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

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Abstract

How important are adjustment costs for individuals who face a change in work incentives induced by a policy change? I estimate heterogeneous adjustment costs by exploiting a policy change in a Disability Insurance (DI) program which increased work incentives by increasing the exemption threshold. I use bunching at the thresholds to estimate earnings elasticity and adjustment costs that vary by individuals' potential earnings. The estimated costs are higher for individuals with lower potential earnings, ranging from zero to 20% of their potential earnings, with an average at 8%. The estimated earnings elasticity with respect to the net-of-tax rate is 0.19; this is twice the size of the elasticity estimated with no adjustment costs. Policies designed to increase labor supply will work if the work incentives are large enough to offset the adjustment costs. Accounting for adjustment costs might explain the disparate findings about the effects on labor supply of an increase in work incentives in DI programs.

JEL classification: H53, H55, J14, J18, J21.

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1 Introduction

Models of labor supply commonly assume that workers can alter their supply of labor 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 schedules 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 the existence and magnitude of adjustment costs , with the exception of Gelber, Jones and Sacks (2019).

In this paper, I estimate the size of the adjustment costs individuals face when they change their labor supply in response to a change in work incentives. I exploit an April 2012 policy change in a Disability Insurance (DI) program in Alberta, Canada called "Assured Income for the Severely Handicapped" (AISH). This policy change increased work incentives by increasing the monthly earnings exemption threshold to C$800 from C$400 for beneficiaries with no dependent.[2] Earnings below the threshold do not affect the DI payments, but for every C$2 of earnings accumulated above the threshold individuals would lose C$1 of their monthly allowance. This 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 threshold are respectively zero and 50%. Such a kink creates incentives for individuals to locate just below the threshold so as to avoid the higher marginal tax rates above the threshold. The excess mass at a kink is called "bunching." I document sharp bunching at the exemption thresholds, suggesting strong behavioural responses to the work incentives. A puzzling observation however is that individuals continue to bunch at the former threshold after the policy change. This suggests that individuals face ad-

[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 studies estimated the size of the adjustment costs.

[2]The monthly exemption threshold for beneficiaries with dependent – less than %10 of all beneficiaries – also increased from C$975 to C$1,950. They do not bunch at the exemption threshold so I exclude them from my bunching estimates (see Table 1 and Figure B.3).

justment costs when changing their labor supply. I use the bunching at the former and new thresholds to estimate earnings elasticity with respect to the net-of-tax rates,[3] and provide the first estimates of heterogeneous adjustment costs which includes both a fixed cost and a variable cost element governed by ability (potential earnings). Heterogeneous adjustment costs have important policy implications for designing policies to increase labor supply in DI programs. I further explore the gradual transition of bunching from the old to the new threshold using a dynamic model, which provides estimates of probability of drawing non-zero adjustment costs in each time period in addition to the earnings elasticity and heterogeneous adjustment costs. I use the method proposed by Gelber, Jones and Sacks (2019) for my estimations.

The effect of the policy change on the labor supply could potentially be a combination of substitution and income effects. The increase in monthly allowances should induce beneficiaries to work less (Gelber et al., 2017). Increase in the exemption threshold rises substitution effects.[4] I estimate the effects of the policy change on the earnings of individuals with plausibly dominant income effects. I use a Difference-in-Difference (DD) framework where benefit recipients of the "Ontario Disability Support Program" (ODSP) – another provincial DI program – with similar earnings are the control group. In my bunching estimates I use a quasi-linear utility function, following the the previous literature (see Kleven (2016) for a review of recent studies). A quasi-linear utility function abstracts from income effects. This DD analysis provides suggestive evidence that the income effects are negligible.[5]

I use administrative data on monthly earnings of AISH and ODSP beneficiaries, obtained from the governments of Alberta and Ontario respectively. The data spans two years of pre- and two years of post policy change from April 2010 to March 2014. The dataset has information of beneficiaries' earnings. The dataset also includes information

[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 use a conceptual framework to illustrate when individuals face adjustment costs to increase their labor supply in response to increase in work incentives induced by a policy change, increase in allowances could result in increase in labor supply. See Section B.1 in Appendix B for more details.

[5]The distinction between income and substitution effects have important welfare implications. If the policy change increases the labor supply through substitution rather than income effects, then the policy change is welfare improving since it is not causing any further excess burden (Autor and Duggan, 2007).

on individuals' characteristics including sex, age, marital status, family size, age and date of entrance into the DI program, type of disability and the location of residence. I use 18–64 year-old individuals with non-physical disabilities who have no dependent for my base estimates. The decision to work for beneficiaries with non-physical disabilities might be more sensitive to adjustment costs. Non-physical disabilities such as depression are hard-to-verify and individuals with these conditions are the marginal entrants into the DI programs (Autor and Duggan, 2006; Liebman, 2015) whom might have at least some ability to work (Maestas et al., 2013). They might respond to the work incentives if they face lower adjustment costs, for instance, if they can find a suitable job which possibly accommodates their disability (Maestas et al., 2018).

My empirical analysis provides four conclusions. First, there are strong behavioural responses to work incentives in DI programs as evidenced by sharp bunching at the exemption threshold. However, bunching at the former threshold suggests that individuals face adjustment costs when changing their labor supply. Individuals with lower potential earnings (ability) face higher adjustment costs. In my base estimate, adjustment costs range from zero to 20% percent of the potential earnings. The estimated adjustment cost for individuals with monthly average potential earnings of C$250 is about 8% of their potential earnings. The bunching estimates use a sub-sample of individuals with relatively high potential earnings compared to the rest of DI recipients who could bunch. The adjustment costs could be much larger for those with lower potential earnings; and my estimates are a lower bond on the size of the adjustment costs individuals face when changing their labor supply.

Second, the estimated elasticity of earnings with respect to the net-of-tax rate at the exemption threshold – accounting for heterogeneous adjustment costs – is 0.19. This estimate is twice the size of the elasticity estimated with no adjustment costs. Adjustment costs, therefore, make a significant differences to responses to policy changes aimed at increasing the labor supply.

