Push and Pull: Disability Insurance, Regional Labor Markets, and Benefit Generosity in Canada and the United States

Kevin Milligan  
Vancouver School of Economics, University of British Columbia  
and NBER  
kevin.milligan@ubc.ca

Tammy Schirle  
Department of Economics, Wilfrid Laurier University  
tschirle@wlu.ca

Preliminary / Not for Citation / Comments Welcome

Abstract:

Disability insurance take-up has expanded substantially in the past twenty years in the United States while shrinking in Canada. We empirically assess these trends by measuring the strength of the ‘push’ from weak labor markets versus the ‘pull’ of more generous benefits. Using an instrumental variables strategy comparing benefit changes across country, age, and year, we find that both benefits and regional wages matter. Simulations suggest that the upswing in disability insurance take-up in the United States would be reversed, dropping the caseload by one quarter, if benefits and wages had followed the growth path observed in Canada.

This draft has been prepared for presentation at the NBER Public Policies in Canada and the United States conference held in Gatineau, QC on October 27-28, 2016.

Acknowledgements:

We would like to acknowledge David Card, Phil Oreopoulos and Employment and Social Development Canada for organizing the project. The authors thank John Rietschlin and others at Employment and Social Development Canada for their assistance with CPP-D administrative data.
1. Introduction

The emerging debate about the economic and social withdrawal of prime-age workers encompasses several possible contributing factors, ranging from trade, to technology, to policy.\(^1\) Public disability insurance is often raised in this context in the United States. Using administrative data sources, we graph in Figure 1 the incidence of disability insurance benefits in Canada and the United States, separately for men and women over ages 30-59 from 1970 to 2015. Since about 1990 in the United States, the disability insurance takeup rate for men has nearly doubled while for women it has more than tripled. In Canada, disability insurance uptake rose through 1995, and then fell back slightly for men, while leveling out for women.

The contrasts across the two countries are striking, and reveal an opportunity to explore the causes of the observed disability insurance trends. In particular, two leading explanations in the US literature can be assessed by comparing the US to Canada. First, the decline of mid-skill employment opportunities might ‘push’ workers onto disability insurance. While Canada has not been immune to labor market pressures on lower-skilled workers, the resource boom of the 2000s had a much larger impact on these workers in some regions of Canada. Second, benefit generosity might ‘pull’ workers into disability insurance receipt. In the United

\(^1\) For example, consider evidence in Beaudry, Green and Sand (2016), Green and Sand (2015), Acemoglu and Autor (2011) and Autor and David (2013). Recent public debate can be found in Summers (2016) which discusses the book “Men without Work” (Eberstadt 2016).
States, benefit generosity has increased over the last twenty years, while declining in Canada.

This paper aims to assess the role of the ‘push’ and ‘pull’ factors on disability insurance uptake in the United States and Canada. We use large-scale microdata surveys of labor market activity over the period 1995 to 2015 and a quasi-experimental research design that exploits both policy differences and international wage trends. We find that both push and pull factors matter significantly in explaining the uptake of disability insurance benefits. The differing trends in regional labor markets and benefit generosity can explain almost all of the upswing in disability insurance participation in the United States—if wages and benefits had followed Canadian patterns, disability insurance uptake would be about 24 percent lower than currently observed.

Previous evidence strongly suggests that both the stringency with which fitness to work is assessed and also the generosity of benefits has some influence on labor force withdrawal.² In the US, Autor and Duggan (2003) found reduced screening stringency, declining demand for less skilled labor, and increases in replacement rates from disability insurance increased the likelihood of high school dropouts to exit the labor force. Duggan and Imberman (2009) have found that eligibility changes, economic conditions and increased replacement rates were important

² For older workers, European evidence finds that older workers may use disability insurance as a pathway to early retirement. See Coile, Milligan and Wise (2016) for a discussion of older workers.
factors in the growth of SSDI growth among men, while increased coverage because of higher employment was important among women. Maestas, Mullen and Strand (2013) have found benefit receipt by those on the margin of disability benefit entry substantially reduces employment. Maestas, Mullen and Strand (2015) show that disability insurance claims tend to rise in times of high unemployment (although many applications induced by the Great Recessions were denied). In Canada, the evidence is more mixed. Gruber (2000) examines benefit generosity in Quebec relative to the rest of Canada prior to 1987 and finds a large increase in non-participation in response to higher benefits. Campolieti (2004), however, examines an earlier increase in Quebec’s benefit generosity (in 1973) and finds no such relationship. Campolieti and Riddell (2012) examine earnings exemptions and found these have an effect on the likelihood of disabled beneficiaries to work, but do not affect flows on or off disability rolls.

We begin with a description of the disability insurance programs in Canada and the United States. Following that, we explore the differences in disability insurance uptake across subgroups of education, gender, and age across the two countries. We then proceed to describe our empirical strategy and present our main empirical results. Finally, we simulate counterfactual paths for both earnings and benefits to observe the impact on disability insurance uptake trends.
2. Disability Insurance Programs and Earnings

Disability insurance arose as part of the social insurance structure of industrialized countries from a desire to provide income support to those unable to work because of poor health. Typically, these plans are contributory with benefits geared to some function of lifetime earnings. The Canadian and American public disability insurance plans conform to this international pattern in general, but there are subtle differences in how the programs are implemented. We set out key details of the Canadian and American public disability plans in this section, with an emphasis on plan details after 1995. Further details can be found in Baker and Milligan (2012) Milligan and Schirle (2016), Milligan (2012), Coile (2016) and Campolieti and Riddell (2012).

Canada / Quebec Pension Plan Disability Insurance

The Canada Pension Plan (CPP) was introduced in 1966, with a retirement and a disability insurance component (referred to as CPP-D). Workers began making contributions in 1967 and disability benefits began in 1970. Quebec administers its own disability insurance program as part of the Quebec Pension Plan (QPP). Since the late 1980s, the two disability insurance programs have been nearly identical in terms of their benefit formulas, with some small differences in eligibility criteria.

