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ABSTRACT

Adjustment Costs and Incentives to Work: Evidence from a Disability Insurance Program*

How important are adjustment costs for individuals when they face a change in work incentives induced by a policy change? I provide the first estimate of heterogeneous adjustment costs by exploiting a policy change that substantially increased work incentives. The policy change increased the exemption threshold in a disability insurance program. I document strong responses to work incentives as I observe excess mass –"bunching"– right below the exemption threshold where the marginal tax on earnings is low. A puzzling observation is that individuals continue bunching at the former threshold after the policy change. This finding suggests that they face adjustment costs when changing their labor supply. I use the amount of bunching at the new and former threshold to estimate adjustment costs that vary by individuals' ability to work. The estimated adjustment costs are higher for individuals with lower ability; varying from zero to twenty percent of their potential earnings, with an average at eight percent. The estimated elasticity of earnings respect to net-of-tax rate – accounting for heterogeneous adjustment costs – is 0.2, which is double the size of the elasticity estimated with no adjustment costs. To investigate the relative size of the adjustment costs to the work incentives induced by the policy change, I evaluate the overall effect of the policy change on the labor supply using a Difference-in-Differences design. I find that individuals who already work, work more, and those who did not work, start working. Policies designed to increase labor supply will work if the induced work incentives are large enough to offset the adjustment costs. Accounting for adjustment costs then might explain disparate findings on the effects of an increase in work incentives on labor supply in disability insurance programs. These findings have important implications for designing policies and targeting heterogeneous groups to increase labor supply in disability insurance programs.

JEL Classification: H53, J21, J18

Keywords: adjustment costs, bunching, kink, elasticity, disability insurance

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1 Introduction

Models of labor supply commonly assume that workers can adjust their labor supply with no adjustment costs.[1] However, adjustment costs are real; finding a new job, negotiating increased or reduced hours with an employer, and adjusting non-work schedule all cost time and money. Adjustment costs are important in evaluating the welfare effects of a policy change (Chetty, 2009). Adjustment costs can also explain the differences in estimated elasticity of earnings in micro versus macro studies (Chetty et al., 2011; Chetty, 2012; Chetty et al., 2012). There is, however, very little empirical evidence on existence and magnitude of the adjustment costs except for Gelber, Jones and Sacks (2017).

In this paper, I estimate the size of adjustment costs that individuals face when changing their labor supply in response to an increase in work incentives. I exploit a policy change that increased work incentives by increasing earnings exemption threshold in the Assured Income for the Severely Handicapped (AISH), a Disability Insurance (DI) program in Alberta, Canada. Earnings below the exemption threshold do not affect DI benefits in AISH, but earnings above the threshold affect DI benefits where individuals lose one dollar for every two dollars of earnings accumulated above the threshold. It is comparable to a non-linear tax schedule on earnings with a kink at the exemption threshold where the marginal taxes below and above the exemption threshold are respectively zero and 50%. A kink generates incentives for individuals to locate below the threshold in order to avoid high marginal taxes above the threshold. The excess mass at a kink is called "bunching". The policy change in AISH doubled the exemption threshold and increased the maximum DI benefits by 35 percent. Individuals bunch right below the exemption threshold where the marginal tax on the earnings is zero; suggesting strong behavioral responses to the work incentives. The puzzling observation is that individuals continue to bunch at the former exemption threshold after the policy change. This observation suggests that individuals face adjustment costs when changing their labor supply. I use the amount of bunching at the former and new exemption threshold to provide the first estimate of heterogeneous adjustment costs. I extend Gelber, Jones and Sacks (2017) by allowing for heterogeneous adjustment costs that vary by individuals' ability to work, denoted by their potential earnings with no taxes.

Individuals change their labor supply in response to a change in work incentives if the adjustment costs that they face is offset by the utility gain from changing their labor supply. To shed light on this, I evaluate the overall effects of the policy change in AISH on labor supply using a Difference-in-Difference (DD) design. The estimates using the amount of bunching around the exemption threshold provide an incomplete picture of the effects of the policy change on labor supply; since the policy change also increased

[1]Some exceptions are Chetty, 2009; Chetty, Friedman, Olsen and Pistaferri, 2011; Chetty, 2012; Chetty, Guren, Manoli and Weber, 2012; Chetty, Friedman and Saez, 2013; Kleven and Waseem, 2013; Kleven, 2016. However, none of these estimate the size of adjustment costs.

the work incentives for individuals located far away from the exemption threshold. Furthermore, the policy change might also have extensive margin effects, inducing some individuals to start working. Examining the overall effects of an increase in work incentives on labor supply in a DI program is however challenging. First, individuals' labor supply is endogenous since the selection process into a DI program strongly depends on having low labor supply. Second, adjustment costs attenuate the induced incentives to work by a policy change. The policy change in AISH creates an opportunity to investigate the potential to induce greater labor supply when individuals face adjustment costs. I estimate the causal effects of the policy change on the labor supply using Difference-in-Differences (DD) design. I use DI recipients of the Ontario Disability Support Program (ODSP) – another provincial DI program in Canada – as a control group. The ODSP is an appropriate control group since its benefit scheme is similar to – but less generous than – AISH; and ODSP did not go under significant policy changes during the period of my analysis.

I use administrative data on monthly earnings of DI recipients in AISH and ODSP from the Governments of Alberta and Ontario within two years of the policy change in AISH. The datasets also have information on individuals' characteristics including sex, age, marital status, family size, age entering into the DI program and the location of residence. These datasets furthermore include ICD-9 codes[2] of DI recipients' disability conditions. This allows me to investigate the effects of incentives to work on the labor supply of DI recipients with non-physical disabilities. Individuals with non-physical disabilities are believed to be the marginal entrants to DI programs and therefore are expected to be more responsive to work incentives.

My empirical analysis provides three conclusions. First, there are strong behavioral responses to work incentives in the form of sharp bunching at the exemption threshold. However, bunching at the former exemption threshold suggests that individuals face adjustment costs when changing their labor supply. Individuals with lower ability to work face higher adjustment costs, ranging from zero to twenty percent of their potential earnings. The estimated adjustment costs for individuals with an average ability is about eight percent of their potential earnings. I estimate adjustment costs for a sub-sample of individuals who bunch at the exemption threshold and are relatively more flexible in changing their labor supply. The evidence on the existence of adjustment costs for individuals who bunch, suggests that adjustment costs might be even larger for those who do not bunch. My estimates are, therefore, a lower bound on the adjustment costs that DI recipients face when changing their labor supply.

Second, the estimated elasticity of earnings respect to the net-of-tax rate at the exemp-

[2]The ICD-9 is the 9^{th} revision of the International Statistical Classification of Diseases Related Health Problems, a medical classification list by the World Health Organization. It contains codes for diseases, signs, and symptoms, abnormal findings, complaints, social circumstances and external causes of injury or diseases.

tion threshold – accounting for heterogeneous adjustment costs – is 0.2 which is double the size of the elasticity estimated with no adjustment costs.[3] Adjustment costs, therefore, make significant differences in responses to a policy change that aims at increasing labor supply.

Third, policies that provide incentives to work in DI programs increase labor supply only if the increase in work incentives are substantial enough to offset the adjustment costs. My estimate of the effects of the increased work incentives in AISH using a DD design is a twelve percent increase in earnings, and one percentage point increase in the labor force participation rate.[4] This finding suggests that the substitution effects of the policy change are relatively more significant than the income effects; and the policy change, therefore, might be welfare improving.[5] The increase in labor force participation also provides evidence on the importance of the adjustment cost on extensive margins of the labor supply. If the increase in work incentives is substantial enough to offset the fixed costs of the labor force participation (i.e., finding a new job). My findings are all robust to a set of specification tests.

Findings from my analysis have important implications in designing policies and targeting heterogeneous groups to increase labor supply in DI programs. DI programs are among the largest social assistance programs in developed countries.[6] These programs provide benefits to individuals with health conditions that limit the kind or amount of the paid work they can perform. There have been concerns about governments' high expenditure on DI programs. In most of the DI programs benefit recipients lose all or part of their benefits if they work. Losing DI benefits is a disincentive to work. Many countries, therefore, have recently implemented – or are considering – policies to increase work incentives.[7] In the new policies, benefits are reduced more gradually if DI recipients work. More gradual reduction of DI benefits generates work incentives and therefore

[3]The net-of-tax rate at a kink with marginal tax rates of τ_0 and τ_1 respectively below and above the kink is $\frac{\tau_1-\tau_0}{1-\tau_0}$.

[4]I also quantify the effects on earnings and labor force participation using a sharp discontinuity in increase in work incentives at the month of the policy change in AISH. Using administrative data, I document that large incentives to work could induce beneficiaries to increase their labor supply both in intensive and extensive margins. For more details, see Zaresani (2018).

[5]In Appendix C, I provide suggestive evidence that the income effects of the policy change in AISH are negligible.

[6]The average total expenditure on DI programs in OECD countries is about 2.5 percent of their GDP (OECD, 2010).

[7]The US, UK, Norway, and Switzerland are among the countries that recently implemented policies in their DI programs. In the UK's program, DI recipients are allowed to keep fifty percent of their benefits for up to twelve months if they work. In Norway's program benefits are reduced by \$0.6 for every \$1 earned above a pre-set threshold (see Kostol and Mogstad (2014) for an evaluation of the program). The US is currently testing a program where benefits are reduced by \$1 for every \$2 of earnings accumulated above a pre-set threshold, rather than entirely suspending the benefits (see Benitez-Silva et al. (2011) for a calibrated life-cycle model to forecast the effects of the policy. See also Weathers II and Hemmeter (2011); Wittenburg et al. (2015) for evaluations of the pilot project). Switzerland tested a program which offers a conditional cash payment if DI recipients start to work or increase their earnings (see Bütler et al. (2015) for an evaluation of the program).

benefit recipients might start working and eventually exit the DI program.

While policies that provide work incentives intend to increase the labor supply in DI programs, empirical findings on the effectiveness of such policies are not conclusive. Hoynes and Moffitt (1999), Benitez-Silva, Buchinsky and Rust (2011), Weathers II and Hemmeter (2011) and Bütler, Deuchert, Lechner, Staubli and Thiemann (2015) find no effects of financial incentives to work in the US and Switzerland. While Campolieti and Riddell (2012), Kostol and Mogstad (2014) and Ruh and Staubli (2014) find positive responses respectively in Canada, Norway and Austria. Beyond a change in financial incentives, medical reassessment of DI recipients and trial work periods in the US do not appear to have effects on the labor supply (Autor and Duggan, 2006). Moore (2015) finds positive effects on the labor supply of those who lost their benefits after removal of drug and alcohol addictions as qualifying conditions for DI programs in the US Borghans, Gielen and Luttme (2014) and Staubli (2011) examine the effects of terminating benefits and stricter eligibility criteria in DI programs in respectively Netherlands and Austria. They find that individuals substitute DI benefits by collecting more from other social assistance programs. Lemieux and Milligan (2008), Fortin, Lacroix and Drolet (2004) and Gruber (2000) find negative effects of providing more generous benefits on labor supply in social assistance programs in Canada. The increase in work incentive from a policy change must be large enough to offset the adjustment costs to cause an increase in the labor supply in a DI program. A better understanding of the heterogeneous adjustment costs also has important policy implications as to how to target individuals for the policy changes. There might be groups of DI recipients who need more support to be able to work whereas some others would not work regardless of the provided supports and work incentives. Accounting for adjustment costs might explain the mixed findings on the effects of an increase in work incentives on labor supply in DI programs.

My paper is also related to the literature on adjustment costs. Earlier work discusses the effects of search costs, hours constraint and institutional constraints on labor supply decisions (Pencavel, 1986; Altonji and Paxson, 1988; Dickens and Lundberg, 1993; Blundell and Mccurdy, 1999; Chetty, Friedman, Olsen and Pistaferri, 2011; Tazhitdinova, 2016). Altonji and Paxson (1992) suggests that individuals face adjustment costs changing their labor supply since the change in hours of work are lumpy. Several other works also suggest that individuals face adjustment costs changing their behavior to policy changes (Chetty, 2009; Chetty, Friedman, Olsen and Pistaferri, 2011; Chetty, 2012; Chetty, Guren, Manoli and Weber, 2012; Chetty, Friedman and Saez, 2013; Kleven and Waseem, 2013). Chetty, Friedman, Olsen and Pistaferri (2011) show that adjustment costs affect estimates of the elasticity of labor supply. None of the previous works, however, provide an estimate of the adjustment costs. Gelber, Jones and Sacks (2017) are the first to specify a model to estimate fixed adjustment costs empirically. I contribute to this literature by extending the model for estimating fixed adjustment costs by allowing for heterogeneous adjustment costs.

For the remainder of the paper, I proceed as follows. I describe the institutional background of AISH and ODSP and the data I use for my analysis in Section 2. I present my model for estimating heterogeneous adjustment costs and elasticity of earnings in Section 3. I present my estimates in Section 4. In section 5, I present my estimates of the effects of work incentives on labor supply using a DD design. Finally, I provide conclusions and policy implications in Section 5.3.2.

2 Institutional background and data

2.1 Disability insurance programs in Canada

The federal and provincial DI programs in Canada are designed to provide benefits to individuals who due to a medically verifiable physical or non-physical disability are limited in the kind or amount of work they can do. Access to the federal DI programs are based on individuals' employment history, or the benefits are available only for a short period.[8] Most of the individuals with lifelong and severe disabilities, therefore, would not be eligible for the federal DI programs, and the eligible individuals would need more assistance since the federal programs provide benefits only for a short period. Provincial DI programs provide long-term benefits for those who are not eligible for the federal DI programs or need more assistance.[9] Alberta, Ontario, British Columbia and Saskatchewan are among Canadian provinces that have provincial DI programs. Each of these programs is operated under different ministries, but they all provide similar DI benefits. Amount of the benefits and the size of the programs, however, differ substantially within the provinces, with Alberta and Ontario's program are respectively the most generous and the largest ones.

2.1.1 Assured Income for the Severely Handicapped program in Alberta

The Assured Income for the Severely Handicapped (AISH) is Alberta's provincial DI program with about 40 thousands benefit recipients (about 1.5 percent of Alberta's adult

[8]Federal Government's benefits include Employment Insurance (EI), Sickness benefits (one must have accumulated at least 600 hours of insurable employment in the qualifying period to receive up to 15 weeks of benefits), Canada Pension Plan (CPP) and Quebec Pension Plan (QPP) disability benefits (to be eligible, one must have enough contributions to the CPP/QPP), Child Disability benefit (CDB) (a tax-free benefit for families who care for a child under 18 with a severe and prolonged disability), Special Benefits for Parents of Critically Ill Children (PCIC) (for eligible parents who take leave from work to provide care or support to their critically ill or injured child for up to 35 weeks) and Employment Insurance Compassionate Care Benefits (for those take time off work to provide care or support to a family member who is gravely ill and is at risk of dying within six months). More information on federal government's disability benefits programs: `http://www.fcac-acfc.gc.ca/Eng/forConsumers/lifeEvents/livingDisability/Pages/Federalp-Prestati.aspx`, Accessed on Feb 29, 2016.

[9]More information on provincial DI programs: `http://www.fcac-acfc.gc.ca/Eng/forConsumers/lifeEvents/livingDisability/Pages/Resource-Ressourc.aspx`, Accessed on Feb 29, 2016.

population at 2008).[10] About half of the benefit recipients in AISH have non-physical disabilities. The education level of more than 80 percent of the benefit recipients is high school or less, and more than 90 percent of the benefit recipients do not have dependent. Eligible individuals for the program must have a disability where no curative therapy is available to improve their condition materially. AISH provides benefits to individuals and their family whom a disability causes a substantial limitation in their ability to earn a living and are in financial needs. The program aims to enable benefit recipients to live as independently as possible in their communities.[11]

Determination Process AISH is a means-tested DI program where eligible individuals are entitled to a prescribed amount of assistance. Eligibility is determined based on individuals' disability, age, income, and assets. Eligible individuals must be 18 years and older and live in Alberta and be a Canadian citizen or permanent resident; where permanent disability is the main cause limiting amount or kind of the work they can do and earn a living. Total assets of an eligible benefit recipient and their partner cannot be worth more than $100 thousands.[12] Individuals cannot collect Old Age Security (OAS) pension while they are in the program; benefits are transferred to the OAS pension once individuals are eligible to collect it. A final decision on individuals' application file is made by a social worker, after receiving all the relevant medical reports from a qualified health professional. Entitled individuals receive monthly benefits and supplemental assistance (i.e., health benefits, child care and subsidized transit).[13]

Duration of the benefits Once an individual is entitled to AISH, there are two main pathways out of the program. First, a benefit recipient may die. Second, they may no longer be eligible to receive the benefits. A benefit recipient may reach the retirement age (65 years) and be eligible to receive Guaranteed Income Support (GIS) or OAS pensions. A benefit recipient may no longer meet the medical or income and asset criteria to receive the benefits. Eligibility based exits account for a tiny fraction of the exits from AISH.

[10]The following information on the AISH and ODSP programs is available from Human Resources and Skill Development Canada, Social Assistance Statistical Report: 2008, available online at `http://publications.gc.ca/collections/collection_2011/rhdcc-hrsdc/HS25-2-2008-eng.pdf`. Accessed on December 26, 2016.

[11]The Provincial Government of Alberta also has other programs to provide more support to disabled individuals. Alberta provides Employment First, Family Support for Children with Disabilities (FSCD), Fetal Alcohol Spectrum Disorder (FASD) initiatives, Persons with Developmental Disabilities (PDD), Provincial Disability Supports Initiatives, and Residential Access Modification Program (RAMP). More information on Alberta's DI programs: `http://www.humanservices.alberta.ca/disability-services/pdd.html`, Accessed at May 26, 2016.

[12]Verification of the financial assets of the benefit recipients is based on an honor system. Each benefit recipient must declare any monetary assets (i.e., saving accounts, bonds) by submitting a monthly bank statement of the banking account which their DI benefits is deposited into.

[13]More information on eligibility criteria in AISH: `http://www.alberta.ca/aish-eligibility.aspx`, Accessed on Nov 8, 2016.

The policy change in AISH The AISH program allows benefit recipients to work while they receive DI benefits. The earnings below an exemption threshold in AISH do not affect the DI benefits, but DI benefits are gradually phased out for the earnings accumulated above the exemption threshold. This is comparable to a non-linear tax schedule on earnings. The marginal tax rate on earnings below the exemption threshold is zero. The earnings above the exemption threshold up to the second earnings threshold are taxes at 50%; DI benefits are deducted $1 for every $2 earnings accumulated between exemption threshold and the second threshold. Earnings above the second threshold are taxed at 100%; DI benefits are deducted $1 for every $1 earnings accumulated above the second threshold. The earnings thresholds are higher for DI recipients with dependents. Effective from April 2012, the exemption threshold doubled and the maximum monthly DI benefits increased by 35 percent.[14] This policy change is comparable to decreasing marginal taxes in a non-linear tax schedule on earnings that induce incentives to work.

Panel (a) of Figure 1 presents the budget constraint of DI recipients in AISH with no dependent before and after the policy change. The horizontal axis denotes the monthly earnings, and the vertical axis denotes the total income including DI benefits and net monthly earnings. The maximum monthly DI benefits before the policy change are $1,188; it is increased by $400 to $1,588 after the policy change (35 percent increase). The earnings exemption threshold before the policy change is $400; in the new policy, it doubled to $800. The second earnings threshold has been at $1,500 since July 2008.[15] Panel (b) of Figure 1 presents the budget constraints for DI recipients with dependents. The maximum monthly DI benefits are the same as that for individuals with no dependent. The earnings thresholds before the policy change are at $975 and $2,500; the exemption threshold increased to $1,950 in the new policy.

2.1.2 Ontario Disability Support program

The Ontario Disability Support Program (ODSP) is a comparable DI program to AISH in Ontario. The ODSP provides benefits to disabled individuals in Ontario whom a disability causes a substantial limitation in their ability to earn a living. The eligibility criteria and determination process in ODSP are quite similar to those in AISH; and beneficiaries receive monthly benefits and supplementary assistance (i.e., health benefits, child care and subsidized transit).[16] The ODSP also allows benefit recipients to work while receiving DI benefits, but DI benefits are reduced by $1 for every $2 earnings. It

[14]After Alberta's 2012 provincial election, the new premier of Alberta decided to shift the ministry responsible for AISH program from Seniors (to which it is now part of the new Health ministry) to the new Human Services ministry, and implement the new policy in AISH.

