countries there is no universal method that counts the number of whiplash cases in Denmark, and we do not know exactly how comprehensive the coverage of the NBII database is.\(^3\) From conversations with people in the insurance industry, we have learned that the NBII is primarily asked to make assessments in cases that involve claims about permanent injury and permanently reduced earnings capacity, and these are 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 cases where the insurance company and the claimant disagree. The potential for disagreement is bigger when there is no demonstrable pathological diagnosis. Therefore, the NBII database tends to include cases where the scope for moral hazard is bigger.

Besides being the most comprehensive database with information about 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

\(^3\) In the period 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% of these.
benefits. This enables us to give a detailed description of pre-whiplash health, so as to assess and control for differences in *ex ante* health risk between the whiplash claimants and the general population. It also holds detailed information about temporary disability over a very long period. This enables us to assess the exact point in time at which economic incentives change behavior and to assess the effects on both the short and the long-term horizon.

Table 3 presents summary statistics for whiplash claimants claiming 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. Remarkably, claimants clearly have poorer health already before they are exposed to the whiplash event, a point emphasized previously by Leth-Petersen and Rotger (2009) and Jöud et al. (2013). They have more temporary disability, and they also have more contacts with the health system. Finally, claimants purchase more prescription drugs than an average person from the population even before they are exposed to the whiplash. Interestingly, drug purchases among claimants are not concentrated only on drugs that are directly related to musculoskeletal disorders, such as pain medicine, but they also purchase psycholeptic drugs, which is medication producing a calming effect upon the patient, and other types of drugs, consistent with the findings of Myrtveit et al. (2013).
Table 3. Summary statistics for claimants before and after the introduction of the compensation reform, July 1 2002, and standardized differences to the random sample from the population.

<table>
<thead>
<tr>
<th>Baseline covariates</th>
<th>Pre-reform claims</th>
<th>Post-reform claims</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean of claimants</td>
<td>Standardized difference to random sample</td>
</tr>
<tr>
<td>Age</td>
<td>36.29</td>
<td>-19.0</td>
</tr>
<tr>
<td>Female</td>
<td>0.67</td>
<td>37.9</td>
</tr>
<tr>
<td>Partner</td>
<td>0.72</td>
<td>-25.1</td>
</tr>
<tr>
<td>Vocational training</td>
<td>0.39</td>
<td>0.6</td>
</tr>
<tr>
<td>Short education</td>
<td>0.05</td>
<td>-3.7</td>
</tr>
<tr>
<td>Medium education</td>
<td>0.11</td>
<td>-3.7</td>
</tr>
<tr>
<td>Long education</td>
<td>0.03</td>
<td>-17.8</td>
</tr>
<tr>
<td>Earnings (1,000 DKK)</td>
<td>170.08</td>
<td>-23.7</td>
</tr>
<tr>
<td>Liquid assets / disposable income</td>
<td>1.84</td>
<td>0.5</td>
</tr>
<tr>
<td>Individual Unemployment</td>
<td>0.04</td>
<td>3.2</td>
</tr>
<tr>
<td>Local Unemployment</td>
<td>0.05</td>
<td>-4.6</td>
</tr>
<tr>
<td>Visits to General Practitioner</td>
<td>0.95</td>
<td>39.5</td>
</tr>
<tr>
<td>Temporary Disability Benefits (weeks)</td>
<td>6.72</td>
<td>21.7</td>
</tr>
<tr>
<td>Musculoskeletal system diseases</td>
<td>0.07</td>
<td>14.6</td>
</tr>
<tr>
<td>Pregnancy, childbirth and the puerperium</td>
<td>0.05</td>
<td>5.7</td>
</tr>
<tr>
<td>Abnormal clinical and laboratory findings</td>
<td>0.04</td>
<td>11.3</td>
</tr>
<tr>
<td>Injury, poisoning and other external consequences</td>
<td>0.18</td>
<td>18.5</td>
</tr>
<tr>
<td>Health status and health services contact</td>
<td>0.16</td>
<td>15.2</td>
</tr>
<tr>
<td>Pain medicine (weeks)</td>
<td>1.03</td>
<td>18.4</td>
</tr>
<tr>
<td>Psycholeptic medicine (weeks)</td>
<td>0.65</td>
<td>10.2</td>
</tr>
<tr>
<td>Other medicine (weeks)</td>
<td>4.01</td>
<td>33.8</td>
</tr>
<tr>
<td>Number of whiplash claimants</td>
<td>2,235</td>
<td>2,362</td>
</tr>
<tr>
<td>Number of control units</td>
<td>51,152</td>
<td>53,941</td>
</tr>
<tr>
<td>Ratio treated/control sample</td>
<td>0.04</td>
<td>0.04</td>
</tr>
</tbody>
</table>