The disability benefit has two components. The first component offers a flat-rate benefit that is indexed to the consumer price index. In 2015, the flat rate portion
offered CAD$466 per month. The second component offers 75 percent of what would be an individual's retirement benefit, allowing for a truncated contribution period to the time of disability claim. Retirement benefits are calculated as 25 percent of average covered earnings. In 2015, this second component reached a maximum of CAD$799 per month. The CPP-D and QPP-D programs also offer a child benefit, adding $235 and $75 per month, respectively, for those with dependent children (under age 18 or students age 18-25).

To determine average earnings (the second component of the disability benefit), one begins by establishing the relevant contribution period, which is the time since the individual turned 18 or 1967 (whichever is later). To update nominal earnings in the contribution period, earnings are multiplied by a ratio of a five-year average of the earnings cap to each year's earnings cap. This earnings cap, known as the year's maximum pensionable earnings or YMPE, was CAD$53,600 in 2015 and is indexed annually to a measure of average wages. Until 1997, a three-year average of the earnings cap was used to update earnings. This was adjusted to a four-year average in 1998 and then the five-year average in 1999. Individuals may drop years from the contribution period associated with care of their young children. Some low-earnings years are then dropped for individuals with at least 10 years in their contribution period. Until 2011, 15% of months were dropped. This increased to 16% for 2012-13 and 17% for 2014-15. The remaining contribution period is used to obtain an average indexed monthly earnings (AIME).
An individual’s benefit from CPP-D and QPP-D can be summarized as

\[
\text{Disability Benefit} = \text{Flat rate} + 0.1875 \times AIME + \text{child benefits}
\]

For the CPP-D, eligibility for the benefit requires that an individual has a disability that is both “severe and prolonged”.\(^3\) Severe implies the disability regularly stops the individual from doing any type of substantially gainful work. Since 1995, the medical adjudication process does not account for socio-economic factors in assessing disability. The QPP-D also has a medical adjudication process, but appears to allow greater flexibility in the process.

Eligibility also depends on labor force attachment. Until 1996, individuals had to contribute to CPP in two of the previous three or five of the previous ten years to qualify. In 1997, eligibility was restricted to those with contributions in four of the last six years. In 2005, this requirement was loosened a bit, allowing those with 25 years of contributions to CPP and contributions in three of the last six years to be eligible. In Quebec (since 1993), individuals are eligible if they made contributions in two of the previous three or five of the previous ten years.

---

\(^3\) Guidelines are offered from ESDC at http://www.esdc.gc.ca/en/cpp/disability/index.page
Social Security Disability Insurance

Social Security provisions for disability insurance (SSDI) were introduced in 1950, with major reforms enacted in the 1970s. The main disability benefit formula has not changed substantially since and primarily depends on an individual’s average covered earnings.

To determine average earnings, covered nominal earnings in the individual’s earnings history (up to the annual maximum taxable earnings, or AMTE, which was US$118,500 in 2015) are multiplied by the ratio of average wages two years prior the claim (or age 60, whichever is earlier) to past average wages. More recent wages are not adjusted. Individuals can drop out up to 20% (maximum 5 years) of low earnings years from their history. The remaining period (at least two years) is used to obtain their average indexed monthly earnings (AIME).

This average then enters a progressive non-linear benefits formula, summarized as

\[
\text{Disability Benefit} = 0.9 \times \min(AIME, BEND1) \\
+ 0.32 \times \max(\min(AIME-BEND1, BEND2-BEND1),0) \\
+ 0.15 \times \max(AIME-BEND2,0)
\]

---

4 Relevant national average wage can be found in the Social Security Administration’s Annual Statistical Supplement, Table 2.A8, found at https://www.ssa.gov/policy/docs/statcomps/supplement/2015/2a8-2a19.html
BEND1 and BEND2 are “bend points” in the benefit formula. In 2015, the first bend point was set at US$826 per month and the second was set at US$4,980. These bend points are indexed to average wages.

Eligibility for the SSDI benefit requires a person’s disability prevent them from doing work they did before, and are unable to adjust to other work because of the medical condition. Furthermore, the disability is expected to last for at least one year or result in death. Consideration is given to socioeconomic factors, including age, education, past work experience, and transferable skills in determining ability to adjust to other work.

Eligibility also depends on previous labor force attachment. Requirements depend on the age at the time of making a claim, but generally need to have worked in 5 of the previous 10 years.

Small Differences That Matter – Benefits and Earnings

One of the key differences between CPP-D and SSDI since 1995 is the adjudication of claims. In Canada, since 1995, eligibility is primarily based on a medical assessment. While a disability must prevent one from working to be eligible for CPP-D, little consideration is otherwise given to socioeconomic factors after 1995. The downturn in CPP-D benefit receipt after 1995 is often attributed to the 1995 reform in the
medical adjudication process. In the United States, explicit consideration is given to one’s socio-economic status.

The main difference between the CPP-D and SSDI lies in their benefit formulas. While the CPP-D formula is a simple linear function of earnings, the SSDI formula is progressively non-linear. Furthermore, SSDI covers a much higher level of earnings than does CPP-D. Since 1995, however, the general structure of the benefit formulas has not changed substantially in either country.

In both the CPP-D and SSDI formulas, key parameters are automatically adjusted, and are indexed to a measure of average wages. It is important to consider, then, that real average wages have trended quite differently in each country. Because average wages affect the benefit formula mechanically, the differential trends in average wages have a mechanical impact on benefit formulas.

In Figure 2a and 2b (Canada), the dashed line represents movements in the 3-5-year average YMPE that is used in the adjustment of earnings histories (indexed here in the graph to 1995=100). We see that the real value of the YMPE was falling slightly through most of the 2000s, nearly recovering to its 1995 levels by 2011. This trend in YMPE largely reflects a period of low wage inflation, relative to price inflation, in the early 2000s. As the flat rate portion of the disability benefit moves with the price index, the lack of movement in the real value of the YMPE will translate into a lack of movement in the real value of disability benefits.
In Figure 2c and 2d (United States), the dashed line represents movements in the first bend point in the benefit formula. This moves at the same rate as the average wage measure used to adjust earnings histories and the second bend point of the formula. In the United States, we see that average wages rose substantially, by more than 20% over the 1995-2015 period. The real value of disability benefits, then, would also be increasing.