Third, the estimated earnings elasticity and adjustment costs using the dynamic model are quite similar to the base estimates from the static model, but slightly smaller. The estimated probability of having non-zero adjustment costs in my base estimate decreases over time, but does not drop to zero within two years after the policy change, except for the 18–64 year-old group.

Fourth, policies designed to increase labor supply will work if the induced work incentives are large enough to offset the adjustment costs. I quantified the effect of the policy change on earnings and labor force participation, using a Regression Discontinuity Design, by exploring the sharp discontinuity in the increase in work incentives at the month of the policy change (Zaresani, 2018). I further estimate a DD model comparing the labor supply in AISH with ODSP.[6] I find that individuals who are working already, work more, and those not working, start work.

DI programs provide benefits to individuals with health conditions which limit the kind or amount of paid work they can perform. These programs are among the largest social assistance programs in developed countries. OECD countries on average spend more than 2.5% of their GDP on DI programs (OECD, 2010), there have been concerns about governments' high expenditure on these programs. In most DI programs benefit recipients lose all or part of their benefits if they work, providing a disincentive to work. Many countries have therefore implemented – or are considering – policies to remove this disincentive by reducing benefits more gradually when DI recipients work. More gradual reduction of the benefits encourages DI recipients to start working and eventually exit the program.[7]

While policies which provide work incentives to DI beneficiaries aim at getting them into the labor force, empirical findings on the effectiveness of such policies are not conclusive. As part of the Ticket to Work (TTW) and Work Incentives Improvement Act of 1999 in the United States, the Social Security Disability Insurance (SSDI) program undertaken the Benefit Offset National Demonstration (BOND), a random assignment

[6] More details on DD analysis are provided in Appendix C.

[7] The United Kingdom, Norway, and Switzerland are among the countries which recently implemented policies to increase the labor supply in their DI programs. United Kingdom's program allows beneficiaries to keep half of their benefits for up to a year if they work. In Norway's program, benefits are reduced by \$0.6 for every \$1 earned above an exemption threshold (See Kostol and Mogstad (2014) for an evaluation of the program). Switzerland tested a program which offered a conditional cash payment if DI recipients started to work or increased their earnings (See Bütler et al. (2015) for an evaluation of the program).

test of a $1 for $2 offset applied to annual earnings above the SSDI's Substantial Gainful Activity (SGA). The BOND allows the beneficiaries in the treatment group to retain some of their monthly cash benefits while earning more than SGA whereas entirely suspending the benefits for the control group. Various evaluations find no confirmatory evidence of an impact of BOND on average earnings (SSA, 2018; Weathers II and Hemmeter, 2011; Wittenburg et al., 2015). Accounting for adjustment costs might explain the mixed findings on the effects of an increase in work incentives on labor supply in DI programs. The increase in work incentives induced by a policy change must be large enough to offset the adjustment costs if the goal is to increase the labor supply of the DI beneficiaries.

Hoynes and Moffitt (1999), Benitez-Silva et al. (2011), Weathers II and Hemmeter (2011) and Bütler et al. (2015) find no effects from financial incentives to work in the United States and Switzerland. Meanwhile 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 United States do not appear to affect 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 United States. Borghans et al. (2014) and Staubli (2011) examine the effects of terminating benefits and stricter eligibility criteria in DI programs in the Netherlands and Austria respectively. They find that individuals substitute DI benefits by collecting more from other social assistance programs. Lemieux and Milligan (2008); Fortin et al. (2004); Gruber (2000); Gelber et al. (2017) find that providing more generous benefits has negative effects on labor supply in social assistance programs in Canada and the United States.

My paper also is related to the literature on adjustment costs. Earlier works discuss the effects of search costs, hours constraints and institutional constraints on labor supply decisions (Pencavel, 1986; Altonji and Paxson, 1988; Dickens and Lundberg, 1993; Blundell and Mccurdy, 1999; Chetty et al., 2011; Tazhitdinova, 2016). Altonji and Paxson (1992) suggests that individuals face adjustment costs when changing their labor supply since the changes in hours of work are lumpy. Several other works also suggest that individuals face adjustment costs changing their behaviour in response to policy changes (Chetty, 2009; Chetty et al., 2011; Chetty, 2012; Chetty et al., 2012, 2013; Kleven and Waseem, 2013). Chetty et al. (2011) show that adjustment costs affect estimates of the elasticity of labor supply. None of the previous works provide an estimate of the adjustment costs. Gelber et al. (2019) are the first to specify a model to quantify the adjustment costs empirically. They allow for heterogeneity in their model, but only estimate fixed adjustment costs since they do not have enough moments of bunching to estimate a heterogeneous model. They interpret fixed adjustment costs as average cost over a range. They explore a policy change in Social Security Earnings Test which decreased the marginal tax rate above a kink. The policy change I explore changed the location of a kink which allows me to match more moments of bunching to estimate more parameters from a heterogeneous adjustment costs. I contribute to this literature by quantifying heterogeneous adjustment costs in the context of a DI program.

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. I present my DD analysis investigating the income effects of the policy change in AISH in section 5. Finally, I provide conclusions and policy implications in Section 6.

2 Institutional background and data

2.1 DI programs in Canada

The federal and provincial DI programs in Canada provide benefits to individuals with medically verifiable physical or non-physical disabilities which limit the kind or amount of work they can do. The federal DI program provides short-term benefits and the eligibility criteria are based on individuals' employment history. Most individuals with lifelong and severe disabilities, would not be eligible for the federal DI programs, and need long-term assistance. The provincial DI programs compliment the federal program, providing long-term benefits to those not eligible for the federal program or needing more assistance.[8] Alberta, Ontario, British Columbia and Saskatchewan are Canadian provinces which have provincial DI programs. Each of these programs is operated under different ministries, but they all provide similar benefits. The amount of benefits and the size of the programs, however, differ substantially across provinces, with Alberta and Ontario having the most generous and largest programs respectively.[9]

2.1.1 Alberta's Assured Income for the Severely Handicapped program

The "Assured Income for the Severely Handicapped" (AISH) is Alberta's provincial DI program. AISH provides benefits to individuals (and their family) with a disability which substantially limits their ability to earn a living and who are in financial need. The program aims to enable benefit recipients to live as independently as possible in their communities. The education level of more than 80% of the benefit recipients is high school or less, about half of the all AISH's benefit recipients have non-physical disabilities (SASR, 2010). More than 90% of all benefit recipients have no dependent (see Table 1) and from now on I focus on beneficiaries with no dependent.