[15]At July 2008, the second earnings threshold in AISH increased by $500 to $1,500 for DI recipients with no dependents and to $2,500 for those with dependent.

[16]More information on Ontario's DI programs: `http://www.mcss.gov.on.ca/en/mcss/programs/social/odsp/index.aspx`, Accessed on May 26, 2016.

is comparable to a flat 50% tax on all earnings. The maximum monthly DI benefits in the ODSP depend on the number of dependent varying from $1,086 to $1,999. Figure 2 shows the budget constraint of DI recipients in the ODSP.[17]

2.2 Data and sample selection

I use administrative data on monthly earnings of DI recipients in AISH and ODSP from the Governments of Alberta and Ontario within two years of the policy change in AISH from March 2010 to April 2014. I use the data from AISH to estimate heterogeneous adjustment costs. I then combine the data from AISH and ODSP for my DD analysis. Observing monthly earnings is essential for estimating adjustment costs since the earnings thresholds are monthly based. Both data sets also have detailed longitudinal information on individuals' characteristics including sex, age, marital status, family size, age entering into the DI program and the location of residence. These datasets furthermore include ICD-9 codes of DI recipients' disability conditions. It allows me to investigate the effects of incentives to work on the labor supply of DI recipients with non-physical disabilities. Individuals with non-physical disabilities are believed to be the marginal entrants to DI programs and therefore are expected to be responsive to incentives to work. My study sample then includes 18 to 64 years old individuals with non-physical disabilities within two years of the April 2012 policy change in AISH from March 2010 to April 2014. The sample sizes in AISH and ODSP are respectively 452 thousand (10 thousand individuals over four years) and 6.9 million (150 thousand individuals over four years). These sample sizes might look quite different, but they are comparable regarding the percentage of the adult population in each province (about one percent).

Table 1 describes the data from DI recipients with non-physical disabilities in AISH and ODSP.[18] "Before" refers to the period before the policy change in AISH from April 2010 to March 2012 and "After" refers to the period after the policy change from April 2012 to March 2014. The first panel presents the labor market statistics. The mean monthly DI benefit in both programs are quite similar before the policy change whereas it is higher in AISH after the policy change. The labor supply in AISH both before and after the policy change are higher than the ODSP; about half of the DI recipients in AISH have positive earnings whereas it is less than ten percent in the ODSP. The mean inflation-adjusted monthly earnings are also higher in AISH than ODSP. The labor supply in AISH after the policy change is higher than that before the policy change.

[17]This policy has been in effect since November 2006. At September 2013, a new policy implemented in the ODSP where an exemption threshold for monthly earnings introduced at $200. Earnings above the exemption threshold are still subject to 50% marginal tax rate. In my DD analysis in Section 5, I also do my analysis using a shorter time horizon to isolate the effects of this policy change. My main findings do not change.

[18]The size of the AISH and ODSP programs is about one percent of the adult population in the corresponding provinces. In each program, about half of the DI recipients have non-physical disabilities.

The second panel of Table 1 shows the individual background characteristics in AISH and ODSP before and after the policy change. There are no notable changes in DI recipients' characteristics after the policy change compared to those before the policy change in AISH and neither in the ODSP. About half of the DI recipients in both programs are female. The average age of DI recipients in AISH is 39, and the average age of new entrants to the program is 29; whereas they are slightly higher in ODSP respectively at 43 and 42 years. In both programs, most of the benefit recipients do not have dependent. About half of the DI recipients in AISH live in metropolitan areas whereas it is about 30 percent in the ODSP.[19] I break down non-physical debilitates into three broad groups of psychic (i.e., Schizophrenia and Bipolar disorder), neurological (i.e., Autism and Down Syndrome) and mental conditions (i.e., Anxiety and Depression). The psychic and mental disabilities are respectively the largest and smallest groups.

3 Adjustment costs and elasticity of earnings

In this section, I start with the model which abstracts from adjustment costs to estimate an elasticity of earning. Next, I document adjustment costs in AISH. I then provide a conceptual framework to illustrate the interaction between adjustment costs and incentives to work, and its effects on individuals' labor supply decisions. Finally, I present my model for estimating earnings elasticity and heterogeneous adjustment costs.

3.1 The model with no adjustment costs

In this section, I provide a review of the model by Saez (2010) which is a base for my model with heterogeneous adjustment costs. This model explores an assumed proportional relationship between elasticity of earnings and the amount of bunching at a kink to estimate an elasticity of earnings respect to net-of-tax rate. It assumes that individuals differ only in their ability to work denoted by α and face no adjustment costs when they choose their earnings. Individuals choose their earnings z to maximize their utility defined as:[20]

$$u(c, z; \alpha) = c - \frac{\alpha}{1 + \frac{1}{e}} \Big(\frac{z}{\alpha}\Big)^{1+\frac{1}{e}} \tag{1}$$

where c denotes consumption, defined as disposable income.[21] e represents elasticity of earnings respect to net-of-tax rate. $d(z; \alpha) = \frac{\alpha}{1+\frac{1}{e}} \big(\frac{z}{\alpha}\big)^{1+\frac{1}{e}}$ represents dis-utility from earning z for an individual with ability α. This is a quasi-linear, iso-elastic utility function.

[19] The metropolitan area in Alberta includes Calgary and Edmonton and in Ontario includes Toronto and Ottawa.

[20] Individuals can choose hours of work h for a given wage w where earnings is $z = wh$.

[21] In absence of non-labor income, the disposable income is net-of-tax labor earnings defined as $c = z - T(z; \tau)$ where τ denotes the tax system.

The iso-elasticity assumption implies that the elasticity is constant and equal to e which simplifies the presentation. The quasi-linearity assumption implies that there are no income effects.[22]

The utility maximizer level of earnings with a linear marginal tax τ_0 is:

$$z = \alpha(1 - \tau_0)^e \tag{2}$$

where when $\tau_0 = 0$, implies $z = \alpha$. Individuals' ability is the only source of heterogeneity in the model, and is assumed to have a smooth distribution. It translates into a smooth distribution of earnings with a linear marginal tax τ_0.[23]

Suppose that the marginal tax on earnings above z^* increased to τ_1. This creates a kink at z^*. A smooth distribution of individuals' ability to work implies that those with ability $\alpha \in [\frac{z^*}{(1-\tau_0)^e}, \frac{z^*}{(1-\tau_1)^e}]$ who would locate in the bunching range $(z^*, z^* + \Delta z^*]$ in absence of the kink, would now bunch in a neighbourhood of z^*. Δz^* is the earnings response range at the z^* kink which is:

$$\Delta z^* = z^* \Big((\frac{1-\tau_0}{1-\tau_1})^e - 1 \Big) \tag{3}$$

Suppose $h(.)$ is the observed distribution of earnings – with a kink at z^* – and $h_0(.)$ denotes a counter-factual distribution of earnings with flat tax τ_0. B denotes bunching at z^* which is the area under the counter-factual distribution of earnings within the bunching range. Assuming that $h_0(.)$ in the bunching range is uniform, the amount of bunching is approximated as:

$$B = \int_{z^*}^{z^*+\Delta z^*} h_0(\zeta) d\zeta \simeq \Delta z^* h_0(z^*) \tag{4}$$

In Section 3.1.1, I describe a procedure for estimating bunching at a kink. Together (3) and (4) result in the elasticity of earnings respect to net-of-tax rate for the individual with ex-ante earnings $z^* + \Delta z^*$ who ex-post bunches at z^*:[24]

$$e = \frac{\Delta z^* / z^*}{(\tau_1 - \tau_0)/(1 - \tau_0)} \tag{5}$$

[22] Despite the limitations of a quasi-linear and iso-elastic utility function, convenience in estimation and expressing findings has made it quite popular in previous literature on bunching models. See for instance: Chetty, Friedman, Olsen and Pistaferri (2011); Gelber, Jones and Sacks (2017); Kleven and Waseem (2013); Bastani and Selin (2014); Aghion, Akcigit, Lequien and Stantcheva (2017). I also will use this utility function to parametrize my model for estimation heterogeneous adjustment costs.

[23] Let $F(.)$ and $f(.)$ denote respectively *cdf* and *pdf* of ability α which are smooth and continues. Then *cdf* of earning z is defined as $H(z) = \Pr(Z < z) = \Pr(\alpha(1-\tau)^e < z) = \Pr(\alpha < \dfrac{z}{(1-\tau)^e}) = F(\dfrac{z}{(1-\tau)^e})$. This implies that pdf of earnings is $h(z) = H'(z) = \frac{1}{(1-\tau)^e} f(\frac{z}{(1-\tau)^e})$ which is smooth and continuous.

[24] I estimate an elasticity of earnings with no adjustment costs to illustrate how it differs from estimates form my model with heterogeneous adjustment costs. The estimates are presented in Table B.2 in Appendix B.

3.1.1 Estimating bunching at a kink

I follow Chetty et al. (2011) and Kleven and Waseem (2013) to construct a counter-factual distribution of earnings $h_0(.)$ by fitting a polynomial to the observed distribution of earnings $h(.)$, excluding an eye ball picked range around the kink.[25] I first divide the observed monthly earnings into z_i bins with width δ where p_i is portion of individuals with earnings in range of $[z_i - \delta/2, z_i + \delta/2]$. I then fit a flexible polynomial of degree D to the observed distribution of earnings at a neighbourhood $Q = [Q^l, Q^u]$ of z^* by estimating the following regression:

$$p_i = \sum_{d=0}^{D} \beta_d (z_i - z^*)^d + \sum_{j=-l}^{l} \gamma_j \mathbb{1}\{z_i - z^* = \delta j\} + \epsilon_i \tag{6}$$

where $\mathbb{1}(.)$ is the indicator function denoting dummies for the bunching bins around the kink in range $[z^* - \delta l, z^* + \delta u]$. l and u indicate the number of excluded bins respectively below and above the kink which are chosen by visual inspection of $h(.)$. These dummies isolates effects of the bunching bins on the estimated counter-factual distribution of earnings. $h_0(.)$ is the fitted values from (6) where contribution of the bunching bins around the kink is excluded and is defined as $\widehat{p_i} = \sum_{d=0}^{D} \widehat{\beta}_d (z_i - z^*)^d$. An initial estimate of bunching at z^* is:

$$\widehat{B} = \delta \sum_{j=l}^{u} (p_j - \widehat{p_j}) = \delta \sum_{j=l}^{u} \widehat{\gamma}_j \tag{7}$$

$\widehat{B}$ overestimates the true amount of bunching at a kink since it does not account for the fact that those who bunch at a kink would have located at points to the right of the threshold if flat tax τ_0 would have been imposed. Furthermore, when a kink is shifted forward, those who bunch at the new kink have moved from points to the left of the threshold. Therefore, the area under the estimated counter-factual distribution is not equal to the area under the observed empirical distribution (called integration constraint in Chetty et al., 2011). I use a technique proposed by Chetty et al. (2011) and shift the estimated counter-factual distribution iteratively until the integration constraint holds. I shift the estimated counter-factual earnings distribution around the former kink at z_1^* to the right and shift it to the left around the new kink at z_2^*. To do this, I estimate the

[25] Gelber et al. (2017) use earnings distribution of a sub-sample who do not face a kink in their tax schedule to generate a counter-factual earnings distribution for their study sample. This approach allows them to estimate bunching with no further distributional assumptions on their counter-factual distribution. This approach however comes with a cost of assuming similarity between distributions of earnings between two different sub-samples. I am not able to use their approach since I do not have any sub-sample who do not face a kink.

following equations recursively where n is iteration counter:

$$
\begin{aligned}
p_i \cdot (1 + \mathbb{1}\{i > u_1\}\frac{\widehat{B_1}^{n-1}}{\sum_{q>u_1} p_q}) &= \sum_{d=0}^{D} \beta_d^n (z_i - z_1^*)^d + \sum_{j=l_1}^{u_1} \gamma_j^n \mathbb{1}\{z_i - z_1^* = \delta j\} + \epsilon_i \\
p_i \cdot (1 + \mathbb{1}\{i < l_2\}\frac{\widehat{B_2}^{n-1}}{\sum_{q<l_2} p_q}) &= \sum_{d=0}^{D} \beta_d^n (z_i - z_2^*)^d + \sum_{j=l_2}^{u_2} \gamma_j^n \mathbb{1}\{z_i - z_2^* = \delta j\} + \epsilon_i
\end{aligned}
\tag{8}
$$

The stop criteria for the recursion is that the area under the estimated counter-factual distribution be equal to the area under the empirical one as $\sum_{i\in Q} p_i = \sum_{i\in Q} \widehat{p}_i$. The estimated bunching at z^* at step n of the recursion is $\widehat{B}^n = \delta \sum_{j=l}^{u}(p_j - \widehat{p}_j) = \delta \sum_{j=l}^{u} \widehat{\gamma_j}^n$. The estimated counter-factual distribution of earnings at z^* using (8) is $h_0(z)$:

$$
\begin{aligned}
h_0(z) &= \sum_{d=0}^{D} \widehat{\beta}_d (z - z^*)^d \\
h_0(z^*) &= \widehat{\beta_0}
\end{aligned}
\tag{9}
$$

I normalize the estimated bunching $\widehat{B}$ by dividing it by the counter-factual mass at z^* bin from (9) to obtain a comparable measure of bunching within the kinks. The normalized bunching $\widehat{b}$ at z^* is defined as:

$$
\widehat{b} = \frac{\widehat{B}}{\delta h_0(z^*)} = \frac{\widehat{B}}{\delta \widehat{\beta_0}} \tag{10}
$$

3.2 Documenting adjustment costs in AISH

Panel (a) of Figure 3 plots the distribution of monthly earnings of DI recipients in AISH who do not have dependent within two years before the policy change when monthly exemption threshold was \$400. The sample includes beneficiaries with non-physical disabilities who are 18-64 years old. There is sharp bunching at the exception threshold. The higher marginal tax rate on earnings above the exemption threshold (50% versus 0) creates strong incentives for many individuals to locate their earnings right below the threshold. There is no bunching at the second kink at \$1,500.[26] Panel (b) plots the distribution of monthly earnings within two years after the policy change when the monthly exemption threshold increased to \$800 (new threshold) from \$400 (former threshold). There is sharp bunching at the new exemption threshold since the marginal tax rate above the threshold is higher than that below the threshold (50% versus 0). There is still bunching at the former threshold even two years after the policy change. There is no bunching at the second kink after the policy change.

[26] The second earning threshold increased to \$1,500 from \$1,000 three years before the policy change of interest, on July 2008. There is also no bunching at the former kink at \$1,000 (%50 and %100 marginal taxes respectively below and above the kink).

Panel (a) of Figure 4 plots distribution of monthly earnings of DI recipients with no dependent over 24 months before the policy change. There are sharp and quite stable bunching at the exemption threshold every month before the policy change, and there is no bunching at the second kink. Panel (b) plots the distribution of monthly earnings over 24 months after the policy change. In months following the policy change, bunching at the former threshold moves away gradually toward the new threshold. However, bunching at the former threshold does not completely disappear, even two years after the policy change.[27]

I have documented bunching of DI recipients in AISH including evidence on bunching at the old exemption threshold, pre-reform; persistent bunching there, post-reform; and the slow emergence of bunching at the new exemption threshold. These evidence all point to that benefit recipients face adjustment costs when they adjust their labor supply in response to work incentives induced by the policy change. Bunching at the former exemption threshold after the policy change is unlikely to be driven by the higher marginal utility of leisure relative to working; since bunching at the former threshold gradually fades away at months following the policy change. It is also unlikely to be driven by a change in individuals' preference to work. It also is unlikely to be due to lack of information on the policy change. Since those who bunch at the exemption threshold are the first to realize the changes in their paycheck. If individuals do not face any adjustment costs, bunching at the former threshold should fade away immediately after the policy change. Those who continue bunching at the former threshold face barriers when changing their labor supply which I am putting them all in a black box and call it adjustment costs. Adjustment costs could either be related to supply or demand side of the labor market. Findings of the several recent papers also suggest that individuals face adjustment costs when changing their behavior in response to a policy change (see, for instance, Chetty, 2009; Chetty, Friedman, Olsen and Pistaferri, 2011; Chetty, Guren, Manoli and Weber, 2012; Chetty, 2012; Chetty, Friedman and Saez, 2013; Kleven and Waseem, 2013). The utility loss associated with adjustment costs offsets utility gain of changing labor supply, and therefore some individuals continue to bunch. In Section 3.3, I provide a conceptual framework to show how facing adjustment costs might affect individuals' labor supply decisions.

[27]Appendix A presents distributions of monthly earnings of DI recipients in AISH who do have dependent within and over two years before and within and over two years after the policy change when the monthly exemption threshold increased to \$1950 from \$975. There is no clear bunching at any kink before the policy change, neither after the policy change. Table 1 shows that the sample of beneficiaries with dependent is less than ten percent of the whole sample. Small sample size might cause no bunching. It also could be that DI recipients with dependent might have another source of income (i.e., their partners' income) and therefore might not be responsive to work incentives. For rest of my empirical analysis using bunching, I use only DI recipients with no dependent. To evaluating the overall effects of the policy change in AISH in my DD analysis, I use both those with and with no dependent.

3.3 A conceptual framework

In this section using a model borrowed from Chetty et al. (2011), I show the interaction between adjustment costs and incentives to work induced by a policy change, and how it might affect individuals' labor supply decisions.

Assume that individuals with ability α choose their earnings z to maximize their utility $u(z;\alpha) = c - d(z;\alpha)$. c denotes consumption which is net-of-tax earnings $z - T(z;\tau)$ and disability insurance benefits b defined as $c = z - T(z;\tau) + b$. τ denotes a tax schedule with a kink at z^*. The marginal tax rate on earnings below and above z^* are respectively τ_0 and τ_1 where $\tau_0 < \tau_1$. Individuals have incentive to locate right at or below the kink as the marginal tax rate is lower.

Let's assume now that a policy change in the tax schedule increased work incentives by reducing the marginal tax rate above z^* to τ_2 where $\tau_2 < \tau_1$. Panel (a) of Figure 5 illustrates an individual with initial earnings at z^* and ability α. If she does not face any adjustment costs when changing her earnings, after the policy change, she would then increase her earnings to z'.

Suppose now that individuals face adjustment costs when adjusting their earnings in response to the policy change. Adjustment costs is realized as dis-utility $\phi(\alpha)$ for individuals with ability α. Individuals with higher ability might face lower utility loss; for instance, they might have better opportunities for finding a new job or better bargaining power for negotiating hours of work with a current employer. Panel (b) of Figure 5 illustrates an individual with initial earnings z^*in $(\underline{z}, \bar{z})$ around the kink at z^* where $\underline{z}$ and $\bar{z}$ are described as:

$$u(c, z^*; \alpha) - u(c, \underline{z}; \alpha) = \phi(\alpha) \quad \text{with } \underline{z} < z^* \tag{11}$$

$$u(c, z^*; \alpha) - u(c, \bar{z}; \alpha) = \phi(\alpha) \quad \text{with } \bar{z} > z^* \tag{12}$$

These individuals might not increase their earnings in response to the tax reduction above the kink. This is because the utility gain from increasing their earnings is not large enough to offset the dis-utility of adjustment costs. Those with initial earnings above $\underline{z}$ might increase their earnings as their utility gain might offset the adjustment costs that they face. Panel (c) of Figure 5 illustrate a case where in there DI benefits increased by ψ, in addition to reduction in marginal tax rate above the kink at z^*. In absence of income effects[28], this would cover up adjustment costs for more individuals and therefore they might increase their earnings.

This simple framework illustrates that induced work incentives from a policy change would result in increase in labor supply only if the induced work incentives are large enough to offset the dis-utility associated with adjustment costs. In Section 3.4, I present

[28] In Appendix C I provide suggestive evidence that the induced income effect of the policy change in AISH is negligible.

my model to estimate heterogeneous adjustment costs.

3.4 The model with heterogenous adjustemnt costs

In this section, I present my model for estimating an elasticity of earnings respect to net-of-tax rate and heterogeneous adjustment costs. I allow for heterogeneous adjustment costs that vary by individuals' ability to work. Ability denotes individuals' potential earnings with no taxes. I explore the policy change in AISH and use the amount of bunching at the former and the new exemption thresholds for my estimation. Bunching at a kink conceptually increases by the elasticity of earnings but also decreases by the size of adjustment costs. My model is fully parametrized using a quasi-linear utility function specified in (1) where individuals' ability is the only source of heterogeneity. Adjustment costs are incorporated into the model as a dis-utility in the utility function. I further parametrize adjustment costs as a linear function of ability. There are mainly three parameters to be estimated; a fixed elasticity and two adjustment costs parameters. These parameters are identified by matching bunching at the new and old kink, so the model accounts for the facts on bunching. A better understanding of heterogeneous adjustment costs has important policy implications in designing policies to increase labor supply and targeting heterogeneous groups in DI programs. Some groups of DI recipients might be in need of more support to be able to work more while some others would not work regardless of the support provided for them.