It is also important to consider how the distributions of wages in each country have evolved differently over time. In Canada (Figures 2a and 2b), we see very little movement in the median annual earnings of women and men at all education levels. Women’s median earnings appear to show some upward movement, generally aligning with changes in average wages (YMPE) toward 2010s.

In the United States (Figures 2c and 2d), we see a divergence in trends for median and average real earnings. For women, median earnings at all education levels roughly kept pace with average earnings (bend points) until the early 2000s. After 2005, women’s median earnings at all education levels stagnated, or even fell, while average earnings continued to increase. For men, median earnings at all education levels stopped growing around 2000 and then decline, particularly for those with less than a Bachelor’s degree. The divergence between median and average earnings is most stark for lower educated men.
What does this imply for disability benefits? As bend points are increased faster than a typical worker’s earnings, the replacement rates offered by SSDI will increase. This type of increase in replacement rates is not possible in Canada, given the linear nature of the formula. The impact of these parameter changes can be seen by graphing the benefits by age for three different years in Canada (CPP-D in Figure 3a) and the United States (SSDI in Figure 3b). For these graphs, we use a common earnings history adjusted only by inflation, and apply the rules applicable in every year.

For Canada at most ages, the highest benefits are in 1995 as seen in Figure 3a. By 2005 these benefits fall back by several hundred dollars, owing to the move from three-year to five-year averaging for the YMPE. By 2015, benefits have edged back up close to the 1995 level. In the United States in Figure 3b, benefits rise through time, driven by the bend-point increases discussed earlier. The increase from 1995 to 2005 was larger than the increase from 2005 to 2015. The benefit changes in the United States were substantially larger than those in Canada.

3. Trends in DI take-up

The trends in DI take-up for men and women were shown to be very different across Canada and the United States in Figure 1 discussed in the introduction. In this section, we dig into the trends more deeply, looking at differences by age and

---

5 Given the relatively low level of YMPE in Canada, if average earnings increased faster than median or upper quartile earnings, higher earners would see an increase in replacement rates as a larger share of their earnings were covered by CPP. This, however, is not what we see in Figures 4a and 4b.
education in order to better motivate and provide context for our empirical investigation.

Figure 4 traces the proportion of the population in different age groups that is a recipient of CPP-D in Canada, separately for women and for men. The same general trends revealed in Figure 1 also manifest in this graph by age group, with strong cohort eligibility effects evident for women. For both men and women, the rate increases sharply with age, with a stronger age gradient for men than for women.

The United States is graphed in Figure 5, showing by age and gender the take-up rate of SSDI benefits. The top age group here shows the rate from age 60 to the full retirement age (FRA), which has grown slightly through time. The other ages are the same as for Canada. The level of SSDI uptake is higher in Canada, but the age gradient is not as strong as in Canada. For example, in the United States, the take-up rate for men approximately doubles between ages 40-49 and 50-59, then again for the top age group. In contrast, the Canadian men show much larger increases between these age groups.

We now turn to education, which is of interest as a proxy for lifetime earnings potential. The movement of bend points in SSDI and earnings in Figure 2 for the United States suggests that some education groups saw more deterioration of earnings over our time period of interest compared to others. So, the attractiveness of SSDI benefits should differ by education groups. Because the administrative
tables we used for the previous take-up graphs do not include education, we turn to our microdata for this analysis. While sample sizes are large, there is some sampling variation introduced by this choice, which is evident on these graphs compared to the relatively smooth administrative data charts shown earlier. The US data come from the Current Population Survey and the Canadian data from the Survey of Labour and income Dynamics. Both of these data sources are described in detail below. In order to highlight the changes by education category, we set each group equal to an index level of 100 in 1995.

Panels A and B of Table 6 show women and men in Canada; panels C and D show the same for the US. There is little strong pattern to be seen, except for very large growth for high-school educated women in Canada. For the United States there is much stronger growth for those with High School and Some College than for those with a BA or more or less than High School. The strongest contrast is for men in panel D. Here, the take-up of SSDI grew by about 60 percent from 1995 to 2015 for everyone with a high school diploma or more; but was relatively flat for those with less than high school.

Overall, this analysis has exposed strongly different trends in disability insurance uptake in Canada and the US. Moreover, there are important differences across sex, education group, and age. We take this information as context for the formation of our empirical strategy in the next section where we exploit differences across these groups.
4. Empirical strategy

Our empirical strategy is quasi-experimental, exploiting variation in policy and international (Canada-US) earnings trends. At the core of our strategy is a differencing framework, within which we use instrumental variables to improve our estimates. We lay out our methods in this section, starting with the estimating equation of interest, then our measurement of disability insurance benefits and moving on to the regional earnings measure.

Estimating Equation

With respect to individual behavior, we think of individuals comparing the utility associated with taking up disability insurance against the utility associated with not taking up disability insurance and continuing to work in the labor force (which we term \( DI^* \)). The individual’s decision will depend primarily on the replacement rate offered by the disability insurance program, which is comprised of two parts – the disability benefit offered (\( \ln DB \)) and their potential earnings in the local labor market (\( \ln Earn \)). The individual’s decision to take up disability insurance can be described by the equation

\[
DI^*_it = \beta_0 + \beta_1 \ln DB_{it} + \beta_2 \ln Earn_{it} + \varepsilon_{it}
\]

We estimate the equation using a linear probability model.

\[
DI_{it} = \beta_0 + \beta_1 \ln DB_{gea_{it}} + \beta_2 \ln Earn_{gea_{it}} + X_{it} \Gamma + \varepsilon_{it}
\]

Where \( DI_{it} = 1 \) when we observe receipt of CPP/QPP-D or SSDI disability benefits and zero otherwise. As described in more detail below, we do not observe all
individual’s potential disability benefits or earnings. Rather we calculate the benefits that individuals in the same gender-age-education-region cell would qualify for at time $t$. Similarly, the earnings variable will represent average earnings for individuals in the same gender-age-education-region cell at time $t$. In the vector $X_{it}$ we include dummy indicators for marital status, gender, education, region, age, and year. Also in $X_{it}$ is the log mortality rate, as an objectively measurable control for health differences across gender, age, and country.