Determination Process: AISH is a means-tested DI program where eligible individuals are entitled to a prescribed amount of assistance. The eligibility to enter the program is determined based on applicants' disability, age, income and assets. Eligible individuals must be permanently disabled where there is no curative therapy to improve their condition materially (SASR, 2010). They must also be 18 years or older, live in Alberta and be a Canadian citizen or permanent resident. The total assets of an eligible benefit recipient and their partner cannot be worth more than C$100,000. The final decision on an individual's application file is made by a social worker, after receiving all the relevant medical reports from qualified health professionals. Entitled individuals receive monthly allowances and supplemental assistance, such as health benefits and subsidized transport.

[8]Most of the beneficiaries of the provincial DI programs do not have appropriate employment history to qualify for the federal program.

[9]For more information on social assistance programs in Canada, see Appendix A.

Duration of the benefits: Once an individual has accessed 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. For example, a benefit recipient may reach the retirement age of 65 years and be eligible to receive Guaranteed Income Support (GIS) or Old Age Security (OAS) pensions or a benefit recipient may no longer meet the medical or income and asset criteria for receiving the benefits. Eligibility-based exits account for a tiny fraction of the exits from AISH.

The policy change in AISH: AISH beneficiaries are allowed to work while receiving DI benefits, and which earnings below an exemption threshold do not affect the DI benefits, DI allowances are gradually phased out for the earnings accumulated above the exemption threshold. This is comparable to a non-linear tax schedule on earnings with a zero marginal tax rate on earnings below the exemption threshold. Earnings above the exemption threshold, up to the second earnings threshold, are taxed at a rate of 50%. That is, the monthly DI allowances are reduced by $1 for every $2 of earnings accumulated between the exemption threshold and the second threshold. Earnings above the second threshold are marginally taxed at a 100% rate, so monthly DI allowances are reduced by $1 for every $1 of earnings accumulated above the second threshold.

In April 2012, the monthly exemption threshold was increased from C$400 to C$800 and the monthly DI allowances were increased by 35% to C$1,588 from C$1,188. Panel (a) of Figure 1 presents the budget constraints of DI recipients in AISH before and after the policy change. The horizontal axis denotes monthly earnings, and the vertical axis denotes the total income which is the monthly allowances and after tax earnings added together.[10]

2.1.2 Ontario Disability Support Program

The "Ontario Disability Support Program" (ODSP) is the provincial DI program in Ontario. The eligibility criteria and determination process in ODSP are similar to those in AISH. ODSP beneficiaries receive monthly allowances and similar supplementary assis-

[10]See Figure B.2 for budget constraints for beneficiaries with dependents.

tance. The monthly allowances are determined by the number of dependents and range from C$1,086 to C$1,999. Panel (b) of Figure 1 plots the budget constraints of the ODSP beneficiaries. As with the AISH, ODSP allows the beneficiaries to work but DI allowances are reduced by $1 for every $2 of earnings. This is comparable to a marginal tax rate of 50% on all earnings.

2.2 Data and sample selection

I use administrative data on monthly earnings of the AISH and ODSP beneficiaries obtained respectively from the governments of Alberta and Ontario. The data spans April 2010 to March 2014, which includes two years of pre and two years of the post policy change in AISH. 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. The data includes information on individuals' sex, age, marital status, family size, age and date of entrance into the program, type of disability and the location of residence. The study sample in my base estimates includes 18–64 year-old individuals with non-physical disabilities who do not have dependent, including the existing beneficiaries and those entering into the program over four years from April 2010 to March 2014.

Less than 10% of all beneficiaries have dependent, and they do not bunch at the exemption threshold (see Table 1 and Figure B.2 and Figure B.3 in Appendix B). I exclude them from my bunching estimates but include them in my DD analysis. The work decision of beneficiaries with non-physical disabilities might be more sensitive to adjustment costs. Non-physical disabilities, such as depression, are hard-to-verify and individuals with these conditions are the marginal entrants into the DI programs (Autor and Duggan, 2006; Liebman, 2015) whom might have at least some ability to work (Maestas et al., 2013). They might respond to the work incentives if they face lower adjustment costs, for instance, if they can find a suitable job which possibly accommodates their disability (Maestas et al., 2018).

Table 1 presents the summary statistics. "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 sample sizes in AISH and ODSP are respectively 452,000 (10,000 individuals over four years) and 6.9 million (150,000 individuals over four years). These sample sizes might look quite different, but they are comparable in terms of the percentage of the adult population in each province (about 1%). The first panel of the table presents the labor market statistics. The mean monthly after-tax allowances in both programs are quite similar before the policy change, but are higher in AISH after the policy change (allowances increase by C$400 after the policy change). The labor supply in AISH is higher than for the ODSP, both before and after the policy change. About half of the AISH beneficiaries have positive earnings compared with less than 10% in the ODSP. The mean inflation-adjusted monthly earnings are also higher in AISH than ODSP, both before and after the policy change. 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 individual background characteristics. The demographic characteristics in AISH and ODSP are quite similar and do not change after the policy change. Half of the beneficiaries in each program are female. In both programs, about half of all beneficiaries have non-physical disabilities (SASR, 2010). I divide non-physical disabilities into three groups of Psychotic (i.e., Schizophrenia and Bipolar disorder), Neurological (i.e., Autism and Down Syndrome) and Mental conditions (i.e., Anxiety and Depression). The composition of disability types is quite similar in both programs and does not change after the policy change. The Psychotic and Mental disabilities are respectively the largest and smallest groups. The average age at entrance into the program and average beneficiary ages in AISH are lower than ODSP. A larger portion of AISH beneficiaries live in metropolitan areas. In both programs, most of the benefit recipients do not have dependent where more than 90% of the AISH beneficiaries do not have dependent. I include only beneficiaries with no dependent in my empirical analysis exploring the bunching at the exemption thresholds, but I include all beneficiaries in my DD analysis.

