Post-accident Earning and Benefits Adequacy and Equity

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Principle Investigator: Emile Tompa, Scientist
Institute for Work & Health
etompa@iwh.on.ca
Tel. 416-927-2027 ext 2113
Fax 416-927-4167

Co-investigators: Cameron Mustard, President
Institute for Work & Health

Sandra Sinclair
Institute for Work & Health

Miao Fang, Research Associate
Institute for Work & Health

Heather Scott-Marshall, Post-doctoral Fellow
Institute for Work & Health

Grant Administration: Mary Cicinelli, Director, Human Resources and Corporate Services
Institute for Work & Health
481 University Avenue, Suite 800
Toronto, Ontario
Canada M5G 2E9
mcicinelli@iwh.on.ca
Tel. 416-927-2027 ext 2153
Fax 416-927-4167

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List of Terms and Abbreviations

Bifurcated program: A type of workers' compensation program that can provide benefits for the same condition based two different approaches to benefits determination. The long-term disability program in British Columbia was bifurcated, providing benefits based on permanent impairment or loss of earnings capacity, depending on whichever was higher.

British Columbia (BC): The western most province in Canada whose capital is Vancouver.

British Columbia Linked Health Database (BCLHD):

Dual award (FEL/NEL) Program: The Ontario workers' compensation program implemented on January 1, 1990. The program introduced a dual award program that provided for a future economic loss (FEL) benefit as well as a non-economic loss (NEL) award. Individuals receive FELs if they sustain a temporary total impairment lasting 12 months or longer, or sustain a permanent impairment as a result of a work accident, and are deemed unable to earn an income that was at least 90% of their pre-accident earnings.

Future economic loss (FEL): An assessment of the loss of earnings capacity due to long-term work disability.

No lost-time claim (NLT): A claim for only medical benefits. There is no time off work due to the accident, or at least time off work eligible for wage replacement benefits.

Non-economic loss (NEL): An assessment of total bodily impairment based on the American Medial Association Guides to Permanent Impairment.

Lost-time claim (LT): A claim for which there is time off work and benefits paid for wage replacement.

Low Income Measure (LIM): The LIM is defined as 50% of median income. The LIM is adjusted for composition and size of the family using an equivalence scale in which the first individual is assigned a weight of one, subsequent individuals are assigned a weight of 0.4 if they are aged 16 or over, and 0.3 if they are younger than 16. No adjustments are made for community size and region of residence.

Long-term disability: A permanent impairment sustained by a worker as a result of a workplace accident that has work implication for the worker.

Longitudinal Administrative Databank (LAD): The principal data source used in the present study. The LAD is a 20% random sample of the T1 Family File (T1FF), both of which are maintained by Statistics Canada. The T1FF is a yearly cross-sectional database of all Canadian tax filers and their census families. The data is culled from information available from personal income tax returns provided annually to the Canada Customs and Revenue Agency. Both the T1FF and the LAD have been created for every year from 1982 to 1999, and new years are added as the data become available. The T1FF has become increasingly representative of the Canadian

population with the introduction of tax credits in the late 1980s that encouraged low-income individuals to file tax returns. The T1FF contains over 85% of Canadians 18 years of age and older in the early years of the database and over 94% in the most recent years.

Loss of earnings (LOE) benefits program: The FEL program was replaced with the loss of earnings benefits program starting January 1, 1998. The LOE benefit is similar to the FEL program with minor modifications. LOE is also a term used by WorkSafeBC for one of their long-term disability benefits formula.

Loss of function (LOF): A concept similar to permanent impairment, specifically the permanent loss of function.

Ontario Workplace Safety & Insurance Board (WSIB): Workers' compensation in Ontario is administered by the WSIB, formerly known as the Workers' Compensation Board of Ontario (WCB). It is a provincial, not-for-profit monopoly provider of workers' compensation insurance in the province of Ontario, Canada.

Permanent Disability (PD) Program: The Ontario workers' compensation program in effect prior to 1990. Under this program, the amount of income replacement was based on a formula that considered the percentage of permanent impairment (using a ratings guide similar to the American Medical Association Guide) and pre-accident earnings.

Permanent partial disability (PPD): A permanent impairment sustained by a worker that is not fully disabling.

Social Insurance Number (SIN): Unique identifier used for selection of individuals into the LAD. Once selected, an individual's tax returns are included every subsequent year if present, along with their census family. There is no age restriction for selection into the LAD, but individuals must have a SIN. Individuals without a SIN can only be present in the family component of the file.

T1 Family File (T1FF): The T1FF is a yearly cross-sectional database of all Canadian tax filers and their census families. The data is culled from information available from personal income tax returns provided annually to the Canada Customs and Revenue Agency.

Workers' Compensation Board of Ontario (WCB): Former name of Workplace Safety and Insurance Board of Ontario.

Workplace Safety and Insurance Board of Ontario (WSIB): Workers' compensation in Ontario is administered by the WSIB. It is a provincial, not-for-profit monopoly provider of workers' compensation insurance in the province of Ontario, Canada.

Work-related Musculoskeletal Disorder (WRMSD): An MSD injury due to work exposure.

WorkSafeBC: Workers' compensation in British Columbia is administered by the WorkSafeBC. It is a provincial, not-for-profit monopoly provider of workers' compensation insurance in the province of British Columbia, Canada.

Abstract

In this three part study we investigate labor-market earnings, benefits adequacy and equity, and the probability of marital break up of workers' compensation claimants. Part 1 of the study investigates the long-term labor-market earnings of claimants with permanent impairment and the wage replacement rates provided by two markedly different disability programs that existed in Ontario, Canada over the 1980s and 1990s. One program was a single benefit, impairment-based program and the other a dual award program that provided a future economic loss benefit for loss of earnings capacity as well as a non-economic loss award for pain, suffering and loss of enjoyment of life. A third program from British Columbia, Canada is also brought into the comparison. This program was bifurcated, offering the higher of two formulations for benefits one based on impairment and the other on loss of earnings capacity. In Part 2 the labor-market earnings and benefits adequacy and equity of short-term disability claimants are investigated with a sample of claimants from Ontario. Part 3 is an investigation into the risk of marital breakup of claimants with permanent impairments from Ontario and British Columbia. This study is based on data from a linkage of workers' compensation claims from the two Canadian provinces with Statistics Canada's Longitudinal Administrative Databank. The latter database contains information on the earnings sources and amounts reported to Revenue Canada for a 20% sample of Canadian tax filers and their census families over a period of approximately 25 years.

Highlights and Significant Findings

Part 1 of this study examined the long-term labor-market earnings of individuals with permanent impairment from a work accident, and the adequacy and equity of wage replacement benefits provided by two markedly different long-term disability programs that have existed in Ontario, Canada over the 1980s and 1990s. The first program was a single benefit, impairment-based program. The second program was a dual award program that provided a future economic loss (FEL) benefit for loss of earnings capacity, as well as a non-economic loss (NEL) award for pain, suffering and loss of enjoyment of life. A third type of program (a bifurcated one) that existed in British Columbia, Canada over the 1980s and 1990s was also compared to the two principal programs under investigation in this study. The bifurcated program offered permanent impairment claimants the higher of two benefits formulations—one base on total bodily impairment much like the first Ontario program, and the other based on loss of earnings capacity much like the Ontario FEL benefit.

There were two principal objectives of this investigation: 1) to better understand the adequacy and equity of two markedly different wage-loss compensation programs for individuals sustaining permanent impairments; and 2) to determine whether there are significant differences in labor-market re-entry and earnings post-accident between individuals receiving benefits from one of the two programs. As noted, we have also added a third program to this analysis.

Across the three Canadian programs we found the even claimants with low levels of impairment had large income losses (e.g., claimants with 0-5% impairment had a loss of approximately 20% compared to their uninjured control counterparts). What was also noteworthy in the analysis of the three programs was that earnings recovery of claimants varied dramatically even within impairment brackets. Earnings within a bracket were very polarized, with a large fraction recovering less than 25%, a large fraction recovering more than 75%, and few claimant recovering earnings in the mid ranges (i.e., between 25-75%). Even for the Ontario dual award program, the distribution within FEL strata was also found to be very polarized. It appears the assessment of earnings capacity within the FEL program did not accurately prediction earnings recovery for many claimants.

Of the three long-term disability workers' compensation programs reviewed in this study, the bifurcated program provided the most adequate and equitable benefits based on percentage of control counterpart earnings replaced by benefits and labor market earnings post-accident. A more detailed comparison of the two Ontario programs using a range of replacement rate measures suggests that the post-1990 dual award program is marginally more adequate and equitable than the pre-1990 impairment-based one. Regardless of the replacement rate measure, the post-1990 program achieved the target rate of 90% in more strata than the pre-1990 one, and the overall replacement rates were generally higher. Needless to say, replacement rates were strata averages. As noted, data on the proportion of claimants within quartile of earnings recovery within each stratum indicated that labor-market earnings recovery was quite polarized.

Part 2 of this study examined the long-term labor market earnings of temporary disability claimants. The objective of this investigation was to determine if there were long-term earnings losses for individuals experiencing only a temporary work disability. Consistent with earlier research, we found that short-term disability claimants experience long-term earnings losses. The spread between claimant and control earnings increased over the years post-accident, and was between 13-19% at the 10 year point. These findings suggest that short-term disability has implications long-term labor-market earnings. The observed patterns of earnings divergence

between claimants and controls may also be due to differences in these groups that could not be controlled for in the matching process. We expand on this issue in the translation of findings.

Part 3 of this study examined the probability of marital breakup due to work accident and permanent impairment. The objective of this investigation was to determine whether there is an incremental probability of break up for individuals sustaining a permanent impairment from a work accident. The analysis was undertaken using both the Ontario and BC long-term disability claimant samples. Our findings indicate that workers who sustain a permanent impairment are significantly more likely to experience a marital break up, even after controlling of labor-market earnings post-accident. In Ontario, the risk of marital break up was slightly lower for permanently impaired men than for permanently impaired women, whereas the risk was similar for male and female claimants in British Columbia.

Translation of Findings

Findings from Part 1 of this study suggest that multiple contextual factors are important to consider in assessing loss of earnings capacity. No one measure consistently identified the loss of earnings capacity of individuals in a group. Factors such as level and nature of permanent impairment, age, gender, transferable skills, and labor-market conditions all likely bear on earnings capacity. A multi-facetted approach to earning capacity assessment is consistent with current concepts of disablement. It also suggests the need to consider each case individually.

The three workers' compensation programs for long-term disability reviewed in this study reflect the range of approaches considered in programs across Canada. The bifurcated program is somewhat of an amalgam of the two other programs, i.e., the impairment based and the loss of earnings capacity based programs. It offers the better of two possibilities by providing benefits based on whichever program offers the most generous benefits for a claimant. Hence, as might be expected, it has the most adequate and equitable benefits of the three programs based on percentage of control counterpart earnings replaced by benefits and labor market earnings post-accident. Workers' compensation authorities and insurers might consider adopting such a program in order to better ensure that benefits are adequate and equitable for all claimants.

Part 2 of this study found that short-term disability claimants have long-term earnings losses that increase with time. Further investigation is needed to better understand the reason for these losses. It may be due to loss of skills while off work recovering or stigma associated with being a claimant. There may also be a selection effect occurring where the claimant sample is somehow inherently different than their control counterparts. They may have had a higher rate of accidents subsequent to the one that was tracked due to being more accident prone. It may also be that the controls were in occupations where there is a higher risk of accident than their control counterparts. We were not able to track accident claims for the claimants or controls in the years following the claim being studied, nor did we have data on industry or occupation to include in the matching process.

Findings from the analyses in Part 3 of this study found that workers who sustain a permanent impairment are at risk of experiencing a marital break up. Given that rates of labor market re-entry following work accident are higher for individuals who have strong support networks and those who are married, these findings highlight the need for policy makers and workers' compensation authorities to address the impact of work accident on marital relationships via additional supports (e.g., incremental measures for economic assistance, family-centered counseling) that could help to modify marital strain.

Outcomes, Relevance and Impact

The key findings from Part 1 are as follows: 1) labor-market earnings post accident are very polarized even within age, gender, impairment, region and FEL strata-- few claimants recover earnings in the mid-range (25-75% of control counterpart earnings); 2) a comparison of three long-term disability programs suggests that a bifurcated program offers the most adequate and equitable benefits; and 3) a dual award program consisting of a future economic loss benefit and a impairment based award for pain suffering and loss of enjoyment of life is marginally more adequate and equitable than a single award program based on the degree of permanent impairment. The findings of this study are of interest to the Ontario and British Columbia workers' compensation boards, since these jurisdictions have struggled with identifying an approach to compensating long-term disability that is adequate and equitable for claimants, and can be provided at a reasonable cost for employers. These jurisdictions are not unique in their struggles. Although jurisdictions across North America differ in the determination of income benefits for long-term disability claimants, most share several common goals: 1) to provide fair, adequate and prompt payment of benefits; 2) to administer the program at low cost; and 3) to encourage early and safe return to work. Yet, in most jurisdictions, striving to achieve these goals has proven to be a difficult task at best, so many have experimented with different program designs. This study provides some insights that are invaluable to jurisdictions across North America and in other developed countries around the world that have similar workers' compensation programs.

The findings from Part 2—that short-term disability from a work accident can have long-term implications for labor-market earnings— brings to the fore, the need to better understand what factors might be driving this phenomenon. Two factors that might explain it are the erosion of skills and stigma associated with being a workers' compensation claimant. If this is the case, efforts may be made by workers' compensation authorities to reduce the erosion of skill sets and minimize stigma through educational programs. It might also be that the claimant sample is different than the control sample in characteristics that were not observed in our data set. For example, they may be more accident prone, or work in higher risk occupations and industries. Future research could investigate the phenomenon with data that included accident history, occupation and industry of claimants and controls.

Our finding from Part 3 of this report— that workers with a permanent impairment have an elevated risk of marital break up— has implications for future investigations into the broader social consequences of work accidents. In particular, it is evident that the influences of a work accident can extend into diverse settings including homes and communities. Such "indirect costs" are difficult to measure, though add substantially to the total burden created by occupational injuries and illnesses. Hence, it is important that resources be directed toward developing effective interventions and supports that can modify the impact of work accident on affected workers and their families. Such supports include improved claims management procedures coupled with worker advocacy mechanisms, community outreach programs, family-centered counseling, and vocational rehabilitation programs that take into account the person-in-context nature of work disability. Finding the right mix of supports for disabled workers and their families might also improve rates of labor-market re-entry and heighten long-term productivity of long-term disability claimants.

Scientific Report

Background

Overview

In this three part study we investigate labor-market earnings, benefits adequacy and equity, and the probability of marital break up of workers' compensation claimants. Part 1 of the study investigates the long-term labor-market earnings of claimants with permanent impairment and the wage replacement rates provided by two markedly different disability programs that existed in Ontario, Canada over the 1980s and 1990s. In Part 2 the labor-market earnings and benefits adequacy and equity of short-term disability claimants are investigated with a sample of claimants from Ontario. Part 3 is an investigation into the risk of marital breakup of claimants with permanent impairments from Ontario and British Columbia.

The study has been made possible by the linkage of data from the Ontario Workplace Safety & Insurance Board (WSIB) administrative files with a longitudinal database resident at Statistics Canada called the Longitudinal Administrative Databank (LAD). The database contains information on the earnings sources and amounts for a 20% sample of Canadian tax filers and their census families over a period of approximately 25 years, allowing for investigation of the labor-market earnings patterns and income sources and amounts for a large sample of individuals and their families. The database also contains information on other socio-demographic characteristics, allowing us to study other individual and family phenomena arising from work accident (specifically marital break up due to a work accident and permanent impairment).

Workers' compensation claim records for two cohorts of individuals sustaining permanent impairments (accident occurring between 1986-1989 and 1990-1994) were linked to the LAD, resulting in a 20% sample of individuals sustaining permanent impairments over the time period from 1986 to 1994 in the Ontario jurisdiction. This time frame spans two markedly different benefits programs and allowed for a comparison of the adequacy and equity of benefits provided by each of the programs, and the labor-market earnings patterns of individuals receiving benefits under each.

Workers' compensation claim records from another Canadian jurisdiction were also link to the LAD. Specifically, the sample frame consisted of all claimants sustaining a permanent impairment from work accidents occurring between 1990 and 1994 in the province of British Columbia (BC). The workers' compensation authority for this jurisdiction is WorkSafeBC. The long-term disability program in effect at that time was a bifurcated program. Two methods of wage-replacement benefits calculation were considered for all claimants—one based on loss-of-function (LOF)/permanent-impairment and another based on loss-of-earnings-capacity (LOE). A worker was eligible for whichever benefit was higher. Linking a claimant sample from this program to the LAD allowed us to compare the two distinct Ontario programs to yet another type of program offered in a Canadian jurisdiction.

Two sample frames of claimants with temporary workers' compensation claims were also linked to the LAD to investigate the long-term labor market consequences arising from short-term disability claims. The sample frames were from 1986 and 1992. Both cohorts sustained a work accident resulting in time off work, but no permanent impairment and received temporary total benefits determined using the same formula for wage replacement.

Both Canadian and U.S. jurisdictions have workers' compensation systems with similar design features. In the U.S., workers' compensation is provided at the state level by a mix of

private and public sector providers. In Canada, workers' compensation is administered at the provincial level, and each province has a monopoly, not-for-profit workers' compensation authority under legislation housed within the provincial ministry of labor. All workers' compensation wage-replacement benefits are non-taxable.

Although jurisdictions across North America differ in the determination of income benefits for long- and short-term disability, most share several common goals: 1) to provide fair, adequate and prompt payment of benefits; 2) to administer the program at low cost; and 3) to encourage early and safe return to work. Yet, in most jurisdictions, striving to achieve these goals has proven to be a difficult task at best, so many have experimented with different program designs.

The social and economic consequences of workplace illness and injury for workers and their families is one of the research priority areas under the National Occupational Research Agenda for NIOSH. Findings from the present study contribute to this priority area by providing a better understanding of the adequacy and equity of workers' compensation benefits provided by different programs for individuals sustaining short- and long-term disabilities.

Theoretical Approaches and Framework of the Present Study

There is an extensive theoretical literature on disablement that has important implications for the development of disability policy and the design of disability compensation programs. This literature is largely centered on two conceptual frameworks: those of Nagi, and the World Health Organization (WHO). Nagi's work from the 1960s is one of the first comprehensive conceptualizations of disablement (Nagi, 1965). In his framework, disablement is a series of four interrelated concepts that describe the impact of a health condition on a person's body, activities, and involvement in society (Nagi, 1965; Nagi, 1991). These four concepts are pathology, impairment, functional limitation, and disability. Disability can arise from a functional limitation or directly from an impairment. But not all impairments and functional limitations give rise to disability. A critical factor is the degree to which the social environment creates barriers to involvement for an individual with an impairment or functional limitation.

The WHO developed a conceptual framework for disablement comparable to, but independent of, the Nagi model (World Health Organization, 1980). This framework describes the consequences of disease as four interrelated concepts: disease, impairment, disability, and handicap.[1] The WHO model appears similar to that of Nagi's, with the disease (health condition) dimension comparable to Nagi's pathology, the term impairment (body) being used in both models for the second concept, the disability (activities) dimension comparable to functional limitations, and handicap (participation) to disability. Both frameworks are based on the notion that disability is not a characteristic of an individual, but a relational concept that derives from the interaction of an individual's abilities and other personal characteristics with a particular social environment.

The socio-medical concept of disability described above is difficult to operationalize, particularly for the purpose of assessing permanent partial work disability. Consequently, many U.S. jurisdictions have adhered or returned to medical-based systems of compensating permanent

[1] Through the 1990s the WHO continued to revise the ICIDH, modifying the terminology, definitions, relationships between concepts, and domains within the classification system (World Health Organization, 2001). The new terms for the four concepts are health condition, body function and structure, activities, and participation.

impairment (Dembe, 2000; Peterson et al., 1998).[2] In general, workers' compensation programs use one of four approaches to compensating permanent impairment: 1) a medical assessment of the degree of permanent impairment; 2) an estimate of loss of wage earnings capacity; 3) an estimate of actual wage loss; or 4) a hybrid of the former three (Peterson et al., 1998). Three types of hybrids are common: 1) one that uses a different system for different types of injuries; 2) one that pays both impairment benefits and benefits for loss of wage earnings capacity or actual wage loss; or 3) a system in which the same injury/illness can lead to either an impairment-based benefit or a benefit based on loss of wage earning capacity or actual wage loss.

Determining wage loss requires identifying the counterfactual, i.e. what an individual would have earned if s/he had not been injured. This is a latent variable that cannot be observed. Studies have taken different approaches to identifying this counterfactual situation, depending on the data available. Peterson et al. 1998 classify methods for calculating wage loss into two broad categories: 1) comparing post-accident earnings with pre-accident earnings, and 2) comparing post-accident earnings with the earnings of individuals who have not been injured. Many workers' compensation programs use the first approach to determine disability benefits. There are important limitations to this method. Most notably, it does not take into account the fact that earnings patterns change over the life cycle, generally increasing due to increased experience, but also in response to the macroeconomic environment (e.g., the business cycle and relative price changes). The second approach offers the possibility of accounting for some of the factors that have a bearing on earnings dynamics. At a statistical level, one can incorporate the relevant socio-demographic characteristics of an individual (e.g., age, education, gender and work experience) as well as contextual factors that bear on earnings (e.g., unemployment rates) into a model designed to predict labor-market earnings.[3] In this study we use both approaches to assessing earnings losses and replacement rates.

Relevant Scholarly Literature on Benefits Adequacy and Equity

There is a longstanding interest in better understanding the adequacy and equity of wage loss compensation for individuals sustaining permanent impairments due to work-related accidents. We review the key findings here and provide a summary table of key studies in Appendix I, Table 1.1.

It is well known that unemployment rates for individuals sustaining a permanent impairment from a work accident are quite high several years post-accident (Burkhauser and Daly, 2000; Butler et al., 1995; Johnson and Baldwin, 1993). In two reports, Weiler comments that determining the level of permanent partial disability is one of the most difficult undertakings of workers' compensation boards (Dee et al., 1987; Weiler, 1980; 1986). Johnson and Baldwin (1993) also note the difficulty in determining partial disability, claiming that most U.S. social programs only provide benefits for total disability as a result. The difficulty lies in the fact that earnings losses can be due to more than just the impairment per se. Factors such as the level of education, amount of work experience, financial resources and individual preferences, as well as local labor-market conditions and an employer's willingness to accommodate can all bear on labor-market re-entry and earnings success. Most current models of disablement aptly describe

[2] Impairment-based systems appear more objective because they rely on medical assessment in conjunction with a schedule or guide such as the AMA Guides to the Evaluation of Permanent Impairment (American Medical Association, 1993).

[3] The object of the modeling approach is to ensure that factors other than impairment that bear on labor-market earnings are not incorrectly attributed to the impairment.

disability as a relational phenomenon, determined by the characteristics of the individual, the health condition, and the physical and social context (Nagi, 1965; 1991; World Health Organization, 1980; 2001). Yet it is precisely the interrelated nature of the factors producing disability that makes it difficult for workers' compensation programs to distinguish earnings loss due to impairment from earnings loss due to labor-market conditions and/or individual preferences for work and leisure (Hyatt, 1996).

Even though work disability is one of the most costly and prevalent health issues in North America (Butler et al., 1995), few studies have investigated the labor-market re-entry and earnings success of individuals who have sustained a permanent impairment as a result of a work-related accident. Fewer still have reviewed the earnings losses due to permanent impairment and the adequacy and equity of wage-loss compensation provided by workers' compensation. The few that have are based on data from U.S. jurisdictions. The lack of Canadian studies on these issues is a reflection of the fact that the longitudinal data sources required to address them are not readily available.