1 All variables are measured before the whiplash. 1) Short higher education is defined as 2-3 years education after high school at an occupational academy 2) Medium higher education denotes 3-4.5 years of education at a profession university 3) Long higher education is 5-6 years of university education. 4) Individual unemployment denotes whether the primary labor market state of the individual the year before whiplash was unemployment. 5) Local unemployment denotes the average unemployment rate of the county of residence of the individual before whiplash. 6) Visits to General Practitioner is a dummy variable indicating if the subject has visited a GP/physiotherapist/specialist the year proceeding the year of whiplash. 7) Temporary disability benefits indicates the number of weeks receiving temporary sickness benefit for at least 3 weeks, rehabilitation or social assistance without job activation before the injury date. 8) ‘Musculoskeletal system diseases’ is a dummy indicating a diagnosis under codes M00-M99 in the ICD-10 (v2010) classification. 9) Pregnancy, childbirth and the puerperium indicates a diagnosis under codes O00-O99 in the ICD-10 (v2010) classification. 10) ‘Abnormal clinical and laboratory findings’ indicates a diagnosis under codes R00-R99 in the ICD-10 (v2010) classification. 11) Injury, poisoning and other external consequences is a dummy for a diagnosis under codes S00-T98 in the ICD-10 (v2010) classification. 12) Health status and health services contact indicates a diagnosis under codes Z00-Z99 in the ICD-10 (v2010) classification. 13) 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. 14) 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. 15) 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 \( \frac{\overline{X}_C - \overline{X}_T}{\sqrt{\frac{\sigma_C^2 + \sigma_T^2}{2}}} \) where \( \overline{X}_C \) denotes the sample mean of the covariate among whiplash claimants, \( \overline{X}_T \) denotes the sample mean of the covariate among the 2% of Danish population, \( \sigma_C^2 \) denotes the sample variance of the covariate among whiplash claimants, and \( \sigma_T^2 \) denotes the sample variance of the covariate among the 2% of Danish population.
Comparing differences between claimants and the random population sample before and after the reform reveals no differences, showing that the composition of claimants did not change across the reform period in terms of the characteristics listed in table 3. The fact that the assessment system is voluntary creates the possibility for two types of selection in to our data set. Insurance companies may change their propensity to make requests to the NBII and claimants may change their propensity to apply for compensation for loss of earnings capacity. The fact 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 to requests to 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 depending on 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 and until 338 weeks after the injury. Consistent with the numbers displayed in table 2 the graph clearly shows that the level of temporary disability is higher for whiplash claimants than for the general population already before the whiplash event occurred. Future claimants have a temporary disability rate of about 15%, compared to 7% among the general population and it increases dramatically after the injury. There is an immediate effect after injury, which lasts about 13 weeks, after which disability declines a bit and levels at week 52. After that point disability 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 run, and this pattern is consistent with the findings of Leth-Petersen and Rotger (2009).
However, six years is a considerable time on disability. Comparing temporary disability for claimants claiming before July 1 2002 with those claiming after, it appears that post-reform claimants have a slightly higher level of temporary disability before the whiplash than 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, i.e. 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.

