Appendix to The Longitudinal Effects of Disability Types on Incomes and Employment.

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1 Empirical Representation of Disability Based on Limitations to Daily Activities

I model disability based on self-reported measures of limitations to daily activities. This has the advantage of honing in on an intermediate step in the mapping from a health condition to an individual's labour market outcomes. It is often unclear if, or how, a given health condition will influence behaviour. However, focusing on the activity limitations caused by a given health condition reveals if it impairs performance in productive tasks at work. To illustrate, when left untreated, diabetes can result in a substantial physical impairment, which may restrict the set of physically demanding tasks a worker can perform. However, with proper treatment, diabetes may not limit one's activities or significantly impact work or productivity. Measuring the extent of physical impairment helps to overcome this ambiguity.

I represent disability status using a latent index framework. The "extent" of individual i's disability is modeled as a continuous latent univariate index, $\hat{d}_i$, that summarizes the extent of limitation in a set whose elements represent a specific activity of daily living (ADL) chosen by the analyst. Disability status of individual i, d_i, is a binary variable that equals one for an individual when the extent of their disability breaches some threshold, $\bar{d}_i$. This threshold is indexed by i, as the threshold of disability depends on an

individual's unique economic characteristics and environment.[1] That is, disability status is represented as

$$d_i = \begin{cases} 1, \text{ if } \hat{d}_i > \bar{d}_i \\ 0, \text{ otherwise.} \end{cases}$$

I assume that if $\hat{d}_i = 0$, an individual is completely uninhibited in performing tasks comprising the specified set of ADLs. The larger the value of this index, the more limited an individual is in performing the set of ADLs. For instance, a mildly sprained ankle would give a lower value to $\hat{d}_i$ than a broken ankle if the activities include walking or running. If $\hat{d}_i > \bar{d}_i$, the individual is considered disabled.[2]

Even this simple representation of disability illustrates the difficulties associated with its measurement and representation. $\bar{d}_i$ and $\hat{d}_i$ are private information and are endogenous to the environment, lifestyle, and occupation of the individual. A mild ankle sprain may be more disruptive to the livelihood of a professional athlete than a software engineer.

Defining $\hat{d}_i$ based on a chosen set of ADLs helps to address the empirical difficulties associated with the subjectivity of $\hat{d}_i$ and $\bar{d}_i$. I assume the activities are summarized by a vector, v_i, whose elements are continuous indexes representing the extent of limitation for a specific activity. For instance, an element may represent the extent of limitation in walking on a flat surface for 20 minutes. This vector maps into $\hat{d}_i$ by a chosen function or metric, $F : D^v \to D^d$, where D^j is the domain of "j" for $j \in \{v, d\}$. The threshold, $\bar{d}_i$, can be chosen in terms of v and the mapping from v to $\hat{d}_i$. For example, one may normalize d_i and elements of v_i between 0 and 1. Then F can be: "if the average of the elements of v_i is greater than 0.5, then the individual is flagged for disability." This strategy takes a stance on what constitutes a disability. The definition of disability is relative to the chosen activities, the reported limitation of these activities (observed), the mapping F, and the choice of $\bar{d}_i$.

This framework offers a flexible way to summarize the large variety of disabling conditions and the presence of multiple disabling conditions. For instance, it could be the case that someone may be flagged as disabled if they are severely limited in a given daily activity but uninhibited in all others. Alternatively, someone may be moderately limited in multiple activities, where the combination causes them to be considered disabled (i.e., breach the threshold in the latent index of the extent of disability). In contrast, they may not be flagged if they were only limited in one of these dimensions.[3]

[1] For instance, people differ in the sets of tasks making up work, daily life, and their tolerance for dealing with barriers to performing these tasks.

[2] That is, someone with a mild ankle sprain may not be limiting enough for them to consider themselves disabled, whereas a broken ankle requiring crutches may breach this threshold.

[3] This may be accommodated by adding penalties to multiple conditions in the mapping from v to $\hat{d}_i$.

In this paper, I take these components directly from the model used in LISA. LISA derives disability status using self-reported questions on the frequency and magnitude of difficulty associated with performing specific ADLs.[4] These responses to these questions are categorical and are taken as a noisy measure of the elements of v. I flag disability based on frequency responses exclusively, as there are inconsistencies in questions about magnitude of difficulty across survey waves. The grouping is useful to average out any small measurement error in reporting a continuous number and summarizes the elements v while maintaining ordinality.

[4]The set of ADL includes mobility, flexibility, memory, dexterity, learning, pain, and mental health.