A survey undertaken in 1988 by the WSIB spawned several Canadian studies (Butler et al., 1995; Cater, 2000; Cater and Smith, 1999; Hyatt, 1996; Johnson et al., 1995; Johnson and Baldwin, 1993).[4] These studies provided invaluable insight into the labor-market re-entry experience of permanently impaired individuals who received benefits from the Ontario program in existence prior to 1990. Issues investigated included factors affecting the duration of first absence from work and the duration of re-employment with the accident employer, as well as work disincentives created by permanent partial disability benefits (PPD benefits) and the labor-market re-entry success of permanently impaired individuals. An important finding of this body of work is that first return to work is not an accurate predictor of labor-market re-entry success; though 85% of workers in the sample returned to work, only 50% were employed several years later (Butler et al., 1995). These studies also confirm that characteristics other than the degree of impairment bear on labor-market participation and earnings post-accident. However, due to the nature of the data from the survey, no studies generated from it investigated earnings losses due to permanent impairment, or the adequacy and equity of benefits.

More recently a qualitative study on a sample of pre-1990 WSIB claimants was undertaken to review the claimants' experiences with the Ontario board and to evaluate their quality of life (Ballantyne, 2001). The study found that interviewed subjects experienced chronic employment instability throughout their post-accident years. Less than half of them had secure employment at the time of accident, defined as employment with a large and/or unionized firm. Furthermore, most study participants felt that their pension did not adequately replace the earnings they had lost.

Several studies of earnings loss, and benefit adequacy and equity have been undertaken with data from U.S. jurisdictions (Berkowitz and Burton, Jr., 1987; Biddle, 1998; Boden and Galizzi, 1999; Cheit, 1961; Ginnold, 1979; Johnson et al., 1979; Peterson et al., 1998). Only two of these, Boden and Galizzi (1999) and Biddle (1998), include all individuals who experienced time loss claims. The other studies focus exclusively on those with permanent-impairment claims. Both sets of studies find that many permanently impaired individuals suffer substantial long-term earnings losses, and the latter finds that the same is true for many individuals experiencing only a short-term disability. The studies of PPD claimants confirm that wage loss benefits provided by many programs are not equitable in terms of replacing the same percentage

[4] The survey was based on a sample of injured workers scheduled for an examination for permanent disability assessment by a physician at the WSIB's offices between June 1989 and June 1990.

of lost wages across rating categories.[5] Peterson et al. (1998) find that proportional earnings losses were very similar for individuals with impairment ratings from 1-20%, 4-5 years post-accident in a sample of PPD beneficiaries injured in the early 1990s in California (California had an impairment-based system of compensation at that time). Berkowitz and Burton (1987) also find considerable variability in wage-loss replacement rates across rating categories for California, Wisconsin, and Florida in data on PPD claimants injured in 1968 (at that time, California had a loss of earnings capacity system, Wisconsin an impairment-based system, and Florida a system that provided a choice between the two compensation methods). Similar variability in wage-replacement rates is found in studies by Ginnold (1979) and Johnson et al. (1979). Biddle (1998) goes so far as to state that estimated post-accident losses bear little relationship to the size of benefit awarded (Biddle, 1998, p. 47-48) for accident claims from 1993 and 1994 in Washington State.

Benefits adequacy is generally assessed with reference to some standard. In many U.S. jurisdictions, temporary disability benefits replace 2/3^{rds} of pre-tax, pre-accident earnings (with a maximum and minimum), so many studies use this proportion as the standard to assess the adequacy of long-term wage-replacement rates. Using this standard, replacement rates identified in most studies are inadequate. It is difficult to make direct comparisons between studies because of time period, jurisdiction, and methodological differences, but the range of results may provide some insights. Ginnold (1979) identified some of the lowest replacement rates, 1/3 or less over a period 1968-1976 for PPD claimants in Wisconsin. Rates identified by Peterson et al. (1998) were also quite low, 38-48.2% over a 4-5 year period for accidents occurring over the period 1991-1994 in California. At the high end, Berkowitz and Burton (1987) identified rates of 46% for California, 59% for Florida, and 75% for Wisconsin for cumulative wage losses over the period 1968-1975.

As noted, most studies have focused on the long-term earnings loss of PPD claimants, but two studies have found that individuals who have sustained a temporary disability can also experience long-term earnings loss. Even individuals with injuries in the least severe category (absences less than 15 days) experienced losses that persisted after three years in a sample of claims for accidents occurring between 1993 and 1994 in Washington State (Biddle, 1998). Boden and Galizzi (1999) find that individuals receiving temporary total benefits for 12 weeks or more (but not PPD benefits) experienced losses over a period of four years that were greater than or comparable to individuals receiving PPD benefits in a sample of lost-time injuries from accidents occurring between 1989 and 1990 in Wisconsin. These studies suggest that an exclusive focus on the earnings losses of PPD claimants provides, at best, a partial picture of long-term earnings losses due to work-related accidents.

This study fills a number of gaps in the literature described above. First, most studies have focused on a relatively short period of time to assess the labor-market earnings losses associated with a workplace accident and the adequacy and equity of workers' compensation benefits (generally in the range of 3 to 5 years), whereas the present study investigates these phenomena using information for 10 years post-accident. Second, the large sample size, and broad range of socio-demographic characteristics in the database used for this project allowed for an assessment of the earnings patterns and benefits adequacy and equity across different subpopulations, including gender, age bracket, and region of residence. Third, in matching claims to controls to assess labor-market earnings losses post-accident, we were able to account for a broad range of socio-demographic and economic characteristics of individuals.

[5] Providing higher wage replacement rates for higher ratings categories may also be viewed as equitable.

We address a number of questions that have not been investigated in the literature, such as: 1) do women experience greater loss of labor-market-earnings than men; 2) how does age affect labor-market earnings losses; and 3) are there regional differences in earnings losses? Fourth, in our investigation of long-term disability benefits, the sample includes individuals receiving benefits from two markedly different programs, allowing us to investigate the impact on the labor-market earnings patterns post-accident of an impairment-based program versus a loss-of-earnings capacity program. We also link data from a third program to the LAD database, allowing us to make comparisons of the two Ontario programs to third type of program in another province. We also investigate the long-term labor-market earnings of short-term disability claimants. Only two published study have been undertaken on this topic. Lastly, we investigated the impact of workplace accidents and permanent impairment on marital break up. This is an important issue that has not been investigated in the literature thoroughly, but is an important aspect of the social and economic consequences of workplace illness and injury.

Literature Related to Work Disability and Marital Break Up

A handful of studies have investigated the relationship between work disability and marital dissolution. A U.S. study found that workers who experienced a workplace injury were 25% more likely to divorce than the non-injured population (Dembe, 1999). Another study by Morse et al. (1998) investigated the economic and social consequences of work-related musculoskeletal disorders (WRMSDs) including its association with divorce. Using a random sample of working-aged individuals in Connecticut, the study compared workers who reported chronic upper extremity conditions with a control group. Findings showed that, compared to controls, WRMSD cases were almost twice as likely to report having been divorced (OR= 1.91), though the cross-sectional design of the study makes it difficult to determine a direct causal association between the two variables. The study also found that WRMSD cases were more likely than controls to report stress at home and that 13% of these workers reported no longer holding the status as main wage earner in the family following the onset of WRMSD, both factors that could contribute to the probability of divorce.

Qualitative research on the consequences of work accident appears to corroborate its adverse impact on marital stability. In a study of 40 permanently partially impaired workers receiving compensation benefits in Ontario, Ballantyne (2001) found that many workers experienced relationship break-ups and that some of these attributed the break up to the social disruption caused by the injury. A New Zealand study of seriously injured workers, their family members, employers and co-workers found several reports of separation, divorce, loss of physical intimacy and breakdown of the family unit (Adams et al., 2002).

Other research on work disability and marital stability has yielded more mixed results. Brown et al. (2007) used the British Columbia Linked Health Database (BCLHD) to compare the probability of marital break-up between a group of married workers injured in 1994 who lost time due to work accident (LT) and another group who did not (NLT) for the period 1995 to 1999. The analyses showed that LTs were slightly less likely than NLTs to experience marital break up following the injury. Additional stratified analysis of LTs showed that time-off work (specifically, 12+ weeks versus >12 weeks) was not associated with relationship break up. The authors note that although these findings appear to contradict much of the qualitative literature (e.g., Adams et al., 2002; Ballantyne, 2001) this may be due to the fact that these studies typically use a sample of more severely injured workers and that the indicators of severity commonly used for studying workplace injuries are limited particularly in administrative data such as that used in their study.

A study by Charles and Stephens (2004) compared the effects of earnings shocks on the probability of divorce under two circumstances, spousal job displacement and spousal disability. An "earnings shock" was defined as an unanticipated change in the earnings capacity of one spouse that has an impact on both the family's consumption of goods and leisure, as well as the gains conferred by marriage to each member of the union. Using a sample of married couples drawn from the US Panel Survey of Income Dynamics (1968-1993) the study found that the divorce hazard increases significantly following a spouse's job displacement, but that the hazard does not change following a spousal disability. Part of the reason for the null findings could be that the study used a "softer" self-report measure of disability, which may conflate serious disabilities with less serious ones.

Research on the economic consequences of work accidents suggests that injured workers are at risk of experiencing chronic unemployment significant long-term financial losses (Ballantyne, 2001; Dembe, 2001; MacEachen et al., 2007). In turn, studies on the marital consequences of job loss and unexpected changes in household income shows that economic factors significantly affect marital stability. A study by Weiss and Willis (1997) examined how unanticipated changes in the predicted earnings capacity of husbands and wives (deemed "surprises") affected the probability of divorce. They found that an unexpected increase in the husband's earning capacity lowers the divorce hazard whereas an unexpected increase in the wife's earning capacity raises the divorce hazard. Other factors affecting marital stability were also identified including the duration of marriage (increased hazard), the presence of children and the accumulation of property assets (decreased hazard).

Jensen and Smith (1999) used panel data for a sample of married couples in Denmark to examine the probability of marital dissolution due to unemployment for both spouses. They found that unemployment was an important factor in marital instability, though only unemployment of the husband had a significant effect on the probability of marital dissolution. Estimates showed that the divorce probability is more than twice as high for a couple where the husband has been unemployed for the entire year compared to a couple that has not experienced unemployment. Unemployment of the wife, on the other hand, had no impact on the probability of divorce. The study also found that neither unemployment in previous years (one and two years earlier) nor change in unemployment from the previous year to the current year affect divorce probability; hence the effect of unemployment on marital stability appears to be immediate and does not accumulate over time.

Several studies have documented the adverse consequences of work disability on domestic functioning and the activities of daily living, which could contribute to marital strain. A study of workers in Maryland found that upper-extremity cumulative trauma disorders interfere with sleep and the performance of household activities (Keogh et al., 2000). Forty percent of these workers reported problems performing several key activities of daily living (e.g., writing with a pen, lifting a child) more than two years after the initial workers' compensation claim filing. Morse et al. (1998) also found that workers with upper-extremity musculoskeletal disorders are more likely than non-injured workers to report difficulty performing activities of daily living such as writing, household chores, child care, bathing and driving a car.

Research on the psychological consequences of work disability also has implications for marital stability. Dawson (1994) found that injured workers who endure a prolonged claims adjudication process report a variety of adverse consequences for themselves and their families including emotional stress arising from feelings of depression and lowered self-esteem, the inability to participate in family activities, and diminished sex life (Dawson, 1994). Self-reported feelings of anxiety and depression have been found to be higher among individuals with work-

related repetitive strain injuries (Helliwell et al., 1992; Keogh et al., 2000). Workers who suffer back injuries commonly report feelings of depression, anger, and strain on family relationships due to chronic pain and other limitations arising from their injuries (Strong et al., 1994; Strunin and Boden, 2000). Furthermore, individuals with more serious work-related disabilities have shown higher rates of psychological problems, drug abuse and marital difficulties (Texas Workers' Compensation Research Center, 1995).

Overview of the Two Long-term Disability Programs Ontario

Workers' compensation in Ontario is administered by the WSIB, formerly known as the Workers' Compensation Board of Ontario (WCB). On January 1, 1990, a major change in the determination of income replacement amounts for individuals with permanent impairments was instituted with the implementation of Bill 162 by the then WCB. The new program introduced a dual award program that provided for a future economic loss (FEL) benefit as well as a non-economic loss (NEL) award. Individuals received FELs if they sustain a temporary total impairment lasting 12 months or longer, or sustain a permanent impairment as a result of a work related injury or illness, and are deemed unable to earn an income that was at least 90% of their pre-accident earnings (the FEL program was replaced with LOE benefits program starting on Jan 1, 1998 which is similar to the FEL program with minor modifications). The FEL benefit was based on a formula that took into consideration both pre-accident earnings and post-accident earnings potential and was given as a periodic payment for as long as a worker was eligible or until age 65. The FEL awards were reviewed at three years and six years post-accident to re-evaluate the appropriateness of the current loss-of-earnings-capacity benefit. The determination of the FEL benefit was as follows:

[pre-accident after-tax earnings - post-accident after-tax earnings capacity] x 90%.[6]

After the second review, benefits were received until age 65. Supplemental benefits were also provided for limited periods of time for vocational or medical rehabilitation. Additionally, older workers could qualify for an old age supplement. NELs were received as compensation for pain and suffering and loss of quality of life by individuals sustaining permanent impairments as a result of work related injuries and illnesses. The amount awarded was based on a formula that took into consideration the percentage of impairment (using the American Medical Association guide) and the age of the recipient and was usually awarded as a lump sum payment. The determination of the NEL benefit was as follows:

age 45 or under: [base amount + (45-age) x age adjustment factor] x percentage of impairment;

over age 45: [base amount - (age-45) x age adjustment factor] x percentage of impairment.

In 1990 the base amount was $45,000 and the age adjustment factor was $1,000.

Prior to 1990, a single payment program was in effect, called the Permanent Disability (PD) program. Under this program, the amount of income replacement was based on a formula that considered the percentage of permanent impairment (using a ratings guide similar to the American Medical Association Guide) and pre-accident earnings. The determination of the PD benefit was as follows:

[6] Insurable earnings are subject to a maximum and minimum.

pre-accident after-tax earnings x 90% x percentage impairment.[7]

Benefits were received for life. Supplemental benefits were also provided for limited periods of time for reoccurrences and medical treatment. In addition, older workers could qualify for an old age supplement.

The pre-1990 and post-1990 systems were markedly different. The older system did not take into account the nature of the work undertaken nor the income received by claimants post accident. Rather, all individuals were subject to the same impairment ratings schedule in determining the degree of impairment, and hence the percent of income replacement benefits received, whether they were able to continue in the same line of work or not. The newer system attempted to consider this factor through the assessment of post-accident earnings capacity (the assumption being that this capacity is based on the skills acquired by the individual prior to the accident, in conjunction with remaining functional ability and retraining potential post-accident).

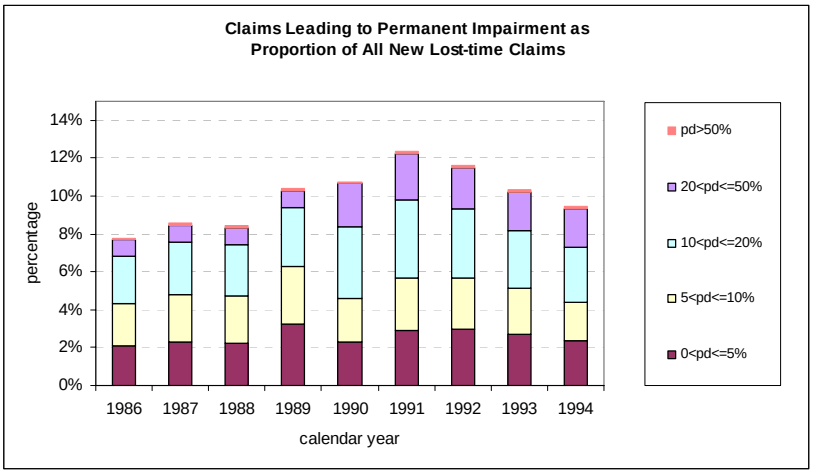
The level of permanent impairment could potentially have been affected by the program change, because different schedules were used by the two programs. This is a concern with regards to the comparability of the two programs, since the same level of impairment may not indicate the same level of anatomical deficit across programs. Also of concern are possible changes in the industrial mix of the economy. This latter issue is a concern if it bears on the potential for labor-market re-entry and earnings post-accident.[8]

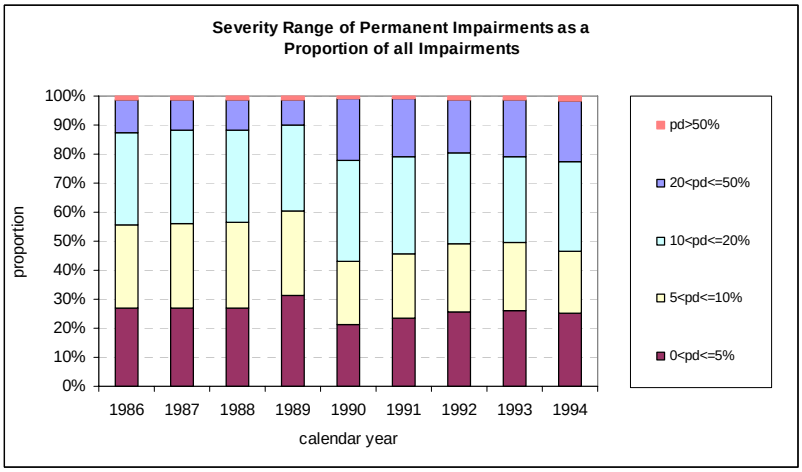
The program change issue was addressed by a report commissioned by the Ontario Workers' Compensation Board during the period of transition. It was found that switching from the Ontario Impairment Schedule (the schedule used in the pre-1990 program time period) to the AMA Guides to the Evaluation of Permanent Impairment (the schedule used in the post-1990 program) would result in annual costs being six percent higher, based on the awards granted for 1980 through 1986 claims (Workers' Compensation Board of Ontario, 1990). The difference was due to a pattern of somewhat higher ratings for less serious but more common impairments, and lower ratings for more serious but less common impairments by the AMA Guides.

To further address the issue of comparability of the two ratings schedules, we reviewed the probability of a workers' compensation claim becoming a permanent impairment claim and the severity distribution of permanent impairments over the nine-year time period of the study. We found that both the probability and severity were comparable over the time period of interest, though there are some differences. These might be due to the schedule change or other factors. Following are two charts that depict these details:

[7] Insurable earnings are subject to a maximum and minimum.

[8] We plan to a matching approach in our analysis, discussed in the methods section of this report.





As is apparent, the probability of a claim becoming a permanent impairment ranged from approximately 8% to 12%, with a peak in 1991. There is a well established cyclical pattern of claims, which might also explain this modest variation. Severity has also varied to some degree over this time period. The category with the largest range is the 20-50% groups. It varies from 8.7% to 21.2% of all impairments.

Overview of the Short-term Disability Benefits Programs in Ontario

Short-term disability benefits in Ontario were received at the beginning of all time-loss claims. Claimants whose accident eventually gave rise to a permanent impairment would transition to long-term disability benefits. For those claimants who returned to the same level of health state as prior to the work accident, benefits were received until return to work or recovery. The determination of short-term disability benefits was as follows:[9]

pre-accident after-tax earnings x 90%

In the two samples of short-term disability claimants used in this study, we include only those claimants who did not sustain a permanent impairment from their work accident.

Overview of the Long-term Disability Program in British Columbia

Prior to July 2002, WorkSafeBC had a bifurcated wage-replacement policy for compensating long-term disability arising from work-related accidents. Two methods of wage-replacement benefits calculation were considered for all claimants—one based on LOF/permanent-impairment and another based on LOE. A worker was eligible for whichever benefit was higher. Following was the determination of wage-replacement benefits: [9]

LOF benefit = pre-accident before-tax earnings x 75% x percentage impairment

or

LOE benefit = [pre-accident before-tax earnings - post-accident before-tax earnings capacity] x 75%

Approximately 85% of claimants received an LOF award and 15% an LOE benefit.

Specific Aims of this Study

The principal goal of this study was to investigate and compare the adequacy and equity of different forms of wage-replacement benefit determination for long-term disability claimants. A second goal was to investigate the labor-market outcome of these claimants. A third objective was to investigate non-economic/social consequences, specifically marital stress and the probability of marital break up associated with permanent impairment from a work accident.

The project has three components. Part 1 focuses on two cohorts of individuals sustaining permanent impairments arising from work accidents—one receiving benefits from an impairment-based benefits program and the other from a loss-of-earnings-capacity-based benefits program. There are two objectives of this research agenda: 1) to better understand the adequacy and equity of two markedly different wage-loss compensation programs for individuals sustaining permanent impairments; and 2) to determine whether there are significant differences in labor-market re-entry and earnings post-accident between individuals receiving benefits from one of the two programs. As noted, we have also added a third program to this analysis.

Part 2 focuses on individuals experiencing a temporary work disability arising from a work-related accident and investigates the long-term labor-market earnings of these individuals. The objective of this research agenda is to determine if there are long-term earnings losses for individuals experiencing only a temporary work disability.

Part 3 investigates the probability of marital break up due to a work accident and permanent impairment. This analysis is undertaken with both the Ontario and BC long-term disability claimant samples. The objective is to determine whether claimants have a higher probability of marital break up compared to the general population, after controlling for the earnings consequences of work injury.

Methodology

Principal Data Source

The Longitudinal Administrative Databank (LAD) is the principal data source for this research project. The LAD is a sample of the T1 Family File (T1FF). Both the LAD and T1FF are

[9] Insurable earnings are subject to a maximum and minimum.

maintained by Statistics Canada. The T1FF is a yearly cross-sectional database of all Canadian tax filers and their census families. The data is culled from information available from personal income tax returns provided annually to the Canada Customs and Revenue Agency. Both the T1FF and the LAD have been created for every year from 1982 to 1999, and new years are added as the data become available. The T1FF has become increasingly representative of the Canadian population with the introduction of tax credits in the late 1980s that encouraged low-income individuals to file tax returns. The T1FF contains over 85% of Canadians 18 years of age and older in the early years of the database and over 94% in the most recent years.

The LAD is a 20% simple random sample of the T1FF. Individuals are selected into the LAD via their Social Insurance Number (SIN). Once selected, individual are included every subsequent year, if present in the tax files, along with their census family. There is no age restriction for selection into the LAD, but individuals must have a SIN. Individuals without a SIN can only be present in the family component of the file. Each year the LAD file is supplemented with 20% of new tax filers in order to keep the file representative of the tax filing population, both cross-sectionally and longitudinally. Longitudinal profiles of individuals and their census families are created by linking the yearly LAD files via an individual identifier.

The LAD files have four categories of variables: individual, spouse, family, and children. The files contain information on income sources and amounts, taxation data, and socio-demographic information for each category of variables. Changes in tax legislation over the years have resulted in some variables not being available for all years and have caused other variables to vary slightly in definitions in some years, whereas labor-market earnings sources and amounts and key socio-demographic variables are available in all years.

Sample Frames and Sample Identification

The first two long-term disability sample frames used in this study consist of all individuals with workers' compensation accident claims occurring in Ontario in the time period from January 1, 1986 to December 31, 1994 that resulted in permanent impairments. In the first four years of this period the PD (impairment-based benefits) program was in place, whereas in the subsequent five years the FEL/NEL program was in place. The third long-term disability sample frame consists of all individuals with workers' compensation accident claims occurring in BC in the time period from January 1, 1990 to December 31, 1994 that resulted in permanent impairments. During this time period, the bifurcated program was in place in BC.