3 Adjustment costs and elasticity of earnings

In this section, I begin with documenting adjustment costs in AISH. I then present my model for estimating earnings elasticity and heterogeneous adjustment costs. I also provide a conceptual framework to illustrate how adjustment costs might affect individuals' labor supply decision in Section B.1 in Appendix B.

3.1 Documenting adjustment costs in AISH

Figure 2 plots the earnings distributions of AISH beneficiaries before and after the policy change. Panel (a) plots the earnings distribution pooled within two years before the policy change where the monthly exemption threshold is C$400. There is sharp bunching at the threshold, suggesting strong responses to work incentives induced by the kink. The higher marginal taxes above the threshold (50% versus 0) create incentives for many individuals to locate their earnings just below the threshold. There is no bunching at the second kink at C$1,500.[11] Panel (b) plots the earnings distribution pooled within two years after the policy change, where the monthly exemption threshold is increased to the new threshold at C$800 from C$400. As expected, there is sharp bunching at the new threshold but there is also still bunching at the former threshold. This observation suggests that some individuals face adjustment costs when changing their supply of labor. There is no bunching at the higher second threshold, either before or after the policy change.

Figure 3 presents the evolution of the bunching at the old exemption threshold and a slow emergence of bunching at the new threshold. Panel (a) shows that there is sharp bunching at the exemption threshold every month prior to the policy change. Panel (b) shows that bunching at the former threshold gradually decreases and emerges as bunching at the new threshold in the months following the policy change. However, bunching at the former threshold does not completely disappear, even two years after the policy change. The main pathway out of the program is death, and it is implausible the bunching at

[11] The second earning threshold increased to C$1,500 from C$1,000 in July 2008, four years before the April 2012 policy change. There is also no bunching at the former kink at C$1,000 (50% and 100% marginal taxes respectively below and above the kink).

the exemption threshold is driven by beneficiaries exiting the program as opposed to changing their earnings.

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 in the months following the policy change. It also is unlikely to be due to lack of information about the policy change, since anyone receiving monthly allowances would see that the amount has changes, so they are unlikely to be unaware that something has happened. Further, all beneficiaries are informed about the policy change by their social workers.

Figure 5 plots the earnings distribution of the new beneficiaries entered into the program after the policy change. The monthly exemption threshold for these individuals is C$800. The distribution is quite fuzzy compared with Figure 2, there is no clear bunching at the former exemption threshold at C$400, but there is a spike at the new threshold at C$800. This figure provides a placebo test that the bunching at the former threshold in Panel (b) of Figure 2 is not caused by overlapping thresholds from other programs.

Figure 6 plots the earnings distribution of individuals whose monthly earnings during one year prior to the policy change was very close to the exemption threshold – between C$350 and C$450 – at least half of the times. The figure suggests that individuals who bunch at the former threshold after the policy change are mostly those who also bunched at the threshold before the policy change.

I have documented bunching 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. All this evidence suggests that benefit recipients face adjustment costs when they adjust their labor supply in response to work incentives induced by the policy change. 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, all of which I put in one box and call “adjustment costs.” The utility loss associated with adjustment costs offsets the utility gains from changing labor supply, and therefore some individuals continue to bunch. It is worth stressing that while in short run adjustment costs might limit labor supply responses to the policy change, it differs from the long-run when new beneficiaries eventually replace the old ones.

3.2 Model with heterogenous adjustemnt costs

In this section I present my model for estimating earnings elasticity and heterogeneous adjustment costs which vary by individuals' ability; denoted by individuals' potential earnings with no taxes. Bunching at a kink conceptually increases by the earnings elasticity, but also decreases by the size of adjustment costs. I use Gelber et al. (2019) estimation method and explore the policy change in AISH and use the amount of bunching at the former and the new exemption thresholds in static and dynamic settings. Adjustment costs are incorporated into the models as dis-utility. I further parametrize adjustment costs as a linear function of ability, including both a fixed cost element and a variable cost element governed by potential earnings (ability). In the static model, there are mainly three parameters to be estimated: earnings elasticity and two parameters of the adjustment costs. These parameters are estimated by matching bunching at the old and new thresholds from the pooled distribution of earnings presented in Figure 2. In the dynamic model with T time periods, in addition to the three previously mentioned parameters, T parameters indicating the probabilities of drawing non-zero adjustment costs in each time period are estimated. These parameters are estimated by matching bunching at the old and new thresholds in each time period.

Adjustment costs with a component governed by the only source of heterogeneity in the model – ability – provide a better understanding of how adjustment costs affect individuals' labor supply decision. This has important implications for designing policies to increase labor supply in DI programs and targeting beneficiaries with heterogeneous working ability ranging from marginal entrants with higher working ability to those with more severe disabilities with much lower working ability. Some beneficiaries might need more support to find a suitable job, which accommodates their disability and stay employed whereas some others may not work regardless of the support provided for them.

Gelber et al. (2019) build on Saez (2010) to develop a novel framework to estimate adjustment costs and earnings elasticity. They explore a policy change in the Social Security Annual Earnings Test (AET) in the United States which decreased the marginal tax rate above a kink. They use bunching at the kink before and after the policy change to estimate earnings elasticity and fixed adjustment costs. The policy change in AET changed the size of a kink where there is bunching at the kink both before and after the policy change (two moments of bunching). The policy change in AISH changed the location of a kink where there is bunching at the new threshold after the policy change and at the old threshold both before and after the policy change (three moments). More bunching moments allows me to estimate a model with adjustment costs parametrized as a line to varying by individuals' ability.