Gelber et al. (2017) estimate a fixed adjustment costs and elasticity of earning.[29] they build upon (Saez, 2010) to develop a novel framework to estimate an elasticity of earnings and fixed adjustment costs. They explore a policy change in the Social Security Annual Earnings Test (AET) in the US where the marginal tax rate above a kink is reduced. They assume that individuals face a fixed adjustment costs when they change their labor supply. They then use the amount of bunching at the kink before and after the policy change to estimate an elasticity of earnings respect to net-of-tax rate and the fixed adjustment costs.

The nature of the policy change in AISH is different from AET in (Gelber et al., 2017). In AISH, the location of a kink is changed (exemption threshold is increased) whereas in the AET program size of a kink is changed (marginal tax above a kink is decreased). I observe bunching at the former kink both before and after the policy change as well as bunching at the new kink after the policy change (three moments of bunching). They observe bunching at a kink before and after the policy change (two moments of bunching). Intuitively, since I observe more moments of bunching, it allows me to estimate more parameters than them.

[29] Gelber et al. (2017) and Kleven and Waseem (2013) potentially allow for heterogeneity in adjustment costs. However, the data requirements do not allow them actually to estimate heterogeneous adjustment costs. I develop a model with heterogeneous adjustment costs which is empirically estimable.

Gelber et al. (2017) assume that everyone – no matter what their working ability is – faces the same adjustment costs when changing their earnings. It is because the nature of the policy change in AET does not allow to do otherwise as they can only estimate two parameters and not more. Although these might seem restrictive assumptions, they are quite convenient and plausible in their set-up as their study sample includes 62-69 years old individuals. It is a potentially more homogeneous group of individuals regarding their ability to work.

My study sample includes 16-64 years old individuals with non-physical disabilities. This group potentially could be more diverse regarding individuals working ability. It is because most of the non-physical disabilities are hard-to-verify and therefore individuals with different levels of disability end up getting into the program. Although a model with both heterogeneous elasticity and adjustment costs might seem to be better, the nature of the policy change in AISH does not allow me to do. I follow the previous work and assume an so-elastic elasticity of earnings.[30]

3.4.1 The model

In this section, I present my model for estimating an elasticity of earnings and heterogeneous adjustment costs. Assume that individuals with ability α face heterogeneous adjustment costs $\phi(\alpha)$ in the form of utility loss when they change their labor supply. An individual with earnings $z > z^*$ is a marginal buncher at z^* kink if she is indifferent between staying at z –where the marginal tax on earnings is higher– and enduring adjustment cost, and reducing her earnings to z^*, where the marginal tax on earnings is lower. Initial earnings of a marginal buncher denote her earnings with a flat tax τ_0. From now on z_1^* and z_2^* denote respectively the former and the new monthly exemption thresholds in AISH (\$400 and \$800 respectively) with marginal tax rates of τ_0 and τ_1 respectively below and above each kink where $\tau_0 < \tau_1$ (0 and 50% respectively).

Panel (a) of Figure 6 illustrates an individuals with ability $\alpha^{m_1^0}$ who is a marginal buncher at z_1^* kink before the policy change. Her initial earnings is $\underline{z}_1^0$ where she is indifferent between staying at $\underline{z}_1^0$ – where marginal tax on earnings is higher – or enduring utility loss $\phi(\alpha^{m_1^0})$ and decreasing her earnings to z_1^* where marginal tax on earnings is lower. Let $u(c, z; \tau, \alpha)$ to denote utility of an individual with ability α who faces marginal tax τ while earning z. c denotes consumption which is net-of-tax earnings defined as

[30] Simplifying models by assuming a fixed elasticity of earnings – captured by iso-elastic utility functions– is a pretty common practice in the literature. Kleven (2016) reviews all the recent papers on bunching. Almost all of them use the same iso-elastic, quasi-linear utility function specified in (1).

$c = z - T(z)$.[31] The *marginal buncher* condition at z_1^* before the policy change is:

$$u\left((1-\tau_0)z_1^*, z_1^*; \tau_1; \alpha^{m_1^0}\right) = u\left((1-\tau_0)z_1^* + (1-\tau_1)(\underline{z}_1^0 - z_1^*), \underline{z}_1^0; \tau_1; \alpha^{m_1^0}\right) + \phi(\alpha^{m_1^0})$$

In absence of adjustment costs, those with initial earnings in range of $(z_1^*, z_1^* + \Delta z_1^*]$ would bunch at z_1^*. If individuals face adjustment costs when changing their earnings, then only those whose gain from relocation is higher than the utility loss associated with adjustment costs would bunch at the kink.

Theorem 1. *Suppose utility loss $\phi > 0$ is associated with adjusting earnings when kink $z^* = (\tau_0, \tau_1)$ is introduced where $\tau_1 > \tau_0$ and $u(c, z; \alpha)$ is individuals' utility with $\dfrac{\partial u_c}{\partial \alpha} < 0$ (marginal utility of consumption decreases as ability increases). If for $z_2 > z_1$, $\dfrac{\partial (z_2 - z_1)}{\partial \alpha}$ increases at a rate that dominates $\dfrac{\partial u_c}{\partial \alpha} < 0$, then utility gain of relocation to z^* for initial earning level z_2 is higher than that at z_1.*

Theorem (1) shows that under mild assumptions on underlying utility function $u(.)$, those with higher initial earnings gain more from relocation.[32] A proof is presented in Appendix B.1. Therefore, those with initial earnings in range of $(\underline{z_1}^0, z_1^* + \Delta z_1^*]$ would bunch at z_1^*.

Figure 7 shows that the bunching range at the kink at z_1^* is smaller when individuals face adjustment costs. The bunching range in absence of adjustment costs would have been $i + ii + iii$ where it is $ii + iii$ if individuals face adjustment costs. Bunching at z_1^* before the policy change is the area under the counter-factual distribution of earnings in the bunching range. The *bunching equation* at z_1^* before policy change is:[33]

$$B_1^0 = \int_{\underline{z}_1^0}^{z_1^* + \Delta z_1^*} h_0(\zeta) d(\zeta) \approx (z_1^* + \Delta z_1^{*0} - \underline{z}_1^0) h_0(z_1^*)$$

Using the utility function specified in (1), ability of marginal buncher at z_1^* before the policy change is $\alpha^{m_1^0} = \frac{\underline{z}_1^0}{(1-\tau_0)^e}$. Parametrizing adjustment costs as $\phi(\alpha) = \phi_1 + \phi_2 \alpha$, the below defined *bunching equation* and *marginal buncher* at z_1^* before the policy change together define an equation of elasticity of earnings e and parameters of adjustment costs

[31] This definition of consumption abstracts from non-labor earnings. In my empirical estimation, I use a quasi-linear utility function witch implicitly assumes that there is no income effects. I provide suggestive evidence in Appendix C that it is a plausible assumption.

[32] The utility function specified in (1) satisfies conditions of Theorem (1).

[33] The approximation assumes that the distribution of $h_0(.)$ on $(\underline{z}_1^0, z_1^* + \Delta z_1^{*0})$ is uniform. This is a common assumption in the bunching literature (e.g. Chetty et al., 2011; Kleven and Waseem, 2013).

ϕ_1 and ϕ_2:

$$\begin{aligned} \underline{z}_1^0 &= \left(\frac{1-\tau_0}{1-\tau_1}\right)^e z_1^* - \delta\widehat{b_1^0} \\ (1-\tau_1)(\underline{z}_1^0 - z_1^*) &- \frac{1-\tau_0}{1+\frac{1}{e}}\left(\underline{z}_1^0 - {z_1^*}^{1+\frac{1}{e}}{\underline{z}_1^0}^{-\frac{1}{e}}\right) + \phi_1 + \alpha\phi_2 = 0 \end{aligned} \tag{13}$$

After the policy change when the exemption threshold at z_1^* increased to z_2^*, bunchers at z_1^* would increase their earnings only if their utility gain from relocation exceeds their utility loss associated with the adjustment costs. Panel (b) of Figure 6 illustrates a marginal buncher at z_1^* after the policy change whose ability is $\alpha^{m_1^1}$ and initially would have located at $\underline{z}_1^1 \in (\underline{z}_1^0, z_1^* + \Delta z_1^*]$. She is indifferent between continuing to bunch at z_1^* or enduring utility loss $\phi(\alpha^{m_1^1})$ and relocating to her optimal earnings ${\underline{z}_1^1}'$ with the new taxes. The *marginal buncher* equation at z_1^* after the policy change is:

$$u\left((1-\tau_0){\underline{z}_1^1}', {\underline{z}_1^1}'; \tau_0; \alpha^{m_1^1}\right) = u\left((1-\tau_0)z_1^*, z_1^*; \tau_0; \alpha^{m_1^1}\right) + \phi(\alpha^{m_1^1})$$

Theorem (1) suggests that those with initial earnings in range of $(\underline{z}_1^0, \underline{z}_1^1]$ continue bunching at the former kink at z_1^*. Figure 7 illustrates bunching at the former kink at z_1^*. The *bunching equation* at z_1^* after the policy change is:

$$B_1^1 = \int_{\underline{z}_1^0}^{\underline{z}_1^1} h_0(\zeta)d(\zeta) \simeq (\underline{z}_1^1 - \underline{z}_1^0)h_0(z_1^*)$$

Using the utility function specified in (1), ability of marginal buncher at z_1^* after the policy change is $\alpha^{m_1^1} = \frac{\underline{z}_1^1}{(1-\tau_0)^e}$. The *bunching equation* and *marginal buncher* equations at z_1^* together define another equation of elasticity of earnings e and parameters of adjustment costs ϕ_1 and ϕ_2:

$$\begin{aligned} \underline{z}_1^1 &= \underline{z}_1^0 + \delta\widehat{b_1^1} \\ (1-\tau_0)&\left(z_1^* - \frac{1}{1+\frac{1}{e}}{\underline{z}_1}^{1-\frac{1}{e}}{z_1^*}^{1+\frac{1}{e}} - \frac{\underline{z}_1^1}{1+e}\right) + \phi_1 + \alpha\alpha_2 = 0 \end{aligned} \tag{14}$$

I follow a similar procedure for bunching at the new kink at z_2^*. In absence of adjustment costs, individuals with initial earnings in range of $(z_2^*, z_2^* + \Delta z_2^*]$ would bunch at z_2^*. If individuals face adjustment costs when they change their labor supply, bunching at z_2^* would be attenuated. Panel (c) of Figure 6 illustrates a marginal buncher at z_2^* with ability z_2^* with initial earnings $\underline{z}_2 \in (z_2^*, z_2^* + \Delta z_2^*]$. When the kink at z_1^* is first introduced, a marginal buncher would relocate to $\underline{z}_2'$ which is her optimal earnings with marginal tax τ_1. When the exemption threshold at z_1^* is increased to z_2^*, she is indifferent between staying at $\underline{z}_2'$ with marginal tax τ_1 or enduring adjustment costs $\phi(\alpha^{m_2})$ and decreasing her earnings and bunch at z_2^*. The *marginal buncher* condition at z_2^* is

$$u((1-\tau_0)z_2^*, z_2^*; \tau_1; \alpha^{m_2}) = u((1-\tau_0)\underline{z}_2{}', \underline{z}_2{}'; \tau_1; \alpha^{m_2}) + \phi(\alpha^{m_2})$$

Figure 7 shows that those with initial earnings in range of $(\underline{z}_2, z_2^* + \Delta z_2^*]$ would bunch at z_2^*. *Bunching equation* at z_2^* is:

$$B_2 = \int_{\underline{z}_2}^{z_2^*+\Delta z_2^*} h_0(\zeta)d\zeta \approx (z_2^* + \Delta z_2^* - \underline{z}_2)h_0(z_2^*)$$

Using the utility function specified in (1), ability of a marginal buncher at z^*2 is $\alpha^{m_2} = \frac{\underline{z}_2}{(1-\tau_1)^e}$. The *bunching equation* and *marginal buncher* equations at z_2^* together define the third equation of elasticity of earnings e and parameters of adjustment costs ϕ_1 and ϕ_2:

$$\begin{aligned} &\underline{z}_2 = \left(\frac{1-\tau_0}{1-\tau_1}\right)^e z_2^* - \delta\widehat{b_2} \\ &(1-\tau_1)\left(\frac{\underline{z}_2}{1+e}\left(\frac{1-\tau_1}{1-\tau_0}\right)^e - z_2^*\right) + \frac{1-\tau_0}{1+\frac{1}{e}}\left(\underline{z}_2{}^{-\frac{1}{e}} z_2^{*1+\frac{1}{e}}\right) + \phi_1 + \alpha\phi_2 = 0 \end{aligned} \tag{15}$$

Equations (13), (14) and (15) define three equations of three parameters of interest elasticity of earnings e and parameters of adjustment costs ϕ_1 and ϕ_2. I numerically solve the system to pin down the parameters.[34]

4 Empirical implementation

In this section, I first describe underlying assumptions for estimating my model. I then explain a procedure for estimating standard errors and making an inference. I finally present the estimates.

4.1 Estimation assumptions

A crucial underlying assumption for using the amount of bunching at a kink to estimate structural parameters of a utility function is that the distribution of earnings would be smooth and continuous if a flat tax would have been imposed on earnings. Another key parametric assumption is that the adjustment costs and elasticity of earnings are the same at all kinks, and do not change after the policy change. I parametrize adjustment costs a linear function of individuals' ability. I also assume that the induced income effects of the policy change are negligible, and use a quasi-linear utility function specified in (1)

[34] I also replicate (Gelber et al., 2017) to estimate fixed adjustment costs ϕ and elasticity of earnings e by solving (13), (14) numerically to pin down e and ϕ.

to parametrize my model.[35] Annual earnings of almost all of the DI recipients falls in the lower bracket of the income tax schedule of the federal and provincial governments in Canada which are exempted from income taxes. However, they still have to contribute to the Employment Insurance (EI) –about 2-5% of earnings in income tax exempted bracket– which is relatively small compared to the marginal tax rates at the kinks. For my main estimates, I abstract from income taxes and EI contributions. I check the robustness of my findings by including 5% income taxes.

4.2 Estimating parameters of the model

My main study sample includes 18-64 years AISH beneficiaries with no dependent who have non-physical disabilities. I use the pooled sample of observations within two years before the policy change to estimate bunching at the old exemption threshold before the policy change. Similarly, I use the pooled sample of observations within two years after the policy change to estimate bunching at the former and new exemption thresholds after the policy change.

To estimate bunching at each kink, I set the bin size $\delta = 10\$$ and fit a polynomial degree $D = 6$ to the observed distribution of earnings, where I exclude $l = u = 3$ bins at each side of a kink. Figure 8 plots the fitted polynomials at the former and new exemption thresholds and shows the normalized bunching at each threshold. I investigate the robustness of the estimated bunching to the selected parameters in Table B.1.

Figure 9 shows the estimated normalized bunching at exemption thresholds before and after the policy change respectively at Panel (a) Panel (b). The horizontal axis denotes month relative to the policy change in AISH, and the vertical axis denotes the estimated normalized bunching at the corresponding threshold. The estimated bunching at the former exemption threshold is quite stable before the policy change. However, it gradually decreases during the months proceeding the policy change, but it does not completely disappear. There is no bunching at the new exemption threshold before the policy change, but it gradually starts to increase after the policy change. The gradual change in bunching and the fact that the estimated bunching at the old exemption threshold after the policy change is still significant, suggests that individuals face adjustment costs when changing their labor supply.

4.3 Inference

I use bootstrapped standard errors to make inference on the estimated parameters. I calculate standard errors using a parametric bootstrapping procedure described by Chetty et al. (2012). I draw 200 times with replacement from the estimated vector of errors ϵ_i

[35]In Appendix C I provide suggestive evidence that the induced income effects of the policy change in AISH are negligible.

from (8) to generate new earnings distributions. For each bootstrapped distribution then, I estimate the parameters of interest. I define standard error of a parameter θ as the standard deviation of its bootstrapped distribution $S_{\widehat{\theta}}$. These standard errors reflect the misspecification of the fitted polynomial to the observed distribution of earnings rather than sampling error. To test whether an estimated parameter $\widehat{\theta}$ is significantly different than zero $H_0 : \theta \neq 0$, I construct test statistic $T = \frac{\widehat{\theta}}{S_{\widehat{\theta}}}$ for each bootstrapped distribution. The bootstrapped critical values at level β are the lower $\beta/2$ and the upper $\beta/2$ quantiles of the ordered bootstrapped test statistics. I then determine whether an estimate is significantly different from zero within a $100(1-\beta)$ confidence interval if the corresponding t-statistic lies within the critical values at level β.

4.4 Estimation results

Figure 9 plots the estimated bunching at the new and old exemption threshould by month relative to the policy change in AISH. Panel (a) shows that the bunching at the old threshold does not vary much but it starts to decrease gradually in the months following the policy change but it doe does not get to zero even two years after the policy change. Panel (b) shows that bunching at the new threshold gradually increases. The gradual increase of bunching at the former threshold and gradual increase of bunching at the new threshold suggests that individuals face adjustment costs when changing their labor supply when work incentives change.

Table 2 presents the estimated bunching, elasticity of earnings respect to net-of-tax rate e and parameters of heterogeneous adjustment costs ϕ_1 and ϕ_2 specified as $\phi = \phi_1 + \alpha\phi_2$ the model specified in Section 3.4.1. The first row of the table presents estimates for the full sample which includes 16-64 year AISH beneficiaries with non-physical disabilities who do not have dependent, within two years of the policy change in AISH. Estimated parameters of adjustment costs are $\phi_1 = 20.69$ and $\phi_2 = -0.02$. An estimated negative slope for the adjustment costs denotes that adjustment costs are higher for those with lower ability. Figure 10 plots the estimated adjustment costs as percentage of the potential earnings. The estimated adjustment costs vary from zero to twenty percent of the potential earnings with an average at eight percent. Estimated elasticity of earnings with respect to net-of-tax ratio – accounting for heterogeneous adjustment cost – is 0.19. Table 2 shows that the estimates do not change much using data within a year of the policy change nor including %25 income taxes.[36]

Table 2 also presents estimates by age, gender, disability type and location of residence. The estimates are slightly higher for older, males and those living in metropolitan

[36]The federal income taxes in the first bracket is 15%. The threshold in 2010 is \$40,970 and gradually increases to \$43,953 in 2014. The provincial income taxes in Alberta for all earnings is %10 during my study. For more information see `https://www.canada.ca/en/revenue-agency/services/forms-publications/tax-packages-years.html`, Accessed on August 29, 2018.

areas. Heterogeneity in estimated elasticity and adjustment costs within disability types however is striking. The estimates are considerably higher for those with Psychotic disabilities among the others. The estimated elasticity for those with psychotic disabilities is 0.71 and adjustment costs vary from zero to more than half of the potential earnings. The estimated elasticity for individuals with mental disabilities is 0.34 and adjustment costs vary from zero to more than one-third of their potential earnings. Estimates for those with neurological disabilities are quite similar to those estimated for the whole sample, elasticity of earnings at 0.15 and adjustment costs that vary from zero to fifteen percent of the potential earnings.

Figure B.1 in Appendix B plots the estimated elasticity of earnings respect to net-of-tax rate using the model with no adjustment costs by (Saez, 2010) specified in Section 3.1. This figure plots the estimated elasticities at the old and new exemption thresholds within two years of the policy change in AISH. The horizontal axis denotes the month relative to policy change and the vertical axis denotes the estimated elasticity. Saez (2010) explores an assumed proportional relationship between bunching at a kink and elasticity of earnings. The estimated elasticity (bunching) at the old threshold is quite stable in months preceding the policy change where it gradually increases at the new threshold in months proceeding the policy change. Table B.2 in Appendix B presents the estimated elasticity of earnings using the pooled sample within two years of the policy change. The estimated elasticity for the base sample is 0.10, about half of the one estimated with heterogeneous adjustment costs at 0.19. This table also shows the estimated elasticity of earnings by age, gender, disability type and living location. Estimated elasticities for all the sub-samples are much smaller than those estimated accounting for adjustment costs. This finding suggest that accounting for adjustment costs is important when estimating elasticity of earnings and ignoring them might result in small elasticities.