**Disability Insurance Benefits**

The disability insurance benefits for which one is eligible depends on one’s earnings history, the benefit formula in a given year, and current age. The earnings history matters because benefits are calculated explicitly accounting for the pattern of earnings over one’s lifetime. The benefit formula matters because it translates the earnings history into a benefit. The age matters because younger people have a smaller number of potential years in work, requiring them to keep more lower-earning years in their earning history, and thus receive a smaller benefit through the application of the formula, given the earnings history.

Calculating the benefit as a function of one’s own earnings history introduces potential endogeneity to the benefit calculation. Those who may have a latent disability may have a weaker earnings history, leading to a smaller potential benefit and also a higher likelihood of receiving benefits. To overcome this potential
endogeneity problem, we calculate a simulated benefit using a common earnings history for all people. This simulated benefit varies only by three exogenous factors—the system (Canada or the US), the year, and the age. We use this simulated benefit as an instrument to predict the calculated individual benefit.

In our empirical implementation, we control directly for each of these three factors along with the two-way interactions of each of these three factors.

**Regional Earnings**

The second key variable we wish to relate to disability insurance uptake is the potential earnings on offer to workers. We measure potential earnings as the average earnings within cells defined by age group, education, gender, region and year. Potential earnings, however, reflect supply conditions such as human capital, experience, and other attributes, which may not be observable. If these supply-side attributes are correlated with factors that also influence disability insurance uptake, we need a way to isolate variation in earnings from these other endogenous factors. For this reason, we implement an instrumental variables strategy, which depends on national earnings trends and fixed local characteristics. This ‘Bartik-style instrument’ strategy is commonly used in this circumstance. The Bartik instrument is constructed as

---

6 Bartik (1991) developed this method of isolating changes in local labor demand and has been used in a wide range of studies including Autor and Duggan (2003), Bertrand et al. (2015), and Maestas, Mullen and Powell (2013) with further references therein.
\[ \text{Bartik}_{gear} = \sum_{k=1}^{3} \text{Earn}_{k,\text{gear}(\sim r),t} \times \text{Share}_{k,\text{ger}95} \]

Where \( \text{Earn} \) represents average earnings among individuals in industry \( k \) (primary, manufacturing or other), in all regions (of Canada and the United States) other than region \( r \). \( \text{Share} \) represents industry \( k \)'s share of the 1995 workforce in each region in each of three sectors: primary industries, manufacturing, and the rest (mostly services). The regional earnings and industry shares are used to construct the composite earnings measure \( \text{Bartik} \), a weighted average of the sector level earnings with each region's initial sector shares used as weights. In our implementation, we repeat this Bartik composite earnings calculation separately for cells defined by gender, age and education level; in each case using the national sector trends and initial regional sector shares. This instrumental variable strategy isolates the trends in earnings from regionally-varying unobserved factors.

**Identification**

Of note, we include in our estimating equation the main effects for each of our two instrumental variable strategies. For the simulated disability benefit, we have the main effects for year, age, and country. For the Bartik instrument, we have the main effects for gender, age, education, and year. This allows us to identify the effects of benefits and regional earnings using variation across these factors. That is, by including these main effects we can separate the impact of benefits and earnings from the factors used as inputs for the calculation of the instruments.
In order to fortify our empirical strategy, we go beyond this specification by also including the second-order interactions between the three factors for each of our instruments. In this way, our strategy is best thought of as a triple-differencing approach. Specifically, for the disability insurance benefits we include the full set of interactions between age and year, year and country, and age and country. For the regional earnings, we include the full set of interactions between gender and education, education and year, and gender and year. Earlier, Figure 3 showed the extent of our policy variation across years for a given age and country. It is this variation that allows us to implement our triple-difference strategy.

5. Data


For all years in Canada and the US, we can observe in the data receipt of benefits from Social Security (for the US) and Canada/Quebec Pension Plan (for Canada).

---

7 In 2012, the Canadian Income Survey replaced SLID. At the time of writing, the new Canadian Income Study files for 2012 and beyond were not yet available to researchers.
This forms our primary dependent variable for the analysis. One important shortcoming of this variable is that it does not distinguish between disability benefits, retirement benefits, and survivor benefits. Our age selection criterion has an upper limit at age 59, which rules out retirement benefits as a possibility in either Canada or the United States. Survivor benefits could be payable to those with a deceased spouse, even if the survivor is under age 60.

Our US data from 2001 forward reports SSDI separately, so we can assess the importance of using the more general SS variable. For men, about 82 percent of benefits in the age range in our data are disability insurance; for women it is about 69 percent. In our results below, we also try specifications for the US using the SSDI receipt indicator.

We make use of regional variation in our data. For Canada, we use the five regions delineated by Statistics Canada. For the United States, we use the nine census divisions. In the rest of this paper we refer to all of these fourteen areas as ‘regions’.

Our main independent variables of interest are the projected disability insurance benefits and potential earnings. We form the disability insurance variable by attaching to each observation an earnings history based on the average earnings of

---

8 The Canadian regions are: Atlantic, Quebec, Ontario, Prairies, British Columbia.
9 The US Census divisions are: New England, Middle Atlantic, South Atlantic, East South Central, East North Central, West North Central, West South Central, Mountain, Pacific.
someone of that gender, region, education, and year of birth cohort.\textsuperscript{10} Using this earnings history, we use a benefit calculator that incorporates the rules as they exist in each year. For potential earnings, we take the average earnings by age group, year, gender, region, and education group.

