CPP

Phase II
Disability
Benefits

Evaluation Report

Labour Supply and Well-Being of Older Workers

Human Resources Development Canada
Développement des ressources humaines Canada

Canada
SP-AH037E-08-97

Canada Pension Plan Disability Insurance Benefits and Labour Supply and Well-Being of Older Workers

Evaluation and Data Development
Strategic Policy
Human Resources Development Canada

August 1997

ACKNOWLEDGEMENTS

I am grateful to Courtney Coile, Kevin Frisch and particularly Sue Dynarski for excellent research assistance, to Doug Bernheim, John Bound, Peter Diamond, Louis Kaplow, Don Parsons and seminar participants at Harvard University, Brown University, and the NBER for helpful comments, to Marilyn Knock and Ging Wong for comments and invaluable assistance with data collection, to Bernard Dussault and Pierre Plamondon for endless patience in explaining the institutional features of the Canadian DI system, and to Human Resources Development Canada and the National Institute of Aging for financial support. Finally, I would add that the views expressed in this study are those of the author, and not necessarily those of Human Resources Development Canada.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Disability Insurance is a public program that provides income support to persons unable to continue work due to disability. The difficulty of defining disability, however, has raised the possibility that this program may be subsidizing the early retirement of workers who are not truly disabled. A critical input for assessing the optimal size of disability insurance benefits is therefore the elasticity of the labour supply response to these benefits. This parameter has been difficult to estimate in the context of the U.S. disability insurance program, since all workers face an identical benefits schedule. In Canada, however, the existence of separate disability insurance programs for Quebec and the rest of Canada offers an opportunity to examine this parameter.

In January, 1987, disability benefits under the Canada Pension Plan (CPP) were raised by over $150 per month, while benefits were unchanged in Quebec. This study examines the rise in CPP disability benefits relative to the Quebec Pension Plan (QPP) disability benefits using two approaches: a "difference-in-difference" analysis, and a replacement rate model. The results imply an elasticity of labour force non-participation with respect to CPP disability benefits of 0.25 to 0.32.

This sizable labour supply response does not necessarily imply that the rise in CPP disability benefits is bad policy, however. The results of a simple social welfare model show that the value to society from a rise in social insurance benefits can outweigh the costs even with this sizable labour supply response.

1. INTRODUCTION

One of the largest social insurance programs throughout the developed world is Disability Insurance (DI). In the U.S., the DI program has over 5 million beneficiaries and benefit payments of almost $40 billion (U.S. Department of Health and Human Services, 1994). In Canada, DI has approximately 340,000 beneficiaries, with benefits payments over $3 billion (Department of Human Resources). As a share of GNP, the two countries spend roughly the same amount on their DI programs.

In theory, DI provides benefits for workers who are physically incapable of finding suitable work. Disability would seem to be an ideal targeting device, allowing program administrators to divert resources towards those truly in need of income support. In practice, however, it is difficult to determine whether workers are truly disabled. A number of studies have revealed substantial error in the disability determination process.[1] The difficulty of appropriately identifying disability and the generous levels of benefits available have led many observers to claim that DI is largely distorting work decisions, and in essence subsidizing the early retirement of the older workers for whom appropriately defining career-ending disability is most difficult.

At the same time, other analysts have claimed that the vast majority of the DI recipient population is truly disabled and unable to pursue gainful employment, suggesting that any distortion to labour supply decisions is minimal. This argument implies that the welfare gains from redistributing resources to the low income disabled would outweigh any costs through reductions in labour supply. A critical input for evaluating this claim, and for modeling the appropriate level of DI benefits, is therefore an empirical estimate of the elasticity of response of labour supply to benefit levels.

There is a substantial U.S. based literature on the effects of DI benefits on labour supply. Evaluating this behavioral response in the context of the U.S. case has proved to be difficult, however. This is because the DI program in the U.S. provides benefits which differ across workers primarily through their past earnings histories. But one's earnings history will most likely be highly correlated with one's tastes for work at older ages, and it is difficult to disentangle the behavioral effects of DI from these taste differences. What is required to distinguish the effects of DI is differences in benefit levels across workers which arise independently of their underlying tastes for work at older ages.

Such differences have arisen in the context of the Canadian DI system. DI in Canada operates in much the same way as it does in the U.S., with the key difference being that the program is administered under two different plans: the Quebec Pension Plan, or QPP, which covers the province of Quebec, and the Canada Pension Plan, or CPP, which

1 These studies are reviewed in Parsons (1991a).

covers the rest of Canada. These two systems are identical in most respects. Since the early 1970s, however, disability benefits have risen more rapidly under the QPP. By the end of 1986, disability benefits under the QPP were substantially more generous than were benefits under the CPP, particularly for those disabled workers who had low earnings before their disability. Then, in January 1987, the CPP raised its benefit levels to equalize the generosity of the two systems. This resulted in a rise in benefits under the CPP of almost $2000 per year. On average, this represents a rise of 36 percent in the replacement rate of the CPP relative to QPP. This dramatic shift in differential benefits generosity is precisely the type of change that can be used to evaluate the labour supply response to DI benefits. That is, this policy change provides an opportunity to study the effect of changing DI benefits differentially for some workers (those not in Quebec) and not for others (those in Quebec).

The primary purpose of this evaluation study is to use this policy change to estimate the elasticity of the labour supply response for older persons with respect to DI benefits. The analysis uses data from the Survey of Consumer Finances (SCF), an annual cross sectional survey which collects information on demographic and economic characteristics. Data from the SCF is matched up with information on the benefits available under the CPP and QPP over time. Two types of estimates of the policy change are computed. The first is a standard "difference-in-difference" estimate which focuses on the labour supply effect of the large change in benefits in the rest of Canada relative to Quebec. The second is a more parameterized estimate that exploits the underlying variation in the impact of this policy change across workers within the CPP and QPP plans.

For both estimators, the results indicate that there is a large effect of benefits on the labour supply of older workers. The central estimates imply that the elasticity of labour force non-participation with respect to benefit levels is 0.25 to 0.32. This finding is robust to a variety of specification checks. Despite this large labour supply response, however, a simplified social welfare analysis suggests that the gains from this transfer to the relatively poorly off disabled under the CPP plan outweighed the net tax cost from financing this increase in CPP rolls, under plausible assumptions about preference parameters.

The report proceeds as follows. Part I reviews the key facts on the DI program in Canada, compares the Canadian system to that in the U.S., and reviews the empirical literature on the behavioral effects of DI. Part II describes the data, and Part III discusses the empirical strategy. Part IV presents the results for labour supply estimation, Part V considers the welfare implications of these findings and Part VI presents the conclusions.

2. BACKGROUND

THE CANADIAN DI PROGRAM

The Canadian DI program dates from January 1, 1966, when it was introduced along with work related retirement pensions under the QPP and CPP. Eligibility is conditioned on working and contributing to the program in 2 of the previous 3 years, or 5 of the previous 10 years. Eligibility is also conditioned on an inability to pursue gainful employment due to a physical disability.[2] This is determined by a medical examiner; individuals who are denied claims have the right to appeal their decisions at least twice to higher levels of adjudication. About 40 percent of claims were denied at the initial determination stage under the CPP in 1989, the last year of my sample (and the earliest year for which data are available). At the same time, the denial rate for the QPP time was 33 percent. While the CPP has a higher initial denial rate, it has a lower denial rate during the appeals process, so that after successful appeals are factored in the overall denial rate is quite similar across the two plans (32 percent under CPP vs. 30 percent under QPP).[3] There is a three to four month waiting period from the onset of disability before benefit receipt begins.