The estimated elasticity of earnings with fixed adjustment costs from (Gelber et al., 2017) are presented in Table B.3 in Appendix B. The estimated elasticity of earnings for the whole sample is quite similar to the one estimated with heterogeneous adjustment costs (0.21 versus 0.19). The estimated fixed adjustment costs are about five percent of the average earnings ($12 of average earnings at $250). My estimated elasticity of earnings is similar in magnitude to Gelber et al. (2017), but the estimated adjustment costs are much larger (%4 versus %0.5 of the average earnings). This table also shows the estimates by age, sex, disability type and location of residence. Estimates are quite heterogeneous within groups.

My estimates show that there is considerable heterogeneity in adjustment costs among DI recipients. Individuals with higher potential earnings face lower adjustment costs when changing their labor supply. It could be because they might have a better chance of finding a job or stronger bargaining power in negotiating their wage or hours of work with a current employer. It also could be that they might need less support and workplace accommodation to work. The estimated heterogeneous adjustment costs are larger than the fixed ones. The estimated adjustment costs might seem quite small, but accounting for adjustment costs doubles the size of the estimated elasticity of earnings. For estimating adjustment costs, I use a sample of DI recipients who bunch at an exemption threshold. These individuals are relatively more flexible in changing their labor supply than the others. Evidence on the existence of adjustment costs even for them magnifies the importance of the adjustment costs. Adjustment costs might attenuate short-term responses to incentives to work even to large incentives. Furthermore, the effectiveness of policies that aim to increase labor supply in DI programs would depend on the size of the induced incentives to work versus the size of adjustment costs that DI recipients face when changing their labor supply. Individuals will increase their labor supply only if utility gain from the change in their labor supply offsets the adjustment costs that they face.

5 Labor supply responses to incentives to work

Bunching estimates use information on the change in the distribution of earnings around an exemption threshold caused by a policy change to recover parameters of interest. These estimates, however, are local and provide an incomplete picture of the effects of the policy change on the labor supply as they mostly capture the intensive margin effects. The policy change in AISH decreased the marginal tax rate on earnings far away from the exemption threshold, and the overall intensive margin effects of the policy change might actually be larger. The policy change might also have extensive margin effects as some individuals might start working (Gelber et al., 2018). Furthermore, evaluating the overall effects of the policy change would shed light on the relative size of the induced incentives to work and adjustment costs that individuals face when changing their labor supply. Overall positive effects on labor supply from the policy change in AISH would then suggest that increase in work incentives offsets the adjustment costs that individuals face when changing their labor supply.

5.1 Identification strategy

Examining the overall effects of an increase in incentives to work on labor supply in a DI program is challenging. First, individuals' labor supply is endogenous since the selection process into a DI program strongly depends on having low labor supply. Second, adjustment costs attenuate the induced incentives to work by a policy change (Chetty, 2012).

I estimate causal effects of the policy change in AISH on the labor supply using a Difference-in-Differences (DD) design. I use DI recipients of the Ontario Disability

Support Program (ODSP) – another provincial DI program in Canada – as a control group. The ODSP is an appropriate control group since its benefit scheme is similar to –but less generous than– AISH; and did not go under major policy changes during the period of my study. The first difference is over time, as the incentives to work increased in the AISH program after April 2012. The second difference is across provinces; there was a policy change in the AISH program in Alberta but not in the ODSP program in Ontario. The control group should capture the counter-factual labor market trends in the absence of the policy change. I implement a DD comparison by estimating a regression of the form:

$$y_{it} = \alpha + \beta(POST_t \times AISH_{it}) + \gamma AISH_{it} + X'_{it}\delta + \lambda_t + \epsilon_{it} \tag{16}$$

where i and t respectively denote individuals and monthly time. y_{it} denotes labor supply outcomes of interest which include inflation-adjusted monthly earnings and labor force participation defined as a dummy that switches on for the positive earnings. $AISH_{it}$ is a dummy variable for the treatment group, DI recipients of AISH. This variable controls for program-specific trends and is equal to one for those in the AISH program and zero otherwise. $POST_t$ is another dummy variable that turns on after the policy change. I also include a vector of time fixed effects λ_t to control for the changes in macroeconomic conditions. The vector X_{it} is a set of individual characteristics to control for any observable differences that might confound the analysis (sex, age, family structure, age entered DI program at, disability type and location of residence). ϵ_{it} captures any unobserved factors affecting individuals' labor supply such as their ability or taste for work. The coefficient of interest is β which measures the effects of the policy change on the labor supply of DI recipients in AISH relative to those in ODSP over time.

To further explore impact of the policy change in AISH over time, I generalize (16) by replacing $POST_t \times AISH_{it}$ with a full set of treatment and quarterly time interaction terms and estimate a regression of the form:

$$y_{it} = \alpha + \sum_{t=-8}^{t=7} \beta_t(q_t \times AISH_{it}) + \gamma AISH_{it} + X'_{it}\delta + \lambda_t + \epsilon_{it} \tag{17}$$

where q_t is a dummy that is one in quarter t relative to the policy change and zero otherwise. The pre-policy change interaction terms provide pre-treatment specification tests. The identification assumption is that there are no unobserved program specific change that first, are correlated with the policy change and second, are correlated with program specific changes in the outcome variable.

5.2 Results

5.2.1 Descriptive evidence

The first panel of Table 1 presents the labor market statistics in AISH and ODSP within two years before and two years after the policy change in AISH. There are two noticeable observations. First, the labor supply in AISH is much higher than ODSP. About half of the AISH beneficiaries have positive labor earnings while less than ten percent of ODSP beneficiaries work. Average monthly earnings in AISH is about five times larger than ODSP. Second, the labor supply in AISH after the policy change is higher than that before the policy change. The second panel of Table 1 shows the background characteristics of beneficiaries in the two programs. AISH and ODSP are quite similar, and it does not seem to be any change in AISH after the policy change.

The higher labor supply in AISH than ODSP despite the higher DI benefits in AISH – which can be a disincentive to work– might be related to differences in work policies in these two programs. AISH has an exemption threshold that allows its beneficiaries to work without losing any DI benefits. Whereas, ODSP does not have an exemption threshold and DI benefits phase out from the first dollar of earnings (see Figure 1 and Figure 2).

To graphically asses the impact of the policy change in AISH on the labor supply, I plot trends in the mean monthly inflation-adjusted earnings and labor force participation rates in AISH and ODSP within two years of the policy change in AISH in Figure 11. Panel (a) shows that earnings in the ODSP are fairly stable before and after the policy change. In the months following the policy change, the average earnings in AISH gradually rise. Panel (b) shows a similar trend for the labor force participation.

The policy change in AISH came into effect in April 2012, but it was publicly announced two months in advance in February 2012. Since individuals had little time to adjust their earnings or start to work, there is no observable evidence of anticipation effect in earnings neither in the labor force participation.

5.2.2 Results

My study sample for DD analysis includes 18-64 year beneficiaries of AISH and ODSP with non-physical disabilities within two years of the policy change in AISH. I present my main findings from estimating (16) in Table 3. The dependent variables are monthly inflation-adjusted earnings and labor force participation. The effect of the policy change on earnings measures the intensive margins whereas the effect on the labor force participation measures the extensive margins. The pre-period in the base specification is April 2010 to March 2012, and the post-period is from April 2012 to March 2014.

The first block of Table 3 shows my estimate of the effects on earnings from the policy change in AISH. The first column shows the estimated effects for the full sample which is a 12 percent increase in mean monthly earnings in AISH ($30 per month). Controlling for individual characteristics including sex, age, age entered DI program at, family status, disability type, and location of residence does not change the estimates presented in the second column.

The second block of Table 3 presents the estimated effects of on the labor force participation rate from the policy change in AISH. The first column of this block shows the estimated effects for the full sample which is about one percentage point increase in the participation rate. The estimated effect does not change after controlling for individuals characteristics as presented in the second column of the block.

The estimates using the full sample within two years of the policy change in AISH might be contaminated for two reasons. First, In November 2008, AISH increased the second earnings threshold to $1,500 from $1,000 for those with no dependent and to $2,500 from $2,000 for those with a dependent. Second, In September 2013, ODSP introduced an exemption threshold at $200. The expected effects of these policy changes are increase in labor supply in both AISH and ODSP (although it does not seem to affect ODSP as shown in Figure 11). To account for the possible contaminations, I estimate the effects of the policy change using a shorter panel within one year and half of the policy change where the pre-period is November 2010-March 2012 and post-period is April 2012-September 2013. The last column of each block of Table 3 show these estimates. The estimated effects do not change much.

The estimates presented in Table 3 will be biased if the treatment and control groups have different labor supply trends before the policy change. I plot the estimated coefficients of the interaction terms in (17) in Figure 12. Panel (a) shows the effects on earnings and Panel (b) shows the estimates for the labor force participation within two years of the policy change in AISH. Each point on the solid line indicates the estimated coefficient of the interaction between a dummy for the quarter relative to the policy change and treatment variable $AISH$. The gray shade represents the corresponding 95 percent confidence intervals. In both panels, the estimated coefficients vary closely around zero before the policy change. However, the estimated coefficients for the labor force participation in the early two quarters are slightly far from zero. It could be due to the delayed responses to the November 2008 policy change in AISH. When facing an increase in work incentives, it might take longer for an individual to find a job than increasing their hours of work if they are already employed. The estimated effects on labor force participation using the shorter panel excluding the contaminated periods are almost the same as the one using the full sample as shown in Table 3. The estimated coefficients are significantly positive and gradually increase in quarters following the policy change.

I present the estimated effects of the policy change on the labor supply for different sub-samples within two years of the policy change in Table 4. It is instructive to investigate the effects of the policy change on those with no dependent and those with dependent separately since the earnings thresholds for those with dependent are higher than those for individuals with no dependent. Estimated effects from (16) are shown in the first panel of Table 4. The estimated increase in earnings and labor force participation of those with dependent is higher. The earnings and labor force participation of those with dependent increased respectively by 17.88 percent and 4.31 percentage points compared to the corresponding 12.77 percent and 0.62 percentage points increase for those with no dependent. There are also sizeable differences in the estimated effects of the policy change within the age groups. The second panel shows that the increase in earnings of younger individuals (18 to 34 years) is more than twice the size of that for the middle-aged group (35 to 49 years) at 23 percent compared to 10 percent. The estimated effect on earnings of older individuals (50 years and older) is a quite small decrease in earnings (about 2 percent). The estimated effect on labor force participation of older individuals is, however, relatively sizeable at 4.07 percentage points decrease compared to 4.21 percentage points increase for the younger ones and 0.79 percentage points decrease for the middle-aged group. The estimated effect on labor force participation does not differ between males and females, but the increase in earnings for males is slightly higher at 14 percent compared to 11 percent for females.

Individuals' health condition plays an essential role in the determination process for DI benefits. Panel (D) of Table 4 shows the estimated effects of the policy change broken down by types of disabilities. I divide individuals into three sub-groups based on the ICD-9 codes. The increases in earnings of those with psychotic and neurological disabilities are relatively higher than individuals with mental disabilities at 15 and 12 compared to 7 percent. The change in the labor force participation of individuals with Psychotic disabilities is more pronounced than the others at 1.46 percentage point increase compared to 0.07 and 0.05 percentage point reductions, not even significant at conventional levels. The last panel shows the estimates broken down by the location of residence; metropolitan versus non-metropolitan area. The increase in earnings is not that different whereas the increase in labor force participation in metropolitan areas is higher. More employment opportunities in metropolitan areas might cause this finding compared to non-metropolitan areas.

My estimates using a DD design suggest that the overall effect of the policy change in AISH is an increase in labor supply both in intensive and extensive margins. I also quantify the effects on earnings and labor force participation using a sharp discontinuity in the increase in work incentives at the month of the policy change in AISH (Zaresani, 2018). Intuitively, I compare the labor supply outcomes after the policy change to those before the policy change. Using administrative data from AISH, I also document that large incentives to work could induce beneficiaries to increase their labor supply both in intensive and extensive margins. These findings suggest that the increase in work incentives are large enough to offset the adjustment costs that individuals face when changing their labor supply.

My findings also highlight the role of adjustment costs in extensive margin responses to work incentives. Those who did not work before the policy change are unlikely to be affected by the substitution effects of the policy change since their budget constraints before and after the policy change are parallel as shown in Figure 1. One plausible explanation for why they might start working after the policy change –despite receiving more benefits– is that they might have been facing adjustment costs and the extra benefits cover up adjustment costs they might face. Gelber et al. (2018) –in a setting where individuals are not compensated for adjustment costs– find that existence of Annual Earnings Test (AET) in the US results in lower employment rate among the affected older individuals. The overall positive effects of the policy change on earnings suggests that the substitution effect dominates the income effect. In Appendix C, I provide suggestive evidence that the induced income effects of the policy change in AISH are negligible. This finding suggests that the policy change in AISH might be welfare improving.

5.3 Elasticity of labor force non-participation

My estimates show that the policy change in AISH increased the labor supply both in extensive and intensive margins. In this section, I adopt the approach of Kostol and Mogstad (2014) to the policy change in AISH to estimate the implied elasticity of labor force non-participation to Participation Tax Rate (PTR) ϵ is defined as:[37]

$$\epsilon = \frac{\Delta(1-LP)/(1-LP_{before})}{\Delta PTR/PTR_{before}} \tag{18}$$

where LP denotes the labor participation defined as a dummy that turns on for earnings above the exemption threshold. $1-LP$ denotes non-participation rate. The PTR captures the behavioural responses to the policy change which is defined as $PTR_z = 1 - \frac{I_0 - I_z}{z}$ for earnings z above the exemption threshold. The PTR is zero for earnings below the threshold. I_0 denotes the mean income (DI benefits and labor earnings) of individuals who do not participate (earnings below the exemption threshold). I_z denotes the mean income of individuals who participate (earnings above the threshold). ΔPTR denotes changes in PTR before and after the policy change.[38]

To estimate (18), I divide observed monthly earnings in AISH within two years of the policy change into $[z-\delta/2, z+\delta/2]$ bins with width δ (I set $\delta = \$10$). ΔPTR is the mean of differences in PTR in each bin weighted by p_w^{before}, the portion of the individuals in

[37] Kostol and Mogstad (2014) estimate elasticity of labor force non-participation to PTR form work incentives induced by a policy change in a Norwegian DI program where the marginal taxes on earnings above a threshold is decreased.

[38] This specification for estimating an elasticity of non-participation respect to PTR ignores the income effects, but the estimated elasticity could be interpreted as an effect of the policy change. In Appendix C, I provide suggestive evidence that the income effects of the policy change on labor supply are negligible.

each bin before the policy change:

$$\Delta PTR = \mathbb{E}_z[(PTR_z^{after} - PTR_z^{after})p_z^{before}] \tag{19}$$

5.3.1 Results

Figure 13 plots PRT by earnings before and after the policy change for individuals with no dependent in Panel (a) and for those with dependent in Panel (b). PTR is zero for exempted earnings, but it increases afterwards. For any earnings levels, PTR is lower after the policy change than that before the policy change. Figure 13 also plots a smoothed density of earnings before and after the policy change. The figure suggests that the lower PTR is associated with a higher density of earnings.

Table 5 presents the estimated elasticity of labor force non-participation respect to PTR. The standard errors are estimated using a non-parametric bootstrap. I obtain 200 samples of the observed earnings with replacement. For each bootstrapped sample, I then estimate the elasticities. The standard error of a parameter is the standard deviation of its bootstrapped distribution. The first column shows the estimates for individuals with no dependent. The estimated elasticity of non-participation respect to PTR is 0.114; a ten percent reduction in PTR decreases labor force non-participation by 11.4 percent. The second column shows the estimates for individuals with a dependent. The estimated elasticity is 0.033, a ten percent decrease in PTR decreases labor force non-participation by 3.3 percent. This estimate is quite smaller than that for individuals with no dependent. My estimates are in line with estimates of Kostol and Mogstad (2014) where their estimates are about 0.119 to 0.186.

5.3.2 Fiscal effects

Table 6 presents the back of the envelope fiscal effects of the policy change in AISH in each fiscal year (April to March) before and after the policy change. The *Cost* denotes the total amount of DI benefits paid to AISH beneficiaries. The *Revenue* includes all the clawback DI benefits in addition to a 25% income taxes. The net cost in each year is the cost of the program net of the collected revenue. All the values are inflation-adjusted based on 2012 dollar.

The cost of the program in years following the policy change is higher than the cost before the policy change. It is mainly due to the higher DI benefits. The revenue of the program after the policy change is also higher in years after the policy change, 13 to 14.5 million dollars. The net cost of the program consequently is higher in years after the policy change. The annual net cost of the program is about 55 million dollars.

6 Policy implications and conclusion

Do individuals with disabilities face adjustment costs when changing their labor supply in response to an increase in work incentives induced by a policy change? Many countries have recently implemented – or consider implementing – policies to increase labor supply in their DI programs. While these policies intend to increase work incentives, findings on their effectiveness are mixed. My findings suggest that adjustment costs might explain the mixed findings on the effects of an increase in work incentives on labor supply in DI programs.

I explore a policy change in a DI program and provide the first estimate of the size of heterogeneous adjustment costs that vary by individuals' ability to work. I use change in bunching at the earnings exemption threshold induced by the policy change for my empirical analysis. Individuals' potential earnings with no taxes denote their ability to work. The estimated adjustment costs are higher for individuals with lower ability; varying from zero to twenty percent of their potential earnings with an average at eight percent. The estimated elasticity of earnings respect to net-of-tax rates – accounting for heterogeneous adjustment costs – is 0.2 which is double the size of the one estimated with no adjustment costs. The overall effect of the policy change on labor supply estimated using a DD design is a twelve percent increase in average earnings and one percentage point increase in labor force participation. The overall increase in labor supply in AISH from the policy change highlights the interaction between induced incentives to work and the adjustment costs. The increase in work incentives must be substantial enough to offset the adjustment costs to increase the labor supply in a DI program. The adjustment costs are estimated for a sub-sample of individuals who bunch at the exemption threshold and are relatively more flexible in changing their labor supply. The evidence on the existence of adjustment costs for the bunchers suggests that the adjustment costs might be even more significant and my estimates are a lower bound on the adjustment costs that DI recipients face when changing their labor supply.

My paper, however, has three main caveats. First, I estimate a fixed elasticity of earnings while allowing the adjustment costs to vary by individuals' ability. Second, I use a static framework where the labor supply decisions are dynamic. For my future research, I will extend the model to a dynamic model with heterogeneous elasticity and adjustment costs. Potentially, the observed mass above the second threshold in the program could be used as another moment of bunching to estimate more parameters. Third, the adjustment costs in my model are all in a black box where not much is known about its nature. It could be related to the supply side or demand side of the labor force. A better understanding of its nature is required to implement policy interventions to increase labor supply in DI programs. It would need data sources on both sides of the market.

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Tables

Table 1: Summary statistics

	AISH		ODSP	
	Before	After	Before	After
Labor market statistics				
Positive earnings (%)	48.1	48.4	9.9	9.4
Mean monthly earnings (2012$)	255	285	50	55
	(420)	(470)	(235)	(245)
Mean monthly net benefits (2012$)	1,160	1,530	1,020	1,015
	(120)	(150)	(470)	(460)
Number of new DI awards	1,215	636	8,440	9,965
Background characteristics				
Male (%)	55.3	55.4	53.4	53.9
Mean age (years)	38.5	39.8	43.0	42.9
	(12.5)	(12.8)	(12.6)	(12.9)
Mean age DI awarded at	28.8	29.1	33.2	33.1
	(11.1)	(11.4)	(11.8)	(11.9)
Has no dependent	91.3	90.8	82.1	82.2
Type of disability				
-Psychotic (%)	42.1	42.1	42.6	43.5
-Neurological (%)	50.1	51.0	36.3	36.4
-Mental (%)	7.3	6.9	21.1	20.2
Live in metropolitan area (%)	49.5	48.9	29.1	29.0
Mean number of individuals	8,940	9,890	142,970	160,775
Total number of observations	214,595	237,285	3,431,300	3,385,615

Notes: This table provides summary statistics of Assured Income for Severely Handicapped (AISH) and the Ontario Disability Support Program (ODSP) data. "Before" refers to the period before the policy change in AISH from April 2010 to March 2012 and "After" denotes the period after the policy change from April 2012 to March 2014. Mean earnings and benefits are inflation-adjusted and rounded to the closest five according to the confidentiality guidelines of the Statistics Canada. The standard deviation of the continuous variables are in the pantheists.