Two short-term disability sample frames from Ontario were also used. They consist of all individuals with short-term disability accident claims in 1986 and 1992 that did not result in a permanent impairment.

Information on the date of accident, benefits received, percentage of permanent impairment, other claims information, and a personal identifier (the individual's SIN) was extracted from workers' compensation administrative records for all samples. This information was then linked with the LAD via the personal identifier, which was also available on the LAD. Information on labor-market earnings and socio-demographic characteristics was taken from the LAD.

Figure 2.1 in Appendix II provides a representation of the sample frames and time periods. These frames allow us to observe income information for each claimant identified in the LAD for four or more years prior to, and at least 10 years after the accident year. The final sample drawn from each sample frame would ideally consist of 20% of the sample frame since the LAD is a simple random sample of all tax filers.

Prior to its execution, the linkage was reviewed and approved by several individuals and

organizations. The release of data from the WSIB was reviewed by the WSIB Information and Privacy Coordinator. The release of data from WorkSafeBC was reviewed by the WorkSafeBC Privacy Office. Linkage of claims data from Ontario and BC to the LAD was approved by the Policy Committee of Statistics Canada. The Policy Committee is the senior executive group in the agency, composed of the Chief Statistician and his Assistant Deputy Ministers. The Policy Committee reviews non-consenting linkages of personal information to examine the balance between privacy intrusion and benefit to the public good, with an additional criteria requiring that the research cannot be accomplished by any other means. Application for ethics review was submitted to, and approved by, the Health Sciences Review Committee of the University of Toronto's Office of Research Services. We also discussed the proposal with the Office of the Ontario Privacy Commissioner, which provided useful guidance on privacy protection protocols.

We obtained letters of support for the study from injured workers' representatives and from a senior policymaker at the WSIB. Similar letters of support were received from BC. In an effort to minimize the potential harm to recipients of workers' compensation benefits from the study findings, we had requested a letter from the WSIB that assured us that no retroactive reduction in benefits would be instituted as a result of the study findings. The WSIB has confirmed in writing that there will be no detrimental change to current beneficiaries.

The data linkage took place in the secure environment of Statistics Canada and all micro level data is resident at Statistics Canada and is stored on a stand-alone UNIX box. Only a few Statistics Canada employees have direct access to the LAD. Programs were submitted by remote access to be run on the LAD. Statistics Canada has a policy to release only aggregate level data from the LAD after a number of confidentiality requirements on the aggregate data are met.

Matching Claimants with Uninjured Control Counterparts

For the primary set of analyses on labor-market earnings success post-accident and benefits adequacy and equity, we selected up to ten controls for each event observation based on pre-accident labor-market earnings, gender, age, and pre-accident self-employment earnings. The essential criterion for candidate controls was that they were living in the same province in the accident year of the candidate claimant match, that they had wage and salary earnings in the accident year, and that they were present in the database in at least one of the four years prior to the accident year of the candidate claimant match. The selection of controls for each claimant observation was based on two sets of characteristics. One set required an exact match of characteristics between the claimant and control and the other required a match within some acceptable range. The exact match characteristics were province of residence, gender, and having substantial self-employment earnings in any of the four years prior to accident.[10] The non-exact match characteristics were the propensity score (+/- 25% of standard deviation of logit of the propensity score), [11] age (+/- two years of the event), presence patterns in the database in each of the four years prior to accident (both "present" = "present" and "not present" = "not present" were considered a match), and wage and salary earnings in each of those four years (wages and salaries within +/- 20% of event wage and salary level were considered acceptable). For candidate controls meeting the exact match criteria and having fulfilled the propensity score

[10] Substantial self-employment earnings was defined as an absolute value of unincorporated self-employment income in any one year greater than average yearly wages and salaries in the four years prior to injury.

[11] Propensity scores were calculated based on a logit regression model of the probability of being a claimant based on explanatory variables derived from age, gender, individual labor-market earnings, total family income, region of residence, substantial self-employment income, presence patterns, and year of injury.

criteria, the following formula was used to calculate the weighted distance (closeness of the match) between an event and a candidate control:

$$D_{ec} = w_1|age_e - age_c| + {}_{t=1}\sum^{t=4} w_2(dummy_{ect}) + {}_{t=1}\sum^{t=4} w_3|log(earnings_{et}) - log(earnings_{ct})|;$$

where D_{ec} is the total distance between the event (e) and candidate control (c), w_1 is the weight given the age difference, w_2 is the weight given the matching of years, $dummy_{ect}$ is 0 if the presence pattern matches in year t and 1 otherwise, w_3 is the weight given earnings differences between claimants and controls, and $earnings_{et}$ and $earnings_{ct}$ are event and candidate control earnings in year t.[12] The selection of controls was randomized and undertaken without replacement in order to simplify the weighting of observations for statistical purposes. Final selection of controls was based on the smallest total distance between a claimant and control using the above noted matching characteristics and a weight that was assigned to each characteristic. A maximum of ten controls were selected for each claimant observation.

The matching approach used for the marital break up study was similar to the one described above. The exact match characteristics were province of residence, gender, being married in the year prior to the accident year, and having children under 18 years of age prior to the accident. The non-exact match characteristics were the propensity score (+/- 25% of standard deviation of logit of the propensity score), age (+/- two years of the event), presence patterns in the database in each of the four years prior to accident (both "present" = "present" and "not present" = "not present" were considered a match), wage and salary earnings in each of those four years (wages and salaries within +/- 20% of event wage and salary level were considered acceptable), and the ratio of own labor-market income to total family income over the four years prior to accident.

Analysis of Claimant and Control Labor-market Earnings

Claimant and control earnings were aggregated by age bracket and impairment brackets to compare the relative earnings of the two groups within and across strata. In aggregating control earnings for a particular claimant observation, a weight of one over the number of controls present in that year for the claimant observation was given to each control. Claimant and averaged control counterpart earnings for a particular year were then averaged within each strata, with claimant and averaged control counterpart earnings included only if the claimant observation was present in that year. The following are details on the calculation of strata averages (we use a lower case "e" to represent claimants/events and a lower case "c" for controls):

$$S_{iet} = ({}_{e=1}\sum^{e=N} earnings_{et})/N;$$
$$S_{ict} = ({}_{e=1}\sum^{e=N} ({}_{c=1}\sum^{c=n} earnings_{ct})/n);$$

where S_{iet} and S_{ict} are the strata average earnings for claimants and controls respectively, N is the number of claimants in a strata present in a particular year t, n is the number of controls associated with a particular claimant that are present in year t, and $earnings_{et}$ and $earnings_{ct}$ are the earnings of claimants and controls, respectively.

The proportion of claimant to control earnings in a particular calendar year was then

[12] The largest weight was placed on the earnings difference, and the maximum allowable difference was 20%. The specific values used for the weights are as follows: w_1=1, w_2=5, and w_3=50.

calculated as follows:

$$prop_t = S_{iet} / S_{ict}$$

To test the LAD control matching fit for the Ontario long-term disability samples, we compared the labor-market earnings of the claimant group (by impairment bracket and age group) with their control counterparts in the four years prior to the matching period, i.e., from the fourth to eighth year prior to the accident.

Analysis of the Distribution of Labor-market Earnings of Claimants

Strata average labor-market earnings post-accident for claimants may mask a high degree of variability in earnings recovery that exists within each stratum. To investigate the distribution of earnings within each impairment bracket we calculated the proportion of claimants within each bracket that had labor-market earnings in four quartiles, relative to controls: 1) less than 25% of control earnings, 2) between 25-50% of control earnings, 3) 50-75% of control earnings, and 4) greater than 75% of control earnings.

Determination of Labor-market Earnings Loss

Two approaches were used to calculate labor-market earnings loss. The first is a comparison of the pre- and post-accident earnings of impaired individuals. This is the basis by which most workers' compensation programs assess earnings loss. The second approach is a comparison of post-accident earnings of claimants with the earnings of controls. This is not the basis of comparison for current policy, but is a policy option that is evaluated in many studies on the subject. This approach accounts for career earning trajectories of individuals over their time in the labor force. Chart 3.1 in Appendix III provides a representation of these two approaches to assessing earnings loss. For both analytic approaches, actual and potential labor-market earnings were averaged across impairment brackets, and the proportion of post-accident earnings recovery was then calculated as the fraction of actual versus potential earnings. Conversely, the proportion of earnings loss is one minus the proportion of earnings recovery. In calculating average labor-market earnings within impairment brackets, two treatments of missing years were considered based on Peterson et al. (1998), but little difference was found between them. One approach is to treat missing years as zero earnings and the other is to not include missing years in the calculation of earnings. We use the latter approach in this study.

Determination of Replacement Rates

The replacement rates provided by workers' compensation benefits can also be conceptualized in two ways. One approach is to calculate replacement rates based on the proportion of earnings loss replaced by benefits (with earnings loss based on pre-accident or control counterpart earnings). With this calculation the numerator is the amount of workers' compensation benefits received, and the denominator is the amount of earnings loss. This is the method commonly used in many research studies on the subject of benefits adequacy and equity.

A second approach to calculating replacement rates is to identify the proportion of uninjured earnings capacity (determined by pre-accident or control counterpart earnings) replaced by own earnings plus benefits. With this approach, the numerator consists of workers' compensation benefits received plus post-accident labor-market earnings. The denominator is the uninjured earnings capacity. In calculating sample average replacement rates for a particular group, the first approach gives equal weight to small and large losses. Thus small,

uncompensated losses experienced by individuals with modest losses can substantially reduce average loss replacement rates of a sample. For example, consider a claimant with an uninjured earnings capacity of $50,000 who earns 90% of this capacity post accident ($45,000). If this person receives 5% of earnings capacity in the form of workers' compensation benefits ($2,500), the loss replacement rate would be 50%. Details are as follows:

lost earnings = uninjured earnings capacity – post-accident earnings
= $50,000 - $45,000
= $5,000
loss replacement rate = workers' compensation benefits / lost earnings
= $2,500 / $5,000
= 50%

The latter approach gives less weight to small uncompensated losses in sample averages, by focusing on replacement of uninjured earnings capacity with post-accident actual earnings plus workers' compensation benefits.[13] Using the same example with the latter method, the earnings replacement rate is 95%. Details are as follows:

earnings replacement rate = (post-accident earnings + workers' compensation benefits) / uninjured earnings capacity
= ($45,000 + $2,500) / $50,000
= 95%

Details of these two approaches are presented in Appendix III Chart 3.2. Estimating individual-level replacement rates and then averaging individual-level rates for the entire sample may give rise to unusually high or low average rates due to some extreme values at the individual level. One way to address the issue of extreme replacement rate values at the individual level is to estimate average earnings, average workers' compensation benefits, and average losses first, and then calculate replacement rates using these averages. This approach smoothes out extreme values by calculating replacement rates with average values for earnings and workers' compensation benefits. It is the approach taken in some studies (e.g., Reville et al., 2001b). We present both individual-level and aggregate-level averages replacement rates in our analyses. Estimation of individual-level replacement rates also allows for the calculation of a confidence interval for average replacement rates. We estimated 95% confidence intervals for average, individual-level replacement rates using a bootstrap approach.

To evaluate the earnings loss, earnings replacement and relative benefits adequacy of each of the workers' compensation benefits programs, we compared the replacement rates provided by each program based on discounted benefits and earnings over a 10 year period post-accident. We used a discount rate of 3%. As noted, we considered both pre-accident earnings and control counterpart earnings as a basis for comparison. The four formulations of replacement rates considered are as follows:

Loss Replacement based on pre-accident earnings = $\{_{t=0}\sum^{t=9} benefits_{et} / 1.03^t\} / \{_{t=0}\sum^{t=9} [(pre\text{-}accident\ earnings_e – earnings_{et}) / 1.03^t]\}$;

[13] The latter approach is also a lower bar for acceptable compensation of losses in that the implicit level of acceptable uncompensated losses are higher with this approach than with the alternative one.

Loss Replacement based on control earnings = $\{_{t=0}\sum^{t=9} benefits_{et} / 1.03^t\} / \{_{t=0}\sum^{t=9} [((_{c=1}\sum^{c=n} earnings_{ct})/ n) - earnings_{et}) / 1.03^t]\}$;

Earnings Replacement based on pre-accident earnings = $\{_{t=0}\sum^{t=9} (earnings_{et} + benefits_{et}) / 1.03^t\} / \{_{t=0}\sum^{t=9} pre\text{-}accident\ earnings_e / 1.03^t\}$;

Earnings Replacement based on control earnings = $\{_{t=0}\sum^{t=9} (earnings_{et} + benefits_{et}) / 1.03^t\} / \{_{t=0}\sum^{t=9} [(_{c=1}\sum^{c=n} earnings_{ct}) / n] / 1.03^t\}$;

Adequacy and Equity Analysis

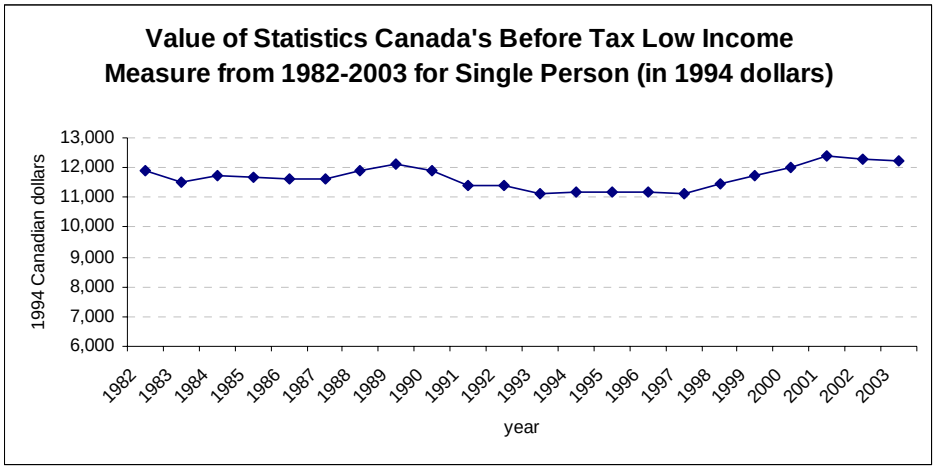
To evaluate the adequacy and equity of the workers' compensation benefits programs, we used the temporary total wage replacement rate targets of the Ontario program as a measure of adequacy (it was 90% for the time period from 1986 through to 1994), and the relative replacement rates across different strata as a measure of distributional equity (i.e., similar wage replacement rates across strata, or a replacement rate of at least 90% in each stratum). We stratified the sample by gender, age bracket, impairment bracket and region, calculating each type of replacement rate for each stratum.

Low Income Analysis

Another measure we used to evaluate the adequacy of labor-market earnings post-accident is the proportion of claimants and controls whose labor-market earnings are below Statistics Canada's Low Income Measure (LIM) for a single person. The LIM is defined as 50% of median income. The LIM is adjusted for composition and size of the family using an equivalence scale in which the first individual is assigned a weight of one, subsequent individuals are assigned a weight of 0.4 if they are aged 16 or over, and 0.3 if they are younger than 16. No adjustments are made for community size and region of residence.

The LIM is meant to be used as a relative measure. LIM values have changed over time with the business cycle and on average have increased over time with the growth of income of the Canadian population. The graph below presents the LIM values for the period of 1982 through 2003, which is the time period over which we consider the earnings of claimants and controls in our sample.

Statistics Canada's Low Income Measure for a Single Person



We consider LIM values for a single individual and determine whether the before-tax labor-market earnings of claimants and controls in each program were above or below the LIM.

Analysis of Marital Break Up

We used two of the three long-term disability samples to model the time from accident year to year of marital break up (specifically the post-1990 Ontario and BC samples). The objective was to assess whether permanent impairment from a workplace accident results in an incremental probability of marital break up, after controlling for a number of individual, family and contextual variables. For this modeling we used the complementary log log (c-log-log) function for continuous time processes (Allison, 1995; Kiefer, 1990; Meyer, 1990). The c-log-log approach treats the within-period (in this case calendar year) hazard as constant (exponential) with an across- period baseline that takes the form of a step function with no pre-defined shape (Cox, 1972). Covariates are integrated into the functional form using the proportional hazard approach. This duration model specification works well with interval censored data in which events unfold in continuous time, but for which information about event occurrence is limited to discrete-time intervals (Hosmer and Lemeshow, 2000; Singer and Willett, 2003). It is well suited to the yearly information available in the LAD.

The c-log-log approach allows for both time vary and constant explanatory variables. Since each married claimant and control was followed from the first year post-accident till marital break up or the end of the observation period (in which case the years till break up was censored), each year post-accident that an individual remained married provided a new observation for the model. The outcome variable indicated whether the individual separated from his/her spouse in a particular calendar year.

Explanatory variables used in the analysis were as follows: a dummy variable indicating whether the individual was impaired from a workplace accident (i.e., whether the individual was a claimant or control), age, age squared, age difference between the individual and his/her spouse (specifically, male-age less female age), number of children under 16, family income from all sources, change in earner status from prior to the accident (there were three possibilities— move to principle income earner, move to dependent, and no change in status), years married (including up to eight years of marriage prior to accident), a dummy variable indicating rural residence, and dummy variables indicating the calendar year. All explanatory variables were based on information from the year prior to the outcome variable.

Models were run in SAS version 9.1 using PROC GENMOD. Correlation of errors for within person-year observations over time was controlled for by specifying an autoregressive error structure. This autoregressive structure corrects for correlation across observation years from a person's time in marriage.

Results

Part 1: Comparison of Three Long-term Disability Programs

Match Quality

The event-control matching was very successful; it resulted in a match of 5 to 10 controls for 97% of the Ontario long-term disability samples (see Figure 4.1 and Table 4.2 in Appendix IV for details) and 90% for the BC long-term disability sample (see Figure 4.3 and Table 4.4 in Appendix IV for details). Approximately 80% of the controls were selected based on comparisons with the event observations of 3 or 4 years of prior earnings for the Ontario samples (79% for the BC sample), with the remaining 20% selected based on comparisons of 2 years or 1 year (this is due to intermittent tax filing of some event and control observations). Having similar pre-accident labor-market earnings in the 4 years prior to accident was the key criterion for selecting controls. Most controls had earnings within 10% of their event counterparts (approximately 71% of the controls for the Ontario samples and 61% for the BC sample) and the remainder had earnings within 10-20% of their event counterparts.

For all age groups and impairment brackets the fit appears to be quite good, with some exceptions for the 51-100% impairment bracket for some age groups. This is likely due to small sample sizes of this stratum within each age group, which ranged from 10 to 50 observations in the four years prior to the matching period. Graphs 5.1 and 5.2 in Appendix V present data on the claimant-control fit in the four years prior to matching for the age group 35 years or less by impairment bracket and program. A similar fit test was undertaken for the BC long-term disability sample. Graph 5.3 in Appendix V presents data for the entire BC claimant sample.

The final samples, after observations with missing data were eliminated, is approximately 18% of the original sample frames. This is a very good success rate given that 20% is the expected sample size under optimal conditions.

Descriptives

The linked long-term disability samples identified in the LAD are as follows: approximately 13,500 claimants for the pre-1990 (PD) Ontario program, 15,500 for the post-1990 (FEL/NEL) Ontario program, and 3,300 for the post-1990 (bifurcated) BC program. Table 6.1 in Appendix VI presents the distribution of the claimants within the three programs by gender, age bracket, and impairment bracket.

The distribution of claimants in the Ontario and BC jurisdictions are somewhat different, likely due to differences in their industrial bases. BC has a higher proportion of resource based industries compared to Ontario, which has more manufacturing and services. The samples from the two Ontario programs have a higher proportion of female claimants and a higher proportion of impairments in the mid-range (i.e., 5-10%, 10-20% and 20-50%). Because of the difference in the distribution of severity of impairments, it is more meaningful to consider outcomes within impairment brackets when comparing programs across the two jurisdictions.

Labor-Market Earnings Recovery

A comparison of claimant to control earnings, stratified by impairment bracket, is presented in Graphs 7.1 to 7.3 in Appendix VII for each of the three programs. The graphs present data on a yearly basis for four years pre- accident, the accident year, and nine years post-accident. Though accident years vary for claimants within each program, they have been lined up for presentation and analysis purposes. The y-axis presents the proportion of control earnings that claimants in each impairment bracket earn, on average, for each of the years. The basis for this comparison is pre-tax labor-market earnings. For the four years prior to the accident year, earnings of claimants and controls were matched to be equal. Hence, each impairment bracket earns approximately 100% of control earnings in these years.

As is apparent in all three graphs, claimants in each impairment bracket experience lower levels of labor-market earnings post-accident relative to their control counterparts. Furthermore, the ranking of the proportion of earnings losses is consistent with severity of the impairment bracket, i.e., higher impairment brackets experience greater earnings losses. What is also noteworthy is that the proportion of earnings loss is greater than the impairment level. Claimants in the 0-5% impairment bracket experience an earnings loss substantially greater than 5%. For this group it is approximately 20%. Claimants in the 5-10% bracket experience losses in the 30-40% range. The 10-20% bracket experience losses in the 40-60% range. For the 20-50% bracket, it is 40 to 70%. In the highest impairment bracket, i.e., those with impairments greater than 50%, the average earnings loss is approximately 80%. These findings suggest that, on average, impairment ratings consistently underestimate earnings losses.

Claimants in the 0-5% impairment bracket in all three programs appear to fare equally well in the labor market. Earnings recovery is also similar for the highest impairment bracket, that of >50%. Those in the mid-range impairment brackets — 5-10%, 10-20% and 20-50% — appear to do better in the bifurcated program than in the two Ontario programs. In particular, their earnings recovery increases over time at a greater pace than claimants in the same bracket within the Ontario programs.

Distribution of Labor-market Earnings

The labor-market earnings recovery rates presented above are impairment bracket means. These values mask a high degree of variability in earnings recovery that exists within each bracket. Graphs 8.1-8.11 in Appendix VIII provide insight into this variability. The graphs depict the proportion of claimants within an impairment bracket that have labor-market earnings in four quartiles, relative to controls: 1) less than 25% of control earnings, 2) between 25-50% of control earnings, 3) 50-75% of control earnings, and 4) greater than 75% of control earnings. These proportions are read on the left-hand y-axis. Also depicted in the graph are the average labor-market earnings of the controls in each year. These values are read on the right hand y-axis.

Graphs 8.1-8.3 are for the 0-5% bracket for each of the three programs. Within this bracket, approximately a quarter of the sample recover less than 25% of their control counterpart earnings, and approximately half recover more than 75%. Interestingly, only a small proportion of the sample is in the middle ranges, i.e., recovering between 25-75% of their control earnings. This is surprising, particularly for such a modest impairment level. It suggests that earnings recovery is generally either substantial or inconsequential. Few have mid-range recovery. It might be that claimants are either able to fully engage in the labor force and recover a substantial amount of pre-accident earnings, or they end up being only modestly engaged and recover only a modest amount. Experiences are polarized, with the middle ground being experienced by few.

Comparing the three programs based on the size of the proportions in the lowest and highest quartile of earnings recovery, it appears that injured workers in the bifurcated program fare better than those in the dual award program, and in turn, those in the dual award program fare better than those in the single award program.

Graphs 8.4-8.6 present the quartile distribution for the 10-20% impairment bracket. Here too we see a similar polarization of experiences. A larger fraction of the claimants is in the lowest quartile compared to the 0-5% bracket, and a smaller fraction in the highest one. Once again, it appears that the bifurcated program has the most favorable earnings recovery for this group, the dual award program the next, and the single award program the least favorable.

Graphs 8.7-8.9 present the quartile distribution of earnings recovery for the highest impairment bracket, those with impairments greater than 50%. As might be expected, a substantial fraction of the claimants in this bracket recover less than 25% of their control counterpart earnings. For all three programs this fraction is approximately 80%. In contrast, only between 7-18% recover more than 75%. Similarly, only a very small proportion of claimants are in the middle quartiles.