We control for the demographic characteristics of each individual using available data. These controls include a dummy for marital/common law status, for gender, and a set of four dummy variables for education.\textsuperscript{11} We form age group dummies by five-year age clusters, ranging from 25-29 to 55-59.

The final data we bring to the regression are mortality rates. We draw these data from the Human Mortality Database (www.mortality.org). These data are available separately for Canada and the US by age and gender for each year.

We present descriptive statistics on our sample in Table 1 for several samples and a selection of our variables. Our full sample, pooling together the CPS and the SLID, comes to 2.36 million observations. There are slightly more women than men, and observations from Canada make up one quarter of our sample.

\textsuperscript{10} For Canada, we use the Survey of Consumer Finances income files to extend backward to 1973, interpolating for missing years. For years before 1973, we project backward using the consumer price index. For the United States, we use the Current Population Survey back to 1966 and project backward from there using the consumer price index.

\textsuperscript{11} The four education categories are less than high school, high school graduate, some post-high school, college/university degree or more.
In our full sample, 3.6 percent are receiving disability insurance benefits. The rate of receipt is slightly higher for women, and one third higher in the United States than in Canada. There is a strong education gradient, with 7.0 percent of those with less than high school receiving disability insurance, compared to 1.4 percent of those with a college or university degree.

Our regional earnings variable aims to measure the potential earnings available to a worker in a given region, year, education, gender and age category. Average earnings is higher for males over females, the US over Canada, and follows the expected positive education gradient.

The projected benefits variable contains the result given by our benefit calculators given an earnings history depending on year of birth, education, gender, and region. The average benefits are higher for males and for those with more education, reflecting higher lifetime earnings paths for these groups. Benefits in the United States are 73 percent larger than those in Canada. This is a substantial and important difference.

6. Results and simulations

Our regression results are presented in three tables, showing how our result varies in different specifications and samples. Following that, we present the results of some simulations, which help to explore the implications of the magnitudes of our estimates.
The first results are in Table 2. Each column of the table has the results of a separate regression, with coefficients and standard errors appearing in each row. The dependent variable in all cases in this table is a dummy for receiving Social Security or Canada/Quebec Pension Plan benefits. Our first regression in column (1) has an ordinary least squares (OLS) regression that includes our two main variables of interest along with a full set of controls—including the 2nd order interactions as described above. The resulting coefficients for both the log of regional earnings and the log of disability insurance benefits are small and statistically insignificant. The other control variables show sensible results, with lower rates of disability insurance uptake for those who are married and more highly educated.

The second column shows the results of implementing our instrumental variables strategy. Here, we instrument for regional earnings using the Bartik-style composite earnings variable, and for disability insurance benefits using the simulations based on a common earnings history. The results for both the regional earnings and disability insurance benefits now show the expected signs and are strongly significant. The higher are potential regional earnings, the lower is the receipt of benefits, with a 10 percent increase in earnings predicted to lead to a 0.68 percentage point drop in take-up. The positive 0.049 coefficient for disability insurance benefits suggests that a 10 percent increase in the value of disability insurance benefits would lead to about a half point increase in the take-up rate.
The last two columns of Table 2 show the results of the first stage regressions in our instrumental variables implementation. Our Bartik-style composite earnings measure, which exploits national variation in earnings across industrial sectors, is a strong predictor of our regional earnings measure with a coefficient of 0.550. For our simulated benefit derived from a common earnings history, we obtain a coefficient of 1.059, suggesting a strong relationship between the simulated instrument and the actual benefits for someone in that region, gender, education, age, and year category.

We display the first stage relationships in Figure 7 by collapsing the data to the region-year level. The top panel shows the relationship between the Bartik composite earnings and observed regional earnings. There is a clear and strong relationship evident. The bottom panel depicts the simulated benefits and actual disability insurance benefits. Again, there is a clear and strong relationship. In this graph, the cluster at the bottom left are the data points for Canada, where benefit generosity is markedly lower.

The next set of results in Table 3, showing how our results vary across Canada and the United States separately. We also show results combing both the regional earnings and benefits variables into a replacement rate. The first column of Table 3 replicates our main result from column (2) of Table 2. In the replacement rate specification, the coefficient of 0.147 implies that a ten-point increase in the
replacement rate would increase disability insurance uptake by 1.47 percentage points.

The next two columns of Table 3 show separately our results from our Canadian and US samples. In these specifications, we leave out our 2nd order interactions because we are looking at each side of our Canada-US differencing strategy separately. The coefficients for Canada are insignificant, while for the United States they are similar in magnitude to the main specification. This does not mean that the Canadian disability insurance program has no impact; it may be that there is not enough variation in Canada alone across age groups and years to identify an impact.

The last column shows the results using a different dependent variable: the receipt of SSDI rather than the more general Social Security benefit receipt we use in the other specifications. Here, the coefficients are quite similar to those in column (3), suggesting that the inclusion of survivor benefits as part of our dependent variable does not materially affect our results.

The next table explores the results in subsamples defined by gender and education. Again we present the results for the two main variables separately in the top half of Table 4, and then combined into a replacement rate in the bottom half of the table. The response by men overall seems stronger than for women as indicated by the replacement rate coefficients of 0.182 and 0.080. However, the coefficient for
regional earnings (the ‘push’ factor) is much stronger for males while the coefficient for disability insurance benefits (the ‘pull’ factor) is stronger for females.

Looking across education groups in Table 4, the response as indicated in the replacement rate specification appears to be monotonically decreasing in education. For the lowest education group, both regional earnings and benefits matter, while for those with a high school diploma or some post-high school education are much more sensitive to the potential disability insurance benefits than regional earnings.