3.2.1 Static model

In this section I present a static model for estimating earnings elasticity 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 (C$400 and C$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 7 illustrates a marginal buncher at z^* before the policy change. Her ability is $\alpha^{m_{10}}$ and she initially would locate at $\underline{z}_{10}$ under a linear tax rate of τ_0. She is indifferent between staying at $\underline{z}_{10}$ – where marginal tax on earnings is higher – or enduring utility loss $\phi(\alpha^{m_{10}})$ and decreasing her earnings to z_1^* where marginal tax on earnings is lower. $u(c, z; \tau, \alpha)$ denotes the utility function of an an individual with ability

α facing marginal tax τ. The *marginal buncher* condition at z_1^* before the policy change is:

$$u\left((1-\tau_0)z_1^*, z_1^*; \alpha^{m_{10}}\right) = u\left((1-\tau_0)z_1^* + (1-\tau_1)(\underline{z}_{10} - z_1^*), \underline{z}_{10}; \alpha^{m_{10}}\right) + \phi(\alpha^{m_{10}}) \quad (1)$$

In the absence of adjustment costs, individuals with initial earnings in $(z_1^*, z_1^* + \Delta z_1^*]$ would bunch at z_1^*. Under mild assumptions about the underlying utility function, which holds for all quasi-linear utility functions, the gain from relocating to a kink is increasing in distance from the kink.[12] If individuals face adjustment costs when changing their labor supply, only those whose gain from changing their earnings is higher than the adjustment costs they face would bunch at the kink. Therefore, the bunching range shrinks to $(\underline{z}_{10}, z_1^* + \Delta z_1^*]$. Figure 8 plots the counter-factual distribution of earnings and bunching ranges. The bunching range in the absence of adjustment costs is $i + ii + iii$. The bunching range with adjustment costs is $ii + iii$. 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:[13]

$$B_{10} = \int_{\underline{z}_{10}}^{z_1^* + \Delta z_1^*} h_0(\zeta) d(\zeta) \approx (z_1^* + \Delta z_{10}^* - \underline{z}_{10}) h_0(z_1^*) \quad (2)$$

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 the adjustment costs they face. Panel (b) of Figure 7 illustrates a marginal buncher at z_1^* after the policy change with ability is $\alpha^{m_{11}}$ who initially locates at $\underline{z}_{11} \in (\underline{z}_{10}, z_1^* + \Delta z_1^*]$. She is indifferent between continuing to bunch at z_1^* or enduring utility loss $\phi(\alpha^{m_{11}})$ and relocating to her optimal earnings $\underline{z}'_{11}$ with the new taxes. The *marginal buncher* equation at z_1^* after the policy change is:

$$u\left((1-\tau_0)\underline{z}'_{11}, \underline{z}'_{11}; \alpha^{m_{11}}\right) = u\left((1-\tau_0)z_1^*, z_1^*; \alpha^{m_{11}}\right) + \phi(\alpha^{m_{11}}) \quad (3)$$

[12] The assumption is that the size of the adjustment in earnings increases in α at a rate faster than the decrease in the marginal utility of consumption. For more details see (Gelber et al., 2013).

[13] This approximation assumes that the distribution of $h_0(.)$ on $(\underline{z}_{10}, z_1^* + \Delta z_{10}^*)$ is uniform. This is a common assumption in the bunching literature (see for instance; Chetty et al., 2011; Kleven and Waseem, 2013).

Individuals with initial earnings in the range of $(\underline{z}_{10}, \underline{z}_{11}]$ keep bunching at z_1^* after the policy change. Figure 8 illustrates bunching at z_1^* after the policy change. The *bunching equation* at z_1^* after the policy change is:

$$B_{11} = \int_{\underline{z}_{10}}^{\underline{z}_{11}} h_0(\zeta)d(\zeta) \simeq (\underline{z}_{11} - \underline{z}_{10})h_0(z_1^*) \tag{4}$$

I follow a similar procedure for bunching at the new kink at z_2^*. In the absence of adjustment costs, individuals with initial earnings in the 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 7 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 bunching at z_2^*. The *marginal buncher* condition at z_2^* is:

$$u((1 - \tau_0)z_2^*, z_2^*; \alpha^{m_2}) = u((1 - \tau_0)\underline{z}_2', \underline{z}_2'; \alpha^{m_2}) + \phi(\alpha^{m_2}) \tag{5}$$

Figure 8 shows that those with initial earnings in the range of $(\underline{z}_2, z_2^* + \Delta z_2^*]$ bunch at z_2^*. The *Bunching equation* at z_2^* is:

$$B_2 = \int_{\underline{z}_2}^{z_2^* + \Delta z_2^*} h_0(\zeta)d\zeta \approx (z_2^* + \Delta z_2^* - \underline{z}_2)h_0(z_2^*) \tag{6}$$

3.2.2 Dynamic model

In this section I provide a dynamic version of the model for estimating heterogeneous adjustment costs and earnings elasticity presented in Section 3.2.1, which is based on the framework by Gelber et al. (2019). The model incorporates the gradual evolution of bunching over time in the delayed adjustment of earnings to the policy change presented in Figure 3. It is important to point out the two key features of the data. First, a delayed response to the policy change. Second, the lack of anticipatory responses to the policy change, since there is no bunching at the new kink at time periods before the policy change. As pointed out by Gelber et al. (2019), assuming that adjustment costs are drawn from a stochastic process where individuals do not anticipate the policy change could capture these two features of the data.[14] A discrete distribution captures, for instance, the stochastic arrival of job opportunities or information about the policy change. An individual may adjust her earnings in a given time period only if the utility gain from the adjustment is large enough to offset the adjustment costs in that time period. This would generate a gradual response to the policy change observed as a gradual decrease in bunching at the former kink and a gradual increase in bunching at the new kink at time periods following the policy change.

At time period 0, an individual with ability α begins with her optimal earnings under a linear tax τ_0 when facing no adjustment costs. At time 1 the z_1^* kink is introduced. The kink is implemented for T_1 periods after which it is moved to z_2^*. An individual with ability α draws adjustment costs from a discrete distribution $\{0, \phi(\alpha)\}$, which with probability π_t equals $\phi(\alpha)$ and with probability of $1 - \pi_t$ equals zero, at each time period t. She will adjust her earnings at time t only if the utility gain of adjusting her earnings exceeds the drawn adjustment costs.