Graphs 8.10-8.13 present the quartile distribution of earnings recovery for four FEL ranges. Recall that these ratings are meant to reflect the expected earnings loss percentage. For the stratum with 0% or no rating, 22- 29% recover less than 25% of their control counterpart earnings. More than half (a range of 52-61%) recover more than 75% in the years post-accident. For the 5% FEL stratum, the proportion in the lowest quartile of earnings recovery is substantially larger (a range of 43-70%) and the proportion in the highest quartile substantially smaller (9-37%). As with the impairment strata, with higher FEL strata the proportion of claimants in the lowest quartile of earnings recovery increases and the proportion in the highest quartile decreases.

Low Income Analysis

Graphs 9.1-9.3 in Appendix IX present the difference between the proportions of claimants and controls whose before-tax labor-market earnings are below the LIM value in each year. One would expect the two proportions to be similar in the years pre-accident, since the matching of claimants to controls was based on pre-accident labor-market earnings. Graph 9.1 depicts the difference in proportions, stratified by impairment bracket, for the pre-1990 Ontario program. As might be expected, the difference in proportions increases post-accident for all brackets. Noteworthy is the fact that the difference in proportions is relatively similar for all brackets, ranging from 5-13% nine years post-accident. One might have expected the difference to increase substantially with higher impairment brackets, but this is not the case. The range of differences is similar for the post-1990 Ontario program as for the pre-1990 one. For the post-1990 BC program the range of differences is a little higher, from 9-13%.

What can be established from these graphs is that a small fraction of the claimants in all three programs have a higher probability of having inadequate income compared to their control counterparts, if they were to rely solely on their labor-market earnings. This probability appears unrelated to impairment level.

Next we consider the proportion of claimants and controls above and below the single person LIM based on income from all sources, including workers' compensation.[14] The reason to consider this is to ascertain if workers' compensation and income from other sources

[14] Since matching of claimants to controls was not based on income from all sources, but rather labor-market income, these results must be interpreted with caution.

substantially reduces the probability of having earnings below the LIM, relative to their control counterparts. Graphs 10.1-10.3 in Appendix X present data with this analysis. Graph 10.1 presents the pre-1990 Ontario program. With all income sources considered, claimants in this program fare quite well compared to their control counterparts. Nine years post-accident, the difference ranges between -10% for the highest impairment bracket to 3% for the 5-10% impairment bracket. Graph 10.2 presents the post-1990 Ontario program. For this program, the difference is -3% for the highest impairment bracket. The largest difference is 8%, which is for the 20-50% bracket. Lastly, the post-1990 BC program data is presented in Graphs 10.3. Here the highest impairment bracket has a difference of -9%, and the highest difference is 1%, which is for the 0-5% and 10-20% brackets. Overall, it appears that claimants in the post-1990 Ontario program are most likely to be below the LIM, relative to their control counterparts, when considering income from all sources.

Comparison of Workers' Compensation Replacement Rates

We consider the replacement rates provided by each of the three programs in Tables 11.1-11.3 in Appendix XI. The analysis is based on a comparison of pre-tax labor-market earnings of claimants compared to their control counterparts. Both loss replacement and labor-market earnings replacement are considered. Each table presents the total sample size and proportion of sample with an earnings loss over a ten year period post-accident by impairment bracket and for the entire sample. Table 11.1 presents the replacement rates for the pre-1990 Ontario program. Between 70-97% of the claimants have a loss, depending on the impairment bracket. Loss replacement rates average over 100%, whereas earnings replacement rates are lower, varying between 90 to 97%. On average, the program reaches its target replacement rate of 90%, and each impairment bracket achieves this target rate.

Table 11.2 presents the replacement rates for the post-1990 Ontario program. With this program there is a similar range in the proportion of claimants experiencing a loss, specifically between 71-97% depending on the impairment bracket. Loss replacement rates are 100% or more for all brackets, though they are smaller than for the single award program, with the exception of the 10-20% bracket. Earnings replacement rates are lower, though most brackets achieve the target rate of 90%. The exception is the 20-50% bracket, which achieves a replacement rate of 89%.

Table 11.3 presents the replacement rates for the post-1990 BC program. The proportion of claimants experiencing an earnings loss over the ten year period is similar to the single and dual award programs, ranging from 70% to 91% depending on the impairment bracket. The loss replacement rates are all over 100% and, in most cases, substantially higher than the single and dual award program. Earnings replacement rates for all impairment brackets achieve the 90% target rate and in fact, are all over 100%. It appears that the benefits from the bifurcated program are the most generous of three programs.

Detailed Comparison of Two Ontario Programs

Tables 11.1 through 11.4 in Appendix XI provide detailed replacement rates for the pre-1990 and post-1990 Ontario programs. Rates and their related confidence intervals are highlighted in yellow if they are below the target of 90%.

Tables 11.1 and 11.2 provide replacement rates based on pre-accident earnings (this is the basis of comparison for most workers' compensation programs). Both individual-level and aggregate-level replacement rates are provided. The average individual-level loss replacement rates (column B) suggest that benefits are adequate in both programs for all strata except

claimants aged 50 to 59. Loss replacement rates for this group are 73% for the pre-1990 program and 61% for the post-1990 program. Most other average individual-level loss replacement rates are well over 100%, with the exception of the 1-5% pre-1990 program stratum. It has a rate of 90%. Overall, the replacement rate for the pre-1990 program is 123% and for the post-1990 program 202%. In contrast, aggregate-level loss replacement rates (column D) suggest that rates are inadequate for most strata in both the pre-1990 and post-1990 programs. Overall, the rate is 66% for the pre-1990 program and 79% for the post-1990 program.

Earnings replacement rates provide another perspective on benefits adequacy and equity, with less emphasis given to small, uncompensated losses. Average individual-level earnings replacement rates (column F) suggest that benefits are adequate for most strata in both programs. The exception again is claimants aged 50 to 59, but only for the pre-1990 program. Overall, the rate is 98% for the pre-1990 program and 105% for the post-1990 one. Aggregate-level earnings replacement rates (column G) suggest that many of the strata in the pre-1990 program are not adequate, whereas the post-1990 program has only two strata below the 90% target—claimants aged 50 to 59 and claimants in the central region. Overall, the pre-1990 program does not achieve the target (the overall rate is 85%) whereas the post-1990 program does (the overall rate is 92%).

Tables 11.3 and 11.4 provide replacement rates based on control-counterpart earnings (this is the basis of comparison used in the academic literature on benefits adequacy and equity). Average individual-level loss replacement rates (column B) suggest that both the pre- and post-1990 programs are adequate for most strata. The only possible exception is the FEL=0 or missing stratum for the post-1990 program.[15] The rate is 80%, but its confidence interval straddles the 90% rate. Overall, the rate is 202% for the pre-1990 program and 104% for the post-1990 one. Aggregate-level loss replacement rates (column D) suggest a different picture, with rates for many strata below the target for both the pre- and post-1990 programs. Overall the rate is 76% for the pre-1990 program and 80% for the post-1990 one.

Earnings replacement rates based on control earnings provide a positive picture of adequacy with average-individual level rates (column E). All strata for both programs are above the 90% target rate. Aggregate-level earnings replacement rates (column G) are adequate for some, but not all strata in the pre-1990 program, where as their counterparts in the post-1990 all reach the target. The only exceptions in the post-1990 program are the mid-range FEL strata, which are slightly below target.

Tables 11.5 through 11.8 map the confidence intervals for the individual-level rates. As can been seen by comparing Tables 11.5 and 11.6, confidence intervals for loss replacement rates based on pre-accident earnings are much wider than those for earnings replacement rates. The same is true for the confidence intervals for replacement rates based on control earnings (Tables 11.7 and 11.8), i.e., loss-replacement rates have much wider confidence intervals than earnings replacement rates. This suggests that loss replacement rates have more extreme values and/or are much more varied.

Part 2: Analysis of the Short-term Disability Program

Labor-market Earnings Recover

Tables 12.1 through 12.4 in Appendix XII present the yearly labor-market earnings post-accident of the two short-term disability claimants compared to their controls. Table 12.1 identifies a

[15] Recall, the FEL ratings are unique to the post-1990 program. These ratings are the claims adjudicators' assessments of claimants' post-accident earnings capacity as a percentage of pre-accident earnings.

divergence in labor-market earnings between the claims and controls that begins in the accident year and continues to grow in magnitude over the ten years post-accident. The difference in earnings by the 10th year is $4,200 in 1994 after-tax dollars. Claimants' earnings range from 81% to 87% of the controls, depending on the stratification of the sample. Tables 12.2 through 12.4 provide earnings recovery rates by gender, age bracket and region of residence. As is apparent, all strata experience similar declines in earnings recovery. All are in the range of 81% to 87% in the 10^{th} year post-accident.

Benefits Adequacy and Equity

Table 12.5 in Appendix XII provides a breakdown of the earnings, benefits and losses over a ten year period post-accident for the short-term disability sample. Discounted benefits (column A) are modest, on average ranging from $1,100 to $3,200 for a stratum. In contrast, average individual-level losses (column B and F) are quite high. At the aggregate level, these losses are substantially offset by the gains of some claimants, making the aggregate-level earnings losses less pronounced (columns D and H). In fact, the less than 24 age bracket does not have a loss at the aggregate level, but rather a gain of $30,800 based on pre-accident earnings.

Tables 12.6 and 12.7 in Appendix XII present various replace rates for the short-term disability samples. Table 12.6 uses pre-accident earnings as the basis of comparison. The average individual-level loss replacement rates (column B) suggest that rates are inadequate for all strata. Aggregate-level loss replacement rates indicate the same, with the exception of the less than 24 age bracket, which does not have a loss, and therefore has a negative replacement rate. Average individual-level earnings replacement rates (column E) are all above 100%, with the exception of the 50-59 age bracket. This bracket has a replacement rate of 85%. Aggregate-level earnings replacement rates have a similar pattern with all rates above the 90% target with the exception of the 50-59 age bracket. It is 77% for this stratum.

Replacement rates based on control earnings (Table 12.7) provide a similar picture. Individual- and aggregate-level loss replacement rates are substantially below target for all strata. In contrast, individual- and aggregate-level rates (columns E and G respectively) all achieve the target with the exception of the 25-34 year age bracket. Aggregate-level earnings replacement rates for this stratum is 88%.

Part 3: Marital Break Up Study

Table 13.1 in Appendix XIII presents an overview of the socio-demographic characteristics of the Ontario sub-sample including the proportion that experienced a marital break up. Among men, a slightly higher proportion of individuals with a permanent impairment experienced a marital break up compared to non-injured individuals. Women who sustained a permanent impairment were also somewhat more likely than non-injured women to experience a marital break up.

Men were slightly older than women on average and the mean age difference between individuals and their spouses was higher for men compared to women. The number of children under 16 residing in the household was higher among men relative to women on average; however, average family income from all sources and mean number of years married were similar between men and women.

Men were much more likely than women to experience a change to dependent status, perhaps in part because many more women are already in this role. A slightly higher proportion of women than men reported becoming the principal income earner in the household. A similar proportion of men and women live in rural jurisdictions.

Tables 13.2 and 13.3 in Appendix XIII present results from the modeling, stratified by gender. For men, we find that having a permanent impairment due to work accident is associated with a significantly increased risk of marital break up (HR = 1.15, $p < 0.01$). Other factors associated with a significantly increased risk of marital break up in men included becoming the principal income earner (HR = 1.20, $p<0.01$), rural residence (HR = 1.07, $p<0.01$), and having a much younger wife (HR = 1.06, $p<0.01$). Factors associated with a decreased probability of marital break up in men were older age (HR = 0.89, $p<0.01$), more children under 16 residing in the household (HR = 0.83, $p<0.01$), higher family income (HR = 0.86, $p<0.01$), and more years married (HR = 0.87, $p<0.01$).

Findings for women also show an elevated risk of marital break-up due to work-related permanent impairment (HR = 1.25, $p<0.01$); moreover, the risk of marital dissolution was 10% higher in permanently impaired women relative to their male counterparts. Other factors predictive of marital break up in women were becoming the principal income earner (HR = 1.61, $p<0.01$) and change to dependent status (HR = 1.44, $p<0.01$). Variables associated with a lower probability of marital break up in women were older age (HR = 0.84, $p<0.01$), having a much older husband (HR = 0.94, $p<0.01$), higher family income (HR = 0.85, $p<0.01$), and greater number of years married (HR = 0.90, $p<0.01$).

Results from the analyses using BC data are presented in Table 13.4, Table 13.5 and Table 13.6 in Appendix XIII. The proportion of long-term disability claimants in BC who experience a marital break up is similar to the proportion in Ontario (Table 13.4). Both men and women who sustain a permanent impairment are slightly more likely than their non-injured counterparts to experience a marital break up. Findings from the modeling show that, after adjusting for potential confounders, both men and women who sustain a permanent impairment are 11% more likely than their non-injured counterparts to subsequently report a marital break up. Whereas the increased risk for male injured workers in BC are similar to the findings for the Ontario sample (11% and 15%, respectively), women in BC who sustain a permanent impairment are 14% less likely than their counterparts in Ontario to experience a marital break up.

Discussion and Conclusions

Part 1 of this report compared the labor-market outcomes and benefits adequacy and equity of three distinct long-term disability workers' compensation programs in Canada, with a focus on two Ontario programs.

In terms of wage replacement benefits, most workers' compensation programs in Canada are based on loss of earnings capacity. The transition to this approach has been motivated by the fact that percentage of total bodily impairment is not a good measure of percentage loss of earnings. As was noted in the three Canadian programs even claimants with low levels of impairment had large income losses (e.g., claimants with 0-5% impairment had loss of approximately 20% compared to uninjured control counterparts). What was also noteworthy in the analysis of the three programs was that earnings recovery varied dramatically even within impairment brackets. Earnings of claimants within a bracket was very polarized, with a large fraction earning less than 25%, a large fraction recovering more than 75%, and few claimant recovering earnings in the mid ranges (i.e., between 25-75%). Furthermore, even for the post-1990 program in Ontario, the distribution within FEL strata was also found to be very polarized. Evidently, averages do not accurate reflect the common experience even within subgroups that

are meant to be similar. Furthermore, it appears the assessment of earnings capacity within the post-1990 program did not accurately prediction earnings recovery for a large fraction of claimants. Even a large fraction of claimants with an assessment of up to 5% recover less than 25% of their control counterpart earnings. Additionally, across the three programs the increased probabilities of low labor market earnings for different impairment strata are similar.

Findings from the analyses suggest that individuals and contextual factors are very important to consider; factors such as gender, age, level of impairment, transferable skills, and labor-market conditions may all bear on earnings capacity. This approach is consistent with current concepts of disablement. It also suggests the need to consider each case individually.

The three workers' compensation programs reviewed reflect the range of approaches considered in programs across Canada. The bifurcated program is somewhat of an amalgam of the two other programs reviewed— the impairment based and the loss of earnings capacity based programs. It appears to offer the better of these two alternative forms of compensation by providing benefits based on whichever program offers the most generous benefits for a claimant. Hence, as might be expected, it has the most adequate and equitable benefits of the three programs based on percentage of control counterpart earnings replaced by benefits and labor market earnings post-accident. The bifurcated approach to compensation appears to be an effective means to address the contextual variability affecting claimants' loss of earnings capacity, to ensure adequate and equitable wage replacement at both the aggregate and individual claimant levels.

A more detailed comparison of the two Ontario programs using a range of replacement rate measures suggests that the post-1990 loss-of-earnings-capacity program is marginally more adequate and equitable than the pre-1990 impairment-based one. Regardless of the replacement rate measure, the post-1990 program achieved the target rate in more strata than the pre-1990 one, and the overall replacement rates were generally higher. Needless to say, replacement rates are strata averages. As seen with the distribution of claimants by quartile of earnings recovery, even within strata the distribution of labor-market earnings recovery was quite polarized.

Part 2 of this reported investigated the labor-market outcomes and benefits adequacy and equity of short-term disability workers' compensation claimants in Ontario. Consistent with earlier research by Boden and Galizzi (1999), we found that short-term disability claimants experience long-term earnings losses. The spread between claimant and control earnings increases over the years post-accident, and was between 13-19% at the 10 year point. It may be that a short-term disability has long-term implications for reasons such as loss of skills while off work recovering or stigma associate with being a claimant. There may also be a selection effect occurring where the claimant sample is somehow inherently different than their control counterparts. They may have a higher rate of accidents subsequent to the one we tracked due to being more accident prone, or being in occupations where there is a higher risk of injury than their control counterparts. We were not able to track accident claim rates for the claimants or controls in the years following the primary accident that we tracked, nor did we have data on industry or occupation to include in the matching process.

Part 3 of this report examined the probability of marital break-up due to work accident and permanent impairment. This analysis was undertaken using both the Ontario and BC long-term disability claimant samples. Our findings show that workers who sustain a permanent impairment are significantly more likely to experience a marital break up. In Ontario, the risk of marital break up was slightly lower in injured men compared to injured women, whereas the risk was identical for male and female claimants in BC. The elevated risk of marital dissolution in injured workers provides insight into the full range of social and economic consequences of work

disability. Factors associated with the increased risk of marital dissolution include reduced household income due to diminished individual earnings, difficulties fulfilling familial roles and responsibilities due to physical limitations, and mental health problems such as depression, anxiety and anger (Boden et al., 2001; Keogh et al., 2000; Reville, 1999; Wall et al., 2008; Weil, 2001). In view of the fact that rates of labor market re-entry following work injury are higher for individuals who have strong social and interpersonal support networks and those who are married, it is critical that policy makers together with workers' compensation authorities address the impact of work disability on marital relationships. Understanding the full range of needs of injured workers and their families can help to identify effective interventions (e.g., improved economic remedies, family-centered counseling) that could modify marital strain.

Publications and Presentations

Publications

Tompa E, Scott-Marshall H, Fang M, Mustard C. Comparative Benefits Adequacy and Equity of Three Long-term Disability Programs. *In preparation for submission to Occupational and Environmental Medicine.*

Tompa E, Scott-Marshall H, Fang M, Mustard C. Labor-market Earnings after Work Accident and Permanent Impairment, in preparation. *In preparation.*

Tompa E, Scott-Marshall H, Fang M, Mustard C. Long-term Earnings Losses of Temporary Work Disability Claimants. *In preparation for submission to the Journal of Occupational and Environmental Medicine.*

Tompa E, Scott-Marshall H, de Oliveira C, Fang M. Does Permanent Impairment from Workplace Accident Increase the Risk of Marital Break-up? *In preparation for submission to Journal of Disability Policy Studies.*

Scott-Marshall H, Tompa E, Morassaei S. Marital Formation in Individuals with Permanent Work-Related Impairment. *In preparation for submission to Disability and Society*.

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Appendix I: Table 1.1 Summary of Benefits Adequacy and Equity Studies

Article Citation Jurisdiction	Type of Claimants Study Time Period	Methods Details	Loss Replacement Rate
Berkowitz and Burton (1987) California, Florida, and Wisconsin, United States	Cases: male PPD claimants. Accident year(s): 1968.	Earnings loss estimated by subtracting actual earnings post accident from pre-accident earnings projected forward by adjusting for expected growth ratios of future earnings. Loss replacement rate estimated by dividing the average workers' compensation benefits by the average loss. To calculate present values used a 6% discount rate. Values are for 6 year projected period.	6 year before-tax loss replacement rate for Wisconsin: 75%. 6 year before-tax loss replacement rate for Florida: 59%. 6 year before-tax loss replacement rate for California: 46%.
Johnson *et al* . (1979) California, Florida, New York, Washington, and Wisconsin, United States	Cases: PPD claimants with severe permanent impairments. Accident year(s): N/A. Survey year: 1975	Earnings loss estimated by subtracting actual earnings post accident from pre-accident earnings projected forward by adjusting for inflation and productivity. Loss replacement rate calculated as average workers' compensation benefits divided by average earning loss. Discount rate not applicable since values are only for one calendar year.	Single year after-tax loss replacement rate for the 5 states: 10%. Loss replacement rate values ranged from a low of 5.42% to a high of 21.84% depending on gender and labour-force participation experiences post accident.
California Workers' Compensation Institute (1984) California, United States	Cases: PPD claimants with severe permanent impairments. Accident year(s): Jul. 1, 1975 to Jun. 30, 1976.	Used data from survey undertaken 6-7 years post accident. Estimated lifetime earnings loss and replacement rate. Discount rate not provided in source document.	Overall lifetime before-tax loss replacement rate: 49%. Lifetime before-tax loss replacement rate for impairment ratings between 1-9%: > 80%. Lifetime before-tax loss replacement rate for permanent total disability claimants = 67%.
Peterson *et al.* (1998) California, United States	Cases: PPD claimants. Accident year(s): 1991-1993.	Earnings loss estimated by subtracting actual earnings post accident from uninjured earnings capacity projected over 10 years. Loss replacement rate estimated by dividing the average workers' compensation benefits by the average loss. To calculate present values used a 2.3% discount rate.	10 year before-tax loss replacement rate: 29% using the minimum method.

Article Citation Jurisdiction	Type of Claimants Study Time Period	Methods Details	Loss Replacement Rate
Reville *et al.* (2001b) California, United States	Cases: PPD claimants in self-insured and insured firms. Accident year(s): focus is on 1993, but study includes1991-1995.	Earnings loss estimated by subtracting actual earnings post accident from uninjured earnings capacity projected over 10 years. Loss replacement rate estimated by dividing the average workers' compensation benefits by the average loss. To calculate present values used a 2.3% discount rate.	10 year loss replacement rate: 35% before tax (46% after tax) for self-insured firms, 40% before tax (52% after tax) for insured firms.
Reville *et al.* (2001a) New Mexico, Washington, California, Oregon, and Wisconsin, United States	Cases: PPD claimants. Accident year(s): 1994-1998 for New Mexico, 1993-1994 for Washington, 1993-1995 for California, 1992-1993 for Oregon, and 1989-1990 for Wisconsin.	Earnings loss estimated by subtracting actual earnings post accident from uninjured earnings capacity projected over 10 years. Loss replacement rate estimated by dividing the average workers' compensation benefits by the average loss. To calculate present values used a 2.3% discount rate.	10 year loss replacement rate: New Mexico 46% before tax (60% after tax); Washington 41% before tax (53% after tax); California 37% before tax (48% after tax); Wisconsin 29% before tax (38% after tax); Oregon 42% before tax (55% after tax).
Boden and Galizzi (1999) Wisconsin, United States	Cases: temporary disability claimant with time off of 8 days or more and PPD claimants. Accident year(s): Apr. 1, 1989 to Sept. 30, 1990.	Regression modeling used to identify the determinants of change in earnings. Projected earnings loss and replacement rates for a 10 year period. To calculate present values used a 3% discount rate.	10 year loss replacement rate: temporary disability claimants: men range 15-65% before tax (20-102% after tax), women range 14-71% before tax (19-108%); PPD claimants: men 57% before tax (83% after tax), women 46% before tax (63% after tax); compromise claimants: men 47% before tax (63% after tax), women 42% before tax (54% after tax); all claimants (not including permanent total and death): men 45% before tax (64% after tax), women 37% before tax (50% after tax).