**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. This is essentially done by comparing the curves in Figure 2, i.e. by subtracting the level of temporary disability of the control group from the level of the claimant group and then comparing this difference
between claimants who are exposed to a whiplash before July 1, 2002 and claimants who are exposed to a whiplash after July 1, 2002. Formally, we quantify the effect by estimating the following difference-in-difference model

\[ \tau_{it} = \beta_{0t} + \beta_{1t}D_{i}^{\text{post}} + \beta_{2t}W_{i} + \beta_{3t}(D_{i}^{\text{post}} \times W_{i}) + \beta_{4t}X_{i}^{\text{pre}} + u_{it} \]  

Where \( \tau_{it} \) is the outcome measured for person \( i \) at time \( t \), where \( t \) is an indicator of the week running from -104 to 364 weeks after the whiplash, i.e. from two years before to seven years after. \( D_{i}^{\text{post}} \) is a dummy variable taking the value 1 if person \( i \) has been exposed to a whiplash after 1 July 2002, which is the date of the introduction of the new compensation scheme. \( \beta_{1t} \) is the associated parameter capturing movements in temporary disability from before to after the reform date that are common for all persons in the sample. \( W_{i} \) is a dummy variable taking the value one if person \( i \) has been exposed to a whiplash. For control group observations, the random sample from the population, this variable will always take the value zero. \( \beta_{2t} \) is the associated parameter vector measuring how whiplash claimants generally deviate from people that do not claim irrespective of the time at which the whiplash event occurs. Figure 2 clearly showed that whiplash claimants have a higher level of temporary disability, both before and after the whiplash, when compared to the random sample from the population, and this effect is captured by the vector \( \beta_{2t}^{k} \). The third term is the interaction between the \( D_{i}^{\text{post}} \) and the vector \( W_{i} \). The associated parameter vector, \( \beta_{3t} \), is the effect on temporary disability among claimants that have been exposed to a whiplash after the introduction of the new compensation scheme. Finally, \( X_{i}^{\text{pre}} \) is a vector of pre-
whiplash characteristics including the characteristics in table 3. All parameters are $t$-specific. In practice this is obtained by running regressions independently period-by-period. The estimator effectively compares the change in the propensity to stay out of work for whiplash claimants from before to after the whiplash for individuals claiming before the reform with the corresponding change for claimants claiming after the reform, and this relative change is compared to the change in the propensity to be out of work for a random sample from the population. Equation (1) is thus effectively a triple differences-in-differences estimator.

Given the appropriateness of the specification of equation (1) $\beta_{3t}$ 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. Most whiplash incidences are related to car collision. Cassidy et al. (2000) show that whiplash claimants are not at fault in the vast majority of incidences generating a whiplash, and this supports the idea that people are not intentionally exposed to a whiplash. In terms of our application this 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. This is not directly testable, but under this hypothesis one should expect the development in temporary disability to be similar in the pre-whiplash period, and this is testable with our data.

Figure 3 presents baseline estimates of $\beta_{3t}$. 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

\footnote{It turns out that our results do not depend on including this vector of control variables.}
whiplash. At 40-50 weeks after the whiplash the effect of the reform is biggest reaching about 7.5 percentage-points. This increase should be compared a level of temporary disability for pre-reform claimants of about 42 percent yielding a relative increase of about 18 percent. The reform changed compensation for both temporary loss of income and compensation for permanent loss of earnings capacity. Compensation for temporary loss of earnings is not screened, but compensation for permanent loss of earnings capacity is subject to extensive screening and verification by the NBII, and the results are consistent with this. The scope for rent seeking behavior is bigger for compensation for temporary loss of earnings than for compensation for loss of earnings capacity. We note that the there are no differences in the level of temporary disability in the pre-whiplash period and this is consistent with the notion that the compensation reform did not change the composition of the claimant group, i.e. there is no evidence that the increased level of compensation has led people with less severe whiplash injuries to apply, an effect emphasized by Neuhauser et al. (2004), in the context of workers compensation, or that insurance companies have changed the composition of requests to the NBII around the time of the reform.