Under both the CPP and QPP, benefits consist of three parts. The first is a flat rate portion available to all eligible workers. The second is an earnings related portion. The earnings related portion is calculated by first inflating the worker's earnings history[4] to current dollars using a wage index, dropping the lowest 15 percent of months of real earnings, and taking 18.75 percent of the average of the remaining series.[5] The final portion is a child allowance, which is a fixed amount per month per child under the age of

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2 Under the CPP, gainful employment means any job. Under the QPP gainful employment means "usual job" since 1993; it was any job before then. Since 1984, for those over age 60 in the QPP, gainful employment means one's last job, but this paper focuses on those below age 60 only.

3 Based on unpublished administrative data from the CPP and QPP. It is difficult to infer relative differences in screening stringency across the programs from these figures, since the underlying pool of applicants at any point in time may differ in their health; see Gruber and Kubik (forthcoming) for a further discussion of the interpretation of denial rate data.

4 The earnings history for workers goes back to 1966.

5 Months of previous receipt of disability insurance are also excluded, as are months where the worker had primary child-bearing responsibility. Since the focus of this study is older men, the second item is ignored in the benefits calculation.

18. Averaging across both the CPP and QPP, benefit levels replaced approximately 26 percent of the average earnings of 50-59 year old workers in Canada in 1986.[6]

While the computation of the earnings related portion has been identical across the CPP and QPP since the programs' inception, there have been differences in the other two parts of the benefits computation. The flat rate portion was identical in the two provinces until 1972, at which point it began to rise more rapidly in Quebec. This time series pattern is illustrated in Figure 1, which graphs the flat rate benefit over time. As indicated in Figure 1, there was a growing gap between the two provinces over time, which by 1987 was over $150 per month. In January, 1987, the CPP raised its flat rate portion to be identical to that of the QPP, a rise of over 150 percent. The two series have moved in tandem ever since. There have also been differences in the computation of the child allowance over time. The child allowance became more generous under the CPP, rising steadily from $57 per child per month in 1981 to $155 in 1993, while it remained low ($29) until 1993 under the QPP. This counteracted some of the time series gap in flat rate portions for those disabled workers with children, but had little effect on the huge relative change in benefits in January, 1987.

It is important to note that the increase in disability benefits under the CPP was not the only policy change of 1987. There were two other changes that are potentially relevant for this analysis. The first was a reduction in the required earnings history to qualify for CPP disability benefits. Before 1987, eligibility was conditioned on having contributed in the lesser of 10 years or 1/3 of one's career. In 1987, the requirements were eased to those described above. While making a number of younger workers eligible for DI, however, this had little practical effect on the older population on which this study is focused, since older workers generally had enough experience to be eligible under either system.

The second policy change is potentially more problematic: the introduction of the early retirement option (at age 60) for retirement benefits under CPP.[7] This means that even in the absence of a change in DI benefits there may be reduced labour force participation among those aged 60 to 64. Therefore, this paper focuses on workers below age 60. It seems unlikely ex ante that this change had important effects on workers below age 60, since Baker and Benjamin (1996) find little effect on workers in the age 60 to 64 group who were directly affected by the policy change. Nevertheless, in a life-cycle labour supply model it is certainly possible that changes in the opportunity set after age 60 can have impacts on decisions made before that point.[8] However, by

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6 Based on author's computation, using the potential benefits calculation methodology described below.

7 Individuals who choose to retire before age 65 see their benefits reduced by 0.5 percent per month for each month before age 65 that they claim CPP retirement benefits, for a total reduction in benefits of 30 percent for those claiming at age 60.

8 For example, consider an individual who under the old regime was planning to retire at 63 and live for two years off their savings. In the new regime that worker may choose to retire at 59, live for one year off of their savings, and use the other year of savings to make up for the actuarially reduced benefits at age 60. On the other hand, the early retirement age may be reducing the attractiveness of the DI program for older workers, since they can now leave their jobs at 60 and receive retirement income without the possible stigma of calling themselves "disabled". This could cause those who would otherwise leave in

exploiting the fact that Quebec changed its age of early retirement several years earlier, evidence presented in this report is able to show that the early retirement change in the CPP is not driving the empirical results for the 45 to 59 year old sample. Of course, one cannot automatically rule out the hypothesis that this increase in benefits was itself motivated by underlying (relative) changes in the (non-Quebec) economy that affected the relative job prospects of older workers.[9] Therefore, the report also discusses a number of tests which suggest that this is not the case.

COMPARISON TO THE U.S. PROGRAM

The DI programs in the U.S. and Canada are quite similar, with only two major differences. The first is in the structure of benefits. Benefits in the U.S. consist primarily of an earnings related portion, without any flat rate component. On the other hand, the schedule translating past earnings to benefits is much more progressive in the U.S., so that the two countries have a similar redistributional structure to their benefits schedules. Benefits are much higher in the U.S. on average, with a replacement rate of 42 percent for the average worker (U.S. Congress Committee on Ways and Means, 1990). Moreover, income from DI is not taxable for most households in the U.S., whereas it is fully taxable in Canada. As a result, after tax replacement rates in the U.S. are much higher.

The second difference is the stringency of the screening process for DI. While the basic structure is the same (with an initial claiming stage and an appeals process), the denial rate at the initial stage in the U.S. is 57 percent. The ultimate denial rate (factoring in appeals) is 47 percent in the U.S., compared to roughly 30 percent under the Canadian system. Also, the waiting period for the receipt of benefits (5 months) is somewhat longer than in Canada. Despite more stringent screening (and perhaps because of the more generous benefits), the incidence of DI receipt in the U.S. is somewhat higher. For example, 4.8 percent of men age 45 to 59 are on this program in the U.S., compared to 3.9 percent of men in this age group in the CPP provinces.[10]

their late 50s to go on DI to delay leaving until age 60, and to then get retirement benefits. Thus, the direction of the expected effect on those below age 60 is unclear.

9 No such motivation is mentioned by either the law itself or by narratives describing the political economy of the DI program (Human Resources Development Canada, 1995).

10 Data for 1993, the most recent year available. Data for Canada from Human Resources Development Canada (1996); data for U.S. from U.S. Department of Health and Human Services (1994). The cost of the DI program is, as a result, roughly 10 percent higher as a share of GNP in the U.S. than in Canada.

DI AND THE BEHAVIOR OF OLDER WORKERS - THE U.S. EVIDENCE

The literature on the effects of DI on the labour market in the U.S. is motivated by a striking time series fact: the almost exactly parallel increase in the DI rolls and decline in the labour force participation of older men in the 1960s and 1970s. DI enrollment grew from 455,000 in 1960 to 2.9 million by 1980 (U.S. Department of Health and Human Services, 1993). Over this same period, the non-participation rate among men age 45 to 54 rose by 105 percent, and the non-participation rate for men age 55 to 64 rose by 111 percent (Bound, 1989). Drawing causal inferences from this time series data is problematic, however, as there were a number of other changes in the labour market and non-labour market opportunities of older males during this era.[11]

A sizeable literature has attempted to use cross-sectional variation to identify the role that DI plays in the labour force participation decisions of older men. These studies generally proceed by modeling labour force participation or DI recipiency as a function of potential DI benefit levels. The first study to do so was Parsons (1980, 1984), who estimated an elasticity of labour force non-participation with respect to DI benefit levels of 0.49 to 0.93. His upper bound estimate implied that increases in DI benefits (as well as in benefits from other welfare programs for older workers) over the 1960s and 1970s could explain the entire time series trend in non-participation. Other estimates have supported the contention that DI has a significant disincentive effect, although the estimated magnitudes have generally been much smaller than that of Parsons. Leonard (1986) and Bound (1989) provide reviews of this evidence, which estimates elasticities of non-participation in the range of 0.1 to 0.2.