**Simulations**

In order to gauge the magnitude of our results, we present some counterfactual simulations based on our main specification in Table 2, column (2). To form the counterfactual, we take the initial 1995 values for benefits and regional earnings and impose the growth rates for these variables coming from a different region or country. This allows us to illustrate the impact of the push and pull factors on disability insurance uptake according to our estimates.

The simulations appear in Figure 8. In the top panel, we take the baseline SSDI uptake in the CPS for the United States. We then impose a counterfactual path for earnings in all regions, using the earnings growth rate from Canada. This short-dashed line is above the baseline until 2007, reflecting slower earnings growth in Canada than the United States in the late 1990s and early 2000s. Lower earnings
pushes up the SSDI takeup rate. In the later years, the higher earnings growth in Canada pulls the predicted SSDI participation rate under the baseline. We then impose that benefits follow the growth rate for Canadian benefits, instead of the actual path which had benefits growing substantially. We graph this with the long dash, and the effect is dramatic—the time path for SSDI uptake is now slightly downward at some contrast to the upward trajectory in the baseline. By 2011, the gap is approximately one percentage point, which is about one quarter of the 2011 level.

We move from countries to regions in the bottom panel of Figure 8. Here, we impose the wage growth and benefit growth of the Midwest Census region of the United States onto the Prairie region of Canada. The Midwest is a region with high disability insurance growth rates and stagnated earnings over this time period; the Prairies in contrast had the strongest earnings growth and the disability insurance takeup rate declined. The bottom panel of Figure 8 shows that again the up and down of wage growth does have some impact relative to the baseline, but it is the change in benefit generosity that has the most substantial impact. By the last year of the simulation in 2011, CPP-D participation is predicted to be 3 percentage points higher in the Prairie region of Canada if they had experienced the same wage growth and benefit growth as the Midwest region of the United States.

These simulations provide two strong conclusions. First, the magnitude of our estimated coefficients for regional earnings and benefit generosity is sufficient to
completely explain the trend differences between Canada and the United States in disability insurance uptake. Second, of these two factors, the pull of higher benefits seems to be more quantitatively important than the push of weak labor markets in explaining the trend in disability insurance take-up.

7. Conclusions

In this paper we explore the pull of benefit generosity and the push of regional labor market conditions on the take-up of disability insurance benefits in Canada and the United States. While disability insurance uptake has grown remarkably over the last twenty years in the United States, it has shrunk in Canada. Using an instrumental variables strategy exploiting policy variation and international earnings growth trends, we find that both push and pull factors matter and can substantially explain the trend differences in disability insurance take-up rates in Canada and the US. If the US had experienced Canadian earnings growth and benefit generosity changes between 1995 and 2015, SSDI take-up would fall by about one quarter from observed levels.

While disability insurance is only one factor in the greater puzzle of labor force withdrawal by middle-skill middle-age workers, our results here suggest may play some role. Future research could look more deeply into the labor supply impact of the rise in disability insurance uptake in the United States, possibly using administrative data sources which more closely follow transitions in and out of the labor force.
References


Coile, Courtney, Kevin S. Milligan and David A. Wise. "Introduction to Social Security Programs and Retirement Around the World: Disability Insurance Programs and

Duggan, Mark and Scott A. Imberman (2009), “Why are the disability rolls skyrocketing? The contribution of population characteristics, economic conditions, and program generosity,” in David M. Cutler and David A. Wise (eds.) Health at Older Ages: The causes and consequences of declining disability. Chicago: University of Chicago Press.


Figure 1: Disability Insurance Takeup Rates, Age 30-59

Sources: US data come from the Social Security Administration (numerator) and the Census Bureau (denominator). Canadian data come from Employment and Social Development Canada (numerator) and Statistics Canada (denominator). Canadian data exclude Quebec.
Figure 2: Earnings and Disability Insurance Parameters

a. Women Age 25-59, Canada

a. Men Age 25-59, Canada
Source: CPS and SLID files, Bend point from Social Security Administration and YMPE from Employment and Social Development Canada.
Figure 3: Disability Insurance Benefits by Year and Age

a. CPP-D Benefits, Canada

b. SSDI Benefits, US

Notes: Graph shows simulated CPP-D and SSDI benefits for a common earnings history across years. Calculations by authors.
Figure 4: Canada Pension Plan Disability Receipt by Age

Source: Administrative records from Employment and Social Development Canada and population data from Statistics Canada CANSIM database.
Figure 5: United States Social Security Disability Insurance Receipt by Age

a. Women, United States

b. Men, United States

Source: Social Security Administration (SSDI recipients) and US Census Bureau (Population).
Figure 6: Disability Insurance Take-up Rate by Education, ages 25-59

a. Women, Canada

b. Men, Canada
Notes: Data source is Current Population Survey for US and Survey of Labour and Income Dynamics for Canada. The sample includes all ages from 25 to 59.
Figure 7: First Stage Relationships

Notes: These scatter plots show data points at the region-year level as described in the text. All dollar values are 2015 US dollars.
Figure 8: Counterfactual Simulations