1.1 Sample Survey Questions on Limitations to Daily Activities

Table 1: Questions used to Measure Limitations to Daily Activities

Questions to Derive Aggregate Physical Disability
How much difficulty do you have walking on a flat surface for 15 minutes without resting?
How much difficulty do you have walking up or down a flight of stairs, about 12 steps without resting?
How much difficulty do you have reaching in any direction, for example, above your head?
How much difficulty do you have using your fingers to grasp small objects like a pencil or scissors?
Do you have pain that is always present?
Questions to Derive Mental-Cognitive Disability
Do you think you have a condition that makes it difficult in general for you to learn? This may include learning disabilities such as dyslexia, hyperactivity, attention problems, etc..
Has a teacher, doctor or other health care professional ever said that you had a learning disability?
Has a doctor, psychologist or other health care professional ever said that you had a developmental disability or disorder? This may include Down syndrome, autism, Asperger syndrome, mental impairment due to lack of oxygen at birth, etc..
Do you have any ongoing memory problems or periods of confusion? Please exclude occasional forgetfulness such as not remembering where you put your keys.
Do you have any emotional, psychological or mental health conditions? These may include anxiety, depression, bipolar disorder, substance abuse, anorexia, etc..

Source: Table comes directly from Grondin, C. (2016). A new survey measure of disability: The Disability Screening Questions (DSQ). Statistics Canada.

2 T1FF Components of Income and Variable Construction

This section offers more detail about the measures of income and breakdown of personal income in the T1FF. Theses data are derived from annual tax filings, which is especially advantageous in mitigating concerns with measurement error that often plagues survey data. Figure 1 shows the breakdown of personal income used for the Canadian Census. There are some slight differences in the more dis-aggregated measures of income in the T1ff. However the overall decomposition is parallel to what I focus on in this paper. For this papers purposes, the income concepts from this figure are the sufficient.

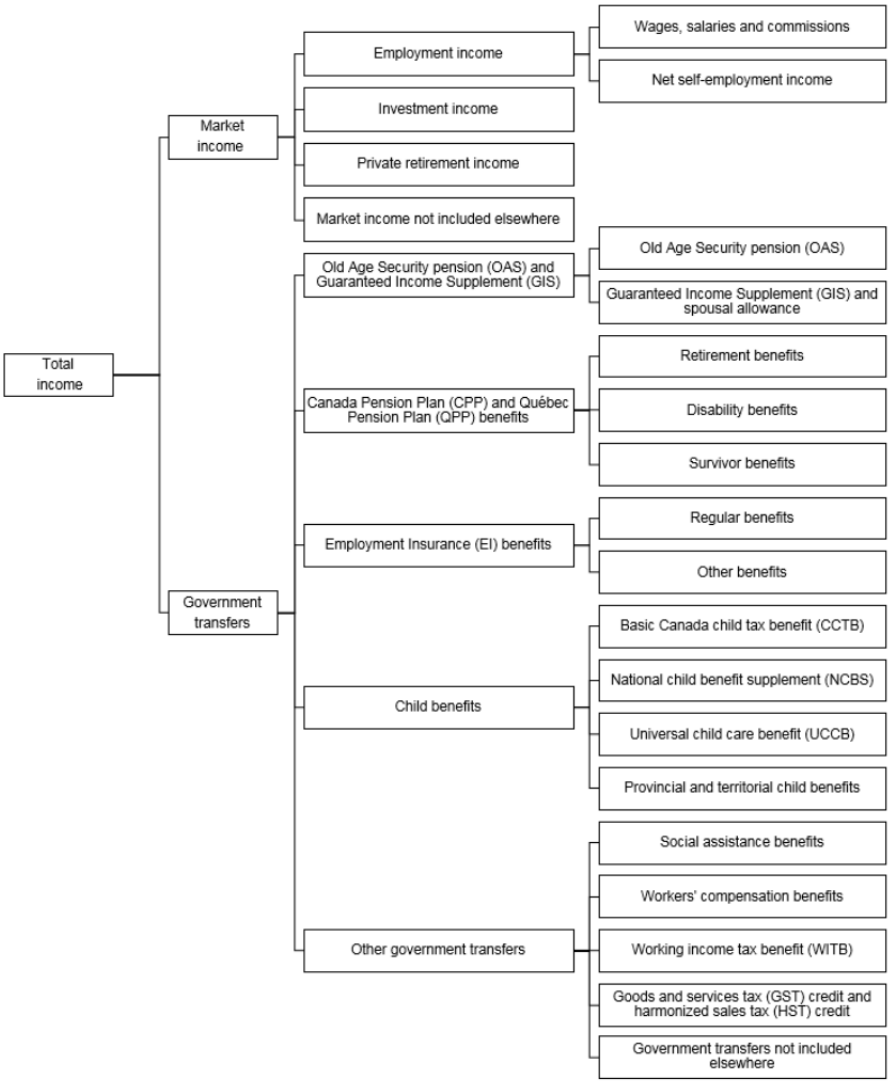
An individual's personal income can be partitioned into market income and income from transfer payments. This distinction is important for separating resources that are earned through market participation, such as the labour market (wages) or investment market (Dividends, savings, etc..). Transfer income is associated with publicly provided resources made available to individuals with low or zero earnings. For instance, Employment Insurance (EI) may be available for people who lose their job, or specific barriers or costs that may limit one's ability to provide for themselves or dependents. For example, disability insurance is available to aid with the costs and barriers to work caused by a disability.