Bound (1989) argues, however, that this type of strategy is likely to yield misleading inferences for the effect of DI generosity on labour force participation. Since DI benefits are a redistributive function of past earnings which is common to all workers, variation in potential benefits comes primarily from differences in earnings histories across workers. This leads to a fundamental identification problem in modeling the effect of potential DI benefits on work decisions. Therefore, a finding that workers with higher potential DI replacement rates are more likely to leave their jobs may simply reflect the fact that low earning workers have less of a desire to continue working.[12] Bound suggests an alternative empirical strategy which involves examining the behavior of workers who apply for DI benefits but are rejected. In theory, these workers should be at

11 For example, there was rapid growth in retirement incomes in this era, both due to increased Social Security benefit levels, and increased coverage of the labour force by pensions (Lumsdaine and Wise, 1990). There was also a rapid rise in the labour force participation of wives, which could either increase (through the income effect) or decrease (through complementary leisure effects) non-participation.

12 Studies such as Haveman and Wolfe (1984) attempt to correct for this omitted variables bias, but Bound (1989) argues that the problem has not been convincingly resolved because of the strict distributional assumptions necessary to achieve their solution.

least as healthy as those who are on the program, so that their labour force participation rates provide an upper bound on the potential labour force participation of accepted workers. Bound finds, however, that fewer than 50 percent of rejected workers had returned to work by 18 months (or more) after their rejection, which suggests that DI program growth can explain no more than 40 percent of the rise in non-participation among older males.

The validity of denied applicants as a control group, however, rests on two key assumptions. First, these applicants must be unobservably no less likely to work than accepted applicants. Bound uses pre-application differences in characteristics to suggest that this is true. Second, the process of applying for DI must have no lasting effects on labour market performance. This assumption is more difficult to evaluate, and Bound (1991a) and Parsons (1991b) provide differing opinions on its validity. In any case, what is clearly needed to identify the behavioral impact of DI benefits is variation in program generosity which is independent of underlying tastes for work. This variation is provided by the large relative benefits increase under the CPP in 1987.

While most of the literature has focused on the effect of potential DI benefits on labour supply, there are a number of other tools available to the DI policy-maker who is trying to mitigate moral hazard. Marvel (1982), Halpern and Hausman (1986), Parsons (1991a), and Gruber and Kubik (forthcoming) examine the effect of the DI denial rate on applications to DI and on labour force participation. Halpern and Hausman and Parsons find a strong association between denial rates and DI applications, and Gruber and Kubik also find a strong association with the labour force participation of older workers. Gruber and Kubik estimate that each 10 percent rise in denial rates led to a statistically significant 2.8 percent fall in labour force non-participation among 45 to 64 year old males. This estimate corresponds to a steady state elasticity of non-participation with respect to benefits generosity of 0.12 to 0.17, which is the range of the post-Parsons U.S. literature.[13]

DI AND THE BEHAVIOR OF OLDER WORKERS - THE CANADIAN EVIDENCE

I am aware of only one article which has analyzed the behavioral incentives of the Canadian DI system. Maki (1993) pursues two different strategies in analyzing the effects of benefits on labour force attachment. First, he uses a panel of aggregate province-level data for the 1975-1983 period, and he finds a strong negative correlation between benefits (normalized by average wages) and participation. But this effect disappears when he includes province and year fixed effects in the regression, which may be necessary to control for underlying trends in labour supply and fixed differences in tastes for work across areas. Second, he uses a cross-section of micro-data for

13 Behavioral responses to denial rate changes are converted to benefits elasticities by noting that in steady state a 10 percent rise in the acceptance rate has the same budgetary implications as a 10 percent rise in the benefit level.

1985 to estimate a structural model of the effect of DI, along the lines of must of the U.S. literature. With this approach, his estimates are very sensitive to the exact specification of his model. But this technique is once again subject to Bound's (1989) criticism, since the variation here mostly comes from differences in individual characteristics that may otherwise be correlated with tastes for work.

3. DATA USED IN ANALYSIS

The Canadian Survey of Consumer Finances (SCF) is an annual supplement to the nationally representative monthly Labour Force Survey (LFS), conducted each April. The SCF contains data on labour force attachment, demographics, and income. There is survey data collected for individuals from April 1982 onwards, with the exception of April 1984. Family level data was also collected every other year from 1976 to 1980.[14] The analysis presented in this report uses the surveys from April 1985-86 as the "before" period, and those from April 1987-89 as the "after" period.[15] The earlier surveys are not used in the base case analysis because there is no April 1984 survey. However, the 1982 and 1983 data is used in a specification check. The later surveys are not used because there was a major change in the classification of the education variable in April 1990, rendering it difficult to follow precise education groups from before 1990 to after. Following educational groups is a key feature of the approach used in this report to measure potential DI benefits. Also, the selected set of years avoids the contamination of estimates by the recessions of the early 1980s and early 1990s, which might affect older workers propensity to apply to the DI program.[16]

The analysis focuses on men age 45-59. The focus on men follows the previous literature on DI. Also, the analysis must use cross-sectional data on a worker's labour force attachment, and this type of data does not indicate whether that worker has the requisite earnings history to be eligible for the DI program. This problem is minimized by focusing the analysis on older men, because older men generally have sufficient earnings histories to qualify for DI benefits.

The choice of age group is also dictated by two other considerations. First, the age group was chosen so that the workers are old enough for DI to be a relevant option in their choice set. For the 45 to 59 age group, the incidence of DI benefits for men in the CPP is 3.9 percent. This is 4 times as high as the incidence of DI benefits among those age 40 to 44. Second, as was noted earlier, the increase in DI benefits under the CPP was not the only important policy change in 1987. There was also a reduction in the age of eligibility for CPP retirement benefits to 60, which the analysis seeks to avoid by focusing on those below age 60.

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14 There are actually some family surveys for some earlier years, but differences in the definition of the education variable render them useless for the purposes of this study.

15 The policy change of interest was enacted in July, 1986, and became effective in January, 1987; since the 'before period' ends in April, 1986, any anticipatory labour force leaving behavior between the enactment and effective dates is avoided.

16 See Lewin-VHI (1996) for evidence on the cyclical responsiveness of DI applications.

4. METHODOLOGICAL APPROACH

DIFFERENCE-IN-DIFFERENCE ESTIMATION

The most straightforward means of analyzing the 1987 increase in the flat rate portion of CPP disability benefits is through the "difference-in-difference" framework (Card, 1992; Gruber, 1994). This framework involves a simple comparison of the change in behavior outside of Quebec, where benefits increased, with the change in behavior inside Quebec, where benefits did not increase.[17] This comparison can be implemented in a straightforward manner by estimating logistic regressions of the form:[18]

(1) $NP_i = f(\alpha + \beta_1 CPP + \beta_2 AFTER + \beta_3 CPP*AFTER + \beta_4 X_i + \varepsilon_i)$

where NP_i is a dummy variable specification for non-participation in the labour force by person i

CPP is an indicator for whether the individual lives in CPP province

AFTER is an indicator for whether the year is after the policy change

X_i is a set of covariates for person i (age, married, education, number of children)

With this regression framework, location is controlled for by including a dummy for whether an individual lives in a CPP province or in Quebec. Time is controlled for by including a dummy for whether each observation is before or after the policy change. The coefficient of interest (β_3) therefore measures the effect of being covered by the CPP, relative to being covered by the QPP, after the benefits increase, relative to before.