Notes: Simulations by authors.
<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Male</th>
<th>Female</th>
<th>Canada</th>
<th>US</th>
<th>Less than High School</th>
<th>High School / Some post-secondary</th>
<th>College or University Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>2,355,317</td>
<td>1,130,752</td>
<td>1,224,565</td>
<td>573,065</td>
<td>1,782,252</td>
<td>308,261</td>
<td>1,409,515</td>
<td>637,541</td>
</tr>
<tr>
<td>Benefit receipt</td>
<td>0.036</td>
<td>0.034</td>
<td>0.038</td>
<td>0.028</td>
<td>0.037</td>
<td>0.072</td>
<td>0.040</td>
<td>0.014</td>
</tr>
<tr>
<td>[0.186]</td>
<td>[0.180]</td>
<td>[0.192]</td>
<td>[0.165]</td>
<td>[0.188]</td>
<td>[0.258]</td>
<td>[0.196]</td>
<td>[0.117]</td>
<td></td>
</tr>
<tr>
<td>Regional earnings</td>
<td>46,549</td>
<td>57,278</td>
<td>36,183</td>
<td>36,808</td>
<td>47,739</td>
<td>25,089</td>
<td>38,778</td>
<td>70,781</td>
</tr>
<tr>
<td>[22,927]</td>
<td>[25,308]</td>
<td>[14,003]</td>
<td>[14,231]</td>
<td>[23,361]</td>
<td>[8,447]</td>
<td>[11,626]</td>
<td>[24,325]</td>
<td></td>
</tr>
<tr>
<td>Projected</td>
<td>14,809</td>
<td>16,681</td>
<td>13,001</td>
<td>8,897</td>
<td>15,350</td>
<td>10,908</td>
<td>13,929</td>
<td>18,157</td>
</tr>
<tr>
<td>Benefits</td>
<td>[4,609]</td>
<td>[4,893]</td>
<td>[3,463]</td>
<td>[1,617]</td>
<td>[4,411]</td>
<td>[2,421]</td>
<td>[3,643]</td>
<td>[4,940]</td>
</tr>
<tr>
<td>Married/Common</td>
<td>0.617</td>
<td>0.610</td>
<td>0.625</td>
<td>0.693</td>
<td>0.61</td>
<td>0.544</td>
<td>0.604</td>
<td>0.674</td>
</tr>
<tr>
<td>[0.486]</td>
<td>[0.488]</td>
<td>[0.484]</td>
<td>[0.461]</td>
<td>[0.488]</td>
<td>[0.498]</td>
<td>[0.489]</td>
<td>[0.469]</td>
<td></td>
</tr>
<tr>
<td>Mortality rate</td>
<td>0.0029</td>
<td>0.0037</td>
<td>0.0021</td>
<td>0.0020</td>
<td>0.0020</td>
<td>0.0030</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[0.0023]</td>
<td>[0.0026]</td>
<td>[0.0017]</td>
<td>[0.0017]</td>
<td>[0.0017]</td>
<td>[0.0024]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Each column shows a different sample. All observations weighted using provided sample weights. Data source is the Current Population Survey for the US, and Survey of Labour and Income Dynamics for Canada. Death rate data come from the Human Mortality Database. Dollar values are reported in 2015 US dollars. The mortality rate is not shown for the education groups because it only varies at the year-age-gender-country level.
Table 2: Basic OLS and IV results

<table>
<thead>
<tr>
<th></th>
<th>(1) OLS</th>
<th>(2) IV</th>
<th>(3) 1st stage</th>
<th>(4) 1st stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td>SS/CQPP receipt</td>
<td>SS/CQPP receipt</td>
<td>SS/CQPP receipt</td>
<td>SS/CQPP receipt</td>
</tr>
<tr>
<td>Observations</td>
<td>2,355,317</td>
<td>2,352,298</td>
<td>2,352,298</td>
<td>2,355,317</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.031</td>
<td>0.030</td>
<td>0.942</td>
<td>0.933</td>
</tr>
<tr>
<td>Log regional earnings</td>
<td>-0.001</td>
<td>-0.068***</td>
<td>[0.003]</td>
<td>[0.015]</td>
</tr>
<tr>
<td>Log DI benefits</td>
<td>0.003</td>
<td>0.049***</td>
<td>[0.006]</td>
<td>[0.005]</td>
</tr>
<tr>
<td>Log Composite earnings</td>
<td></td>
<td></td>
<td>0.550***</td>
<td>0.562**</td>
</tr>
<tr>
<td>Log simulated DI benefits</td>
<td></td>
<td></td>
<td>[0.029]</td>
<td>[0.022]</td>
</tr>
<tr>
<td>Canada</td>
<td>0.018***</td>
<td>0.012*</td>
<td>-0.148***</td>
<td>-0.179***</td>
</tr>
<tr>
<td></td>
<td>[0.004]</td>
<td>[0.005]</td>
<td>[0.024]</td>
<td>[0.016]</td>
</tr>
<tr>
<td>Male</td>
<td>-0.017**</td>
<td>0.009</td>
<td>0.279***</td>
<td>0.451***</td>
</tr>
<tr>
<td></td>
<td>[0.005]</td>
<td>[0.009]</td>
<td>[0.026]</td>
<td>[0.021]</td>
</tr>
<tr>
<td>Married or common-law</td>
<td>-0.035***</td>
<td>-0.035***</td>
<td>0.004***</td>
<td>0.008***</td>
</tr>
<tr>
<td></td>
<td>[0.002]</td>
<td>[0.002]</td>
<td>[0.001]</td>
<td>[0.001]</td>
</tr>
<tr>
<td>Log death rate</td>
<td>0.016***</td>
<td>0.007***</td>
<td>-0.055***</td>
<td>-0.140***</td>
</tr>
<tr>
<td></td>
<td>[0.002]</td>
<td>[0.002]</td>
<td>[0.006]</td>
<td>[0.017]</td>
</tr>
<tr>
<td>High school graduate</td>
<td>-0.032***</td>
<td>-0.017</td>
<td>0.169***</td>
<td>0.222***</td>
</tr>
<tr>
<td></td>
<td>[0.006]</td>
<td>[0.008]</td>
<td>[0.033]</td>
<td>[0.017]</td>
</tr>
<tr>
<td>Some post-high school</td>
<td>-0.038***</td>
<td>-0.015</td>
<td>0.244***</td>
<td>0.300***</td>
</tr>
<tr>
<td></td>
<td>[0.006]</td>
<td>[0.009]</td>
<td>[0.036]</td>
<td>[0.018]</td>
</tr>
<tr>
<td>College/university degree</td>
<td>-0.053***</td>
<td>-0.013</td>
<td>0.408***</td>
<td>0.476***</td>
</tr>
<tr>
<td></td>
<td>[0.007]</td>
<td>[0.013]</td>
<td>[0.040]</td>
<td>[0.025]</td>
</tr>
<tr>
<td>Age group dummies</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Year dummies</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>2nd order interactions</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Notes: Each column reports coefficients and standard errors from separate regressions with the indicated dependent variable. Regressions include the indicated control variables, plus dummies for region, and interactions between Canada and education, region, and male. The 2nd order interactions include interactions between the age group dummies, the year dummies, and the Canada indicator. Robust standard errors are clustered by region. Stars indicate significance at the 1 percent (3 stars), 5 percent (2 stars), and 10 percent (1 star) levels of confidence. Data source is the Current Population Survey for the US, and Survey of Labour and Income Dynamics for Canada.
Table 3: Canada compared to United States