One possible explanation for the drop in temporary disability could be that claimants exit to permanent disability pension schemes. To assess this we re-estimate equation (1) but using an indicator for receiving permanent disability pension as the dependent variable. The result from this is shown in Figure 4. The pre-whiplash level is by construction the same as we have selected out of our sample people who were on a permanent disability scheme already before the whiplash. There is no sign that the increase in temporary disability pension shown in Figure 3 is followed by transits to permanent disability schemes.
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. Full line is the estimated effect, i.e. $\beta_{3t}$ from equation (1), and dotted lines are 95% confidence intervals. The dashed lines mark the zero-level on both axes.

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. Full line is the estimated effect, i.e. $\beta_{3t}$ from equation (1), and dotted lines are 95% confidence intervals. The dotted lines mark the zero-level on both axes.
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. Prescription drug purchases are very volatile and it is not possible to identify any effects, neither visibly nor statistically, when estimating effects using data at the weekly frequency (not reported). We have therefore aggregated 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 up in to pain drugs (Panel B), Psycholeptic Drugs (Panel C) and other drugs (panel D). Panel A shows that it is not possible to identify any change in the purchase of prescription drugs for whiplash claimants following the reform. In panel B we consider only prescription pain drugs, which is the class of medicine most directly targeting potential whiplash associated disorders.

There appears to be a slight increase in the purchase of pain drugs as a consequence of the reform, but the effect is significant only in the phase immediately following the whiplash and is of a magnitude that cannot account for the increase in temporary disability reported in Figure 3. Panel C isolates the purchase of Psycholeptic drugs, which are medications producing a calming effect upon the patient, and Panel D considers remaining prescription drugs. In neither case is there any indication that the reform is associated with increased prescription drug purchases at any point around the whiplash event.
Figure 5. Estimated Effect of Reform on the Frequency of Prescription Drug Purchases for Whiplash Claimants

Panel A: Total prescription drug purchases

Panel B: Pain Medicine

Panel C: Psycholeptic Medicine

Panel D: Other Types of Prescription Medicine

Note: Effects are estimated by applying equation (1) where the dependent variable is 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. $\beta_{33}$ from equation (1), and dotted lines are 5% confidence intervals. Panel A presents estimates for all prescription drug purchases while panel B-D breaks total drug purchases up into pain drugs, Panel B, Psycholeptic Drugs (Panel C) and other drugs (panel D). Prescription pain drugs includes anti-inflammatory, antirheumatic products, topical products for joint and muscular pain, muscle relaxants or analgesics. Psycholeptic drugs includes barbiturates, benzodiazepines, nonbenzodiazepines, phenothiazines, opiates/opioids, carbamates, ethanol, 2-methyl-2-butanol, cannabinoids, some antidepressants, neuroleptics, and some anticonvulsants.
We also have access to other health related outcomes measuring the use of services from general practitioners, physiotherapists, chiropractors, and specializes practitioners, albeit these measures are available only at an annual frequency. 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.\(^5\)

The results are presented in table 4, and they 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 an increase in the use of prescription drugs and health services that is able to explain the increase in temporary disability displayed in Figure 3.

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<th>Year</th>
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<th>S.E.</th>
<th>Physiotherapist Coef.</th>
<th>S.E.</th>
<th>Chiropractor Coef.</th>
<th>S.E.</th>
<th>Other Coef.</th>
<th>S.E.</th>
<th>Any Coef.</th>
<th>S.E.</th>
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<td>0.01</td>
<td>-0.01</td>
<td>0.01</td>
</tr>
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</table>

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 of significance.