The dependent variable is a dummy for whether the 45 to 59 year old man was not working during the week of the SCF survey. Thus, the coefficient β_3 measures the effect of the policy change on labour force non-participation, defined as non-work. The regression equation also includes variables for education, age, marital status, and number of children to control for any observable differences between workers that might confound the analysis. Education is measured by four dummy variables for less

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17 Note that the analysis assumes that there is not migration across the Quebec border in response to DI benefits differences. Under CPP or QPP rules, if a worker moves from a CPP region to Quebec and immediately files for benefits, he receives the benefits he was entitled to under the CPP (similarly QPP benefit rules apply for moves from inside to outside Quebec). If, however, this worker moved and then worked in Quebec before applying, he would be eligible under the QPP rules. Therefore, workers would have to anticipate a future application need for there to be a migration incentive.

18 A logistic function is used. The results are similar when either probit models or linear probability models are used.

than 9 years of education, 9 to 10 years of education, 11 to 13 years of education, and some post-secondary education. Age is measured by a set of dummies for single years of age from 45 to 59. There are separate dummies for each number of co-residing children under age 18 (up to a maximum of 8 children).

This approach is attractive because it can cleanly identify the effects of the benefit change. However, it does have two limitations. First, it does not directly measure the elasticity of response to the change in DI benefits, since it measures only the numerator of the elasticity (the change in labour supply) and not the denominator (the change in potential benefits). Second, this approach uses a very rough categorization of the data that does not fully take advantage of the policy change -- particularly the further variation available in potential benefits *within provinces at a point in time*. Since only the flat rate portion was increased by the CPP, the percentage point increase in the replacement rate is much larger for those with a low lifetime level of earnings, as the flat-rate portion is a larger share of their DI benefits. This fact can be used to further identify the effect of the benefit change, by exploiting the differential impact of the benefits change across workers of different lifetime earnings levels.

PARAMETERIZED MODELS

To address both of these points, one must measure the change in potential benefits for each person in the SCF sample. In theory, calculating potential DI benefits requires longitudinal information on workers' earnings since 1966, which is not available in the SCF (an annual snapshot of earnings). Thus, "synthetic earnings histories" are calculated for groups of workers in order to impute their potential DI benefits. This is done in several steps. The first step is to create a database using each of the individual SCF's for April 1982-1989, and using data on the male heads of families from the family SCF for April 1976, 1978, and 1980. In each of these data sets, workers are then divided into cohort cells according to their age, location (four regions: Quebec, Ontario, the Atlantic Provinces, and the remainder of Canada), and their educational attainment (the four groups described above). Next, the median earnings are tabulated in each cohort cell for each year.[19] By stringing together the median earnings in each cohort cell through time, one can form a proxy for the earnings history of a worker in that cohort cell.

These surveys contain annual earnings data for the years 1981-1988, with the exception of 1983 when no survey was carried out, and biannual data from 1975-1979. For the missing years, earnings are imputed as an average of the surrounding years. To backcast from 1975 to 1966, before cross-sectional survey data is available, cross-sectional age-earnings profiles are estimated by education group in the 1975

19 That is, for 45 to 59 year old cohort in 1989, the 44 to 58 year old cohort in 1988, 43 to 57 year old cohort in 1987, and so on back through time is used. When the mean was used to compute benefits, the results were quite similar.

survey. Next, these estimates are applied to "un-age" the workers in the 1975 survey back to 1966. Finally, these pre-1975 profiles are deflated by average wage growth by region, using data from Gruber and Hanratty (1995).

With these synthetic earnings histories in hand, it is then straightforward to compute potential DI benefits using the legislative rules in place in CPP and QPP in a given year. The key regressor, the replacement rate, is this potential benefit over the synthetic earnings for the cell in the year before the survey. This measure does not vary individual-by-individual, but rather only cell-by-cell, where the cells are defined by each education/region/year group.[20]

The regression models are estimated in the form of:

(2) $NP_i = f(\alpha + \beta_1 RR_i + \beta_2 X_i + \beta_3 \tau_t + \beta_4 ED_i{*}\delta_j + \beta_5 ED_i{*}\tau_t + \varepsilon_i)$

where RR is potential replacement rate

ED is a set of dummies for education categories (four categories)

δ_j is set of region dummies (four regions)

τ_t is set of year dummies

This model controls for fixed effects for year, for each of the 16 education*region cells in each year, and for education*year. The first of these is included to capture secular trends in labour market opportunities in Canada, as in equation (1). The second of these is included to account for the fact that there is a potential spurious correlation between the labour supply choices of these 16 groups and their potential replacement rate. This is just a restatement of the criticism leveled by Bound (1989) against the U.S. literature. By taking out fixed effects for each group, only changes in each group's potential replacement rate over time are used to identify the effect of DI. Finally, the set of education*time interactions are included because there is a potential concern about identification from changes in the return to education over this period, which would affect both the replacement rate and the decision to work.

Conditional on this set of controls, the model is identified by two sources of variation: changes over time in the CPP provinces relative to Quebec (region*time), and how those

20 The worker's potential child benefits are not included in the computation of the replacement rates, for two reasons. First, this preserves the variation in potential benefits only at the cell level, which is important for the identification strategy used in the analysis. Second, it is not clear how to combine child benefits, which for these older workers will only be paid for the presumably small number of years until the child turns age 17, with the other benefit components, which will be paid until age 65 (at which point all disabled are shifted to the retirement income system). In practice, this is not a very important consideration, as only 1/3 of my sample has any children. Adding child benefits to the computed benefit total, based on the actual number of children, raises the level of the replacement rate somewhat, but not the relative change; and the estimated elasticities reported below are similar whether or not child benefits are accounted for in calculating replacement rates.

changes evolve differentially across these 16 groups (region*education*time). The first of these is the difference-in-difference variation that was used to identify model (1). The second is additional variation from the differential impact of this policy change across groups. This additional variation is potentially useful in pinning down the elasticity of labour supply. Moreover, the resulting coefficient β_1 is now directly interpretable as the benefit semi-elasticity of labour supply.

5. RESULTS

MEANS

Table 1 presents the means of the data set, divided into the CPP regions and the QPP region, before the law change and afterwards. The final column of the table shows a first pass difference-in-difference estimate of the policy effect. There are two findings of interest from Table 1. First, as the first two rows show, the policy change was associated with a significant increase in benefits. While the replacement rate was roughly constant in Quebec, it rose substantially in the rest of Canada. The relative rise in CPP disability benefits was 8.8 percentage points, or 36 percent of the baseline average replacement rate.

Second, there is strong evidence of a labour supply response to the benefits increase. Non-participation raises from before to after in the CPP regions, and falls in the QPP regions. The latter finding reflects the underlying improvements in the Canadian economy over this period. As a result, there is a large relative rise in non-participation in the CPP regions of 2.7 percentage points.

DIFFERENCE-IN-DIFFERENCE REGRESSION RESULTS

The next table formalizes the inferences from the table of means in a regression model, including as well the set of covariates in (1). Recall that the regression also includes a full set of dummies for age and number of children which are not reported in the table. The regression is estimated as a logistic model. The last row shows the effect of the difference-in-difference interaction on the probability of being non-employed, which is the average effect across the sample on the predicted probability of non-participation.

These findings confirm the conclusion from Table 1 that there is a response to the policy change. The effect is slightly smaller than in Table 1, with a relative rise in non-employment in the CPP regions of 2.3 percent and it is statistically significant. This is still a quite sizeable response, indicating that the 36 percent benefits rise led to a rise in non-employment of 11.5 percent, for an implied elasticity of labour force non-participation of 0.32. Thus, this straightforward difference-in-difference estimate is very supportive of a strong labour supply response to the benefits increase. The control variables in the regression have their expected effects, with married and more educated workers less likely to be non-participants. The age dummies (not shown) have the expected upwards trend, while there is no clear pattern from the dummies for number of children (also not shown).