Table 2: Estimted elasticity of earnings and heterogeneous adjustment costs

	Bunching at kink at \$400 before policy change	Earnings response at kink at \$400 before policy change	Bunching at \$400 after policy change	Bunching at kink at\$800 after policy change	Earnings response at \$800 kink after policy change	Fixed Elasticity	Heterogeneous Adjustment costs $\phi = \phi_1 + \phi_2 \alpha$	
	b_1^0	Δz_1^*	b_1^1	b_2	Δz_2^*	e	ϕ_1	ϕ_2
A. Full sample								
Within two years	2.920***	56.898***	1.950***	1.880***	113.796***	0.192***	20.692***	-0.0236*
	(0.209)	(6.641)	(0.110)	(0.090)	(13.282)	(0.021)	(2.185)	(0.0688)
Within one year and half	2.790***	53.146***	2.120***	1.820***	106.293***	0.180***	20.247***	-0.0232***
	(0.203)	(4.146)	(0.157)	(0.157)	(8.939)	(0.014)	(1.085)	(0.0011)
Adding 25%	2.920***	45.233	1.950***	1.880***	90.467	0.098***	14.676***	-0.017
income taxes	(0.287)	(4.922)	(0.112)	(0.086)	(9.190)	(0.010)	(1.220)	(0.069)
B. Age								
18-34	2.660***	53.078***	1.630***	2.580***	106.156***	0.180***	19.658***	-0.023***
	(0.175)	(5.175)	(0.101)	(0.377)	(10.349)	(0.016)	(1.767)	(0.003)
35-49	2.680***	54.179***	1.550***	2.820***	108.357***	0.183***	20.031***	-0.024***
	(0.189)	(8.897)	(0.175)	(0.173)	(17.793)	(0.027)	(4.537)	(0.070)
> 50	3.600***	67.820***	2.770***	-0.320	135.639	0.226***	24.405***	-0.0259***
	(0.424)	(11.139)	(0.222)	(0.158)	(22.279)	(0.034)	(3.321)	(0.0027)
C. Gender								
Male	3.510***	69.143***	2.160***	1.040***	138.287***	0.230***	23.655***	-0.0265***
	(0.314)	(10.272)	(0.110)	(0.254)	(20.545)	(0.032)	(4.048)	(0.0039)
Female	2.210***	43.039***	1.680***	3.280***	86.077***	0.147***	18.745***	-0.0243
	(0.216)	(6.889)	(0.109)	(0.210)	(13.778)	(0.022)	(2.378)	(0.1193)
D. Disability type								
Psychotic	4.630*	257.891**	1.620**	1.930***	515.782**	0.718**	107.280	-0.0828
	(2.467)	(108.245)	(0.127)	(0.391)	(216.490)	(0.237)	(42.789)	(0.119)
Neurological	2.330***	43.836***	2.050***	1.770***	87.673***	0.150***	18.131***	-0.0214
	(0.157)	(3.076)	(0.109)	(0.087)	(6.152)	(0.016)	(1.867)	(0.0972)
Mental	4.300***	106.053*	2.100***	2.770***	212.105*	0.339*	38.140	-0.0392
	(0.939)	(61.374)	(0.221)	(0.251)	(122.749)	(0.175)	(29.015)	(0.0975)
E. Living location								
Metropolitan area	4.290***	81.040***	3.180***	3.360***	162.079***	0.266***	30.338***	-0.0336***
	(0.381)	(8.196)	(0.197)	(0.210)	(16.393)	(0.025)	(1.861)	(0.0015)
Other	1.650***	2.645	0.880***	0.420**	5.2894	0.010	0.0111	-0.9928**
	(0.121)	(16.071)	(0.059)	(0.150)	(32.141)	(0.057)	(6.777)	(0.3762)

Note: This table presents the estimated elasticity of earnings respect to net-of-tax rate and heterogenous adjustment costs from the model specified in Section 3.4. The bootstrapped standard errors are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

Table 3: Estimated effect of the policy change on earnings and labor force participation rate

	Earnings ($)			Labor Force Participation Rate (%)		
	(1)	(2)	(3)	(4)	(5)	(6)
AISH × Post	29.98***	31.02***	29.87***	0.79***	0.79***	0.78***
	(1.34)	(1.34)	(1.53)	(0.15)	(0.15)	(0.17)
AISH	202.09***	197.89***	195.57***	38.22***	38.16***	37.66***
	(0.92)	(0.92)	(1.05)	(0.11)	(0.11)	(0.12)
Sample	Full	Full	Short	Full	Full	Short
Individual co-variates	No	Yes	Yes	No	Yes	Yes
Mean in AISH before policy change	252.47 (420.40)	250.18 (420.65)	250.89 (421.03)	48.12	48.12	47.60
R-Sq.	0.04	0.04	0.04	0.08	0.10	0.10
Num. of. Obs.	7,741,795	7,741,795	5,810,529	7,741,795	7,741,795	5,810,529

Notes: This table presents the estimated effects of the policy change in AISH from a Difference-in-Difference framework using (16). The full sample includes individuals with non-physical disabilities within two years of the policy change (April 2010-March 2014). The short panel covers a period of one year and a half within the policy change (October 2010-September 2013). Included individual co-variates are sex, age, age DI awarded at, family structure, disability type and living location. The earnings are inflation-adjusted. The robust standard errors are in the parenthesis.

$*p < 0.10, **p < 0.05, ***p < 0.01$

Table 4: Heterogeneity of the effects of the policy change on earnings and labor force participation

	Earnings ($)		Labor Force Participation Rate (%)		
	AISH × Post	Mean	AISH × Post	Mean	Num. of. Obs.
A. Family structure					
No dependent	31.81***	249.06	0.62***	49.87	6,400,493
	(1.37)	(404.04)	(0.16)		
With dependent(s)	42.39***	237.11	4.31***	29.76	1,341,302
	(5.37)	(498.67)	(0.47)		
B. Age					
18-34	57.29***	249.38	4.21***	45.27	2,323,720
	(2.19)	(425.70)	(0.23)		
35-49	25.82***	262.85	-0.79***	50.80	2,660,571
	(2.39)	(420.75)	(0.26)		
> 50	-4.11*	224.29	-4.07***	49.63	2,757,504
	(2.33)	(375.49)	(0.30)		
C. Gender					
Male	37.79***	263.09	0.80***	49.02	4,162,168
	(1.88)	(428.66)	(0.20)		
Female	24.82***	229.36	0.79***	47.00	3,579,627
	(1.89)	(392.29)	(0.22)		
D. Type of disability					
Psychotic	32.65***	216.60	1.46***	39.22	3,329,884
	(2.02)	(403.23)	(0.23)		
Neurological	32.28***	272.41	-0.07	55.40	2,878,196
	(1.91)	(418.40)	(0.21)		
Mental	19.72***	260.00	-0.50	48.86	1,533,715
	(5.03)	(420.88)	(0.56)		
E. Living location					
Metropolitan area	34.34***	261.63	1.83***	46.82	2,338,947
	(1.97)	(428.07)	(0.21)		
Other	31.40***	234.69	-0.18	49.39	5,402,848
	(1.81)	(397.81)	(0.21)		

Notes: This table presents the heterogeneous effects of the policy change in AISH from a Difference-in-Difference framework using (16). The sample includes individuals with non-physical disabilities within two years of the policy change. All estimates Include individual co-variates sex, age, age DI awarded at, family structure, disability type and living location. The earnings are inflation-adjusted. The robust standard errors are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

‘

Table 5: Estimated elasticity of non-participation respect to Participation Tax Rate (PTR)

	No dependent	With dependent
$\Delta(1-LFP)$	-0.035	-0.030
	(0.001)	(0.003)
$(1-LFP_{before})$	0.747	0.879
	(0.001)	(0.002)
ΔPTR	-0.190	-0.204
	(0.001)	(0.002)
PTR_{before}	0.480	0.205
	(0.007)	(0.004)
$Elasticity(\epsilon)$	0.114***	0.033***
	(0.004)	(0.003)
Num. of Obs.	411,373	40,507

Note: This table shows the estimated elasticity of labor force non-participation respect to Participation Tax Rate (PTR) from (18) exploring the policy chnage in AISH. The sample includes individuals with non-physical debilitates within two years of the policy change in AISH. The bootstrapped standard deviations are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

Table 6: Back of the envelope fiscal effects of the policy change in AISH

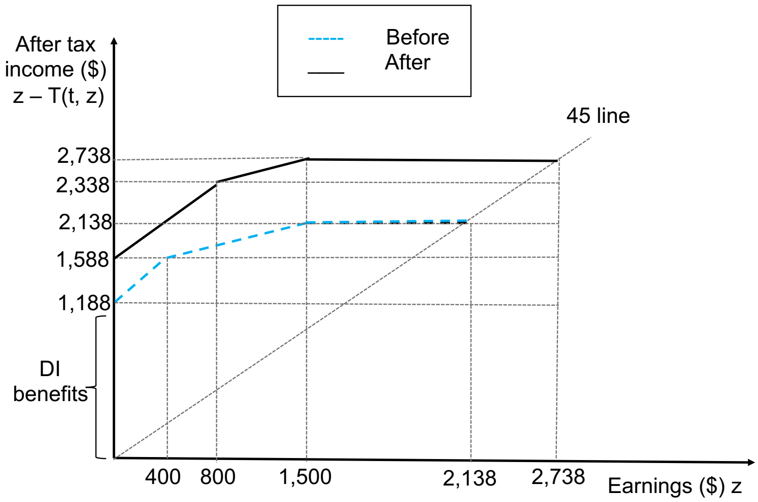
	Before			After	
	2009	2010	2011	2012	2013
Cost (million$)	114.6	124.2	133.1	186.4	193.7
Revenue (million$)	12.1	12.1	13.5	12.6	14.3
Net cost (million$)	102.5	112.7	119.6	173.8	178.7

Note: This table shows the back of the envelope fiscal effects of the policy change in AISH. Each fiscal year spans April to March. The cost includes the DI benefits paid to beneficiaries. The revenue includes the claw backed DI benefits and a 25% income tax on the earnings. All monetary values are in 2012$.

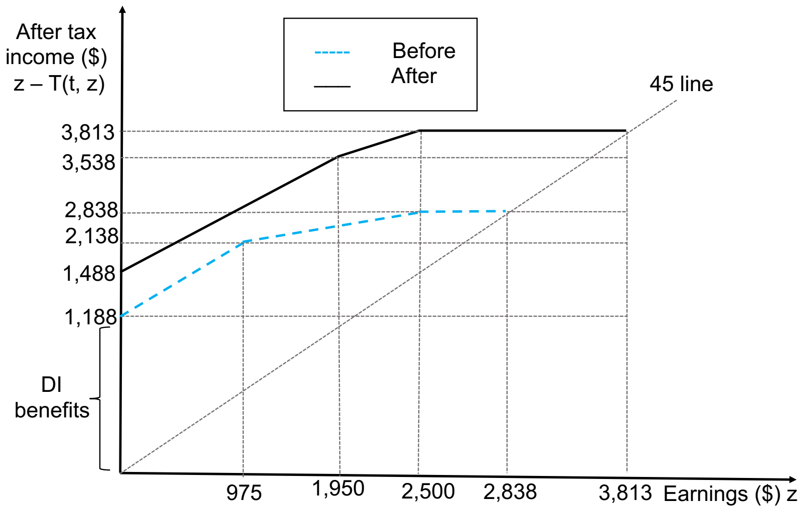
Figures

Figure 1: Budget constraints of benefit recipients of AISH

(a) No dependants

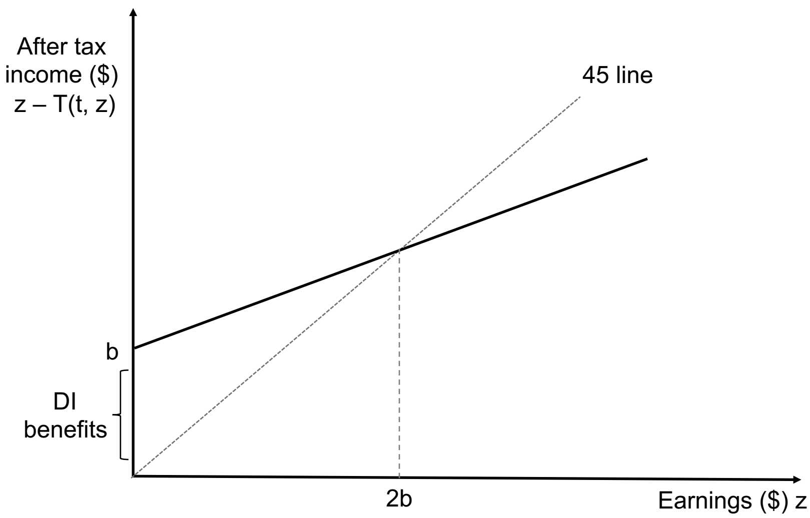


(b) With dependent



Note: This figure shows the budget constraint of DI recipients of AISH before and after the policy change. Panel (a) shows the budget constraints for those with no dependent and panel (b) shows the budget constraints for those with dependants. Horizontal axes represent earnings, and vertical axes are total income (DI benefits and net earnings). The implicit marginal tax rates at each bracket are respectively zero, 50% and 100%.

Figure 2: Budget constraint of benefit recipinets of ODSP

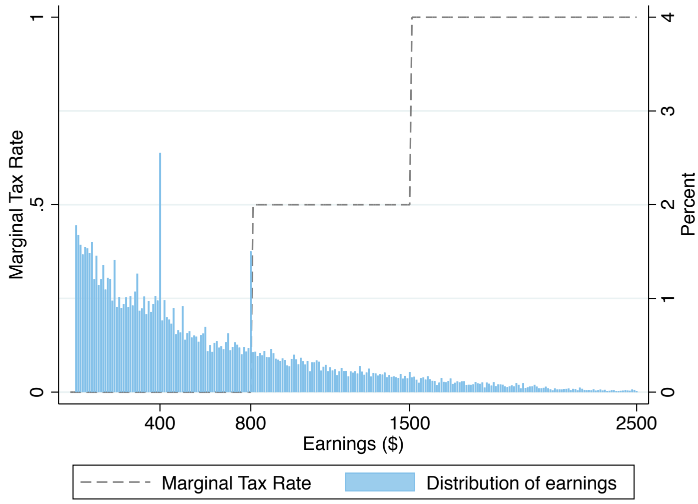


Note: This figure shows the budget constraint of DI recipients of ODSP. The horizontal axes represent monthly earnings, and the vertical axes represent the total monthly income (DI benefits and net earnings). b denotes the monthly DI benefits that depend on the family size that vary from $1,086 to $1,999. The implicit marginal tax rate on all earnings is 50%.

Figure 3: Distribution of monthly earnings of DI recipinets in AISH with no dependent

(a) Before policy change

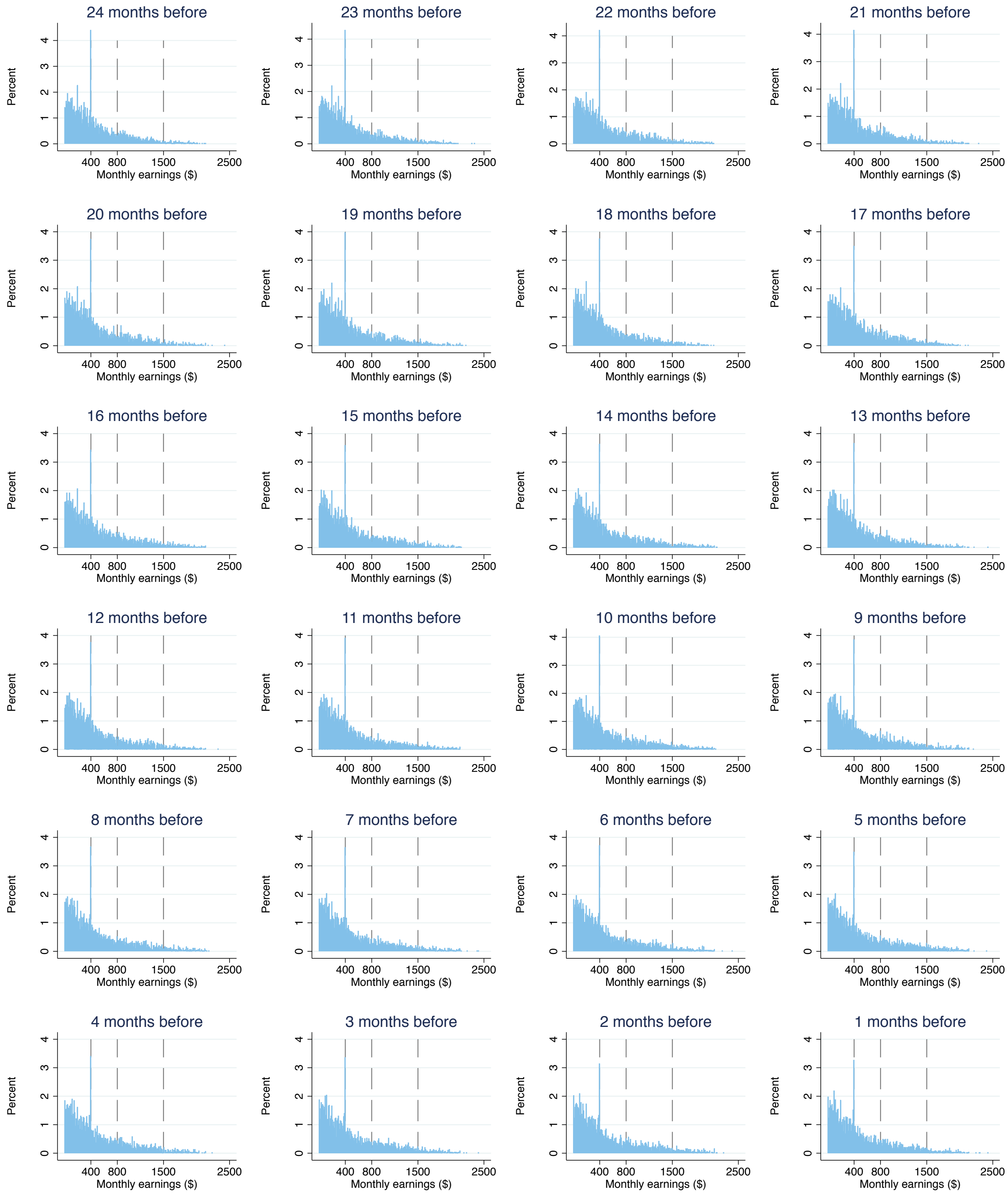
(b) After policy change



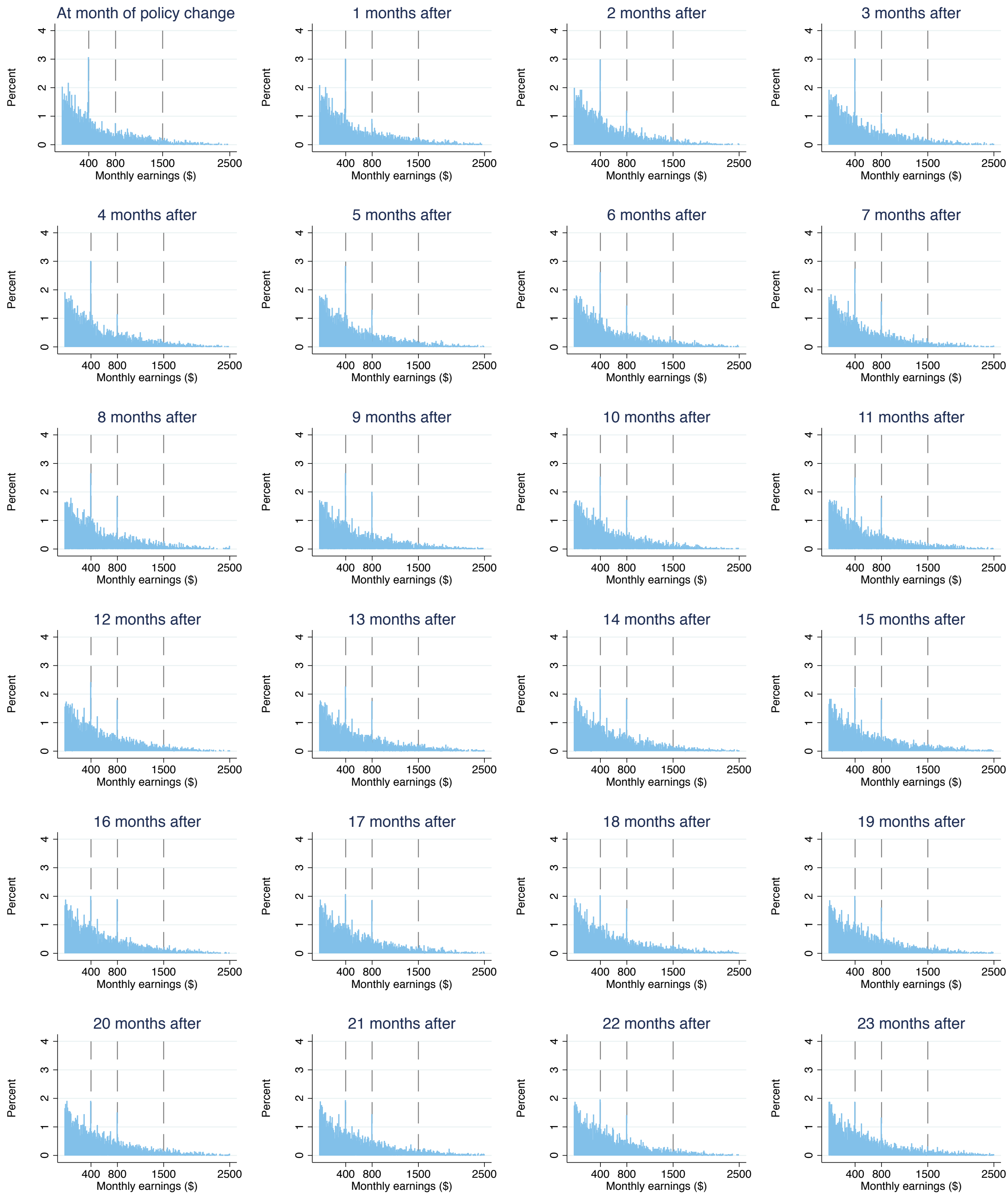
Note: This figure shows the distribution of monthly earnings of DI recipients in AISH. The sample includes 18-64 year individuals with no dependent who have non-physical disabilities. Panel (a) and (b) show the distribution of earnings for the pooled sample respectively two years before and two years after the policy change. There is a noticeable bunching at the exemption threshold before the policy change. The bunching moves away to the new exemption threshold after the policy change. Some individuals, however, continue bunching at the former threshold after the policy change. There is no visually noticeable bunching at the second kink neither before and after the policy change.