Article Citation Jurisdiction	Type of Claimants Study Time Period	Methods Details	Loss Replacement Rate
Ginnold (1979) Wisconsin, United States	Cases: PPD claimants. Accident year(s): 1968.	Earnings loss estimated by subtracting actual earnings post accident from uninjured earnings capacity. Uninjured earnings capacity calculated from pre-accident earnings adjusted by an estimate of earnings and inflation trends in future years. Estimated lifetime earnings loss and loss replacement rate. To calculate present values used a 5% discount rate.	Lifetime before-tax loss replacement rate with 5% discount rate: 5-10% impairment: 6.8% for unscheduled; 10-20%: 33.5% for scheduled, 10% for unscheduled; over 20%: 37% for scheduled and 21.5% for unscheduled.
Biddle (1998) Washington, United States	Cases: short-term claimants with lost-time and no-lost-time claims. Accident year(s): Jul. 1993 to Jun. 1994	Regression modeling used to identify the determinants of earnings. Projected earnings loss and replacement rate for a ten year period. To calculate present values used a 2.3% discount rate.	10 year loss replacement rate: 44% after tax for men and 37% after tax for women.
Tompa *et al.* (2003) Ontario, Canada	Cases: 1) PPD claimants receiving benefits from an impairment based program; 2) PPD claimants receiving benefits from a loss of earnings capacity program. Accident year(s): 1986 and 1992.	Earnings loss estimated by subtracting actual earnings post accident from uninjured earnings capacity in the sixth year post accident. Uninjured earnings capacity separately estimated from pre-accident earnings and uninjured control earnings. Loss replacement rate estimated by dividing the average workers' compensation benefits by the average loss.	6th years post-accident after-tax loss replacement rate in for impairment based program: 43% based on pre-accident earnings and 58% based on control earnings. 6th years post-accident after-tax loss replacement rate in for loss of earnings capacity based program: 55% based on pre-accident earnings and 41% based on control earnings.

Appendix II: Sample Frame and Time Period

Figure 2.1

1) Ontario PD (Impairment-based) Program
Sample Frame: Claimants with accident accurring between 1986-1989

pre-accident years	accident window	post-accident years
1982 - 1985	1986 - 1989	1990 - 2004

2) Ontario FEL/NEL (Loss-of-earnings-capacity) Program
Sample Frame: Claimants with accidents occurring between 1990-1994

pre-accident years	accident window	post-accident years
1982 - 1989	1990 - 1994	1995 - 2004

3) BC Bifurcated Program
Sample Frame: Claimants occurring between 1990-1994

pre-accident years	accident window	post-accident years
1982 - 1989	1990 - 1994	1995 - 2004

4) Ontario Short-term Disability Program
Sample Frame: Claimants with accidents occuring injured in 1986

pre-accident years		post-accident years
1982 - 1985	1986	1987 - 2004

5) Ontario Short-term Disability Program
Sample Frame: Claimants with accidents occuring injured in 1992

pre-accident years		post-accident years
1982 - 1993	1994	1995 - 2004

LAD time frame: 1982-2004

Appendix III: Examples of Measuring Loss and Replacement Rate

Chart 2.1

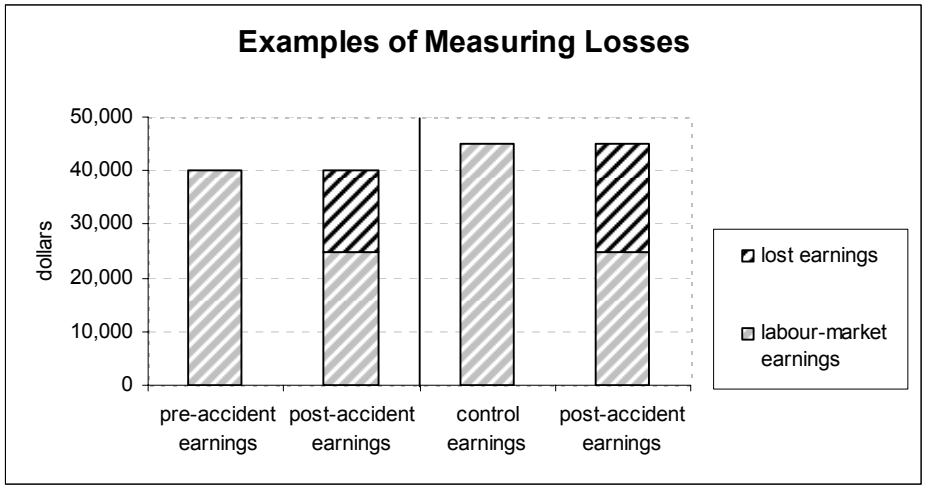
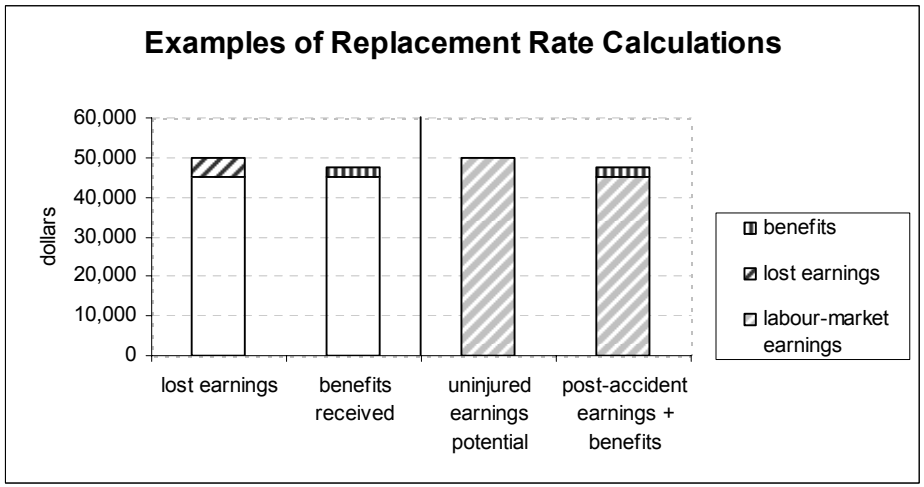


Chart 2.2



Appendix IV: Claimant-control Matching Results

Figure 4.1 Ontario LTD Sample Control Counts

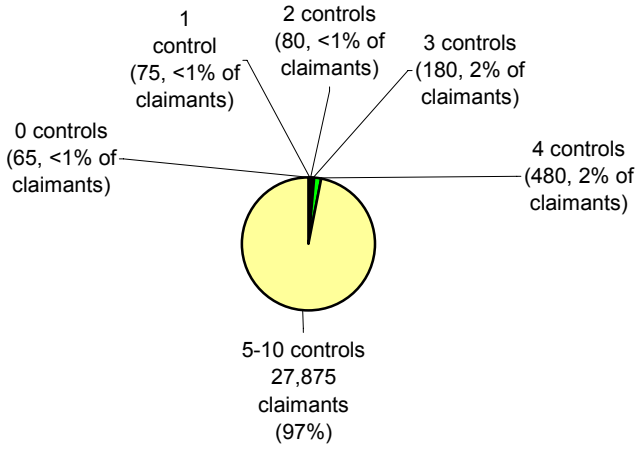


Table 4.2 Ontario LTD Sample Match Fit Characteristics

Number of prior years compared in the matching of claimants and controls		
1 year compared	19,175	8%
2 years compared	28,115	12%
3 years compared	30,020	13%
4 years compared	156,665	67%
Total controls	233,975	100%

Breakdown of income caliper levels for controls matched with claimants		
within 5% of event	93,260	40%
within 5-10% of event	74,020	32%
within 10-15% of event	41,470	18%
with 15-20% of event	25,320	11%
Total controls	234,070	100%

Figure 4.3 BC LTD Sample Control Counts

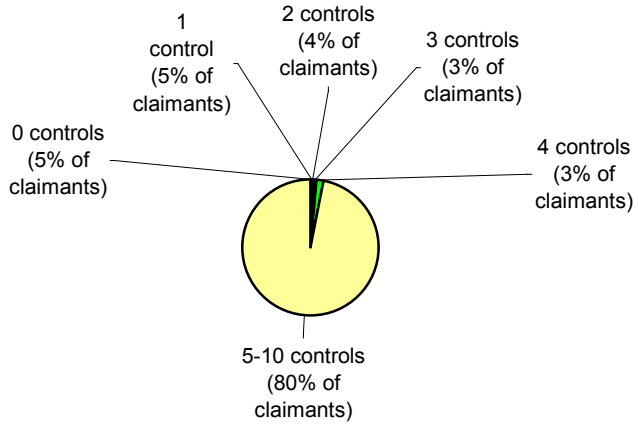


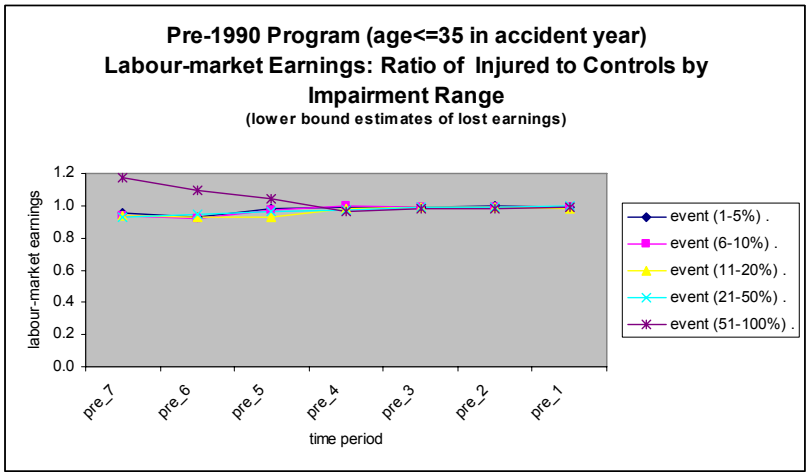
Table 4.4 BC LTD Sample Match Fit Characteristics

Number of prior years compared in the matching of claimants and controls	
1 year compared	9%
2 years compared	12%
3 years compared	15%
4 years compared	64%
Total controls	100%

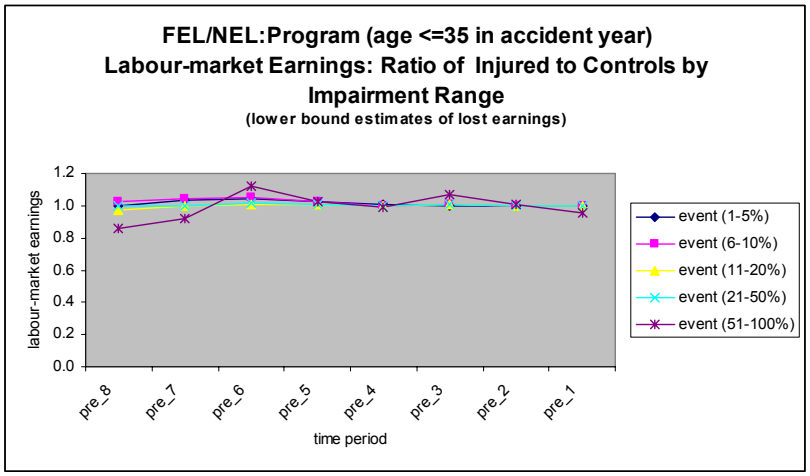
Breakdown of income caliper levels for controls matched with claimants	
within 5% of event	33%
within 5-10% of event	28%
within 10-15% of event	21%
with 15-20% of event	17%
Total controls	0%

Appendix V: Test of Match Quality

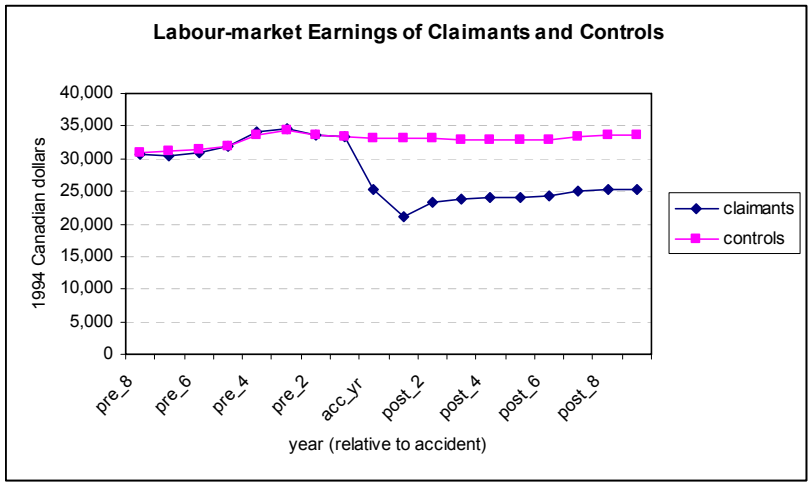
Graph 5.1 Ontario PD (Pre-1990) Sample (age≤35)



Graph 5.2 Ontario FEL/NEL (Post-1990) Sample (age≤35)



Graph 5.3 BC Long-term Disability Sample



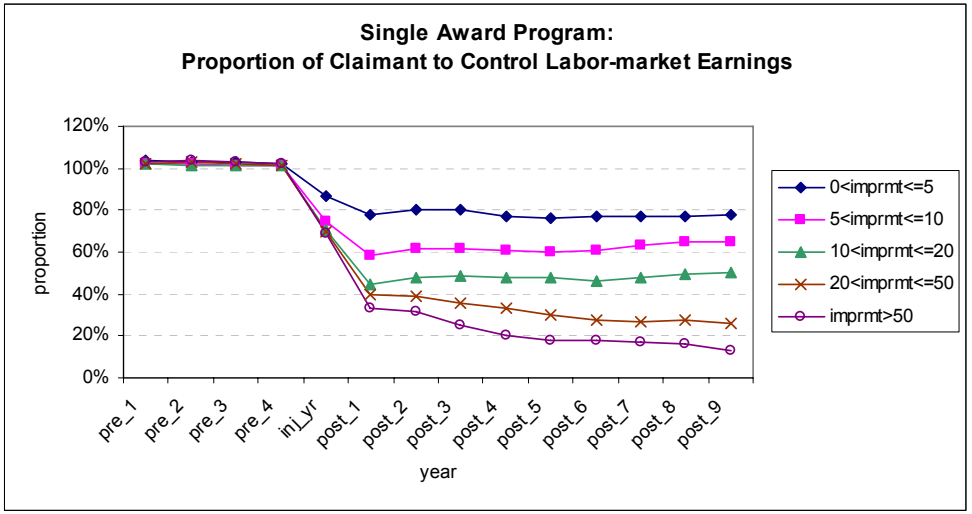
Appendix VI: Sample Size and Characteristics

Table 6.1

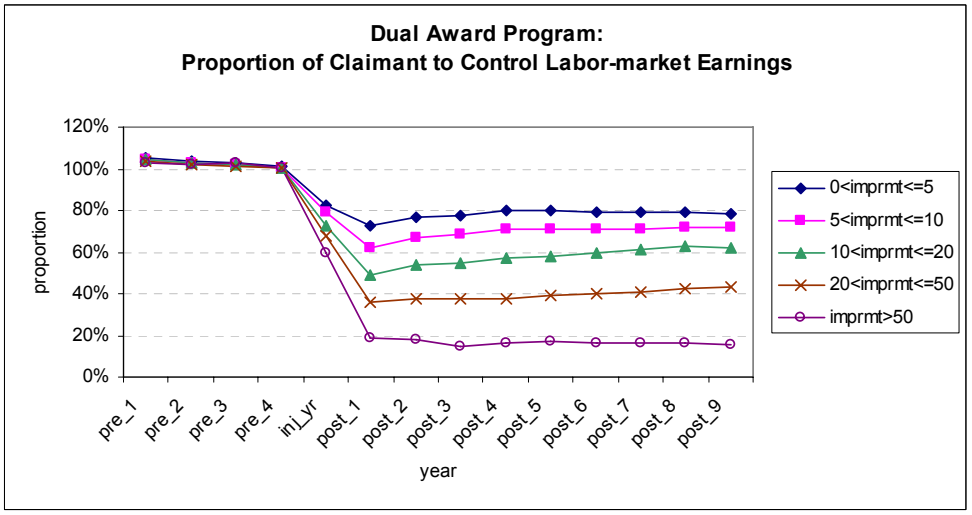
	Pre-1990 Ontario Program	count	Post-1990 Ontario Program	count	Post-1990 BC Program	count
Gender						
female	29%	3,410	33%	4,315	16%	525
male	71%	8,290	67%	8,570	84%	2,800
Age Bracket at Accident						
<=24	7%	810	5%	670	6%	185
25-34	26%	3,025	26%	3,400	23%	765
35-49	41%	4,830	45%	5,735	38%	1,255
50-59	26%	3,035	24%	3,075	24%	790
Impairment Bracket						
0-5	28%	3,235	23%	3,005	63%	2,095
5-10	29%	3,415	21%	2,750	19%	635
10-20	31%	3,630	33%	4,225	11%	375
20-50	11%	1,270	21%	2,755	5%	170
>50	1%	145	1%	150	2%	55

Appendix VII: Labor-market Earnings Recovery

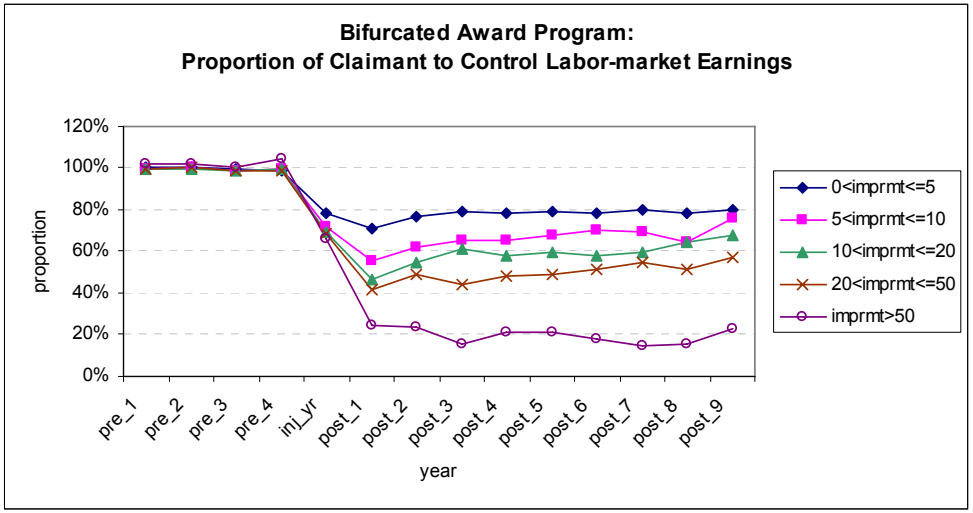
Graph 7.1 Pre-1990 (Impairment-based) Ontario Program, Claimant to Control Labor-market Earnings



Graph 7.2 Post-1990 (FEL/NEL) Ontario Program, Claimant to Control Labor-market Earnings

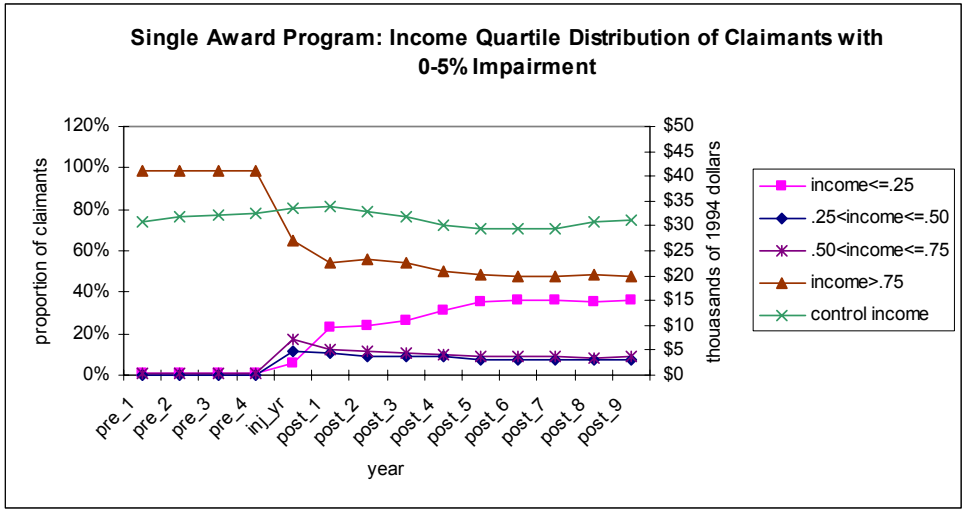


Graph 7.3 Post-1990 (Bifurcated) BC Program, Claimant to Control Labor-market Earnings

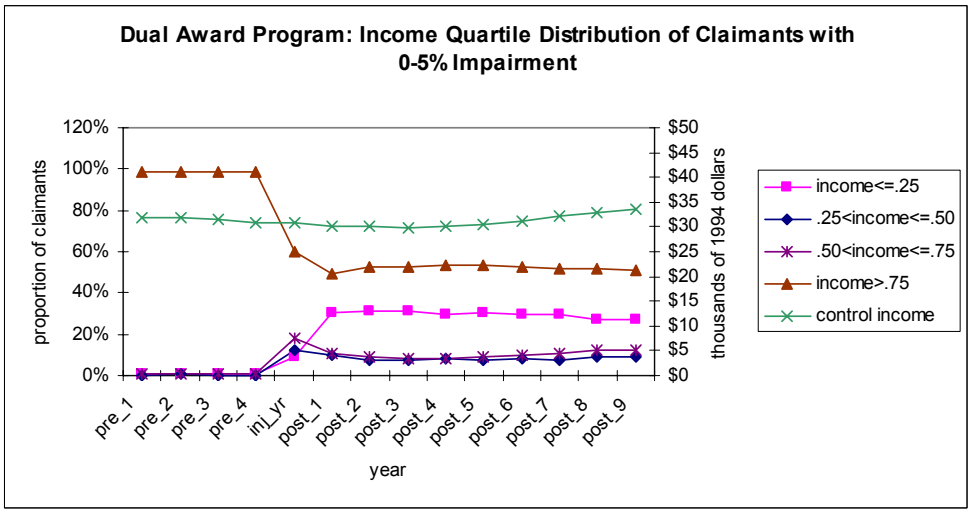


Appendix VIII: Distribution of Labor-market Earnings Recovery

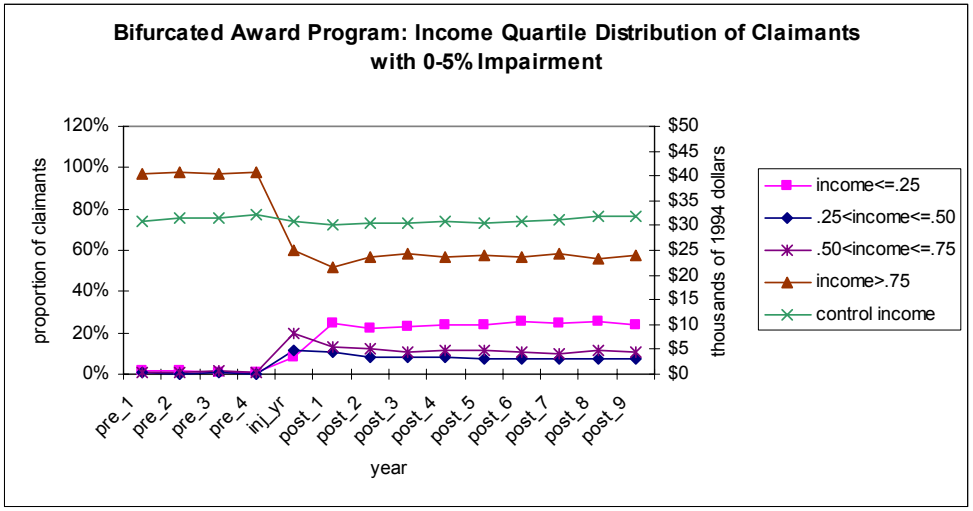
Graph 8.1 Pre-1990 Ontario Program, Income Quartile Distribution for 0-5% Impairment