PARAMETERIZED MODEL

As noted above, these difference-in-difference estimates do not fully exploit the available variation in potential benefits across workers in Canada. To do so, Table 3 presents estimates of the replacement rate model (2). For each model, Table 3 shows the coefficient of interest, the implied effect of the 8.8 percentage point replacement rate rise, and the implied elasticity of labour force non-participation.

The first row presents the basic model. There is a sizeable and significant effect of the potential replacement rate. The estimate implies that this policy change raised the non-employment rate by 1.2 percentage points, which is substantially below the difference-in-difference estimate, but is more precisely estimated. The implied elasticity of labour force non-participation with respect to benefits is 0.17.

One potential concern about the identification of this model, however, is that the variation in benefits does not arise solely from the policy change, as it impacts the 16 different education*region groups, but rather also from year to year changes in replacement rates within the before and after periods. Some of this year to year variation is legislative, arising from evolving system parameters over time (i.e., changes in the flat rate). But some of it also arises from year to year differences in earnings across education*region cells, which induce changes in the potential replacement rate, but which might also be independently correlated with the labour supply decisions of individuals in those cells. Moreover, this year to year variation may reduce the signal to noise ratio in my key regressor, since the true variation of interest comes from the policy change only.

In order to purge the model of these year to year changes and focus solely on the before/after comparison, the next row of Table 3 presents instrumental variables estimates of the model. The instruments are a set of interactions of education* region*AFTER, where as in equation (1) AFTER is an indicator for being after the policy change. When instrumented in this way, the only variation in benefits that is used by the regression model is the before/after difference in benefits, on average and as it impacts differentially these 16 education*region groups. That is, this IV strategy provides the means of extending the difference-in-difference estimation to account for variations in the impact of the policy by education and region.[21] The first stage fit is excellent and the F statistic is 5500.

In fact, this instrumental variables approach raises the estimates substantially, consistent with the notion that noise in the year to year replacement rate changes was biasing the estimate downwards. At this new point estimate, the implied effect on labour force non-participation from the policy change, 1.8 percentage points, is close to the difference-in-difference estimate. The implied elasticity of labour force non-participation with respect

21 In terms of the discussion above, in this model the identification comes solely from region*AFTER and region*education*AFTER.

to CPP disability benefits rises to 0.25. This is higher than the post-Parsons literature in the U.S., but is only half of the lower bound of Parsons' estimates.[22]

ADDRESSING ALTERNATIVE HYPOTHESES

The fundamental identification assumption embodied in the estimation thus far is that there was no other change in the CPP provinces, relative to Quebec, that was correlated with the labour supply decisions of older workers. This section considers the two natural alternatives to this identifying assumption. The first is that the policy was itself responding to a trend in relative labour supply across the provinces. That is, perhaps there was an underlying trend towards lower labour force participation among men in the CPP provinces, relative to Quebec, and the policy was passed in response to this trend.

It is possible to test for this underlying trend by pursuing a falsification exercise: reestimating the model on data around a year when there was no significant change in DI policy. For this purpose a new sample was constructed of men age 45 to 59, with data from April 1982 and 1983 as the "before" period, and April 1985 and April 1986 as "after". There was no significant change in DI policy around 1984. Thus, if I estimate the difference-in-difference model on this data set, and there is a significant positive effect on non-participation, then it suggests that there was a pre-existing trend. If there is no effect, however, it demonstrates that labour supply was moving in parallel in Quebec and the rest of Canada in this pre-policy change period, and that the break in the series arose only when the benefits were increased under the CPP.

The result of this falsification exercise are presented in the first row of Table 4. In fact, there is a small and insignificant positive coefficient. As the second column shows, this coefficient indicates that non-participation rose by 0.3 percentage points in the CPP (relative to the QPP) before the policy change, as opposed to the roughly 2 percentage point increase around the time of the policy change. That is, there was no relative trend before the policy change; the differential between the CPP and QPP grew only after 1987. This timing evidence supports the contention that the policy change caused the relative growth in labour force non-participation, and not the other way around.

Moreover, this finding provides a means of confirming that the contemporaneous change in the early retirement age under the CPP is not driving the main results presented in this report. The effect of this change in retirement age on 45 to 59 year olds is testable

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22 Note also that these estimates are consistent with aggregate relative movements in the DI rolls over this period. From 1984 to 1989, the number of persons on the CPP program, relative to the QPP program, rose by 56,576. Unfortunately, only aggregate enrollment data over time for both provinces was available, so it was not possible to distinguish the share of this increase due to 45 to 59 year old men. But assume that this group represented the share of the increase that they represent of the 1993 CPP rolls (30 percent); the rise for this group was then 16,973 workers. 1.8 percent of the 45-59 year old male population in the CPP provinces, times a 68 percent average acceptance rate, is 16,340 workers, which is quite close to this administrative figure.

because there is a "reverse experiment" arising from the fact that Quebec first lowered its retirement age from 65 to 60 in 1984, without changing QPP disability benefits. As a result, if the early retirement age change is driving the behavior that we see for 45-59 year olds, there should be a similar change in behavior for this group in Quebec, relative to the rest of Canada, around 1984. But this is exactly the hypothesis that is tested, and rejected, by the falsification exercise. There is no relative change in labour supply across these regions around 1984. This rules out the early retirement age change as an explanation for the main findings presented in this report.

The second alternative is that there was some other contemporaneous change in the relative labour market prospects of older workers in Quebec and the rest of Canada, perhaps due to a relatively faster recovery from the recession of the early 1980s in Quebec. It is possible to assess the importance of contemporary economic conditions in driving the results by making use of a within-region control group: workers aged 25 to 39. This younger age group should be subject to the same economic shocks that affected older workers, but is unlikely to be affected in an important way by changes in DI policy, since the incidence of DI is so much lower for young workers.[23] Thus, by rerunning the basic models for this group, it is possible to assess whether there are omitted variables driving the findings.

In fact, as the next two rows of Table 4 show, there is little correlated change in behavior among younger workers. The difference-in-difference coefficient is positive, but it is fairly small relatively to the magnitude for older workers. In the next row, the (instrumental variables) parameterized model is re-estimated for this population, assigning to younger workers the benefits for 45 to 59 year olds in that region/education/year cell. In fact, applying this method to younger workers yields a negative and insignificant coefficient.

Thus, the two specification checks indicate that there was a relative change in labour supply of older workers in the CPP provinces, relative to Quebec, that arose only after benefits increased, and that was present only for the older workers to which the program primarily applies (and not for younger workers). That is, the only potential factors which could be confounding the main findings of this report are sudden changes in the relative economic opportunities or tastes for work of older workers (relative to younger workers), in the CPP provinces (relative to Quebec), around January, 1987.

In fact, there is one further test that can even rule out alternatives in this category. A CPP*AFTER interaction can be explicitly included in the parameterized model, and then used to estimate a "difference-in-difference-in-difference" model (Gruber, 1994) which is identified solely from differences in the effects of this policy change across these 16 groups of workers. That is, this model controls for any changes on average in the economic circumstances or tastes for work of older workers in the CPP regions relative

23 The incidence of DI among male workers age 25 to 39 in is less than 0.2 percent.

to Quebec, ruling out most plausible alternative explanations for the results. After controlling for average relative changes in labour supply across Quebec and the rest of Canada, this model asks whether the groups that saw the largest replacement rate increase were the groups that increased their labour force non-participation the most.