Figure 4: Distribution of monthly earnings of DI recipients in AISH with no dependent by month relative to the policy change

(a) Before policy change



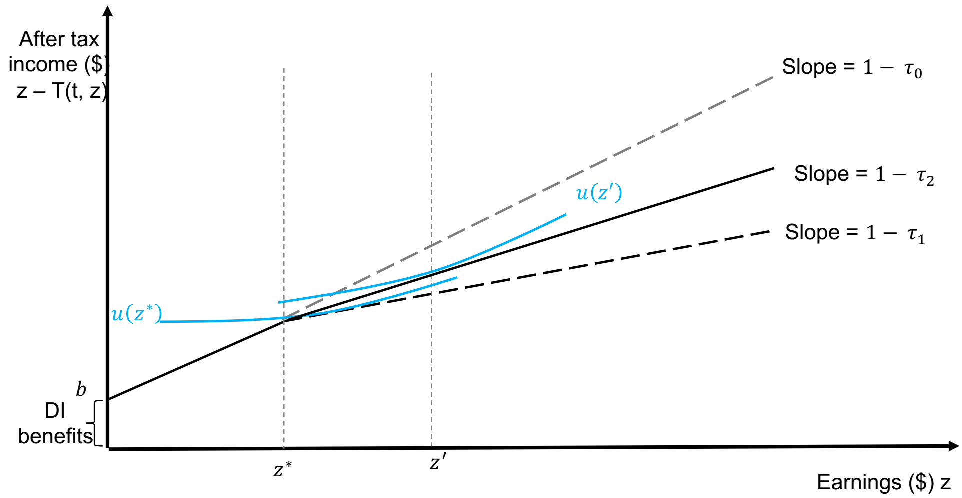
(b) After policy change



Note: This figure plots the distribution of the monthly earnings of DI recipients in AISH. The sample includes individuals 18-64 year individuals with no dependent who have non-physical disabilities. Panel (a) and Panel (b) show the distributions respectively two years before and two years after the policy change. There is bunching at the exemption threshold every month before the policy change. The bunching moves away to the new exemption threshold after the policy change, but still, some individuals continue bunching at the former threshold. There is no noticeable bunching at the second kink neither before and after the policy change.

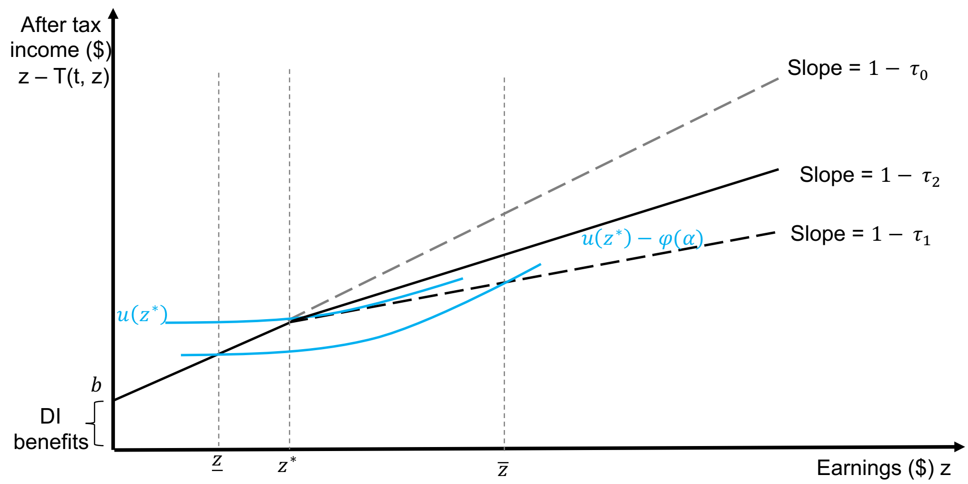
Figure 5: Earnings responses and adjustment costs

(a) No adjustment costs



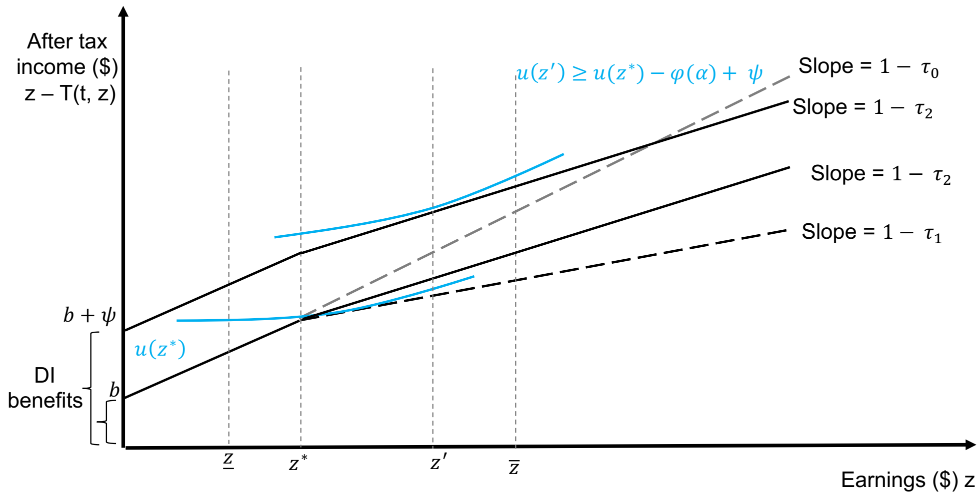
Note: This figure illustrates change in the earnings around a kink at z^* where marginal tax rate below and above the kink are respectively τ_0 and τ_1 where $\tau_0 < \tau_1$. Assume that individuals face no adjustment costs when they change their earnings. When marginal tax rate above the kink is decreased to τ_2 where $\tau_2 < \tau_1$, then an individual with initial earnings z^* would increase their earnings to z' to get higher utility.

(b) With adjustment costs



Note: This figure illustrates change in the earnings around a kink at z^* where the marginal tax rates below and above the kink are respectively τ_0 and τ_1 where $\tau_0 < \tau_1$. Assume that individuals face adjustment cost $\phi(\alpha) > 0$ that varies by individuals' ability α. Suppose that marginal tax rate above the kink is decreased to τ_2 and the Disability Benefits (DI) is increase by $\psi > 0$. Individuals with earnings in range of $[\underline{z}, \bar{z}]$ might change their earnings if their utility gain and the increase in DI benefits is larger than the adjustment costs. $\underline{z}$ and $\bar{z}$ are defined in Equation (11).

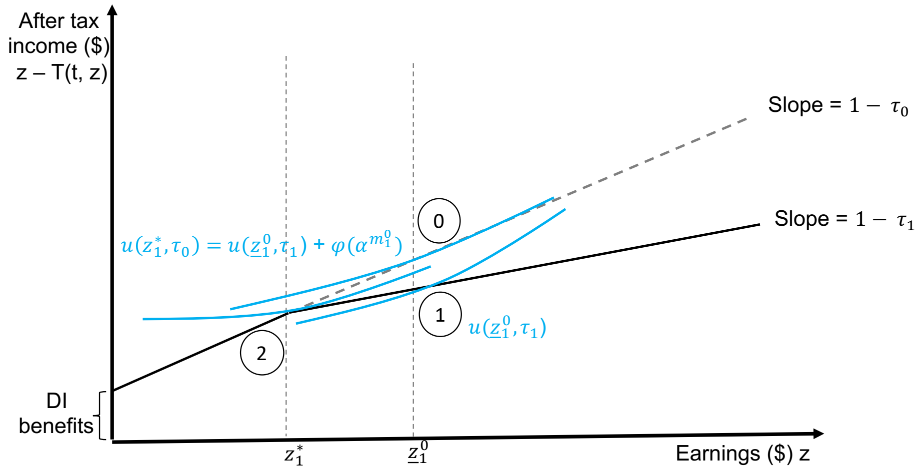
(c) With adjustment costs and increase in benefits



Note: This figure illustrates change in earnings around a kink at z^* where marginal tax rate below and above the kink are respectively τ_0 and τ_1 where $\tau_0 < \tau_1$. Assume that individuals face adjustment cost $\phi(\alpha) > 0$ that varies by individuals' ability α. Suppose that marginal tax rate above the kink is decreased to τ_2 and individuals receive a lump-sum transfer of amount $\psi > 0$. Then individuals with earnings in range of $[\underline{z}, \bar{z}]$ might change their earnings if their utility gain is larger than adjustment costs net of the lump-sum transfer they receive. $\underline{z}$ and $\bar{z}$ are defined in Equation (11).

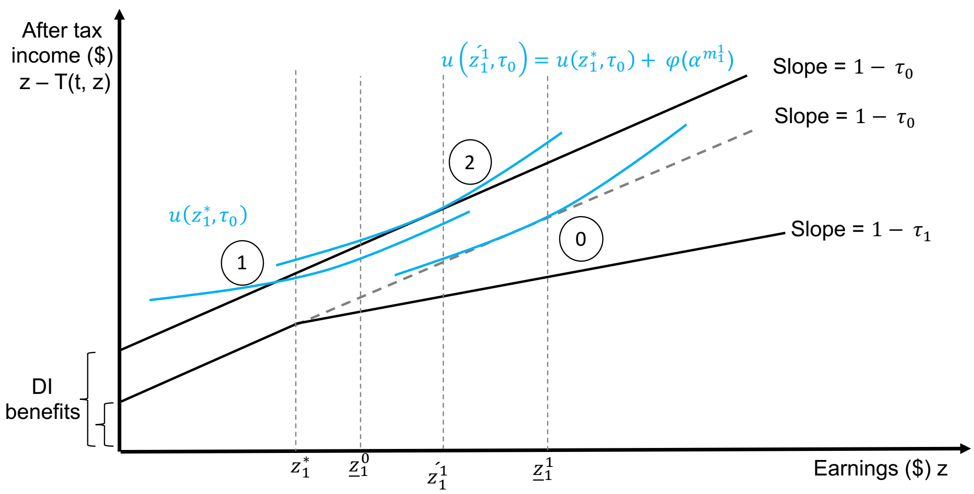
Figure 6: Change in bunching at an exemption threshould induced by a policy change

(a) Introducing an exemption threshould



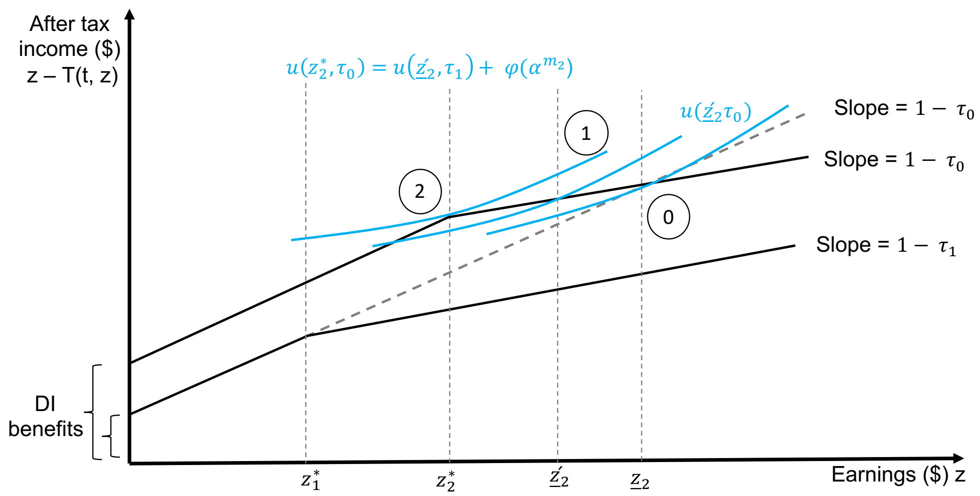
Note: This figure illustrates chnage in earnings of a marginal buncher at the exemption threshold at z_1^* with ability $\alpha^{m_1^0}$ and initial earnings $\underline{z}_1^0$ when utility loss $\phi(\alpha^{m_1^0})$ is associated with changing labor supply. A marginal buncher is indifferent between staying at $\underline{z}_1^0$ with higher marginal tax τ_1 or enduring utility loss $\phi(\alpha^{m_1^0})$ and moving to z_1^* with lower marginal tax τ_0.

(b) Increase in exemption threshould: bunching at the old exemption threshould



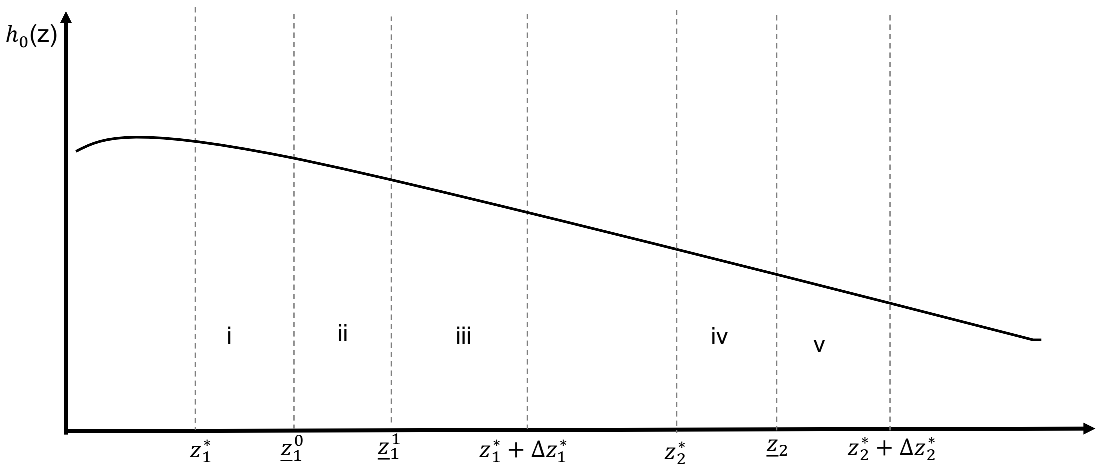
Note: This figure illustrates the change in earnings of a marginal buncher at the former exemption threshold at z_1^* after the policy change with ability $\alpha^{m_1^1}$ and initial earnings $\underline{z}_1^1$ when utility loss $\phi(\alpha^{m_1^1})$ is associated with changing their labor supply. After introducing an exemption threshold at z_1^*, she bunches at the exemption threshold. When the exemption threshold is increased, a marginal buncher at the former exemption threshold is indifferent between staying at z_1^* with marginal tax τ_0 or enduring utility loss $\phi(\alpha^{m_1^1})$ and changing her earnings to the optimal one at $z_1^{1\prime}$.

(c) Increase in exemption threshould: bunching at the new exemption threshold



Note: This figure illustrates change in earnings of a marginal buncher at the new exemption threshold at z_2^* with ability α^{m_2} and initial earnings $\underline{z}_2$ when utility loss $\phi(\alpha^{m_2})$ is associated with changing labor supply. After introducing an exemption threshold at z_1^*, she decreases her earnings to $\underline{z}_2{}'$. When the exemption threshold is increased to z_2^*, she is indifferent between staying at $\underline{z}_2{}'$ with lower marginal tax τ_1 or enduring utility loss $\phi(\alpha^{m_2})$ and bunching at z_2^* with lower marginal tax τ_0.

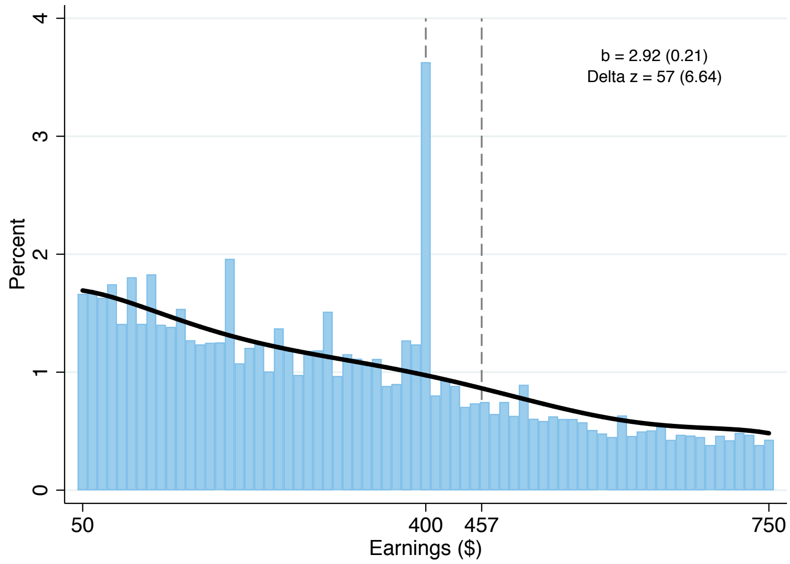
Figure 7: Counter-factual earnings with a flat tax



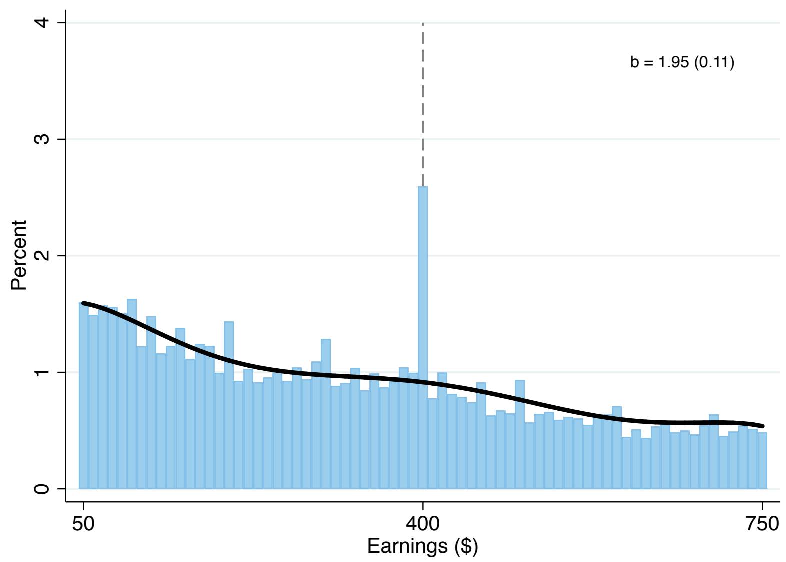
Note: This figure plots the counter-factual distribution of earnings, a earnings distribution with a flat tax τ_0. TYhe bunching at the exemption threshold before the policy change at z_1^* is the area $i + ii + iii$ if individuals face no adjustment costs changing their labor supply. The bunching with adjustment costs is $ii + iii$, less than that with no adjustment costs. The area i is bunching at the former exemption threshold after the policy change. Similarly, the area $iv + v$ and v denote the bunching at the new exemption threshold at z_2^* respectively with and without adjustment costs.