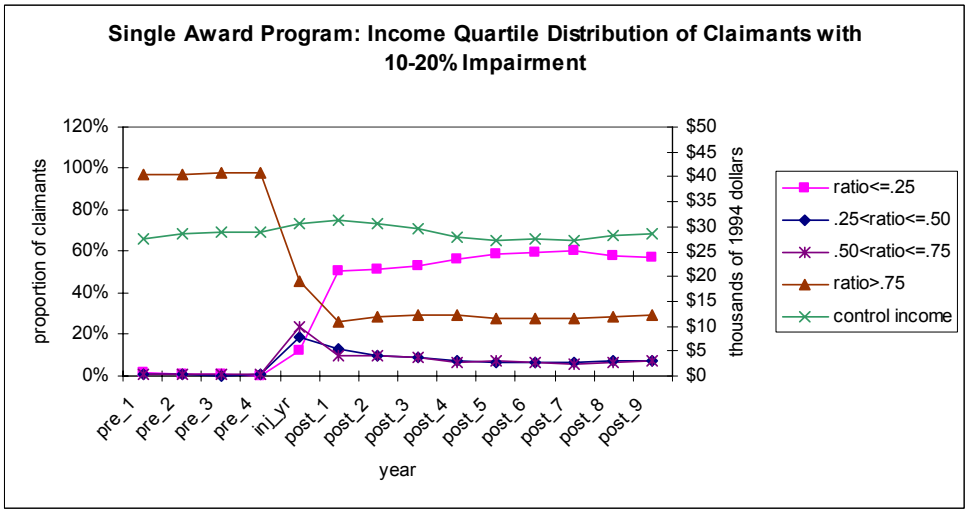
Graph 8.2 Post-1990 Ontario Program, Income Quartile Distribution for 0-5% Impairment



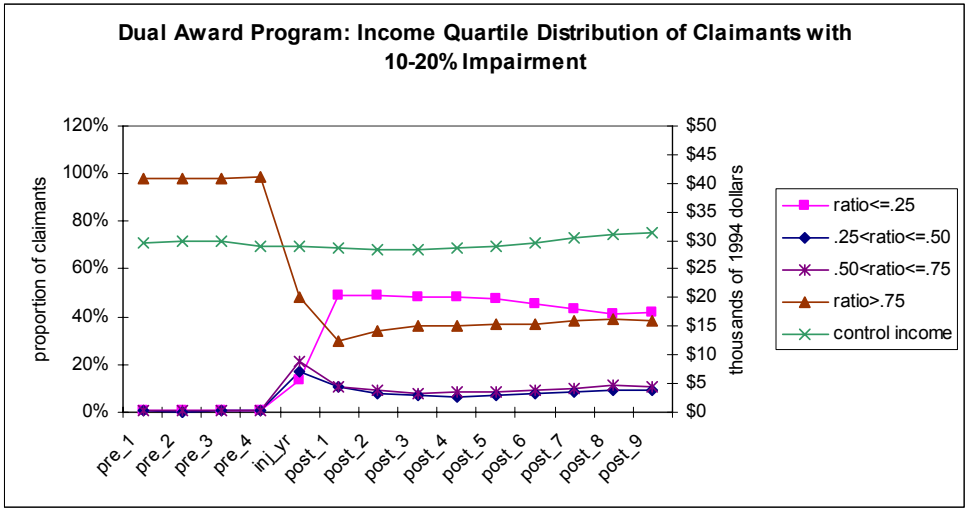
Graph 8.3 Post-1990 BC Program, Income Quartile Distribution for 0-5% Impairment



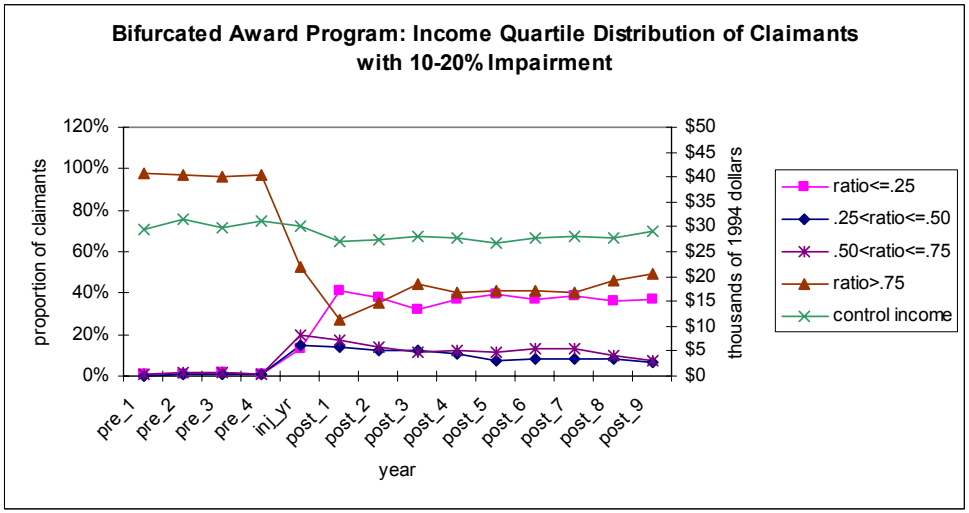
Graph 8.4 Pre-1990 Ontario Program, Income Quartile Distribution for 10-20% Impairment



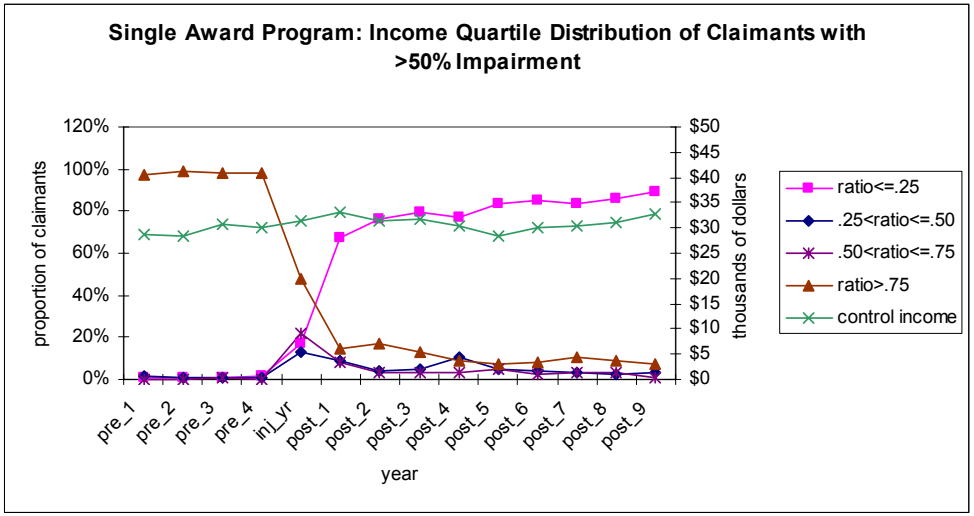
Graph 8.5 Post-1990 Ontario Program, Income Quartile Distribution for 10-20% Impairment



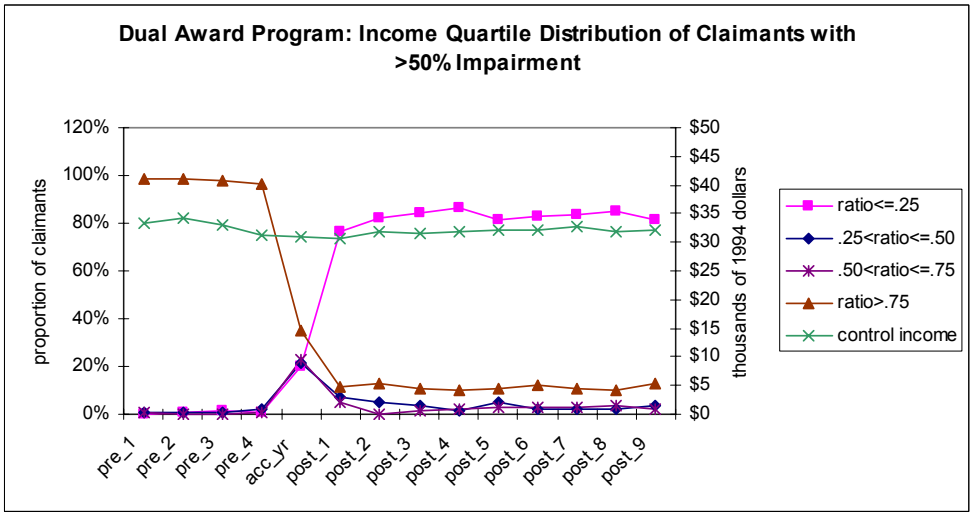
Graph 8.6 Post-1990 BC Program, Income Quartile Distribution for 10-20% Impairment



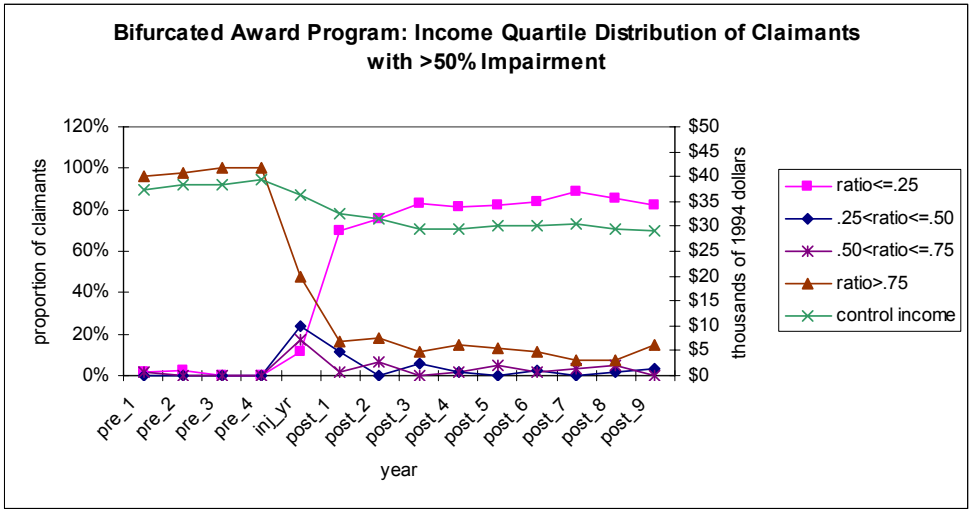
Graph 8.7 Pre-1990 Ontario Program, Income Quartile Distribution for >50% Impairment



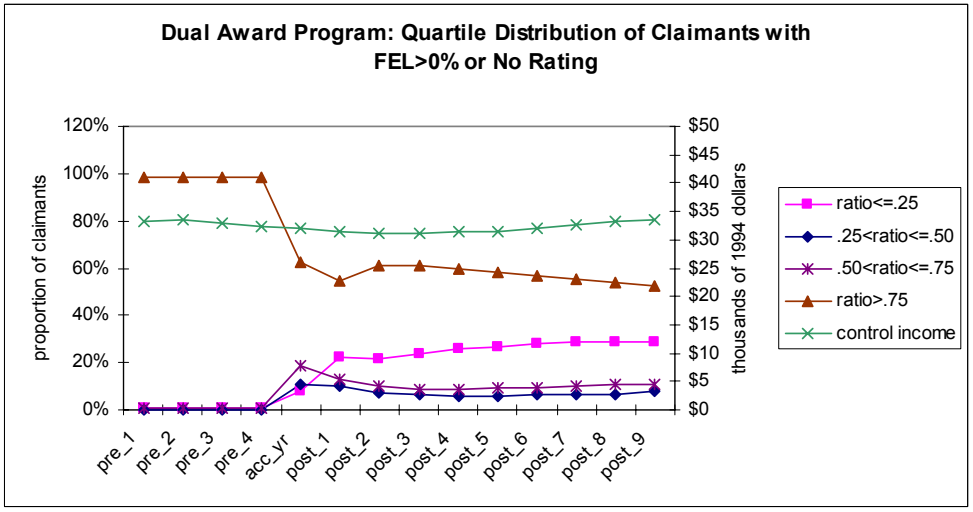
Graph 8.8 Post-1990 Ontario Program, Income Quartile Distribution for >50% Impairment



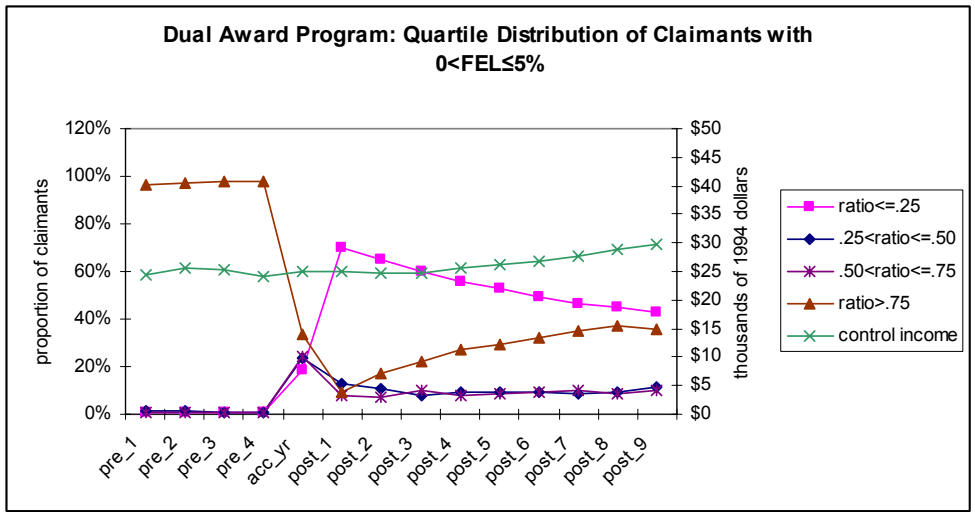
Graph 8.9 Post-1990 BC Program, Income Quartile Distribution for >50% Impairment



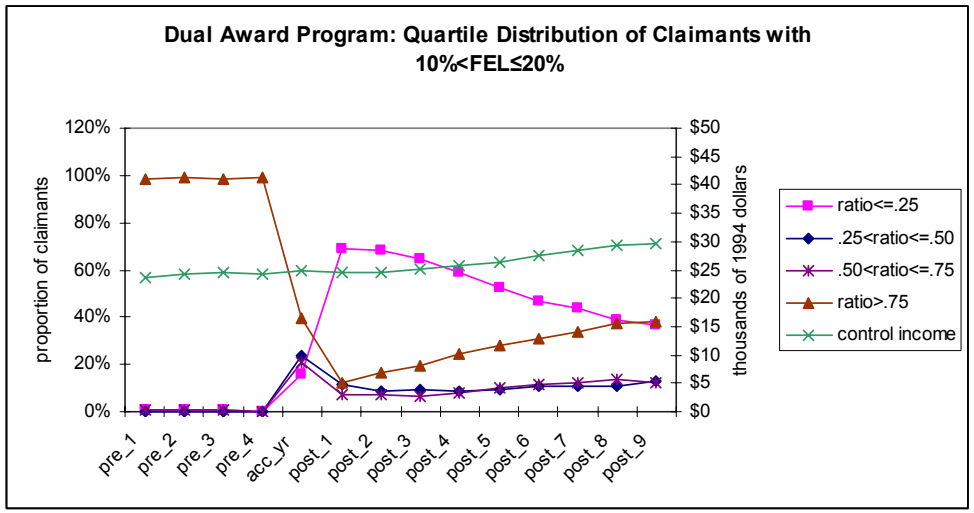
Graph 8.10 Post-1990 Ontario Program, Income Quartile Distribution for FEL=0% or No Rating



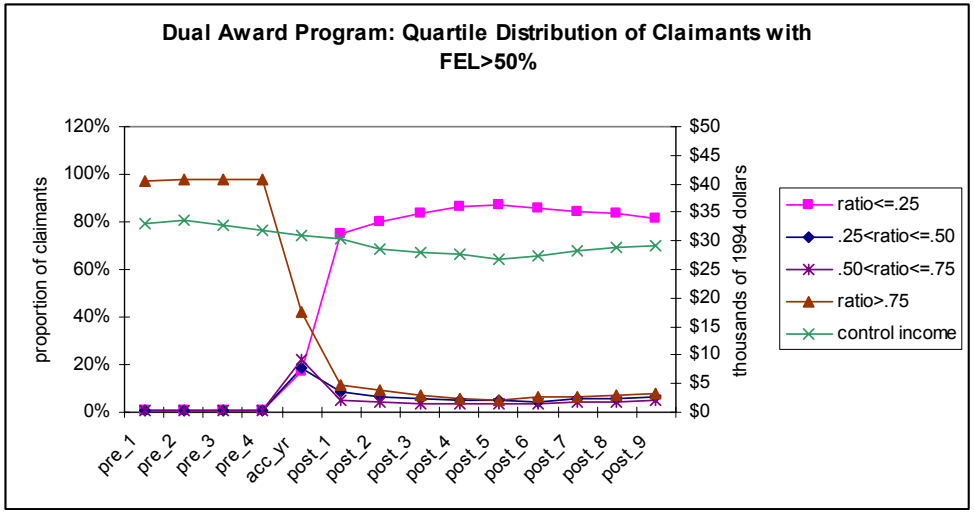
Graph 8.11 Post-1990 Ontario Program, Income Quartile Distribution for 0%<FEL≤5%



Graph 8.12 Post-1990 Ontario Program, Income Quartile Distribution for 10%<FEL≤20%

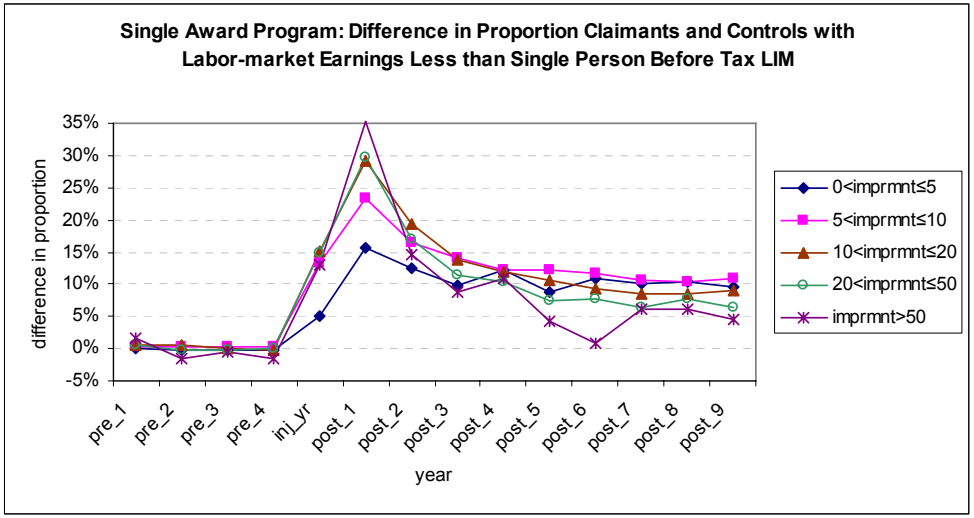


Graph 8.13 Post-1990 Ontario Program, Income Quartile Distribution for FEL>50%

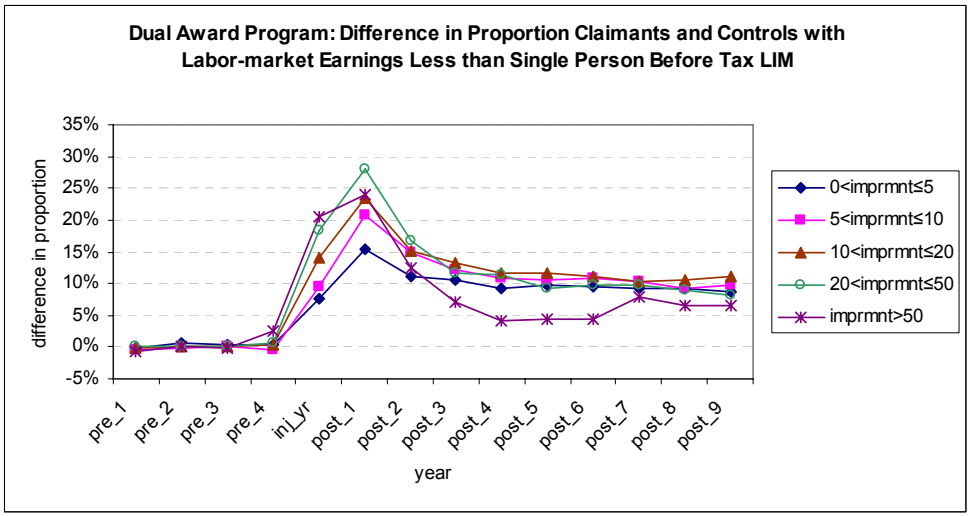


Appendix IX: Change in LIM Status Based on Labor-market Earnings

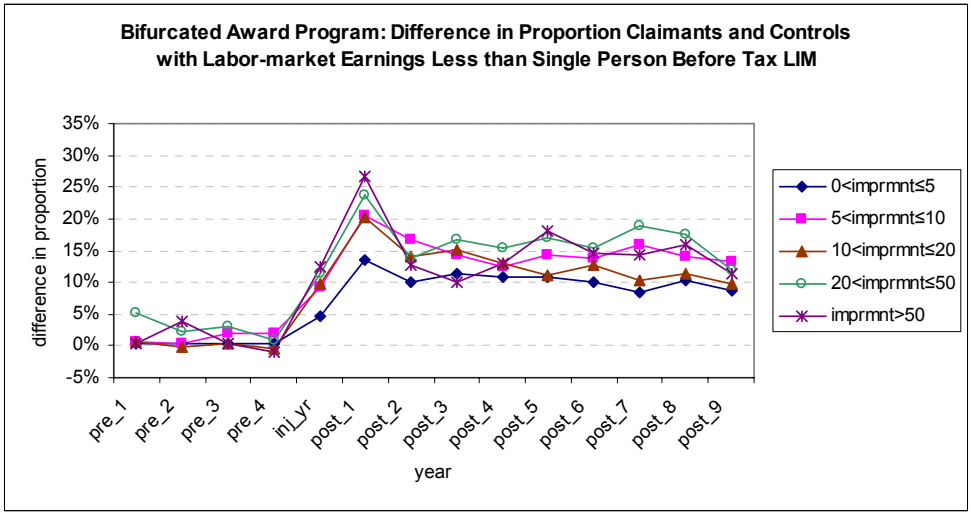
Graph 9.1 Pre-1990 Ontario Program, Difference in Proportion below Low Income