The results of this estimation are presented in the final row of Table 4, for the IV model (instrumented once again by region*education*AFTER). In fact, the estimated effect here is somewhat larger than in Table 3, indicating an elasticity of 0.32, and the coefficient is marginally significant. Taken together with the findings for younger workers, this result suggests that other general changes in the CPP provinces relative to Quebec are not driving the main estimates. Overall, the findings in Tables 2 to 4 suggest a fairly elastic labour supply response of older workers to changes in DI benefits, with the elasticity of labour force non-participation with respect to these benefits being in the range of 0.25 to 0.32.

6. WELFARE IMPLICATIONS

The estimated labour supply response that has been the focus of the paper thus far provides only part of the information required for performing a welfare analysis of the 1987 increase in CPP disability benefits. Disability is the kind of large random event for which individuals would ideally hold insurance, but private insurance markets for disability are incomplete. As a result, individuals may suffer a substantial reduction in their standard of living when they become disabled. This was particularly true under the CPP before the benefits increase, where replacement rates averaged only 25 percent of previous earnings. From the perspective of a social planner, therefore, welfare improvements might result from taxing workers somewhat more highly in order to provide a more level consumption stream for those becoming disabled. Thus, while the effects on labour supply were large, it is hard to gauge their importance without reference to the gains to persons benefitting from the more generous disability benefits under the CPP.

This section, therefore, outlines a rudimentary calculation of the social costs and benefits of the policy change. This calculation proceeds in three steps. First, a social welfare function is presented which allows for the valuing of the transfers from workers to disabled persons that were the beneficiaries of this program. Then, the estimated elasticity of labour supply response is used to measure the net cost to taxpaying workers of this transfer. Finally, these magnitudes are compared for different values of key preference parameters to evaluate whether the estimated labour supply response is large enough to wipe out the benefits from this policy change.[24]

THEORY

The main benefit of this policy change was a transfer from the relatively well off working population to the relatively poor disabled population, which will raise social welfare for a concave social welfare function. To measure the value of this benefit, suppose that social welfare is utilitarian, and that individual utility is of the CES form:

(3) $U = C^{1}\gamma / 1\text{-}\gamma$

Society consists of two groups: workers (whose population is normalized to 1) and the disabled, n_d. The income of all workers is also normalized to 1, and the (ex-ante) income of the disabled is r. Note that r includes both DI benefits, and other sources of income

24 For a much richer analysis of optimal DI benefits determination, see Diamond and Sheshinski (1995).

for those unable to work (such as spousal income or other transfers). Social welfare before the policy change is:

(4) $(1)^{1}\gamma/1-\gamma + n_d*(r)^{1}\gamma/1-\gamma$

The policy change raises benefits by an amount k. However, given that the disabled have some other resources on which they are relying to finance consumption, only a portion of the increase in benefits (βk) may be reflected in increased consumption. In other words, to some extent the increased benefits may "crowd out" other sources of support. For example, if other transfers fall as benefits rise this will offset the increment to net family resources (and therefore to consumption). If $\beta=1$, then there is no crowdout, and each dollar of increased benefits is directly translated to consumption. If $\beta=0$, then there is full crowdout, and net income is unchanged by the rise in benefits. Some of the crowded out resources may accrue back to workers as other transfers are scaled back in response to higher DI benefits. The share of crowded out resources that accrue back to workers is denoted as α.

This policy change is financed by a tax t on workers. After this change, social welfare becomes:

(5) $(1-t+\alpha k)^{1}\gamma/1-\gamma + n_d*(r+\beta k)^{1}\gamma/1-\gamma$

The benefits of this policy change are measured by the quantity t^* that holds social welfare constant from before to after the policy change. That is, t^* is the income equivalent to workers from the increase in DI benefits generosity for the disabled.

To assess the net welfare implications of the policy change, this value t^* can then be directly compared to t^{**}, which is the tax rate on workers necessary to finance the benefits increase. This t^{**} consists of three components. The first is the direct cost of increasing benefits for existing CPP recipients, which is simply a tax of an amount n_d*k on workers. The second is the net cost to society of the labour force leavers. For this group, assuming a full employment economy, the gross cost is the value of their production plus the benefits which must be paid to them; but the gross benefits to this group is the value of their increased leisure (i.e., the reduced disutility of work). This last component may be quite high if these workers were on the margin of leaving the labour force due to health problems.

The key to measuring these factors is to consider the impact of a <u>marginal</u> change in DI benefits. If DI benefits receipt is certain and if each worker's gross wage equals his marginal product, the value of the gain in leisure to the labour force leavers is exactly equal to the (after-tax) value of the production that is lost to society. This is because the worker who moves from work to non-work due to a marginal benefits increase is indifferent between work and leisure at that point. Thus, the net cost of a marginal benefits change is simply the loss in tax revenues from the resultant reduction in labour supply, plus the cost of the benefits paid to these newly disabled workers.[25]

There are two potential complications to this simple calculation, however. First, this was not a marginal benefits increase, but rather a (relative) rise of $1668, leading to a fairly wide bound on the value of leisure. It was assumed that the distribution of values of leisure is uniform, and the average of this range was used.[26] Second, with non-linear utility and uncertain benefits, the value of leisure may actually be higher than that implied by this certainty calculation. Applying for DI is a gamble, and if individuals are denied they may be unable to return to their previous job. Instead, they may be forced to live on some reduced level of income q, which consists of spousal income or other transfers if they remain out of work, as well as some lower level of earnings if they find a new job.[27] Even if the <u>expected</u> benefits plus the value of leisure is greater than after-tax earnings on the job, individuals may be reluctant to take this gamble if they are risk averse. To pursue an analogy to health insurance markets, this uncertainty provides a form of "job lock" for potential DI recipients.

This is modeled by assuming that the value of leisure (or disutility of labour) is additive in consumption, and then calculating the implied bounds on the value of leisure (x) from:

$$(6) \qquad 0.68*(r)^{1\gamma}/1\text{-}\gamma + 0.32*(q)^{1\gamma}/1\text{-}\gamma \ < \ (1 - x)^{1\gamma}/1\text{-}\gamma \ < 0.68*(r + \beta k)^{1\gamma}/1\text{-}\gamma + 0.32*(q)^{1\gamma}/1\text{-}\gamma$$

recalling that the odds of acceptance to the program is 0.68, and outside income if denied is q.[28]

The final cost is the potential deadweight loss of raising the government revenues necessary to finance this transfer. If these increased costs were going to finance a general public good, then it might be appropriate to use traditional estimates of the marginal cost of government funds, which range from 7 cents to 21 cents per dollar raised (Fullerton,

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25 An example is illustrative here. Consider a worker whose marginal product (and thus his gross earnings) is $30,000/year, and whose after-tax earnings are $20,000/year. If he declares himself to be disabled before benefits change, he gets $8000 in DI income. Thus, if he continues to work, the disutility of his work (the value of leisure) must be less than or equal to $12,000. Now, benefits rise to $8001, and he leaves the labour force to go on DI. This says that the value of his leisure is greater than or equal to $11,999. For simplicity, assume that the value is $11,999. In this case, the gross cost to society of his leaving his job is the $30,000 in lost production and the $8,001 in DI benefits; but the gross benefit to the worker is the $8,001 in DI benefits plus the $11,999 in leisure. Thus, the net cost is $18,001, which is the sum of the lost tax revenues plus the DI benefits paid.