Bunching at z_1^* immediately after introducing the kink, B_{10} specified in (2), could be generalized as below for each time period $t \in [1, T_1]$ before the policy change:

$$\begin{aligned} B_{10}^t &= \int_{\underline{z}_{10}}^{z_1^*+\Delta z_1^*} h_0(\zeta)d\zeta + (1 - \prod_{j=1}^{t} \pi_j) \int_{z_1^*}^{\underline{z}_{10}} h_0(\zeta)d\zeta \\ &= \int_{z_1^*}^{z_1^*+\Delta z_1^*} h_0(\zeta)d\zeta - \prod_{j=1}^{t} \pi_j \int_{z_1^*}^{\underline{z}_{10}} h_0(\zeta)d\zeta \\ &= B_{10}^* - \prod_{j=1}^{t} \pi_j (B_{10}^* - B_{10}) \\ &= \prod_{j=1}^{t} \pi_j B_{10} + (1 - \prod_{j=1}^{t} \pi_j) B_{10}^* \end{aligned} \tag{7}$$

The first line of (7) shows that bunching at z_1^* kink before the policy change in time t is composed of two components. First, those in areas *ii* and *iii* in Figure 8 who immediately

[14] Alternatively, individuals who anticipate the policy change could be forward-looking. See Gelber et al. (2019) for more details on a model with forward looking agents.

bunch once a kink at the z_1^* is introduced. Second, those in area i of the figure who would bunch only if they draw zero adjustment costs. The probability of such a draw by period t is $1-\prod_{j=1}^{j=t}\pi_j$. B_{10}^* specified in (B.4) denotes frictionless bunching at z_1^* kink before the policy change. B_{10} specified in (2) denotes bunching at z_1^* kink immediately after introducing the kink at $t=1$ where $\lim_{t\to\infty} B_{10}^t = B_{10}^*$, suggesting that after a long enough period of time bunching at a kink converges to the level of bunching with no adjustment costs.

Similarly, bunching at the z_1^* after the policy change specified in (4) is generalized as below for each time period $t > T_1$ after the policy change at T_1:

$$\begin{aligned} B_{11}^t &= (1-\prod_{j=1}^{T_1}\pi_j)(\prod_{j=T_1+1}^{t}\pi_j)\int_{z_1^*}^{\underline{z}_{10}} h_0(\zeta)d\zeta + \prod_{j=T_1+1}^{t}\pi_j\int_{\underline{z}_{10}}^{\underline{z}_{11}} h_0(\zeta)d\zeta \\ &= (1-\prod_{j=1}^{T_1}\pi_j)(\prod_{j=T_1+1}^{t}\pi_j)(B_1^*-B_1) + \prod_{j=T_1+1}^{t}\pi_j\int_{\underline{z}_{10}}^{\underline{z}_{11}} h_0(\zeta)d\zeta \end{aligned} \tag{8}$$

The first line of (8) shows that bunching at z_1^* at time period t after the policy change consists of two components. First, individuals in area i in Figure 8 who bunched once they drew zero adjustment costs with probability of $1-\prod_{j=1}^{j=T_1}\pi_j$ and then move away only if they draw a zero adjustment costs at time t with probability of $\prod_{j=T_1+1}^{j=t}\pi_j$. Second, individuals in area ii of the figure who bunched immediately after a kink was introduced and they will de-bunch when they draw a zero adjustment costs at time t with the probability of $\prod_{j=T_1+1}^{t}\pi_j$. $\lim_{t\to\infty} B_{11}^t = 0$ suggests that after a long enough time period the bunching at a former kink goes away.

Finally, bunching at z_2^* kink after the policy change specified in (6) is generalized as below for each time period $t > T_1$:

$$\begin{aligned} B_2^t &= \int_{\underline{z}_2}^{z_2^*+\Delta z_2^*} h_0(\zeta)d\zeta + (1-\prod_{j=T_1+1}^{t}\pi_j)\int_{z_2^*}^{\underline{z}_2} h_0(\zeta)d\zeta \\ &= \prod_{j=T_1+1}^{t}\pi_j B_2 + (1-\prod_{j=T_1+1}^{t}\pi_j)B_2^* \end{aligned} \tag{9}$$

The first line of (9) shows that bunching at the new z_2^* kink at time t is composed of two components. First, those in area v in Figure 8 who immediately bunch once a kink at the z_1^* is introduced. Second, those in area *iv* of the figure who would bunch only if they draw a zero adjustment. The probability of such a draw by period t is $1 - \prod_{j=T_1+1}^{j=t} \pi_j$. B_2^* and B_2 denote respectively the frictionless bunching and bunching immediately after introducing the kink at z_2^*. $\lim_{t\to\infty} B_2^t = B_2^*$ shows that after a long enough time period bunching at a kink converges to the frictionless level of bunching. The static model corresponds to the special case of the dynamic model when $\pi_t = 1, \forall t$. This is the case when individuals never draw a zero adjustment costs. Estimating the dynamic model involves estimating the π_js (one for each time period) in addition to the elasticity of earnings e and parameters of the adjustment costs.

4 Empirical implementation

I follow the previous literature and parametrize both static and dynamic models using a quasi-linear utility function as:[15]

$$u(c, z; \alpha) = c - \frac{\alpha}{1+\frac{1}{e}}\Big(\frac{z}{\alpha}\Big)^{1+\frac{1}{e}} \tag{10}$$

where c denotes consumption, defined as disposable income[16] and e represents earnings elasticity with respect to the net-of-tax rate. I further parametrize heterogeneous adjustment costs as a linear function of ability α specified as $\phi(\alpha) = \alpha_1 + \alpha\phi_2$.