An individual's Market income is mainly comprised of income earned from employment but includes other sources. Employment income can be differentiated into wages, salaries and commissions (T4E), self-employment income (SEI), which includes net business income, farming income, fishing, etc.., and other forms of employment income(OEI), which may include tips, gratuities, or wage loss replacement plans (private disability insurance). Market income also includes interest and investment income, corporate dividends, alimony, limited partnership income, retirement savings plans, and income from private pensions (OTHER).

Government transfer payments combine federal and provincial programs aimed at assisting those with little or no market income. Two of the largest transfer programs are federal EI and Canadian Pension Plan, the latter of which offers supplementary benefits to working-age adults affected by disability (CPP-D). Canada offers a set of transfers and tax credits targeting families at both the federal and provincial levels. Notably, The Canadian Child benefit (CTIB), which replaced the family allowance (FA) program in 1992, and the child tax credit (CTC) lowers taxes for low-income families. Provincial tax credits (PTXI) and goods and service and harmonized sales tax credits are included in government transfers (GHST) Additionally, each province offers family benefits (FABEN). Government transfers also consist of non-taxable income received through provincially administered social assistance (SA), workers compensation programs (WC), and net

Figure 1: Census of Population Components of Incomes.

Figure 8: Census of Population Components of Incomes.



Source: https://www12.statcan.gc.ca/census-recensement/2016/ref/dict/app-ann/a4_1-eng.cfm.

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federal supplements, which consist of transfers targeting the elderly (NFSL).[5]

I do not include old age security (OAS) or other programs targeting retirees because the population of interest are not old enough to be eligible. Also, I do not include the working income tax benefit (WITB), which was introduced in 2007 to reduce taxes for individuals earning low levels of income from work.[6]

2.0.1 Variable Construction

$$
\begin{aligned}
MKTINC &= T4E + SEI + OEI + OTHER \\
DISABTRANS &= WC + SA + CPPD + EI + DTC \\
FAMTRANS &= FABEN + FA + CTC + CTBI \\
GOVTRANS &= DISABTRANS + FAMTRANS + GHST + PTXI \\
XTIRC &= MKTINC + GOVTRANS \\
AFTAX &= XTIRC - TAX, \text{ where tax combines...} \\
FTXI &= \sum_i XTIRC_i, \text{ for i in economic family}
\end{aligned}
$$

[5]Net federal supplements are grouped in a measure of non-taxable income. But the sample of study is not eligible for these transfers.

[6]For more details on the types of incomes included in this study and these data, refer to `https://www150.statcan.gc.ca/n1/en/pub/12-585-x/12-585-x2017000-eng.pdf?st=adGLEEeP`.

3 Additional Descriptive Statistics

Table 2: Reason of Disability Onset: Total Disability and Aggregate Types

	Total Disability	Physical	Cognitive	Concurrent
Existed at Birth	0.049	0.032	0.073	0.072
Disease	0.330	0.321	0.202	0.389
Non Work Related	0.205	0.208	0.109	0.232
Work Related	0.276	0.292	0.193	0.2745
Aging	0.212	0.252	0.126	0.165

Note: The sample reflects working age (25-55) Canadians from provinces who reported to have a disability. Survey weights have been applied so the sample reflects the demographic composition of Canada in 2012.

Table 3: Reason of Disability Onset: Non-Mutually Exclusive Activity Limitations

	Mobility	Flexibility	Dexterity	Pain	Cognitive Functioning	Mental Health
Existed at Birth	0.037	0.033	0.033	0.031	-	0.082
Disease	0.435	0.324	0.475	0.322	0.166	0.205
Non Work Related	0.203	0.232	0.134	0.217	0.177	0.085
Work Related	0.297	0.386	0.303	0.296	0.186	0.205
Aging	0.295	0.260	0.342	0.246	0.233	0.086

Note: The sample reflects working age (25-55) Canadians from provinces who reported to have a disability. Survey weights have been applied so the sample reflects the demographic composition of Canada in 2012.