Graph 9.2 Post-1990 Ontario Program, Difference in Proportion below Low Income

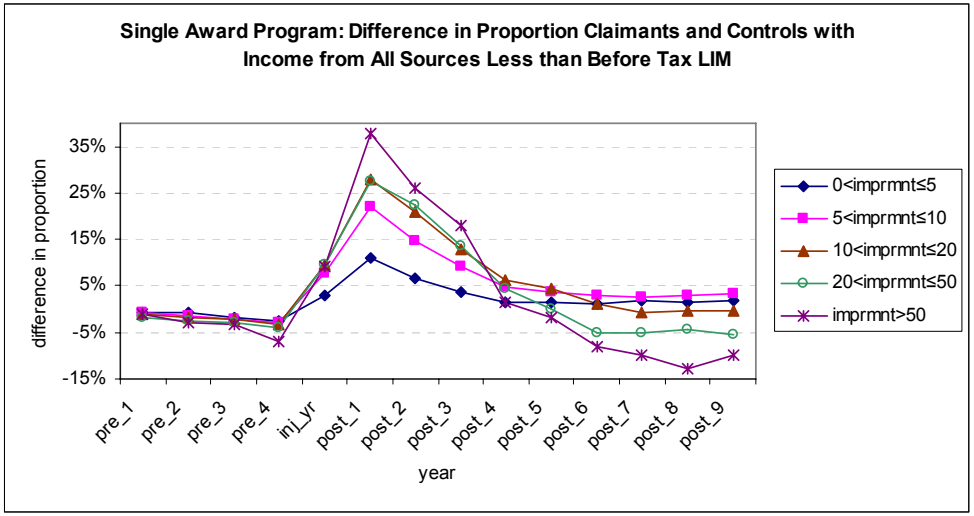


Graph 9.3 Post-1990 BC Program, Difference in Proportion below Low Income

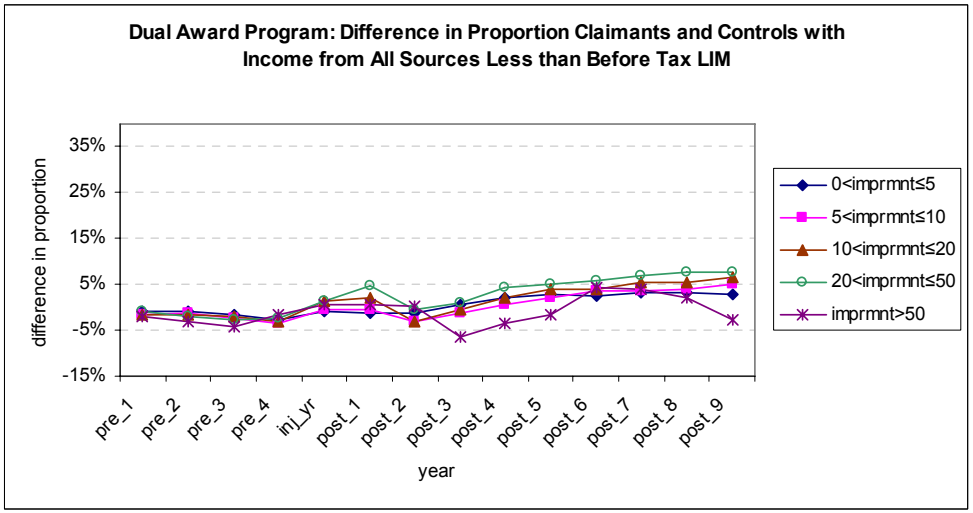


Appendix X: Changes in LIMs Status Based on Income from All Sources

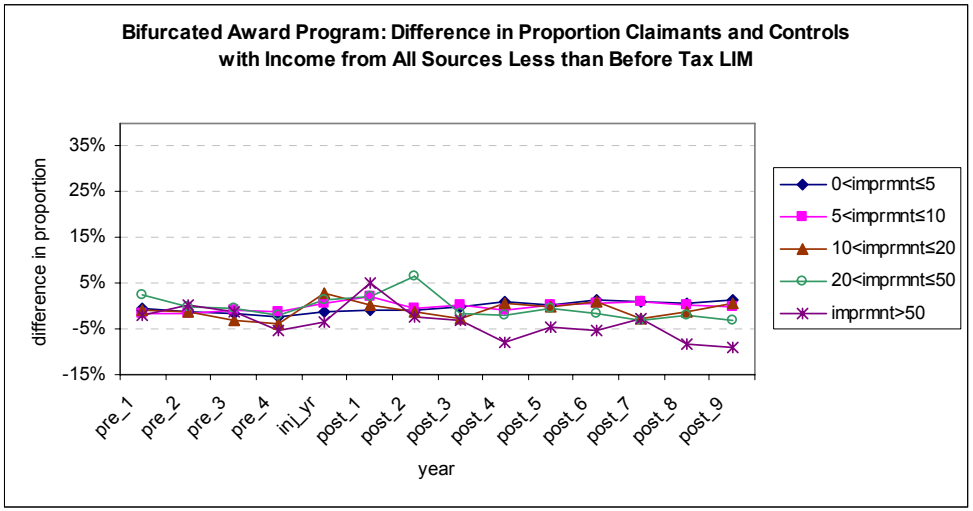
Graph 10.1 Pre-1990 Ontario Program, Difference in Proportion below Low Income



Graph 10.2 Post-1990 Ontario Program, Difference in Proportion below Low Income



Graph 10.3 Post-1990 BC Program, Difference in Proportion below Low Income



Appendix XI: Replacement Rates of the Ontario Long-term Disability Programs

Table 11.1 Replacement Rates Based on Pre-accident Earnings (Pre-1990 Long-term Disability Sample, 1986-1989) ^#

	Sample Size~	Number with loss	Proportion with loss	Average individual-level loss replacement rate based on pre-accident earnings* (only claimants with losses)	Average individual-level loss replacement rate based on pre-accident earnings*+ (all claimants)	Bootstrapped confidence interval&	Aggregate-level loss replacement rate based on pre-accident earnings*	Average individual-level earnings replacement rate based on pre-accident earnings*	Bootstrapped confidence interval&	Aggregate-level earnings replacement rate based on pre-accident earnings*
				A	B	C	D	E	F	G
Claimants age≤24 in accident year	810	530	65%	233%	155%	102%-195%	218%	141%	134%-146%	122%
Claimants 25≤age≤34 in accident year	3,025	2,530	84%	182%	154%	115%-183%	90%	110%	105%-114%	96%
Claimants 35≤age≤49 in accident year	4,830	4,160	86%	153%	129%	83%-160%	65%	94%	91%-98%	85%
Claimants 50≤age≤59 in accident year	3,035	2,790	92%	80%	73%	62%-83%	44%	80%	74%-84%	70%
Female claimants	3,410	3,000	88%	184%	159%	93%-204%	73%	101%	97%-105%	86%
Male claimants	8,290	7,015	85%	127%	108%	93%-120%	64%	97%	94%-99%	85%
1-5% permanent impairment	3,235	2,470	76%	114%	90%	57%-112%	48%	99%	94%-104%	86%
6-10% permanent impairment	3,415	2,910	85%	182%	150%	86%-193%	66%	98%	93%-102%	86%
11-20% permanent impairment	3,630	3,300	91%	140%	128%	108%-144%	68%	97%	92%-100%	83%
21-50% permanent impairment	1,270	1,195	94%	128%	120%	101%-136%	76%	99%	94%-103%	84%
>50% permanent impairment	145	140	97%	120%	115%	98%-130%	94%	110%	100%-119%	96%
Central	6,025	5,290	88%	135%	115%	79%-140%	60%	89%	86%-91%	81%
East	1,280	1,105	86%	150%	133%	53%-177%	71%	99%	94%-103%	87%
North	1,610	1,265	79%	140%	111%	82%-135%	75%	122%	109%-132%	91%
South	2,785	2,355	85%	163%	141%	114%-163%	74%	105%	100%-109%	89%
Entire Sample	11,700	10,010	86%	144%	123%	102%-140%	66%	98%	96%-100%	85%

^ post-accident discounted values include accident year and 9 calendar years post-accident

all dollar amounts 1994 constant dollars (post-tax); discounting based on 3% discount rate

~ sample consists of claimants present in LAD with controls

& bootstrapping sample of 2,000 with replacement

* pre-accident earnings based on average control earnings for a claimant in the accident year

+replacement rate for claimants without loss set to zero

Table 11.2 Replacement Rates Based on Pre-accident Earnings (Post-1990 Long-term Disability Sample, 1990-1994) ^#

	Sample Size~	Number with loss	Proportion with loss	Average individual-level loss replacement rate based on pre-accident earnings* (only claimants with losses)	Average individual-level loss replacement rate based on pre-accident earnings*+ (all claimants)	Bootstrapped confidence interval&	Aggregate-level loss replacement rate based on pre-accident earnings*	Average individual-level earnings replacement rate based on pre-accident earnings*	Bootstrapped confidence interval&	Aggregate-level earnings replacement rate based on pre-accident earnings*
				A	B	C	D	E	F	G
Claimants age≤24 in accident year	670	365	54%	327%	185%	93%-257%	753%	163%	155%-171%	135%
Claimants 25≤age≤34 in accident year	3,400	2,525	74%	339%	274%	79%-410%	116%	119%	112%-124%	105%
Claimants 35≤age≤49 in accident year	5,735	4,625	81%	304%	236%	62%-359%	77%	99%	97%-101%	91%
Claimants 50≤age≤59 in accident year	3,075	2,715	88%	68%	61%	55%-66%	53%	89%	79%-97%	75%
Female claimants	4,315	3,605	84%	178%	155%	80%-204%	78%	103%	97%-107%	90%
Male claimants	8,570	6,625	77%	291%	225%	97%-328%	79%	107%	103%-110%	92%
1-5% NEL	3,005	2,070	69%	169%	129%	(-17%) - 206%	59%	102%	97%-105%	90%
6-10% NEL	2,750	2,080	76%	152%	118%	86%-143%	75%	103%	100%-105%	92%
11-20% NEL	4,225	3,460	82%	424%	342%	96%-525%	81%	108%	100%-114%	92%
21-50% NEL	2,755	2,475	90%	167%	153%	107%-186%	85%	107%	100%-112%	92%
>50% NEL	150	145	97%	148%	146%	115%-170%	103%	122%	106%-134%	102%
Central	6,330	5,095	80%	279%	236%	88%-345%	74%	99%	96%-101%	89%
East	1,550	1,250	81%	159%	133%	90%-167%	78%	105%	95%-111%	91%
North	1,525	1,190	78%	468%	326%	(-123%) -559%	73%	116%	106%-124%	90%
South	3,480	2,695	77%	146%	114%	94%-131%	93%	114%	104%-120%	97%
0% or missing FEL	6,715	4,505	67%	177%	116%	33%-164%	59%	102%	99%-104%	92%
1-5% FEL	975	860	88%	613%	482%	(-488%) - 848%	80%	101%	96%-105%	90%
6-10% FEL	395	335	85%	159%	135%	78%-176%	83%	102%	94%-109%	92%
11-20% FEL	805	725	90%	279%	281%	(-70%) - 453%	86%	109%	96%-119%	93%
21-50% FEL	2,635	2,470	94%	262%	261%	74%-373%	87%	109%	101%-115%	92%
>50% FEL	1,360	1,335	98%	255%	279%	(-49%) - 445%	88%	118%	96%-133%	91%
Entire Sample	12,885	10,230	79%	251%	202%	110%-274%	79%	105%	102%-108%	92%

^ post-accident discounted values include accident year and 9 calendar years post-accident

all dollar amounts 1994 constant dollars (post-tax); discounting based on 3% discount rate

~ sample consists of claimants present in LAD with controls

& bootstrapping sample of 2,000 with replacement

* pre-accident earnings based on average control earnings for a claimant in the accident year

+replacement rate for claimants without loss set to zero

Table 11.3 Replacement Rates Based on Control Earnings (Pre-1990 Long-term Disability Sample, 1986-1989) ^#

	Sample Size~	Number with loss	Proportion with loss	Average individual-level loss replacement rate based on control earnings (only claimants with losses)	Average individual-level loss replacement rate based on control earnings+ (all claimants)	Bootstrapped confidence interval&	Aggregate-level loss replacement rate based on control earnings	Average individual-level earnings replacement rate based on control earnings	Bootstrapped confidence interval&	Aggregate-level earnings replacement rate based on control earnings
				A	B	C	D	E	F	G
Claimants age≤24 in accident year	810	635	78%	160%	129%	95%-157%	96%	104%	100%-108%	98%
Claimants 25≤age≤34 in accident year	3,025	2,590	86%	268%	250%	30%-390%	80%	101%	96%-104%	92%
Claimants 35≤age≤49 in accident year	4,830	4,020	83%	133%	109%	97%-121%	70%	95%	92%-97%	88%
Claimants 50≤age≤59 in accident year	3,035	2,410	79%	151%	120%	83%-145%	76%	102%	96%-106%	91%
Female claimants	3,410	3,010	88%	183%	169%	63%-226%	74%	95%	92%-98%	86%
Male claimants	8,290	6,650	80%	173%	142%	69%-180%	76%	100%	98%-103%	91%
1-5% permanent impairment	3,235	2,310	71%	123%	87%	69%-102%	63%	98%	94%-102%	92%
6-10% permanent impairment	3,415	2,825	83%	211%	185%	37%-264%	75%	99%	94%-102%	91%
11-20% permanent impairment	3,630	3,210	88%	195%	178%	74%-239%	77%	98%	95%-101%	88%
21-50% permanent impairment	1,270	1,180	93%	144%	136%	112%-156%	83%	102%	97%-106%	89%
>50% permanent impairment	145	140	97%	136%	130%	99%-155%	95%	107%	97%-119%	96%
Central	6,025	5,065	84%	170%	147%	58%-197%	69%	93%	90%-95%	87%
East	1,280	1,090	85%	158%	132%	103%-157%	78%	98%	94%-101%	91%
North	1,610	1,195	74%	130%	95%	80%-108%	96%	120%	110%-127%	99%
South	2,785	2,310	83%	221%	195%	59%-268%	80%	101%	98%-104%	92%
Entire Sample	11,700	9,660	83%	177%	150%	96%-188%	76%	99%	97%-101%	90%

^ post-accident discounted values include accident year and 9 calendar years post-accident

all dollar amounts 1994 constant dollars (post-tax); discounting based on 3% discount rate

~ sample consists of claimants present in LAD with controls

& bootstrapping sample of 2,000 with replacement

+replacement rate for claimants without loss set to zero

Table 11.4 Replacement Rates Based on Control Earnings (Post-1990 Long-term Disability Sample, 1990-1994) ^#

	Sample Size~	Number with loss	Proportion with loss	Average individual-level loss replacement rate based on control earnings (only claimants with losses)	Average individual-level loss replacement rate based on control earnings+ (all claimants)	Bootstrapped confidence interval&	Aggregate-level loss replacement rate based on control earnings	Average individual-level earnings replacement rate based on control earnings	Bootstrapped confidence interval&	Aggregate-level earnings replacement rate based on control earnings
				A	B	C	D	E	F	G
Claimants age≤24 in accident year	670	500	75%	133%	100%	79%-118%	103%	108%	103%-112%	101%
Claimants 25≤age≤34 in accident year	3,400	2,795	82%	148%	120%	102%-136%	82%	100%	98%-102%	93%
Claimants 35≤age≤49 in accident year	5,735	4,685	82%	120%	99%	86%-111%	74%	95%	93%-96%	90%
Claimants 50≤age≤59 in accident year	3,075	2,430	79%	120%	94%	76%-108%	85%	102%	100%-104%	94%
Female claimants	4,315	3,610	84%	135%	115%	96%-131%	82%	98%	96%-100%	92%
Male claimants	8,570	6,800	79%	124%	98%	89%-106%	79%	99%	98%-100%	92%
1-5% NEL	3,005	2,135	71%	90%	66%	53%-76%	60%	95%	93%-97%	91%
6-10% NEL	2,750	2,105	77%	139%	106%	79%-128%	77%	99%	97%-101%	93%
11-20% NEL	4,225	3,520	83%	135%	113%	101%-123%	82%	99%	97%-101%	92%
21-50% NEL	2,755	2,505	91%	142%	128%	107%-146%	86%	100%	98%-102%	92%
>50% NEL	150	145	97%	123%	118%	100%-133%	100%	112%	102%-120%	100%
Central	6,330	5,150	81%	119%	96%	84%-105%	76%	95%	94%-96%	90%
East	1,550	1,265	82%	131%	108%	90%-124%	80%	99%	95%-101%	92%
North	1,525	1,185	78%	146%	114%	91%-133%	85%	109%	105%-113%	95%
South	3,480	2,810	81%	137%	112%	90%-130%	86%	100%	98%-102%	95%
0% or missing FEL	6,715	4,575	68%	117%	80%	67%-92%	64%	97%	96%-98%	93%
1-5% FEL	975	885	91%	137%	122%	82%-150%	75%	92%	88%-95%	87%
6-10% FEL	395	350	89%	174%	154%	53%-222%	77%	94%	88%-100%	88%
11-20% FEL	805	745	93%	115%	107%	93%-119%	79%	99%	91%-104%	89%
21-50% FEL	2,635	2,525	96%	137%	131%	116%-143%	83%	98%	96%-100%	89%
>50% FEL	1,360	1,335	98%	138%	138%	126%-148%	98%	114%	110%-117%	99%
Entire Sample	12,885	10,410	81%	128%	104%	95%-111%	80%	99%	98%-100%	92%

^ post-accident discounted values include accident year and 9 calendar years post-accident

all dollar amounts 1994 constant dollars (post-tax); discounting based on 3% discount rate

~ sample consists of claimants present in LAD with controls

& bootstrapping sample of 2,000 with replacement

+replacement rate for claimants without loss set to zero

Table 11.5 95% Confidence Interval for Loss Replacement Rate Base on Control Earnings (Pre-1990 Sample)

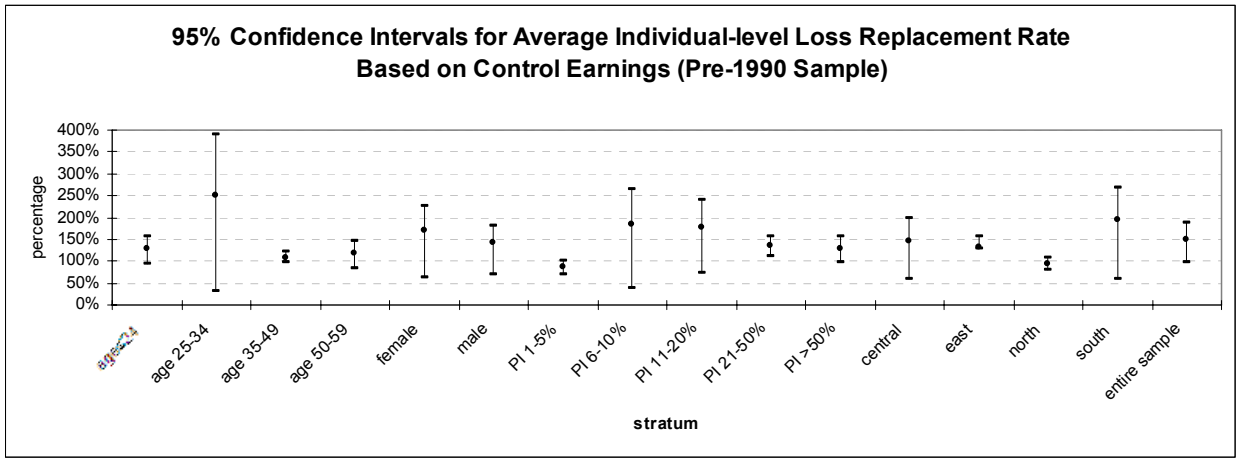


Table 11.6 95% Confidence Interval for Earnings Replacement Rate base on Control Earnings (Pre-1990 Sample)

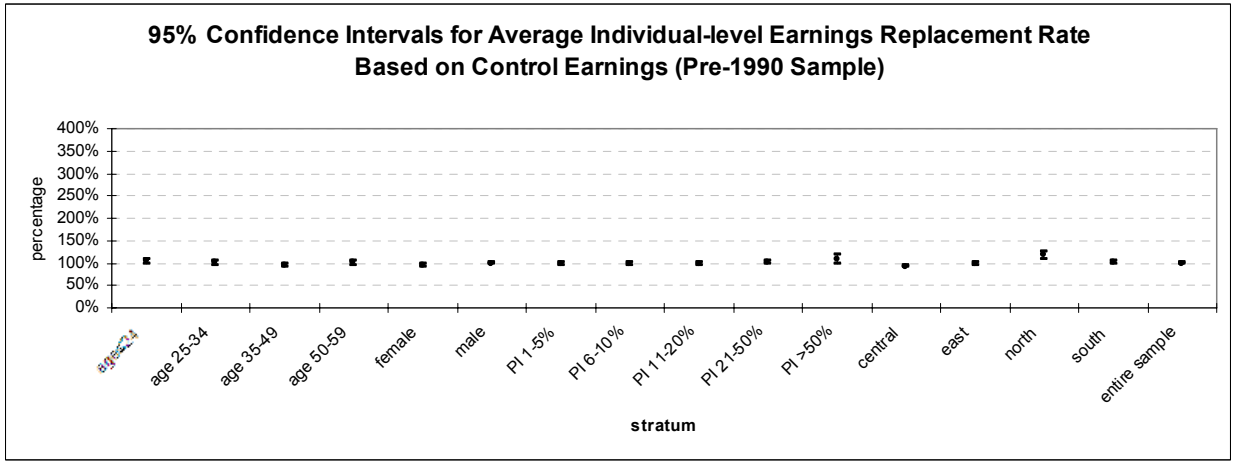


Table 11.7 95% Confidence Interval for Loss Replacement Rate Base on Control Earnings (Post-1990 Sample)

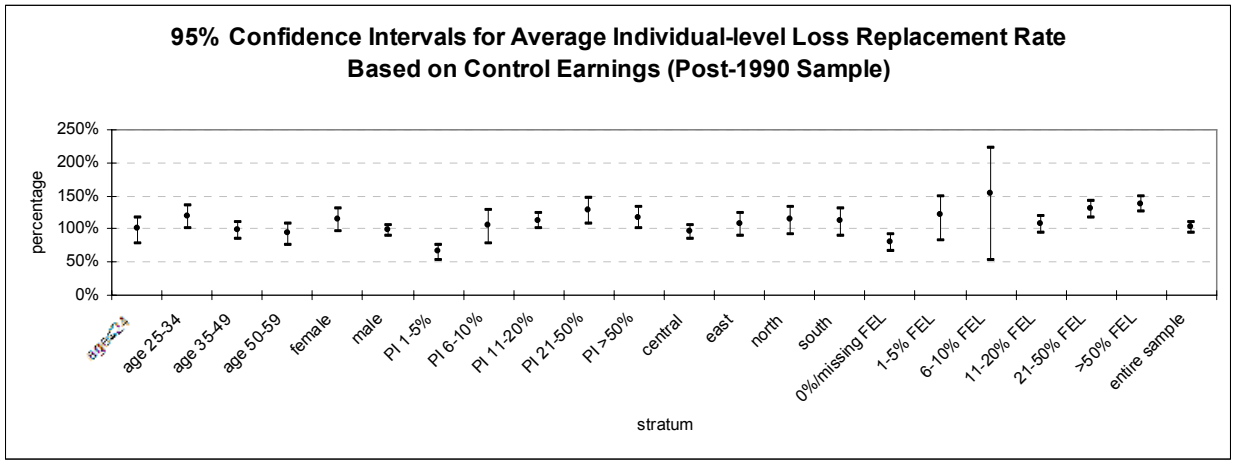
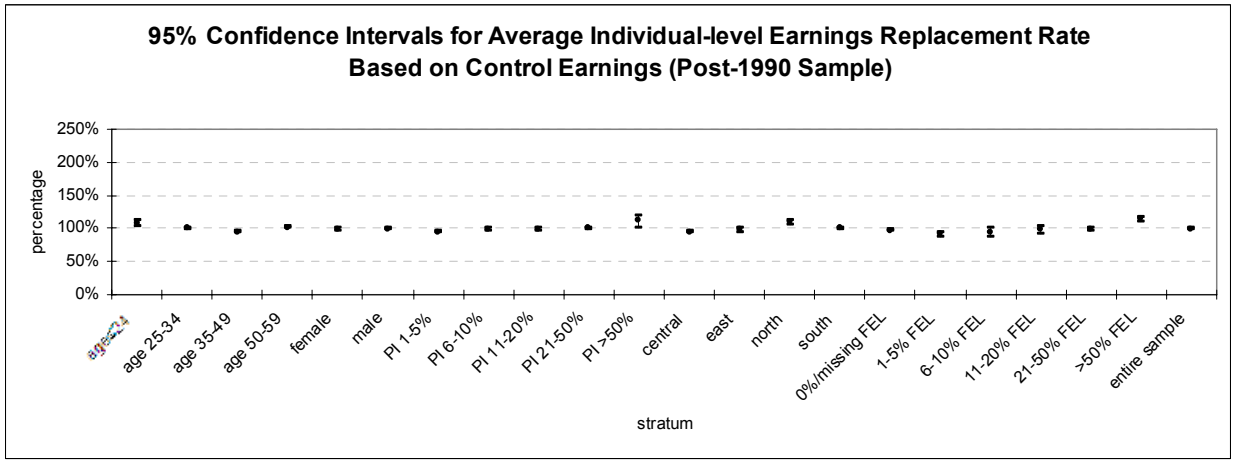