My study sample for the baseline estimates includes 18–64 year-old beneficiaries with no dependent who have non-physical disabilities. I use the data within two years of the policy change, including two years of pre-policy change (April 2010 to March 2012) and two years of post the policy change (April 2012 to March 2014). I use the pooled data to estimate the static model. For estimating the dynamic model, I divide the data into quarters (three-month intervals), where each quarter represents one time period in the

[15]Despite the limitations of a iso-elastic and quasi-linear utility function, convenience in estimation and expressing findings has made it quite popular in bunching literature (Chetty et al., 2011; Gelber et al., 2019; Kleven and Waseem, 2013; Bastani and Selin, 2014; Aghion et al., 2017). Kleven (2016) reviews all the recent studies on bunching where almost all of them use this utility function.

[16]In the 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.

model. For instance, April 2010 to June 2010 represents the first time period in the model. To estimate bunching at a kink, I set the bin size $\delta = C\$10$ and fit a polynomial degree $D = 6$ to the observed distribution of earnings, where I exclude three bins at each side of a kink $l = u = 3$. Bunching at a kink is the difference between the fitted polynomial and the observed distribution of earnings (see Appendix B for more details).[17]

In the static model, this procedure results in three equations which I numerically solve to pin down the three parameters of the model: earnings elasticity e and parameters of the adjustment costs ϕ_1 and ϕ_2. In the dynamic model, I solve a non-linear system of 24 equations to pin down 16 probability of drawing non-zero adjustment costs $\pi_j s$ in addition to e, ϕ_1 and ϕ_2.

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 was imposed on earnings. Another key parametric assumption is that the earnings elasticity is the same for all individuals and does not change post policy change. I assume that the induced income effects of the policy change are negligible, and use a quasi-linear utility function specified in (10) to parametrize my model. Annual earnings of almost all of the DI recipients fall in the lower bracket of the income tax schedule of the federal and provincial governments in Canada, which are exempted from income taxes. However, these beneficiaries still have to contribute to the Employment Insurance (EI) – about 2-5% of earnings in the 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.[18]

[17] Gelber et al. (2019) use earnings distribution of a different group of individuals who do not face a kink as a counter-factual earnings distribution for their study sample. This approach allows them to estimate the 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 groups. The earnings in ODSP are much lower than AISH (see Table 1 and Figure C.1a, since all earnings are subject to a %50 marginal tax rate. Therefore ODSP does not provide an appropriate counter-factual for AISH.

[18] Increasing marginal taxes by 5% does not change the estimates. Estimates are available upon request.

4.2 Inference

I use bootstrapped standard errors to make an 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 from (B.7) to generate new earnings distributions. For each bootstrapped distribution I then 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 from 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.

4.3 Estimation results

4.3.1 Static model

Figure 2 plots the distribution of earnings and the fitted polynomials around the former and new exemption thresholds. Figure 4 plots the estimated bunching by month relative to the policy change. The horizontal axis denotes month relative to the policy change and the vertical axis denotes the estimated normalized bunching at the corresponding threshold using the procedure explained in Section B.3.[19] Panel (a) shows that the bunching at the former exemption threshold is quite stable at months prior to the policy change. The bunching gradually decreases in the months following the policy change, but it does not completely disappear. Panel (b) shows that the bunching at the new threshold gradually increases. The gradual decrease in bunching at the former threshold and gradual increase in bunching at the new threshold suggest that individuals face adjustment costs when

[19] I investigate the robustness of the estimated bunching to the selected parameters in Table B.1 in Appendix B.

changing their labor supply in response to changes in work incentives.

Table 2 presents the estimated bunching b, elasticity of earnings with respect to net-of-tax rate e and parameters of the heterogeneous adjustment costs ϕ_1 and ϕ_2 specified as $\phi = \phi_1 + \alpha\phi_2$ using the static model. The first row of the table presents the baseline estimates. The estimated elasticity is 0.19. The 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 9 plots the estimated adjustment costs as a percentage of the potential earnings. The estimated adjustment costs vary from zero to 20% of the potential earnings with an average at 8%..

The estimated elasticity with heterogeneous adjustment costs is about double the magnitude of the elasticity estimated with no adjustment costs (Saez, 2010) presented in Table B.2 in Appendix B (0.19 versus 0.10). The estimated elasticity from the model with heterogeneous adjustment costs is quite similar to that from a model with fixed adjustment costs (Gelber et al., 2019) presented in Table B.3 (0.19 versus 0.21). The estimated adjustment costs for an individual with average potential earnings (about \$250) is slightly larger but comparable to the estimated fixed adjustment costs (\$15 versus \$11).

Table 2 also presents the estimates by age, gender, disability type and location of residence. The magnitude of the estimated elasticities and adjustment costs for each group are quite similar to the base estimate except for those in the Psychotic and Mental disability groups which are larger than the base estimate, and those living in non-metropolitan areas which are insignificant and much smaller than the base estimates. 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 the base estimates, with the estimated elasticity of 0.15 and adjustment costs that vary from zero to 15% of the potential earnings.

4.3.2 Dynamic model

Table 3 presents the estimated elasticity of earnings and heterogeneous adjustment costs from the dynamic model. The first block of the table presents the base estimates. The estimated elasticity of earnings is 0.16 and the estimated parameters of the adjustment costs are $\phi_1 = 18.80$ and $\phi_2 = -0.02$, which are pretty similar to the base estimates from the static model presented in Table 2. The estimated probabilities of drawing non-zero adjustment costs in each time period are plotted in Figure 10. The estimated probability of drawing a non-zero adjustment costs for the base estimate decreases from 1 to about 0.8 two years after the policy change.