\(^5\) 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 and made available for research purposes as quickly as the registers for disability.
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 go on to explore the characteristics of the individuals that are responsible for this increase. We do this by running regression (2)

\[
\text{Duration}_{i}^{1-76} = \alpha_0 + \alpha_1 X_i + \alpha_2 D_i^{\text{Post}} + \alpha_3 W_i + \alpha_4 (D_i^{\text{Post}} \times X_i) \\
+ \alpha_5 (D_i^{\text{Post}} \times W_i) + \alpha_6 (X_i \times W_i) + \alpha_7 (D_i^{\text{Post}} \times W_i \times X_i) \tag{2}
\]

Duration\(_{i}^{1-76}\) is the cumulated temporary disability between week 0 and week 76 after the whiplash for person \(i\), \(X_i\) is a vector of pre-whiplash characteristics including the characteristics listed in table 3, \(D_i^{\text{Post}}\) 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 one if person \(i\) has been exposed to a whiplash. \(\alpha_7\) is the parameter of interest, and it shows what pre-whiplash characteristics are associated with the post-reform increase in in temporary disability within week 76 after whiplash. Estimates of \(\alpha_7\) are presented in table 5.

The tendency to extend the duration of temporary disability is positively correlated with age, being male, having a short education, the latter effect arguably reflecting that people with a higher level of education are quicker at picking up the implications of the reform. Extending the duration of temporary disability is positively associated with pre-whiplash earnings consistent with the notion that the improved possibility to get 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

<table>
<thead>
<tr>
<th>Baseline covariate</th>
<th>Coefficient</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.10</td>
<td>0.04</td>
</tr>
<tr>
<td>Female</td>
<td>-3.04</td>
<td>0.89</td>
</tr>
<tr>
<td>Partner</td>
<td>-1.44</td>
<td>0.89</td>
</tr>
<tr>
<td>Vocational training</td>
<td>1.61</td>
<td>0.89</td>
</tr>
<tr>
<td>Short education</td>
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<td>1.97</td>
</tr>
<tr>
<td>Medium education</td>
<td>1.71</td>
<td>1.39</td>
</tr>
<tr>
<td>Long education</td>
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<td>2.46</td>
</tr>
<tr>
<td>Earnings (1,000 DKK)</td>
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<td>0.00</td>
</tr>
<tr>
<td>Liquid Assets/Disposable income</td>
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<td>0.09</td>
</tr>
<tr>
<td>Individual Unemployment</td>
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</tr>
<tr>
<td>Local unemployment</td>
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<td>34.49</td>
</tr>
<tr>
<td>Visits to General Practitioner</td>
<td>1.06</td>
<td>1.87</td>
</tr>
<tr>
<td>Temporary Disability Benefits (weeks)</td>
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</tr>
<tr>
<td>Musculoskeletal system diseases</td>
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<td>1.55</td>
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<td>Pregnancy. childbirth and the puerperium</td>
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<td>Abnormal clinical and laboratory findings</td>
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<td>1.97</td>
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<td>Injury. poisoning and other external consequences</td>
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<td>1.06</td>
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<td>Health status and health services contact</td>
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<td>1.23</td>
</tr>
<tr>
<td>Pain medicine (weeks)</td>
<td>0.19</td>
<td>0.15</td>
</tr>
<tr>
<td>Psycholeptic medicine (weeks)</td>
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<td>0.10</td>
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<tr>
<td>Other medicine (weeks)</td>
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<td>0.15</td>
</tr>
<tr>
<td>Number of observations</td>
<td>109,340</td>
<td></td>
</tr>
</tbody>
</table>

Notes: 1) see notes to table 2. The dependent variable measures the number of weeks that the claimant is on temporary disability within week 76 after the whiplash. The table reports estimates of $\alpha_\gamma$ from equation (2). Standard errors are robust to heteroskedasticity. ** indicates significance at the 5% level of significance. * indicates significance at the 10% level of significance.

Extending the duration of temporary disability is negatively associated with the duration of unemployment prior to the whiplash. For people to be able 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. In order to control for the importance of liquidity constraints, we have 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

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6 This is a well-established result from the literature about optimal unemployment insurance, Chetty (2008).
proxy for being affected by liquidity constraints; see for example Zeldes (1989) and Leth-Petersen (2010). The estimate indicates that the propensity to extend 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. However, having controlled for liquidity constraints we still find that other characteristics are correlated with the propensity to extend the duration of temporary disability. Consistent with this, table 5 shows that the level of temporary disability realized before the whiplash event is negatively related to the propensity to extend temporary disability after the whiplash as a consequence of the reform. Similarly, all pre-whiplash health indicators are negatively related to the propensity to extend 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 than the average person on temporary disability when characterized by pre-whiplash characteristics.