26 A natural alternative would be to assume that the most disabled workers (those with the highest value of leisure) are the ones that leave on the margin, and to use as the value of leisure the upper bound from this calculation. In practice this has very little effect on the results. For example, it does not change the "break even" coefficients of relative risk aversion shown in Figure 2 by more than 0.1.

27 As noted earlier, Bound (1989) finds that in the U.S. fewer than half of denied applicants return to work, and those that do earn only 55 percent of their previous earnings level.

28 Alternatively, leisure could be modeled separably. The advantage of this approach is that it can readily convert the value of leisure into consumption equivalent units. As individuals are more risk averse, x rises, although it becomes more tightly bounded. This is because the individual requires a much larger increment to expected DI benefits to induce a move out of the labour force for a given value of leisure. Thus, there is a smaller range of values of leisure for which individuals will leave the labour force for a given dollar change in DI benefits.

1989).[29] However, as Summers (1989) highlights, traditional tax incidence analysis is inappropriate for changes in social insurance financing, since these changes result in tax-benefit linkages. That is, there is another benefit from this policy change beyond the static transfer to those who are disabled: the increased value of insurance to those who may *become* disabled, to the extent that private disability insurance is not available on the margin. Since this valuable increase in insurance on the margin is only available to those who work, this tax-benefit linkage will raise labour supply, offsetting any reductions in labour demand or supply from higher tax burdens, and thereby reducing the inefficiency of financing the benefits increase.

Empirically, several recent studies have considered the implications of social insurance financing for labour market efficiency. Gruber and Krueger (1991), Gruber (1994, forthcoming), and Anderson and Meyer (1995) all conclude that the burden of increased social insurance costs is fully passed onto workers in the form of lower wages, with little effect on employment. This is consistent with the notion of full tax-benefit linkages, and therefore little deadweight loss. Thus, for the simulations below, I assume a zero deadweight loss from raising the required revenues t^{**}.

WELFARE IMPLICATIONS - IMPLEMENTATION

Implementing the calculation of t^{*} and t^{**} first requires recognizing that the 45 to 59 year old male population studied in this report represents only roughly 30 percent of the total population of disabled. Males age 60 to 64 represent another 24 percent, females age 45 to 64 represent 32 percent, and younger males and females represent the remainder. All of these groups will benefit from the higher benefits to the disabled, but my labour supply response estimates only apply to the first group. For the purposes of this calculation, it was assumed that the elasticity of <u>participation</u> with respect to benefits changes is the same for all workers (male and female) age 45 to 64, and that the elasticity for those under age 45 is zero.[30] A key parameter for evaluating t is the

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29 More recently, Feldstein (1995) has suggested a much higher deadweight loss from changes in marginal tax rates at the top of the income distribution.

30 Since my range of estimated elasticities is from 0.25 to 0.32, I use 0.285 as a base case estimate for these simulations. This range implies that the increase in benefits lowered labour force participation by 2.56 percent for 45 to 59 year old men. This same percentage was applied to the other groups of older workers (on their lower base of participation). For women, the assumption of an equivalent response considers on the one hand the fact that female labour supply is generally estimated to be more elastic than male labour supply, and on the other the fact that women may be less likely to be eligible for CPP disability benefits.

ex-ante income available to the disabled (called r in the model). Unfortunately, the information on disability and CPP receipt in the SCF is quite noisy. A conservative target population, those who both report themselves unable to work and report some CPP receipt, was employed.[31] The April 1987 SCF, which asks about income sources in 1986, is used to measure the ex ante after-tax income of this group of disabled, combining the total after-tax income of the individual respondents and their spouses.[32] The median income in this population in 1986 was $14,014. Only 38 percent of the income of this group came from CPP benefits on average, with 22 percent coming from spousal income, 13 percent from other government sources, 13 percent from private retirement income, and the remainder from other sources. This suggests the potential for a parameter $\beta<1$, since there are other sources of income that may be crowded out by increased DI benefits. This amount compares to an average family income for workers of $31,164, for a ratio r of 0.450. Relative to this denominator, the benefits increase in the CPP ($1,668) yields k=0.054.

Unfortunately, there is no direct evidence on the crowdout parameter β, nor on the extent to which crowded out resources flow back to workers (α). In principle, crowdout could be estimated by examining the response of the other income sources or the consumption of the disabled when benefits change. In practice, this exercise is not possible since the pool of disabled is changing (due to the labour supply response measured in this paper), so that any changes in other income may not be due to crowding out but rather to a different mix of disabled persons. Therefore two polar cases for βwere assumed. In the first, $\beta=1$, so that there is no crowdout (and so $\alpha=0$). In the second, the marginal dollar of DI is treated like the average dollar, with 38 cents going to consumption and the remainder being crowded out. It was further assumed that a dollar of crowded out spousal labour supply is worth 50 cents to the family in increased leisure for the spouse, so that the total $\beta = 0.38 + 0.5*0.22 = 0.49$. In this case, the consumption of workers rises by the 40 cents that is non-DI and non-spousal labour supply income of the family (since these are transfers of some kind), so that $\alpha = 0.4$.

As noted above, there are two costs of this policy change. The first is the cost of the transfer to the ex-ante disabled, which is simply the cost of 0.054 per disabled worker, spread over all workers. The second is the cost of the increased labour force leaving, which is the sum of the lost tax revenues and the benefit payments to this group, minus the increased consumption-equivalent value of their leisure. As noted above, it was

31 CPP receipt can also include CPP retirement income or survivors benefits, but by also conditioning on inability to work it was the intention to capture the population that is receiving CPP support for disability.

32 Taxes are calculated for each family in the data using a tax calculator constructed based on Perry (1984, 1990).

assumed that 2.56 percent of all older workers leave the labour force in response to the policy change. It was also assumed that 68 percent of those who left their jobs to apply received benefits. This average acceptance rate may somewhat overstate the acceptance probability of this group (which is presumably less sick on the margin than earlier applicants).

To compute the lost tax revenues, the average tax rate for each worker was calculated, and this average tax rate was multiplied by earnings to obtain a tax loss if the worker leaves the labour force. It was assumed that denied workers do not return to work, so that these tax revenues are lost for all labour force leavers. It was then recognized that the benefits change was highest, and thus the labour force leaving effect largest, for lower income workers, so that using the average tax rate across all older workers would overstate the tax revenue loss. Therefore a weighted average of the tax revenue loss was used, where the weights are the replacement rate for each older person's education*region cell in 1986.[33] A loss in tax revenues per older worker leaving the labour force was thereby obtained which amounted to $6,102 (which is sizeable relative to the $7,776 in DI benefits received by these workers). Finally, it was assumed that the income of workers if they are denied for DI benefits (q) is equal to the average of the non-DI income of the disabled.

Overall, this calculation yields a tax cost per worker of 0.65 percent of wages. Only 0.19 percent of wages results from the transfer to the currently disabled, with the remainder arising from the change in labour supply of older workers. That is, the "static" revenue loss is only 30 percent of the total revenue cost of this policy change.

Finally, comparing this cost to the benefits of the policy change requires assumptions on the coefficient of relative risk aversion, γ. Values from 1 (log utility) to 4 are considered, with 4 corresponding to the high end of the range estimated in the previous macro literature. Most previous estimates place this parameter in the range of 2-3 (Zeldes, 1989; Engen, 1993).

This comparison is shown in Figure 2. The x axis shows different values for the parameter of risk aversion, and the y axis measures the net welfare gain per dollar of income to workers. There are two lines corresponding to the two values of β. The curves are all upward sloping since this transfer and increased insurance are more valuable as individuals (and therefore society) are more risk averse.