Table 11.8 95% Confidence Interval for Earnings Replacement Rate base on Control Earnings (Post-1990 Sample)



Appendix XII: Short-term Disability Claimants Results

Table 12.1 Labor-market Earnings of Claimants and Controls

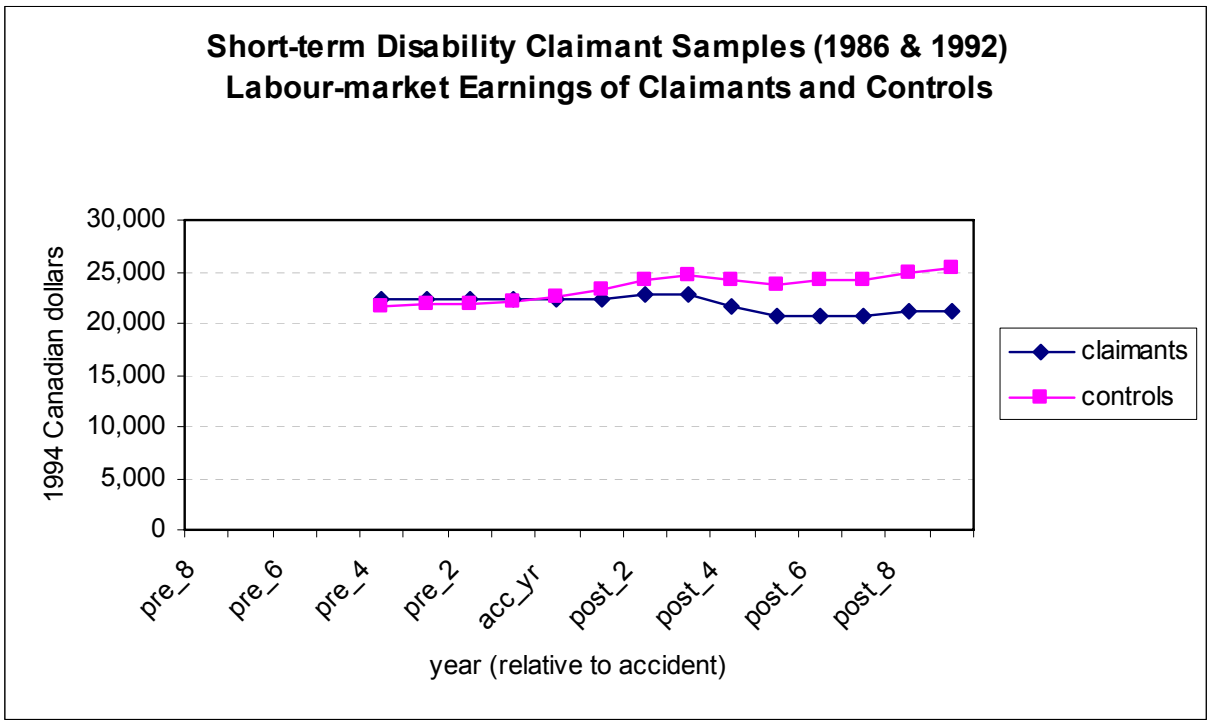


Table 12.2 Labor-market Earnings of Claimants and Controls by Gender

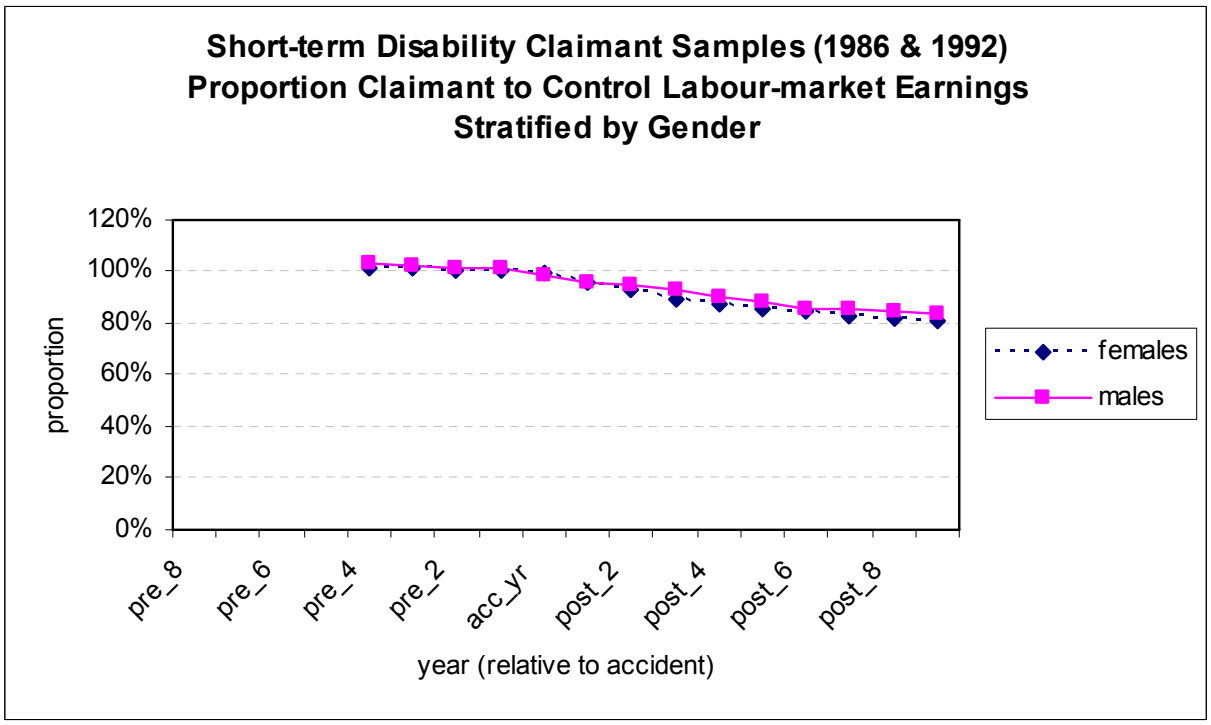


Table 12.3 Labor-market Earnings of Claimants and Controls by Age Bracket

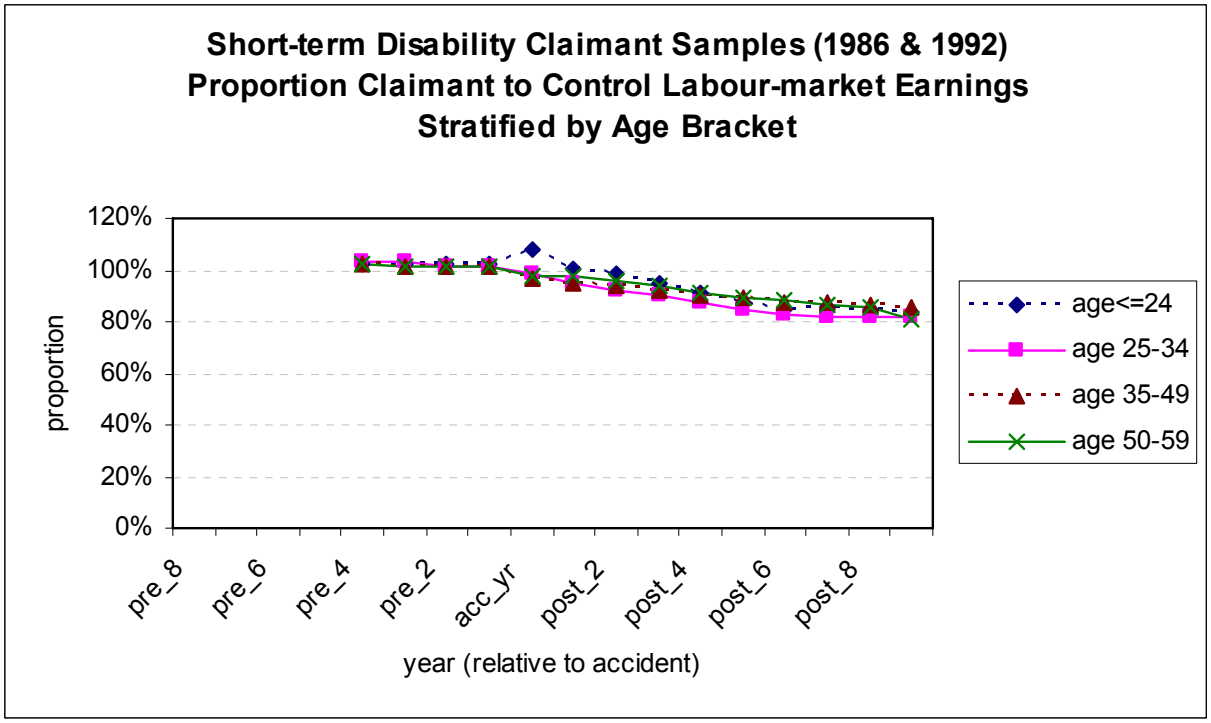


Table 12.4 Labor-market Earnings of Claimants and Controls by Region

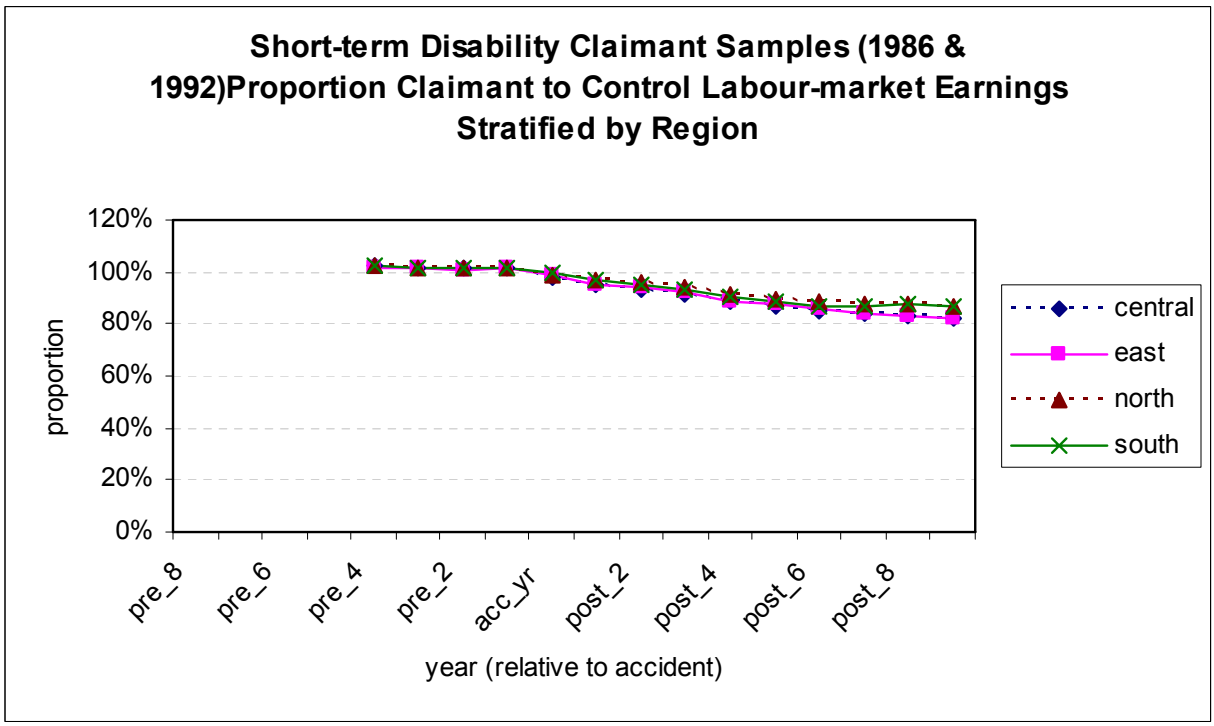


Table 12.5 Earnings and Benefits Post-accident for Claimants and Controls

	Sample Size~	Discounted post-accident labour-market earnings	Discounted total benefits	Discounted pre-accident labour-market earnings*	Average individual-level earnings loss based on pre-accident earnings*+	Number with loss based on pre-accident earnings*	Aggregate-level earnings loss based on pre-accident earnings*	Discounted control labour-market earnings	Average individual-level earnings loss based on control earnings	Number with loss based on control earnings	Aggregate-level earnings loss based on control earnings
				A	B	C	D	E	F	G	H
Claimants age≤24 in accident year	9,565	$151,300	$1,100	$120,500	$44,200	3,195	-$30,800	$166,500	$59,800	5,715	$15,200
Claimants 25≤age≤34 in accident year	17,110	$192,600	$1,800	$199,700	$60,600	8,990	$7,100	$220,000	$71,900	10,715	$27,400
Claimants 35≤age≤49 in accident year	16,545	$207,500	$2,500	$231,400	$67,000	10,060	$23,900	$230,800	$69,600	9,760	$23,300
Claimants 50≤age≤59 in accident year	6,305	$170,100	$3,200	$226,100	$87,800	4,725	$56,000	$184,600	$71,200	3,450	$14,500
Female claimants	13,110	$139,300	$1,900	$152,700	$56,000	7,525	$13,400	$157,700	$58,100	7,935	$18,400
Male claimants	36,415	$203,800	$2,200	$214,800	$69,700	19,440	$11,000	$227,100	$72,600	21,710	$23,300
Central	27,480	$188,400	$2,300	$202,700	$67,300	15,425	$14,300	$212,900	$71,500	16,665	$24,500
East	6,730	$174,000	$1,500	$185,800	$61,700	3,665	$11,800	$195,500	$64,700	4,040	$21,500
North	3,180	$186,700	$2,900	$194,700	$70,900	1,600	$8,000	$202,800	$67,500	1,785	$16,100
South	12,140	$190,100	$1,800	$196,600	$63,400	6,275	$6,500	$208,400	$65,000	7,155	$18,300
Entire Sample	49,525	$186,700	$2,100	$198,400	$65,800	26,965	$11,700	$208,800	$68,700	29,645	$22,100

^ post-accident discounted values include accident year and 9 calendar years post-accident

all dollar amounts 1994 constant dollars (post-tax); discounting based on 3% discount rate

~ sample consists of claimants present in LAD with controls

* pre-accident earnings based on average control earnings for a claimant in the accident year

+ replacement rate for claimants without loss set to zero

Table 12.6 Replacement Rates Based on Pre-accident Earnings (1986 & 1992 Short-term Disability Samples) ^#

Replacement Rates Based on Pre-injury Earnings (1986 & 1992 Short-term Disability Samples) ^#

				includes only those with loss	includes all observations					
	Sample Size~	Number with loss	Proportion with loss	Average individual-level loss replacement rate based on pre-accident earnings* (only claimants with losses)	Average individual-level loss replacement rate based on pre-accident earnings*+ (all claimants)	Bootstrapped confidence interval&	Aggregate-level loss replacement rate based on pre-accident earnings*	Average individual-level earnings replacement rate based on pre-accident earnings*	Bootstrapped confidence interval&	Aggregate-level earnings replacement rate based on pre-accident earnings*
				A	B	C	D	E	F	G
Claimants age≤24 in accident year	9,565	3,195	33%	19%	6%	2%-9%	(-4%)	153%	150%-156%	126%
Claimants 25≤age≤34 in accident year	17,110	8,990	53%	15%	8%	6%-10%	25%	111%	109%-114%	97%
Claimants 35≤age≤49 in accident year	16,545	10,060	61%	39%	22%	1%-34%	10%	120%	81%-142%	91%
Claimants 50≤age≤59 in accident year	6,305	4,725	75%	13%	10%	7%-12%	6%	85%	82%-88%	77%
Female claimants	13,110	7,525	57%	42%	22%	(-3%) - 36%	14%	129%	82%-153%	92%
Male claimants	36,415	19,440	53%	17%	9%	7%-10%	20%	115%	112%-118%	96%
Central	27,480	15,425	56%	31%	17%	4%-24%	16%	117%	95%-128%	94%
East	6,730	3,665	54%	14%	7%	5%-9%	13%	115%	108%-120%	94%
North	3,180	1,600	50%	21%	10%	5%-14%	36%	131%	124%-138%	97%
South	12,140	6,275	52%	13%	7%	5%-8%	28%	123%	113%-129%	98%
Entire Sample	49,525	26,965	54%	24%	13%	5%-17%	18%	119%	106%-127%	95%

^ post-accident discounted values include accident year and 9 calendar years post-accident

all dollar amounts 1994 constant dollars (post-tax); discounting based on 3% discount rate

~ sample consists of claimants present in LAD with controls

& bootstrapping sample of 2,000 with replacement

* pre-accident earnings based on average control earnings for a claimant in the accident year

+ replacement rate for claimants without loss set to zero

Table 12.7 Replacement Rates Based on Control Earnings (1986 & 1992 Short-term Disability Samples) ^#

	Sample Size~	Number with loss	Proportion with loss	Proportion of loss replaced, based on control earnings (only claimants with losses)	Average individual-level loss replacement rate based on control earnings+ (all claimants)	Bootstrapped confidence interval&	Aggregate-level loss replacement rate based on control earnings	Average individual-level earnings replacement rate based on control earnings	Bootstrapped 95% confidence interval&	Aggregate-level earnings replacement rate based on control earnings
				A	B	C	D	E	F	G
Claimants age≤24 in accident year	9,565	5,715	60%	10%	6%	4%-8%	7%	95%	94%-96%	92%
Claimants 25≤age≤34 in accident year	17,110	10,715	63%	21%	13%	7%-18%	7%	94%	93%-95%	88%
Claimants 35≤age≤49 in accident year	16,545	9,760	59%	24%	14%	10%-17%	11%	96%	93%-98%	91%
Claimants 50≤age≤59 in accident year	6,305	3,450	55%	52%	32%	5%-50%	22%	100%	98%-102%	94%
Female claimants	13,110	7,935	61%	19%	13%	5%-18%	10%	93%	92%-94%	90%
Male claimants	36,415	21,710	60%	25%	15%	10%-19%	9%	97%	95%-98%	91%
Central	27,480	16,665	61%	26%	17%	9%-23%	9%	94%	93%-94%	90%
East	6,730	4,040	60%	18%	10%	3%-15%	7%	97%	91%-101%	90%
North	3,180	1,785	56%	25%	13%	5%-19%	18%	104%	99%-107%	93%
South	12,140	7,155	59%	18%	11%	6%-15%	10%	99%	97%-100%	92%
Entire Sample	49,525	29,645	60%	23%	14%	10%-18%	10%	96%	95%-97%	90%

^ post-accident discounted values include accident year and 9 calendar years post-accident

all dollar amounts 1994 constant dollars (post-tax); discounting based on 3% discount rate

~ sample consists of claimants present in LAD with controls

& bootstrapping sample of 2,000 with replacement

+ replacement rate for claimants without loss set to zero

Appendix XIII: Marital Break Up Study

Table 13.1 Descriptives for the Ontario Sub-sample

		no break up@	break up@	proportion break up
males	impaired	10,369	4,670	31%
	not impaired	52,607	20,069	28%
	total	62,976	24,739	28%
females	impaired	3,982	1,988	33%
	not impaired	23,264	9,726	29%
	total	27,246	11,714	30%

@ values based on number of individuals in the sample

		mean+	std dev
male	age	51.88	12.24
	age difference	2.84	5.05
	number of children under 16	0.68	1.04
	family income from all sources	10.51	1.84
	years married	13.28	4.61
female	age	49.42	10.73
	age difference	2.45	5.51
	number of children under 16	0.58	0.94
	family income from all sources	10.64	1.81
	years married	13.20	4.60

+values based on observation years used in the duration modeling

		no+	yes+	proportion change up
male	change to principal earner*	831,625	47,525	5%
	change to dependent*	632,438	246,712	28%
females	change to principal earner*	356,831	36,974	9%
	change to dependent*	362,149	31,756	8%

* reference group is no change in status

+values based on observation years used in the duration modeling

		no+	yes+	proportion rural
male	rural residence^	716,004	163,145	19%
females	rural residence^	328,144	65,761	17%

^reference group is urban residence

+values based on observation years used in the duration modeling

Table 13.2 Duration Model of Time to Marital Breakup (Males, Ontario Sub-sample)

Explanatory Variables	Estimate	95% CI Estimate	95% CI Estimate	Hazard Ratio	95% CI		Percent Difference	95% CI		Sig
Impaired	0.139	0.103	0.175	1.15	1.11	1.19	15%	11%	19%	**
not impaired (reference group)										
Age	-0.113	-0.122	-0.104	0.89	0.88	0.90	-11%	-12%	-10%	**
Measured in years										
Age squared	0.001	0.001	0.001	1.00	1.00	1.00	0%	0%	0%	**
Age difference	0.056	0.054	0.058	1.06	1.06	1.06	6%	6%	6%	**
Male age less female age										
Number of children under 16	-0.181	-0.199	-0.163	0.83	0.82	0.85	-17%	-18%	-15%	**
Count variable										
Family income from all sources	-0.149	-0.162	-0.135	0.86	0.85	0.87	-14%	-15%	-13%	**
1994 dollars										
Change to principal earner	0.184	0.135	0.233	1.20	1.14	1.26	20%	14%	26%	**
Change to dependent	0.027	-0.010	0.063	1.03	0.99	1.07	3%	-1%	7%	NS
No change in status (reference group)										
Years married	-0.144	-0.147	-0.135	0.87	0.86	0.87	-13%	-14%	-13%	**
Years married prior to accident (up to 8+)										
Rural residence	0.071	0.035	0.106	1.07	1.04	1.11	7%	4%	11%	**
Urban residence (reference group)										
Sample size	858,998									

**p≤0.01 *p≤0.05 NS=not significant

Table 13.3 Duration Model of Time to Marital Breakup (Females, Ontario Sub-sample)

Explanatory Variables	Estimate	95% CI Estimate	95% CI Estimate	Hazard Ratio	95% CI		Percent Difference	95% CI		Sig
Impaired	0.220	0.165	0.274	1.25	1.18	1.32	25%	18%	32%	**
not impaired (reference group)										
Age	-0.180	-0.191	-0.168	0.84	0.83	0.85	-16%	-17%	-15%	**
Measured in years										
Age squared	0.002	0.002	0.002	1.00	1.00	1.00	0%	0%	0%	**
Age difference	-0.061	-0.063	-0.059	0.94	0.94	0.94	-6%	-6%	-6%	**
Male age less female age										
Number of children under 16	-0.012	-0.035	0.012	0.99	0.97	1.01	-1%	-3%	1%	NS
Count variable										
Family income from all sources	-0.164	-0.176	-0.152	0.85	0.84	0.86	-15%	-16%	-14%	**
1994 dollars										
Change to principal earner	0.478	0.421	0.535	1.61	1.52	1.71	61%	52%	71%	**
Change to dependent	0.365	0.296	0.435	1.44	1.34	1.54	44%	34%	54%	**
No change in status (reference group)										
Years married	-0.100	-0.109	-0.092	0.90	0.90	0.91	-10%	-10%	-9%	**
Years married prior to accident (up to 8+)										
Rural residence	-0.033	-0.086	0.021	0.97	0.92	1.02	-3%	-8%	2%	NS
Urban residence (reference group)										
Sample size	385,549									

**p≤0.01 *p≤0.05 NS=not significant