Figure 8: Fitted polynomials to distribution of earnings at exemption thresholds

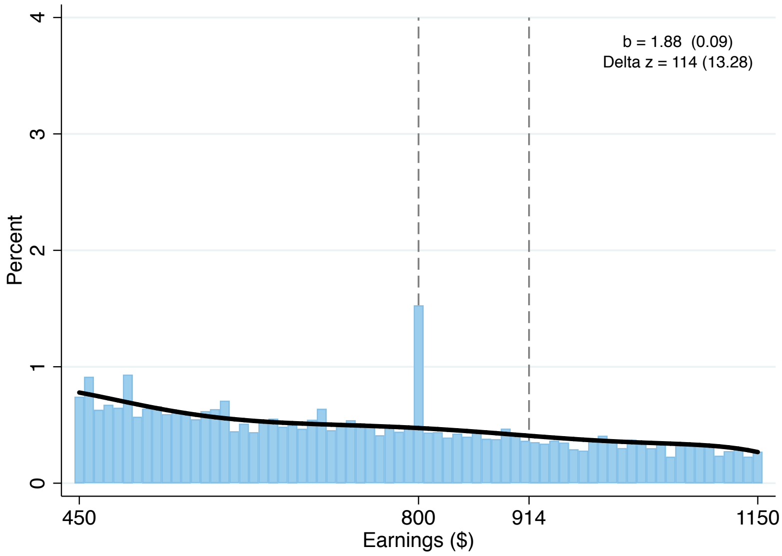
(a) At the exemption threshould before the policy change



(b) At the old exemption threshould after the policy change



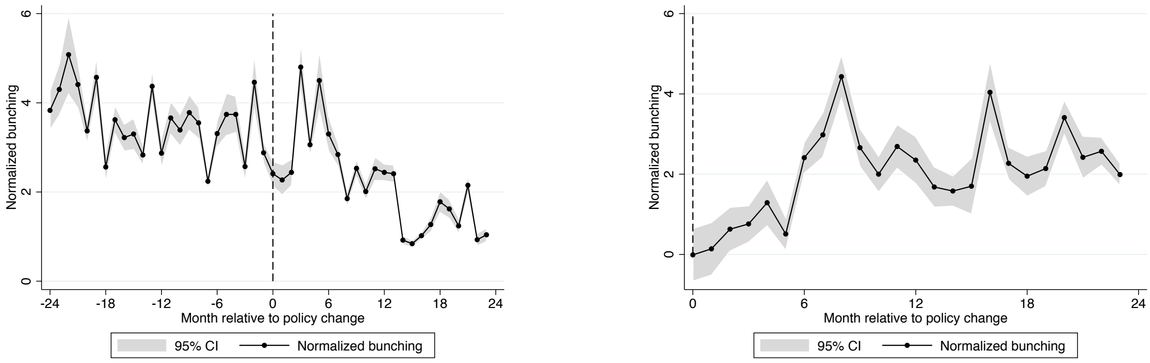
(c) At the new exemption threshould after the policy change



Note: This figure plots the fitted polynomials to the distributions of earnings in AISH using the regression specified in (8). The estimation parameters are $D = 6$, $\delta = 10$ and $l = u = 3$. The sample includes 18-64 year individuals within two years of the policy change in AISH with no dependent who have non-physical disabilities. Panel (a) and (b) show the fitted polynomials at the former exemption threshold respectively before and after the policy change. The last panel shows the fitted polynomial at the new exemption threshold. The normalized bunchings are estimated from (10).

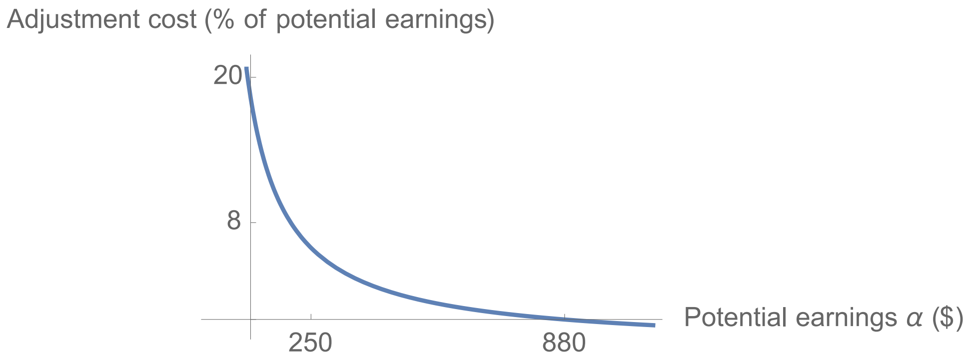
Figure 9: Normalized bunching at the exemption threshould

(a) At the old exemption threshould (b) At the new exemption threshould



Note: This figure shows the normalized bunching at old and new exemption thresholds estimated using the method presented in Section 3.1. The sample includes 18-64 year AISH beneficiaries with no dependent who have non-physical disabilities. The parameters used for the estimation are $\delta = 10$, $D = 6$ and $l = u = 3$. Bunching at the old exemption threshold decreases after the policy change but it does not disappear after the policy change. Bunching at the new exemption threshold gradually increases after the policy change. The 95% Confidence Intervals (CI) from bootstrapped standard errors are shown in gray.

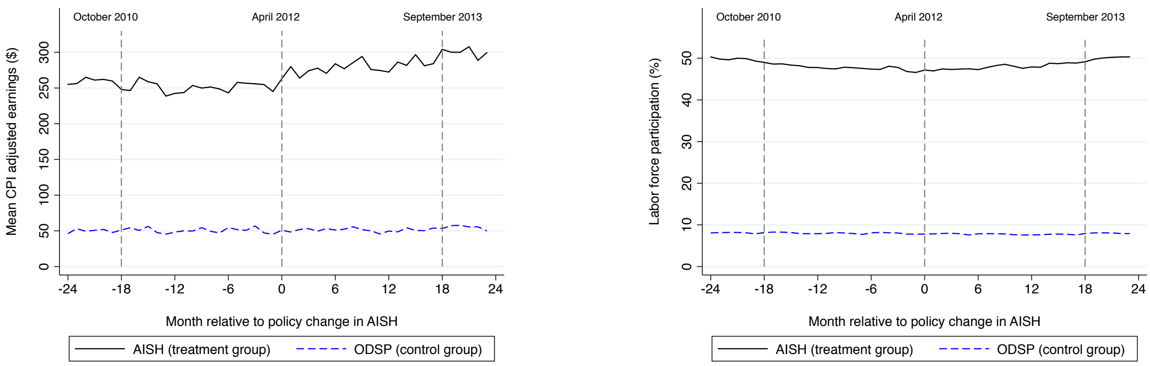
Figure 10: Estimated heterogeneous adjustment costs



Note: This figure plots the estimated heterogeneous adjustment costs as a percentage of the potential earnings using the model specified in Section 3.4. The estimated heterogeneous adjustment costs as shown in Table 2 is $\phi = \frac{20.69}{\alpha} - 0.023$ where α is individuals' ability denoted as their potential earnings. The sample includes 18-64 year AISH beneficiaries within two years of the policy change, with no dependent who have non-physical disabilities. The estimated adjustment costs vary between zero to 20 percent of potential earnings. The estimated adjustment costs for individuals with average potential earnings of 250$ is about 8 percent of their monthly earnings.

Figure 11: Trends in earnings and labor force participation before and after April 2012 policy change in AISH

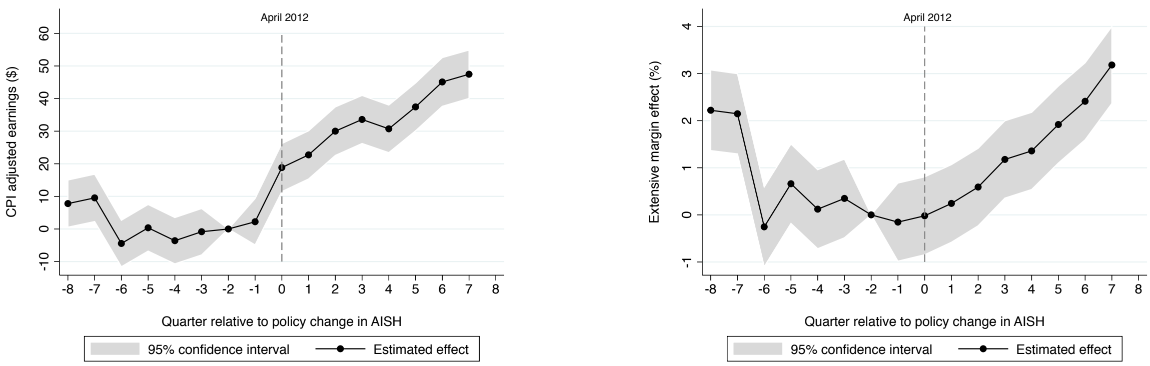
(a) Earnings (b) Labor force participation



Notes: This figure plots the mean monthly earnings and labor force participation rate in the AISH and ODSP respectively in Panel (a) and Panel (b). The x-axis shows the month relative to the policy change in AISH in April 2012. Labor force participation is defined as a dummy that turns on for positive earnings. The sample includes those with non-physical debilitates.

Figure 12: Coefficients of the interaction quarter×AISH in Equation (17)

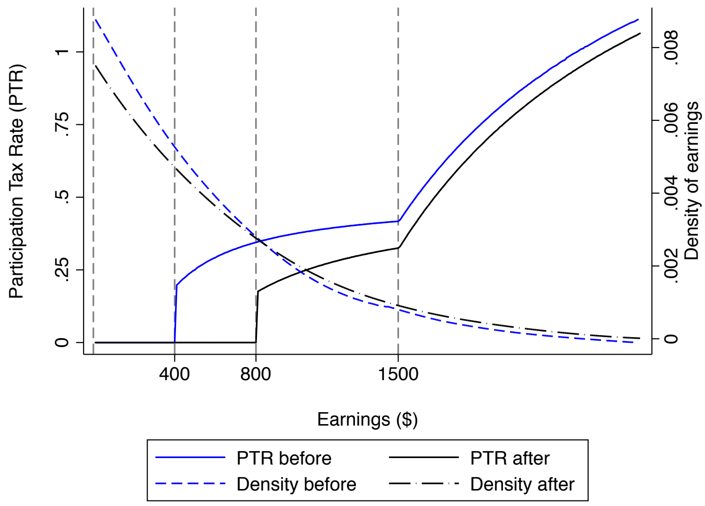
(a) Earnings (b) Labor force participation



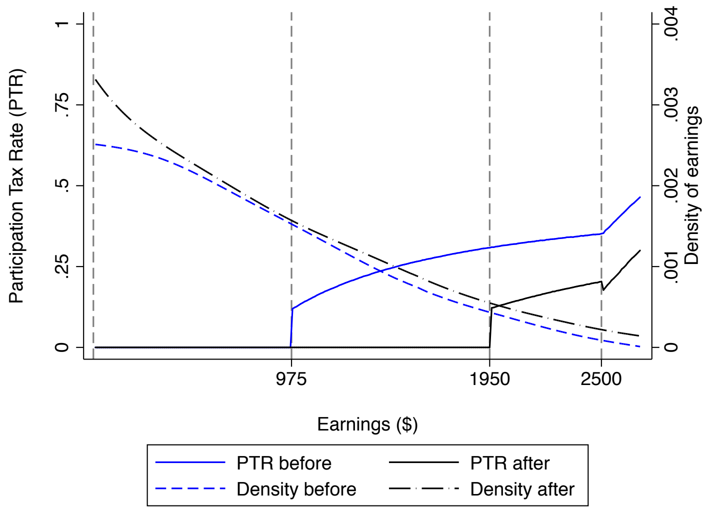
Notes: This figure plots the estimated time trends (β_t) from (17). The individual characteristics including sex, age, age DI awarded at, disability conditions, dummies for whether they live in a metropolitan area and dummies whether they have dependent are included in the model. The sample includes 18-64 year beneficiaries of AISH and ODSP within two years of the policy change in AISH with non-physical disabilities. The gray area denotes the 95% confidence intervals.

Figure 13: Participation tax rates and smoothed density of earnings

(a) No dependent



(b) With dependent



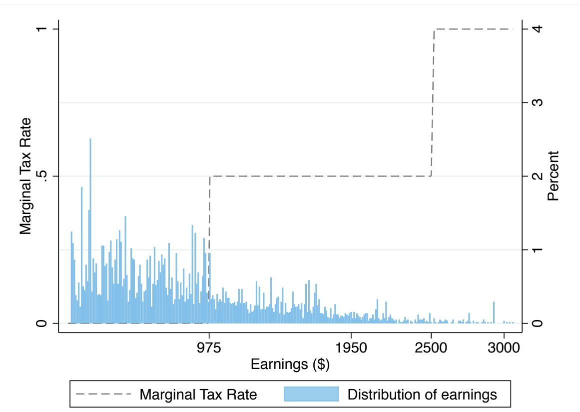
Note: This figure shows the Participation Tax Rate (PTR) by earnings levels, before and after the policy change in AISH. It also plots the smoothed density of earnings in AISH before and after the policy change. The sample includes 18-64 year AISH beneficiaries with non-physical disabilities. Panel (a) and Panel (b) correspond to those respectively with no dependent and with dependent.

Appendix: For On-line Publication

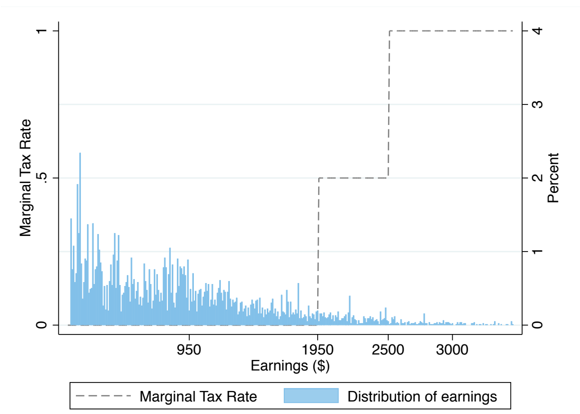
A Earnings distribution of DI recipients with dependent in AISH

Figure A.1: Monthly earnings distribution of DI recipinets with dependent in AISH

(a) Within two years before policy change



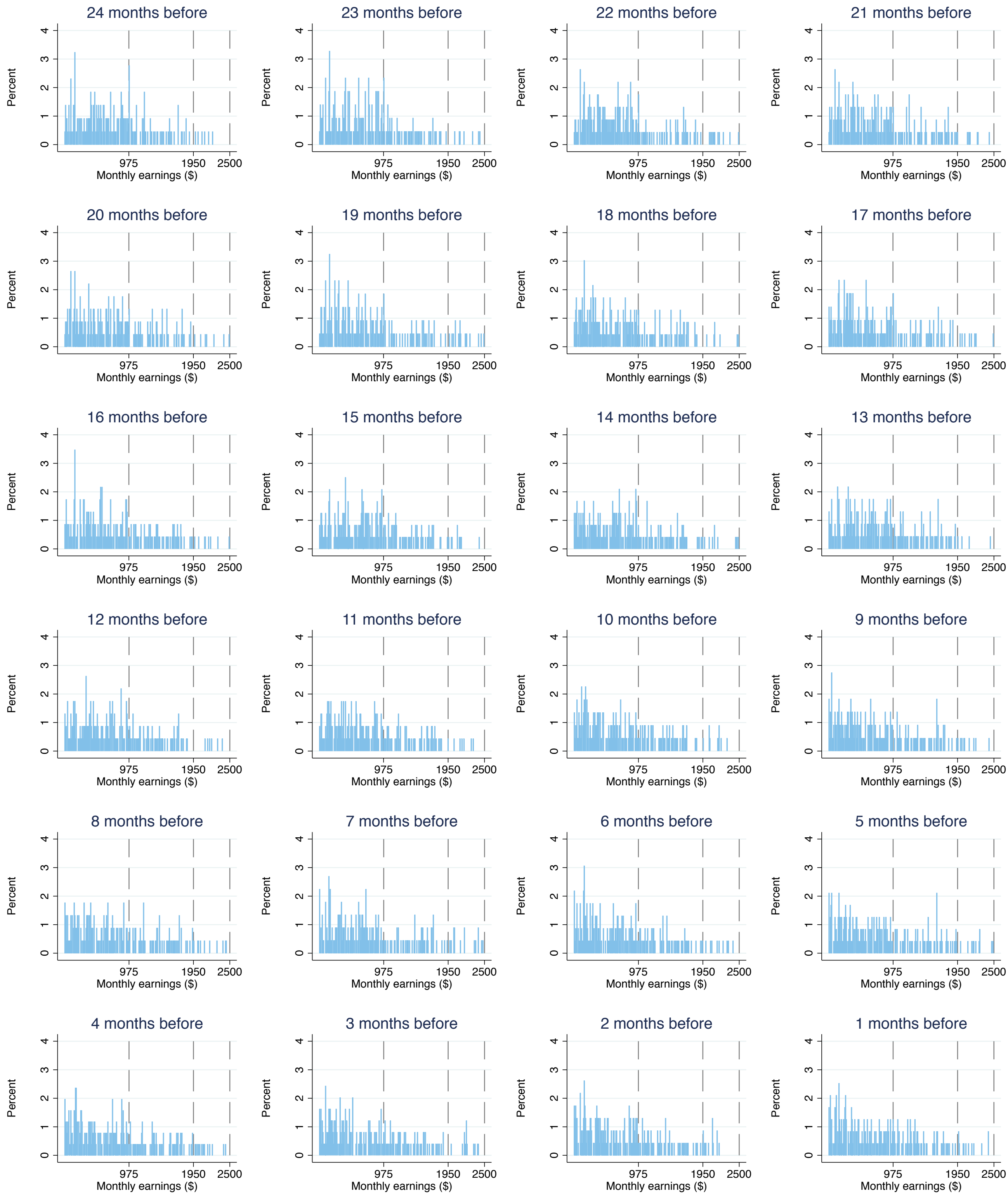
(b) Within two years after policy change



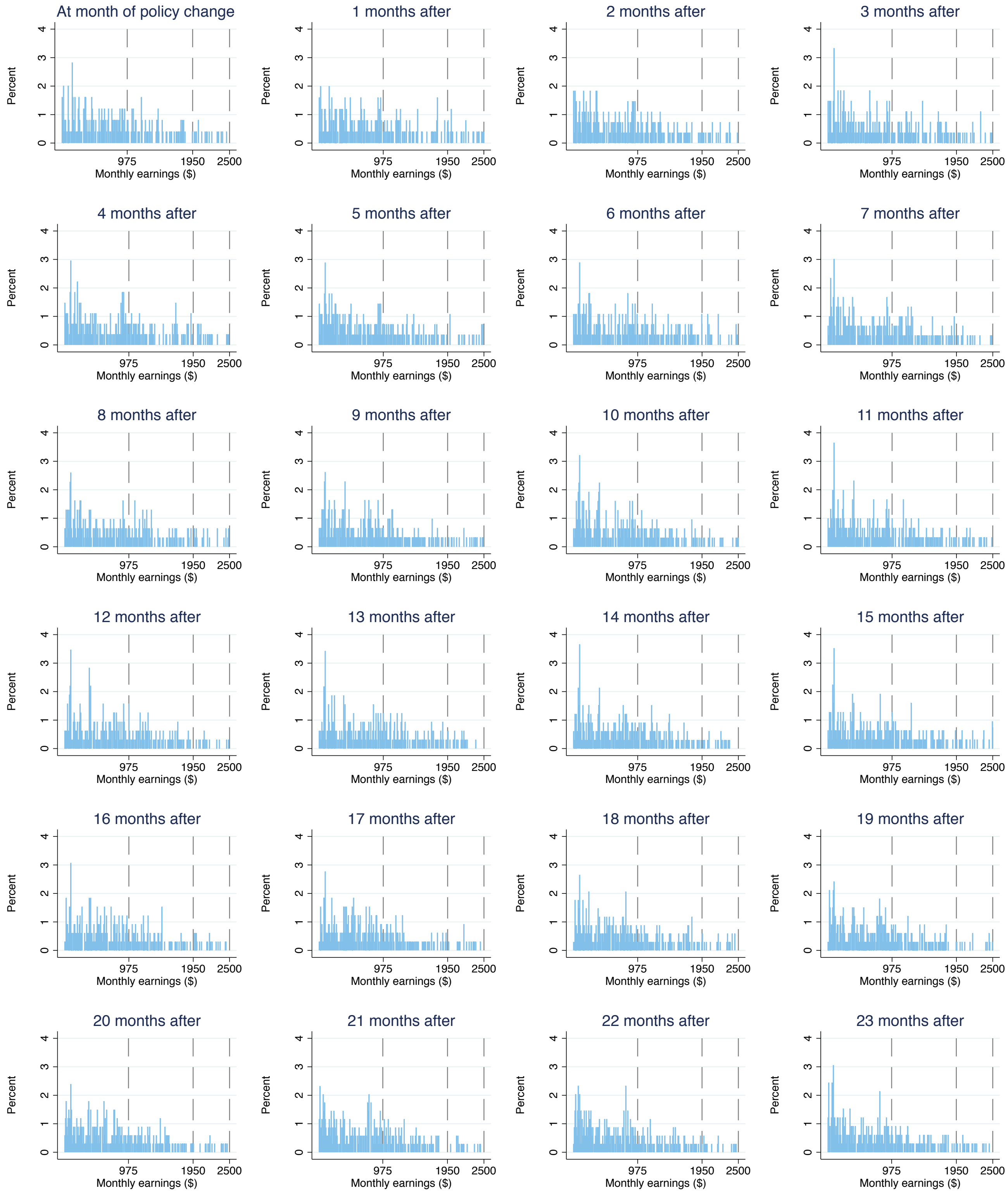
Note: This figure plots the distribution of the monthly earnings of DI recipients in AISH with dependent. The sample includes 18-64 year AISH beneficiaries within two years of the policy change who have non-physical disabilities. Panel (a) and (b) show the distribution respectively before and after the policy change. There is no noticeable bunching at any of the threshold neither before and after the policy change.