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>(1) Main IV</th>
<th>(2) Just Canada</th>
<th>(3) Just US</th>
<th>(4) Just US</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS/CQPP receipt</td>
<td>2,352,298</td>
<td>570,696</td>
<td>1,781,602</td>
<td>1,398,874</td>
</tr>
<tr>
<td>CQPP receipt</td>
<td>2,352,298</td>
<td>570,696</td>
<td>1,781,602</td>
<td>1,398,874</td>
</tr>
<tr>
<td>SS receipt</td>
<td>2,352,298</td>
<td>570,696</td>
<td>1,781,602</td>
<td>1,398,874</td>
</tr>
<tr>
<td>SSDI receipt</td>
<td>2,352,298</td>
<td>570,696</td>
<td>1,781,602</td>
<td>1,398,874</td>
</tr>
<tr>
<td>Observations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2^{nd} order</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>interactions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Separate Earnings and Benefits

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-squared</td>
<td>0.030</td>
<td>0.042</td>
<td>0.030</td>
<td>0.028</td>
</tr>
<tr>
<td>Log regional earnings</td>
<td>-0.068***</td>
<td>-0.033</td>
<td>-0.034***</td>
<td>-0.033***</td>
</tr>
<tr>
<td></td>
<td>[0.015]</td>
<td>[0.018]</td>
<td>[0.005]</td>
<td>[0.005]</td>
</tr>
<tr>
<td>Log DI benefits</td>
<td>0.049***</td>
<td>-0.004</td>
<td>0.054***</td>
<td>0.040***</td>
</tr>
<tr>
<td></td>
<td>[0.005]</td>
<td>[0.007]</td>
<td>[0.006]</td>
<td>[0.004]</td>
</tr>
</tbody>
</table>

Replacement Rate

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-squared</td>
<td>0.030</td>
<td>0.042</td>
<td>0.029</td>
<td>0.028</td>
</tr>
<tr>
<td>Replacement rate</td>
<td>0.147***</td>
<td>0.061</td>
<td>0.160***</td>
<td>0.123***</td>
</tr>
<tr>
<td></td>
<td>[0.014]</td>
<td>[0.041]</td>
<td>[0.015]</td>
<td>[0.011]</td>
</tr>
</tbody>
</table>

Notes: We report coefficients and standard errors from instrumental variable regressions with the indicated dependent variable. The regressions in each column, and in the top and bottom panel, are distinct. Regressions include same control variables as indicated in Table 2, but the one-country samples do not include the Canada interactions or the age group by year interactions. Robust standard errors are clustered by region. Stars indicate significance at the 1 percent (3 stars), 5 percent (2 stars), and 10 percent (1 star) levels of confidence. Data source is the Current Population Survey for the US, and Survey of Labour and Income Dynamics for Canada.
Table 4: Comparing across Demographic Samples

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>(1) Men</th>
<th>(2) Women</th>
<th>(3) Less than high school</th>
<th>(4) High school or some post-secondary</th>
<th>(5) College / University degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS/CQPP receipt</td>
<td>SS/CQPP</td>
<td>SS/CQPP</td>
<td>SS/CQPP</td>
<td>SS/CQPP</td>
<td>SS/CQPP</td>
</tr>
<tr>
<td>Observations</td>
<td>1,130,752</td>
<td>1,221,546</td>
<td>307,933</td>
<td>1,408,615</td>
<td>635,750</td>
</tr>
<tr>
<td>2nd order interactions</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Separate Earnings and Benefits

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-squared</td>
<td>0.031</td>
<td>0.031</td>
<td>0.033</td>
<td>0.023</td>
<td>0.011</td>
</tr>
<tr>
<td>Log regional earnings</td>
<td>-0.078***</td>
<td>0.028</td>
<td>-0.218**</td>
<td>-0.005</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>[0.008]</td>
<td>[0.040]</td>
<td>[0.071]</td>
<td>[0.023]</td>
<td>[0.007]</td>
</tr>
<tr>
<td>Log DI benefits</td>
<td>0.018*</td>
<td>0.028**</td>
<td>0.105**</td>
<td>0.047***</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>[0.007]</td>
<td>[0.007]</td>
<td>[0.030]</td>
<td>[0.006]</td>
<td>[0.003]</td>
</tr>
</tbody>
</table>

Replacement Rate

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-squared</td>
<td>0.031</td>
<td>0.031</td>
<td>0.045</td>
<td>0.022</td>
<td>0.011</td>
</tr>
<tr>
<td>Replacement rate</td>
<td>0.182***</td>
<td>0.080**</td>
<td>0.257**</td>
<td>0.165***</td>
<td>0.020</td>
</tr>
<tr>
<td></td>
<td>[0.031]</td>
<td>[0.020]</td>
<td>[0.064]</td>
<td>[0.017]</td>
<td>[0.012]</td>
</tr>
</tbody>
</table>

Notes: We report coefficients and standard errors from instrumental variable regressions with the indicated dependent variable. Each column has a different subsample. The regressions in each column, and in the top and bottom panel, are distinct. Regressions include same control variables as indicated in Table 2, but the one-country samples do not include the Canada interactions or the age group by year interactions. Robust standard errors are clustered by region. Stars indicate significance at the 1 percent (3 stars), 5 percent (2 stars), and 10 percent (1 star) levels of confidence. Data source is the Current Population Survey for the US, and Survey of Labour and Income Dynamics for Canada.