For the no crowdout case (β=1), there are welfare gains from this policy for values of γ of 1.5 and above. Even if there is substantial crowdout, there are welfare gains for values of γ of 2.1 and above. Thus, despite this large labour supply response that tripled the "static" cost of financing the benefits increase, there are welfare gains for the typical range of

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33 The replacement rates for 45-59 year old men was used to form these weights, but the ratio of replacement rates across cells is likely to be similar for all older workers.

estimated coefficients of relative risk aversion. It is therefore quite important to consider the benefits of this transfer in assessing the implications of the response of labour supply to this policy change.

This calculation is, of course, only illustrative, and requires a number of assumptions. Most importantly, a perfectly competitive full employment labour market was assumed. If there are labour market imperfections, this assumption will overstate the costs of this policy change for two reasons. First, some of the jobs left by older workers will be filled by unemployed younger workers, reducing the lost production to society. Second, the wage earned by older disabled workers may have been above their marginal product, but employers may have been unable to pay them less or fire them due to labour market regulations or workplace norms. This implies that the loss in production from these workers voluntarily leaving their jobs is smaller than the foregone earnings. A representative worker and disabled person, using the median incomes in both populations was employed, rather than a distribution of incomes for each group. This would raise the net benefits of the policy with concave utility, since some disabled will have very low incomes. Also, it was assumed that denied applicants do not return to work. To the extent that they do return to work, it lowers the social cost of the policy change. On the other hand, the costs of this benefits increase are potentially understated in two ways. First, it was assumed that there is no labour supply response among younger workers. Second, it was assumed that there is no deadweight loss of financing the benefits change, on the basis of evidence from other social insurance programs from the U.S.

7. CONCLUSIONS

A critical parameter for the design of DI policy is the responsiveness of labour supply with respect to benefits generosity. Estimating this parameter in the U.S. context has proved difficult, but the substantial rise in CPP disability benefits in 1987 provides a mechanism for doing so. This analysis examines labour responses using both straightforward difference-in-difference models and more parameterized models. In both cases, the analysis finds a large labour supply effect for the benefits increase. The central estimates imply an elasticity of labour force non-participation with respect to benefits of 0.25 to 0.32.

Is this estimate large or small? There are two benchmarks against which it can be compared. First, the estimate can be compared to the previous literature on the U.S. Such a comparison indicates that the estimate presented in this report is closer to the post-Parsons evidence on the elasticity of response than it is to even Parson's lower bound estimate, confirming the notion that DI benefits changes alone cannot explain the dramatic time series trend among older men in the 1970s.[34] Second, the estimate can be compared to the estimated welfare gains from this transfer to the relatively poor off population of disabled. In this case the analysis finds that despite the large labour supply response, there were welfare gains from the policy change for a wide range of preference parameters. While the welfare analysis has some limitations, it illustrates that even with large distortionary effects on labour supply, social insurance generosity increases can raise welfare.

It is important to note that this analysis has ignored dynamic considerations, so the findings may misstate the steady state elasticity of response to benefits levels. In particular, the estimated elasticity may overstate the steady state elasticity if there are "announcement effects", whereby large benefits increases affect behavior more strongly than do incremental benefits differences. On the other hand, by examining behavior for only several years after the benefits change, the analysis may be understating the response if there is some further adjustment to this new higher level of benefits over time. In particular, the effect on the long run stock of disabled workers may be substantially larger if there is a higher elasticity of labour supply with respect to health shocks which slowly accumulate among older workers in the CPP.

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34 More specifically, from 1960 to 1980, potential DI replacement rates rose by 53 percent (U.S. Congress Committee on Ways and Means, 1990). At the central elasticity estimates of 0.25 to 0.32, this increase would induce a rise in labour force non-participation of 13 to 17 percent. But over this time period, as noted above, the non-participation rate of 45 to 54 year old men rose by over 100 percent, so that the increase in DI benefits can explain at most only about 15 percent of the increase in non-participation. This does not rule out a role for the DI program per se, since increased program awareness or easing disability standards may have played a stronger role in this era. See Bound and Waidmann (1992) for a more detailed interpretation of these time series trends.

Table 1: Means

	CPP, Before	CPP, After	QPP, Before	QPP, After	Diff-in-Diff
Benefits	5134	7776	6878	7852	1668 (17)
Replacement Rate	0.245	0.328	0.336	0.331	0.088 (0.003)
Not Employed last week	0.200	0.217	0.256	0.246	0.027 (0.013)
Married?	0.856	0.856	0.817	0.841	-0.024
Any Kids<17?	0.367	0.351	0.354	0.336	0.002
Less than 9 years of Education	0.303	0.274	0.454	0.421	0.004
9-10 Years of Education	0.202	0.199	0.179	0.178	-0,002
11-13 Years of Education	0.246	0.254	0.169	0.187	-0.010
Post-Secondary Education	0.249	0.273	0.198	0.214	0.008
Number of Obs	11349	18059	2134	3113	

Notes: Based on author's tabulations. QPP refers to Quebec; CPP refers to the remainder of Canada. Before is 1985-1986; After is 1987-1989. Standard deviations in parentheses.

Table 2: DD Model

Married	-0.952 (0.035)
< 9 Years of Education	1.291 (0.041)
9-10 Years of Education	0.835 (0.045)
11-13 Years of Education	0.390 (0.046)
CPP Region	-0.173 (0.058)
After Policy Change	-0.005 (0.068)
CPP Region* After Policy Change	**0.150 (0.075)**
Implied Probability Effect	**0.023**
Number of Observations	34655

Notes: Table presents logistic estimation of equation (1) in text. Standard errors in parentheses. Regressions also include full set of dummies for age and number of children.

Table 3: Parameterized Models

Specification	Not Employed		
	Estimate	Policy Effect	Elasticity
Basic Model	0.927 (0.469)	0.012	0.17
IV Model	1.344 (0.563)	0.018	0.25
Number of Obs	34655		

Notes: Coefficients are those on replacement rate from logistic models such as (2); standard errors in parentheses. Regression includes all of the control variables listed in Table 2, as well as a full set of dummies for number of children, age, year, region, education*region, and education*year. IV model uses as instruments a set of education*region*AFTER dummies. Policy effect is impact of relative replacement rate increase in CPP in 1987; elasticity is percentage change in dependent variable (relative to ex-ante CPP value) relative to percentage change in replacement rate.

Table 4: Alternative Hypotheses

Specification:	Estimate	Implied Policy Effect	Elasticity
Falsification Exercise: Preexisting Trends?	0.023 (0.080) 28756	0.003	
DD for Younger Workers	0.055 (0.060) 60483	0.007	
Parameterized Model - Younger Workers – IV	-0.303 (0.605) 60483	-0.003	
DDD Model with CPP*AFTER, IV Estimate	1.710 (0.891) 34655	0.023	0.32

Notes: Standard errors in parentheses; number of observations in final row of each cell. First row shows results of a DD regression of the form of (1), with 1982 & 1983 as before, and 1985-1986 as after. Second row shows DD regressions for younger (25-39 years old) male workers; third row shows parameterized model of the form of (2) for this sample. Final row shows regression of the form of (2), but also including a CPP*AFTER interaction; this is IV model, using as instruments a set of education*region*AFTER dummies. Rows (1) and (2) include control variables listed in Table 2 and footnote to that table. Rows (3)-(5) include all of the control variables listed in Table 2, as well as a full set of dummies for number of children, age, year, region, education*region, and education*year. Policy effect is impact of relative replacement rate increase in CPP in 1987; elasticity is percentage change in dependent variable (relative to ex-ante CPP value) relative to percentage change in replacement rate.

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