Robustness checks
The fact that the NBII assessment system is voluntary implies that any difference that we observe between pre- and post-reform claiming behavior in the NBII sample 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, among other things because the period where they are obliged to cover loss of earnings is extended significantly. On the other hand, the reform also brings an incentive for people to increase their propensity to claim, because the possibility to get compensation is improved. A priori it is not clear whether these forces are important and what their relative importance is in case they are significant. We have already shown some evidence pointing towards that the composition of
the claimant group did not change across the reform period: the evidence presented in table 3 suggested that the composition of the claimant group did not change, and the pre-whiplash effects estimated in Figure 3 and 6 and table 4 all suggested no change in the selection. However, to further assess whether our results are impacted by selection in to the NBII database, we conducted a number of robustness checks and additional analyses.

First, table 3 and figure 2 showed that whiplash claimants are systematically different from the random sample from the population, but differences between whiplash claimants before and after the reform appeared to be negligible. Equation (1) corrects for differences between whiplash claimants and control units by controlling parametrically for differences in observed pre-whiplash characteristics. In order to check that our results are not driven by these functional form assumptions and imbalances between the claimant and the control groups we have estimated the effect of the reform by applying a nearest neighbor propensity score-matching estimator that balances the covariates of the whiplash claimants with that of the 2 percent random sample. Specifically, matching is done on the propensity score estimated using the covariate set entering the regressions underlying Figure 3 as well as a measure of temporary disability in weeks -52 to -1. If the whiplash is not incurred deliberately, then this will assist in controlling differences in the propensity to stay out of work that are unrelated to the whiplash. After matching whiplash claimants with individuals from the random sample from the population the effect of the reform is obtained in a second step by regressing the estimated individual effects on a dummy indicating if the individual had a whiplash after the reform. Figure 6 shows that the estimate reported in Figure 3 and the matching estimate coincide very closely.

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7 This procedure does not correct for potential differences in the composition of covariates between claimants before and after the reform. We have also tried to match pre- and post reform claimants in the second step, but that did not change the results and we do not report this set of estimates.
Figure 6. Results using matching estimator

Note: The solid line denotes the OLS estimates (same as Figure 3), the dashed line is matching estimator, and the dotted lines denote the DID estimated 95% confidence interval. The matching estimates are obtained in two steps: Step 1: Individual effects are estimated with propensity score 1-nearest neighbor matching without replacement on the whole sample of whiplash claimants and 2% control population. The propensity score is estimated using the covariate set including the covariates included in the estimation reported in Figure 3 as well as lagged outcomes spanning 1-52 weeks before the week of the whiplash injury. Step 2: The effect of higher compensation is obtained by regressing the estimated individual effects on a dummy indicating if the individual was exposed to reform.

Second, our database records who made the request to NBII. If the reform induced a change in the propensity for insurance companies to make requests for assessments 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.

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 in the period considered. In Figure 7 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 we
would see that 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, and in particular, that there is no break in the fraction of requests made by insurance companies, as would be expected if insurance companies had changed their propensity to make requests as a consequence of the reform.