Figure A.2: Distribution of monthly earnings of AISH benefit recipients with dependent by month relative to the policy change

(a) Before policy change



(b) After policy change



Note: This figure plots the distribution of the monthly earnings of DI recipients in AISH. The sample includes individuals 18-64 individuals with dependent who have non-physical disabilities. Panel (a) and Panel (b) show the distributions respectively two years before and two years after the policy change. There is no noticeable bunching at any of the thresholds neither before or after the policy change.

B Adjustment costs

B.1 Proof of Theorem (1)

Theorem 1: Suppose utility loss $\phi > 0$ is associated with adjusting earnings when kink $z^* = (\tau_0, \tau_1)$ is introduced where $\tau_1 > \tau_0$ and $u(c, z; \tau; \alpha)$ is individual's utility with $\dfrac{\partial u_c}{\partial \alpha} < 0$ (marginal utility of consumption decreases as ability increases). If for $z_2 > z_1$, $\dfrac{\partial (z_2 - z_1)}{\partial \alpha}$ increases at a rate that dominates $\dfrac{\partial u_c}{\partial \alpha} < 0$, then utility gain of relocation for initial earning level z_2 is higher than that at z_1.

Proof. The utility gain from relocating to kink z^* from z_k for $k \in \{1, 2\}$ is $\Delta u_k = u((1 - \tau_0)z^*, z^*; \alpha) - u((1 - \tau_0)z^* + (1 - \tau_1)(z_k - z^*), z_k; \tau_0; \alpha)$. Differences in utility gains from relocating to z^* is:

$$\begin{aligned}\Delta u &= \Delta u_2 - \Delta u_1 \\ &= u((1 - \tau_0)z^* + (1 - \tau_1)(z_2 - z^*), z_2; \tau_1; \alpha) \\ &- u((1 - \tau_0)z^* + (1 - \tau_1)(z_1 - z^*), z_1; \tau_1; \alpha)\end{aligned}$$

Using a first order approximation:

$$\begin{aligned}\Delta u &\simeq [(1 - \tau_1)u_c + u_z]z_2 - [(1 - \tau_1)u_c + u_z]z_1 \\ &\simeq (z_2 - z_1)[(1 - \tau_1)u_c + u_z]\end{aligned}$$

The differences in the gain of relocation to a kink at z^* from $z_2 > z_1$ depends on the marginal utility of consumption u_c and working u_z. Therefore changes in the differences of relocation to a kink by ability is:

$$\frac{\partial \Delta u}{\partial \alpha} = (z_2 - z_1)\left((1 - \tau_1)\frac{\partial u_c}{\partial \alpha} + \frac{\partial u_z}{\partial \alpha}\right)$$

Since marginal utility of consumption decreases as ability increases ($\frac{\partial u_c}{\partial \alpha} < 0$), then $\frac{\partial \Delta u}{\partial \alpha} > 0$ only if $\frac{\partial u_z}{\partial \alpha}$ increases at a rate that dominates. □

Assuming that $\frac{\partial u_z}{\partial \alpha} > 0$ dominates $\frac{\partial u_c}{\partial \alpha} < 0$, then this theorem implies that gain of relocation to a kink is higher for those with higher initial earnings (ability).

B.2 Tables

Table B.1: Robustness of the estimted bunching at kinks respect to the selected parameters

Bin size ($) δ	Degree of polynomial D	Number of excluded bins at each side l	Bunching at kink at $400 before policy change b_1^0	Bunching at kink at $400 after policy change b_1^1	Bunching at kink at $800 after policy change b_2
			Panel A: Baseline estimate		
10	6	3	2.920***	1.950***	1.880***
			(0.227)	(0.107)	(0.389)
			Panel B: Robustness to bin size		
5	6	6	3.460***	1.430***	0.730***
			(0.353)	(0.172)	(0.197)
15	6	2	1.020***	0.640***	0.310***
			(0.065)	(0.059)	(0.073)
			Panel C: Robustness to degree		
10	5	3	2.030***	1.400***	0.650*
			(0.131)	(0.113)	(0.408)
10	7	3	1.650***	0.880***	0.420*
			(0.115)	(0.092)	(0.327)
			Panel D: Robustness to excluded bins		
10	6	2	1.860***	1.170***	0.750***
			(0.126)	(0.108)	(0.304)
10	6	4	0.760***	0.710***	-0.060
			(0.086)	(0.098)	(0.214)

Note: This table presents the estimated normalized bunching at the kinks with respect to the selected parameters using (8), (7) and (10). The selected parameters include bin size, the degree of the fitted polynomial and the number of excludes bins around a kink. Since changing the bin size also changes the number of excluded bins, the number of the excluded bins are changed accordingly. The bootstrapped standard errors are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

Table B.2: Estimated elasticity of earnings with no adjustment costs

	Bunching b	Earnings response Δz^*	Elasticity e
A. Full sample			
Within two years	2.920***	29.000***	0.100***
	(0.209)	(2.274)	(0.008)
Within one year and half	2.790***	28.000***	0.100***
	(0.203)	(2.019)	(0.007)
Adding 25%	2.920***	29.000***	0.090***
income taxes	(0.287)	(2.274)	(0.007)
B. Age			
18-34	2.660***	27.000***	0.090***
	(0.175)	(1.748)	(0.006)
35-49	2.680***	27.000***	0.090***
	(0.189)	(2.171)	(0.007)
> 50	3.600***	36.000***	0.120***
	(0.424)	(7.048)	(0.023)
C. Gender			
Male	3.510***	35.000***	0.120***
	(0.314)	(3.770)	(0.013)
Female	2.210***	22.000***	0.080***
	(0.216)	(1.439)	(0.005)
D. Disability type			
Psychotic	4.630*	46.000	0.16
	(2.467)	(36.708)	(0.241)
Neurological	2.330***	23.000***	0.080***
	(0.157)	(1.593)	(0.005)
Mental	4.300***	43.000***	0.150***
	(0.939)	(6.300)	(0.021)
E. Living location			
Metropolitan area	4.290***	43.000***	0.110***
	(0.381)	(9.616)	(0.007)
Other	1.650***	16.000***	0.060***
	(0.121)	(1.361)	(0.005)

Note: This table presents the estimated elasticity of earnings respect to net-of-tax rate with no adjustment costs using the model specified in (Saez, 2010). The bootstrapped standard errors are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

Table B.3: Estimated elasticity of earnings and fixed adjustment costs

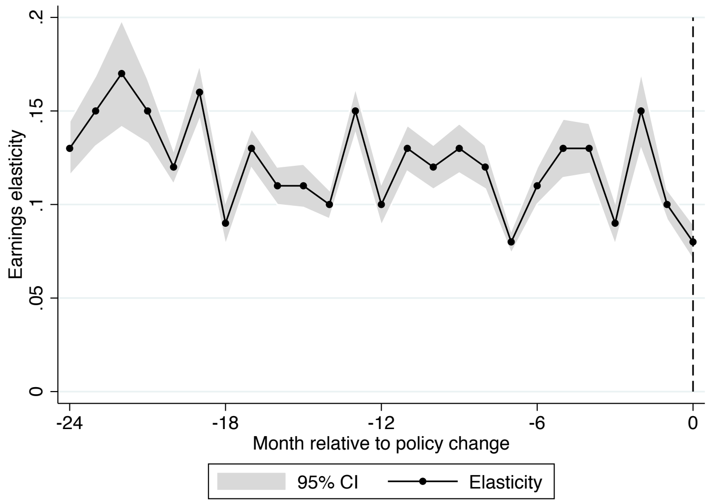
	Bunching at kink at \$400 before policy change b_1^0	Earnings response at kink at \$400 before policy change Δz_1^{*0}	Bunching at \$400 after policy change b_1^1	Elasticity e	Adjustment costs ϕ
A. Full sample					
Within two years	2.920***	62.605***	1.950***	0.210***	11.933***
	(0.209)	(6.028)	(0.110)	(0.019)	(0.972)
Within one year and half	2.790***	58.975***	2.120***	0.198***	11.733***
	(0.203)	(5.009)	(0.157)	(0.016)	(0.744)
Adding 25%	2.920***	59.481***	1.950***	0.102***	8.018***
income taxes	(0.287)	(5.373)	(0.112)	(0.009)	(0.438)
B. Age					
18-34	2.660***	57.295	1.630***	0.193***	10.642***
	(0.175)	(9.160)	(0.101)	(0.029)	(2.202)
35-49	2.680***	58.203***	1.550***	0.196***	10.657***
	(0.189)	(13.112)	(0.175)	(0.041)	(3.142)
> 50	3.600***	77.854***	2.770***	0.257***	15.639***
	(0.424)	(18.100)	(0.222)	(0.055)	(4.288)
C. Gender					
Male	3.510***	77.040***	2.160***	0.254***	14.410***
	(0.314)	(18.436)	(0.110)	(0.056)	(4.450)
Female	2.210***	46.063***	1.680***	0.157***	9.139***
	(0.216)	(3.371)	(0.109)	(0.011)	(0.470)
D. Disability type					
Psychotic	4.630	53.160	1.620***	0.182	3.317
	(2.467)	(35.160)	(0.127)	(0.112)	(14.756)
Neurological	2.330***	48.441***	2.050***	0.165***	10.224***
	(0.157)	(3.443)	(0.109)	(0.011)	(0.496)
Mental	4.300***	184.393***	2.100***	0.547***	39.403***
	(0.939)	(49.252)	(0.221)	(0.122)	(11.420)
E. Living location					
Metropolitan area	4.290***	95.123***	3.180***	0.308***	18.954***
	(0.381)	(18.123)	(0.197)	(0.053)	(3.242)
Other	1.650***	32.933***	0.880***	0.114***	5.647***
	(0.121)	(4.176)	(0.059)	(0.014)	(1.350)

Note: This table presents the estimated elasticity of earnings with respect to net-of-tax ratio with fixed adjustment costs using the model specified in (Gelber et al., 2017). The bootstrapped standard errors are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

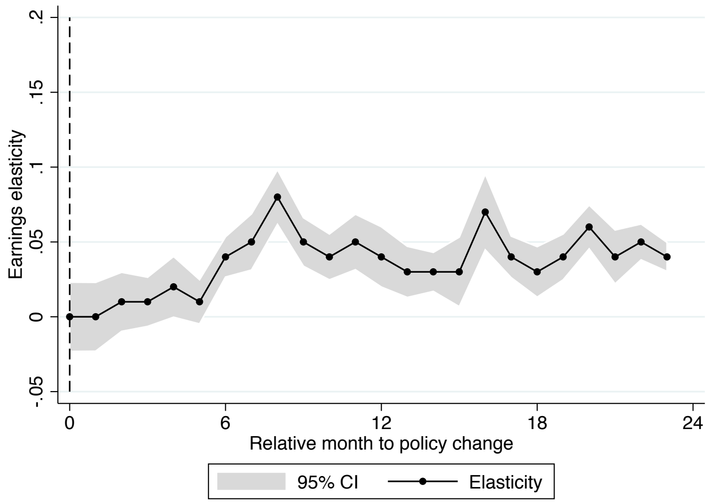
B.3 Figures

Figure B.1: Estimated elasticity of earnings with no adjustment costs (Saez, 2010)

(a) At the old exemption threshould



(b) At the new exemption threshould



Note: This figure shows the estimated elasticity of earnings respect to the net-of-tax ratio at the exemption thresholds before and after the policy change using (Saez, 2010) method described in Appendix 3.1. The sample includes 18-64 years AISH beneficiaries with no dependent who have non-physical disabilities. The parameters used for the estimation are $\delta = 10$, $D = 6$ and $l = u = 3$. The estimated elasticity at the former exemption threshold gradually decreases while it increases at the new exemption threshold. The 95% Confidence Intervals (CI) using the bootstrapped standard errors are shown in gray shades.

C Income effect of the policy change in AISH

The policy change in AISH consists of two pieces. First, it doubled the earnings exemption threshold. Second, it increased the monthly DI allowances by 35%. While this policy change might induce both income and substitution effects, I assume that the induced income effect is negligible and I use a quasi-linear utility function specified in (1) for estimating an elasticity of earnings and heterogeneous adjustment costs. In this section, I provide suggestive evidence that the induced income effect of the policy change are negligible and this is a plausible assumption.

Panel (a) of Figure 1 shows the budget constraints of DI recipients in AISH with no dependent. Theoretically, individuals with monthly earnings between zero and \$400 and those with monthly earnings above \$800 before the policy change are only exposed to income effect (pieces with parallel budget constraints). Similarly, Panel (b) shows that those with monthly earnings between zero and \$950 and above \$1,950 before the policy change are only exposed to income effects. I use a sample of individuals who are expected to be exposed only to income effect, to estimate induced income effects of the policy change in AISH using a Difference-in-Difference (DD) framework. I use the corresponding subsamples of benefit recipients of ODSP as a control group. My estimates of the elasticity of earnings and adjustment costs presented in Table 2 suggest that those with earnings within \$100 of the thresholds would respond to the policy change. I restrict my samples to within \$100 of each threshold to make sure that any other confounding factor does not contaminate my findings.

C.1 Descriptive evidences and findings

Figure C.1 plots the trends in the mean inflation-adjusted earnings of AISH and ODSP benefit recipients for different samples that are exposed to income effect. Panel (a) and (b) show the trends for samples of individuals with no dependent whose monthly earnings is in the range $(0, \$300]$ respectively six months and one year prior to the policy change. Panel (c) and (d) show the trends for samples of individuals with no dependent whose monthly earnings in above \$900 respectively six months and one year prior to the policy change. Finally, Panel (e) shows the trends for those with dependent whose earnings six months prior to the policy change is in the range $(0, \$850]$. The subsample of individuals with a family whose earnings one year before the policy change is in the range $(0, \$850]$ is quite small. These figures all visually suggest that for each subsample trends in earnings in AISH is quite similar to that in ODSP before the policy change.

Table C.1 presents the estimated effects of the policy change for each subsample described above using the corresponding subsample from ODSP as a control group using (16). Most of the estimated effects are negative and insignificant. The estimated positive effects are either insignificant or very small. Each of these subsamples is more likely to be affected by the income effect induced by the policy change and are less likely to be affected by the induced substitution effects of the policy change. Therefore, the estimated effects provide suggestive evidence of the induced income effect of the policy change.

C.2 Tables

Table C.1: Estimated income effect of the policy change

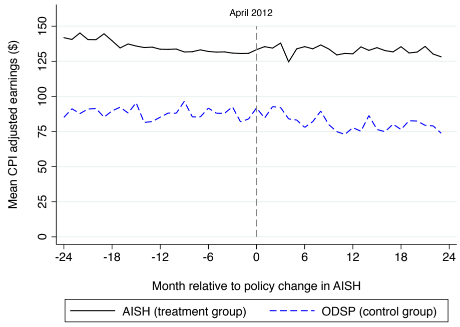
	No dependent				With dependent(s)
	(1)	(2)	(3)	(4)	(5)
AISH × Post	-1.61	4.74***	-4.99	18.97	-4.76
	(1.23)	(1.22)	(12.48)	(10.40)	(11.12)
AISH	44.66***	37.36***	-133.79***	-81.01***	2.21
	(0.81)	(0.83)	(8.23)	(7.19)	(6.67)
Sample	$0 < earnings \leq 300$	$0 < earnings \leq 300$	$earnings \geq 900$	$earnings \geq 900$	$0 < earnings \leq 850$
	12 months	6 months	12 months	6 months	6 months
Individual co-variates	Yes	Yes	Yes	Yes	Yes
Mean in AISH before policy change	138.76	135.59	1,248.98	1,140.49	307.25
	(103.65)	(118.55)	(421.28)	(492.57)	(348.25)
R-Sq.	0.06	0.04	0.07	0.07	0.01
Num. of. Obs.	213,642	268,394	29,361	52,104	55,667

Notes: This table shows the estimated effects from Difference-in-Difference framework using (16) for samples of individuals who are likely to get exposed only to income effect of the policy change in AISH. The sample in each columns includes those whose earnings x months before the policy change always have been $y_1 < earnings \leq y_2$. Each sample covers two years within the policy change. Included individual co-variates are sex, age, age DI awarded at, disability type and living location. Robust standard deviations are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

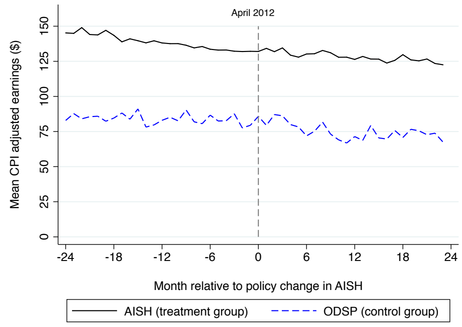
C.3 Figures

Figure C.1: Trends in earnings before and after April 2012 policy change in AISH for those facing only income effect

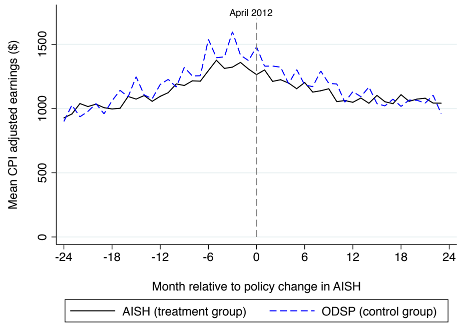
(a) No dependent and earnings in range $(0, \$300]$ six months before the policy change



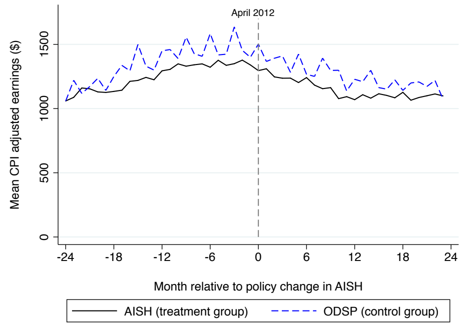
(b) No dependent and earnings in range $(0, \$300]$ one year before the policy change



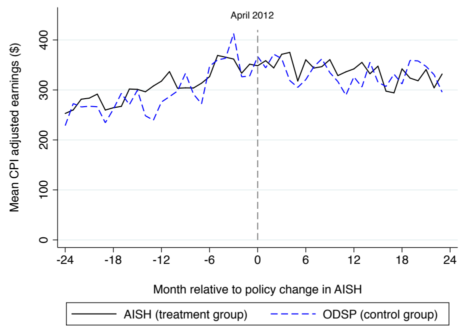
(c) No dependent and earnings over \$900 six months before the policy change



(d) No dependent and earnings over \$900 one year before the policy change



(e) With dependent and earnings in the range $(0, \$850]$ six months before the policy change



Note: This figure shows trends in earnings before and after the policy change in AISH at April 2012 for AISH and ODSP benefit recipients who are only exposed to income effect of the policy change. The sample includes those with non-physical disabilities within two years of the policy change. The sample is further specified in the title of each panel.