Figure 7. Fraction of referrals from insurance companies by injury date

If a whiplash is a truly random event (given the observed characteristics that we condition on) and 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 true health state of the applicants. As another check that there has been no sharp change in the type of cases referred to the NBII around the point of the reform, we consider 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 resumed upon the claimant’s request. There is, however, no monitoring of the actual earnings capacity of the compensated claimant hereafter, and the compensation law does not establish a mechanism to correct a situation of overcompensation. This lack of monitoring and the fact that it is not possible for the insurer to reopen the case if it has been overvalued, provides an incentive for all claimants, whether they have been compensated or not, to exploit all of their actual earnings capacity once the case has been closed, and the observed long-run outcomes are thus likely to reveal the true health state.\textsuperscript{8} 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, we plot the temporary disability rate among claimants at 352 weeks, i.e. about 6.5 years, after the whiplash, against the week where the whiplash happened. In this way we are able to see if there is a discrete change in the true health state around the time of the reform. Figure 8 plots the average temporary disability rate in week 352 after the whiplash against the month where the whiplash happened, where the x-axis is centered at the point of the reform, and superimposes a polynomial regression based on the underlying micro data, together with confidence intervals. The figure shows that there is no break in the long-term temporary disability rate around the time of the reform.

\textsuperscript{8} This institutional setup was exploited in Leth-Petersen and Rotger (2009) to identify the effect of experiencing a whiplash on long run labor market performance of whiplash claimants.
Our estimation approach relies on common trends between the pre- and the post-reform groups (after comparing with the random sample). While the reform did not change the selection discretely around the time of the reform, we estimate the change in outcomes using a five-year period, and the estimated increase could potentially have been generated by a slowly moving upward trend across this period and thus be unrelated but coincident with the reform. However, given that the change in incentives were strong, it would be expected that the change in behavior would occur immediately after the onset of the reform. To look into this we have re-estimated equation (1) and Figure 3 using a narrower window around the reform. Specifically, we have selected two narrower windows spanning six and nine months before and after July 1, 2002, and the results are displayed in Figure 9.
Figure 9. Robustness of the Estimated Effect of Reform to smaller sample time spans

Note: The solid line denotes the DID estimates with all observations, the dashed line is DID estimates with a sample restricted to whiplash injuries within 9 months before and after July 1, 2002, and the short dashed-dotted line is DID estimates with a sample restricted to whiplash injuries within 6 months before and after July 1, 2002.

The results show that the estimated effect is almost identical for all window sizes, and this confirms that the compensation reform impacted the propensity to be on temporary disability immediately.

5. Conclusion

This paper presents an analysis of the effect of a compensation reform on work absence due to whiplash injury in Denmark. The reform resulted in a significant increase in the compensation for temporary loss of earnings and permanent loss of earnings capacity. Learning about claiming behavior after whiplash injury is important because it is the most common traffic injury and can result in prolonged disability. This issue is also of interest.
because there is scope for moral hazard to occur. Whiplash claimants typically do not have any detectible or objective pathology to account for their symptoms, and the only assessment of severity is how the claimant subjectively feels about their injuries, which is hard to qualify.

Our analysis is based on a data set with records about whiplash claims collected via a unique public assessment system. These records are merged with data about the receipt of public transfers measured at a weekly frequency and the purchase of prescription drugs at a daily frequency for a period ranging from two years before the whiplash injury to seven years after it. The high frequency data on temporary disability benefits along with the compensation reform allows us to pinpoint the time at which effects of changing the level of compensation on work absence occur. It provides a clean example where economic incentives change, but ex ante health risks are constant, an almost ideal setup for documenting health related moral hazard behavior.

The results from this study show that propensity to be on temporary disability is increasing with the level of compensation. Specifically, the propensity of temporary disability increased up to 7.5 percentage-points on average 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 increasing with age, education and earnings. Remarkably, the increase in temporary disability is not accompanied by an increase in the use of prescription drugs that can match the increase in temporary disability, and there is no increase in the use of health services such as GPs, specialist, chiropractors and physiotherapists. This 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 scheme is subject to extensive screening of the
claimants, and we find no evidence that duration of disability increases when compensation increased in this scheme.

The results from this study show that temporary disability increases when compensation increases and there is no extensive screening device in place. Cassidy et al. (2004) have demonstrated similar tendencies for compensation after mild traumatic brain injury, which is another common traffic-related injury without demonstrable pathology. This suggests that rent-seeking behavior is relevant to take in to account when designing compensation schemes for health related events where there are no clearly detectible pathologies.
References


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