Table 3 and Figure 10 also present the estimates by age, gender, disability type and location of residence, but only for groups with enough variation in bunching over time. There are not enough variations in the bunching for those above 50 years old, those with Psychotic and Mental disabilities (relatively larger estimated elasticity in the static model) and those living in non-metropolitan areas (relatively smaller estimated elasticity in the static model). Those with higher elasticity de-bunch quickly after the policy change and there is not much variation in periods following the policy change. Those with much smaller elasticity do not de-bunch and therefore there is not much bunching at periods following the policy change. Therefore estimating a dynamic model for these groups is not feasible. The estimated elasticities from the dynamic model are quite similar but in general slightly smaller than those from the static model. The estimated adjustment cost parameters are relatively larger than the corresponding estimates from the static model. The estimated probabilities of drawing non-zero adjustment costs are quite similar to those from the base estimate, except for men and those in the 18–34 year old group. The estimated probabilities for these two groups dramatically drop to ,respectively, 0.2 for men and pretty close to zero for the 18–34 year-old group at time periods following the policy change.[20]

My estimates suggest that there is considerable heterogeneity in adjustment costs among the DI recipients. Individuals with higher potential earnings face lower adjustment

[20]Figure B.5 plots the monthly earnings distribution of 18–34 year-old group. The bunching at the former threshold gradually decreases, and completely disappears.

costs when changing their labor supply. It could be because they might have better chances of finding a job or stronger bargaining power in negotiating their wage or hours of work with a current employer. It could also be that they need less support and workplace accommodation to work. 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 the utility gains from the change in their labor supply offsets the adjustment costs that they face.

5 Income effects of the policy change

The policy change in AISH has two components. First, an increase of the monthly exemption threshold from C$400 to C$800. Second, 35% increase in the maximum monthly allowance from C$1,188 to C$1,588. The effect of this policy change on the labor supply could potentially be a combination of substitution and income effects. The increase in the allowances creates income effects. If leisure is a normal good, the increase in monthly allowances should induce beneficiaries to work less. Increase in the exemption threshold rises substitution effects: creating incentives to earn below the threshold. The distinction between income and substitution effects have important welfare implications. If the policy change increases the labor supply through substitution rather than income effects, then the policy change is welfare improving since it is not causing any further excess burden (Autor and Duggan, 2007). I use a quasi-linear utility function for estimating earnings elasticity and adjustment costs, which abstracts from income effects. I estimate the effects of the policy change on the earnings of individuals with plausibly dominant income effects. I use a DD framework where benefit recipients of the ODSP with similar earnings are the control group.

This analysis provides suggestive evidence that the income effects are negligible for groups of beneficiaries with plausibly dominant income effects. It dose seem implausible that income effects would exactly offset the substantiation effects from the change in work incentives to keep individuals exactly at the former exemption threshold post policy change. This provide further evidence that individuals face adjustment costs when changing their earnings.

5.1 Identification strategy

Figure 1 plots the budget constraints of AISH beneficiaries before and after the policy change. It is likely that income effects are the dominant effect of the policy change for individuals with earnings below C$400 and above C$800 (parallel budget constraints before and after the policy change).[21] I investigate the effects of the policy change in AISH on individuals' earnings with likely dominant income effects using a DD framework. I use ODSP beneficiaries with similar earnings as a control group. The ODSP is an appropriate control group since its benefit scheme is similar to – but less generous than – AISH; and it did not undergo major policy change 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:

$$y_{it} = \alpha + \beta(POST_t \times AISH_i) + \gamma AISH_i + X_i'\delta + \lambda_t + \epsilon_{it} \tag{11}$$

[21]The estimated earnings responses from the model with heterogeneous adjustment costs (Δz_1^* and Δz_2^*) presented in Table 2 are between C$50–C$100. To avoid possible contamination, I restrict my sample to those with monthly earnings below C$300 and above C$900.

where i and t respectively denote individuals and time in months. y_{it} denotes inflation-adjusted monthly earnings. $AISH_i$ 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_i is a set of individual characteristics to control for any observable differences that might confound the analysis (sex, age, family structure, age when entered DI program, 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 earnings of DI recipients in AISH relative to those in ODSP over time.

5.2 Descriptive evidence and findings

Figure 11 plots trends in the inflation-adjusted average earnings of AISH and ODSP beneficiaries with likely dominant income effects. Panel (a) and (b) plot the trends for individuals whose monthly earnings is always less than C$300 within respectively six months and one year before the policy change. Panel (c) and (d) plot the trends for individuals whose monthly earnings is always more than C$900 respectively six months and one year before the policy change. These figures all suggest that earnings trends in AISH are similar to ODSP, both before and after the policy change in AISH. These figures suggest the effects of the policy change on earnings are quite small.

Figure B.2 in Appendix B presents the budget constraints of AISH beneficiaries with no dependent before and after the policy change. The policy change for beneficiaries with dependent is similar to that for beneficiaries with no dependent except that the exemption thresholds are higher. The policy change increased the monthly exemption threshold from C$975 to C$1,950 and increased the monthly allowances from C$1,188 to C$1,588; a 35% increase. Individuals with earnings less than C$850 are likely to have only income effects. Panel (e) of Figure 11 plots the trends for these individuals and compares their earnings with the corresponding group from ODSP. The figure suggests that the earnings in AISH are similar to ODSP.

Table 4 presents the estimated effects of the policy change for each sub group presented in Figure 11 using (11). Most of the estimated effects are either very small or negative and insignificant. The estimated effects of the policy change on individuals with likely only income effects are negligible. This finding provides suggestive evidence that the income effects of the policy change in fact are negligible.

6 Policy implications and conclusion

Many countries have recently implemented – or are considering implementing – policies aimed at increasing the labor supply of DI beneficiaries in order to decrease the cost of DI programs. These policies involve increasing incentives to work, but findings on the effectiveness of such policies are mixed. In this paper, I investigate whether adjustment costs which individuals face when changing their labor supply could explain these mixed findings. I provide the first estimate of heterogeneous adjustment costs by exploiting a policy change in a DI program which substantially increased work incentives by increasing the exemption thresholds. I document strong responses to work incentives as I observe excess mass –"bunching"– just below the exemption threshold where the marginal tax on earnings is lower. 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, ranging from zero to 20% of their potential earnings, with an average at 8%. The estimated earnings elasticity with respect to the net-of-tax rate – accounting for heterogeneous adjustment costs – is 0.2, which is twice the size of the elasticity estimated with no adjustment costs.

6.1 Labor supply responses to work incentives

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 also decreased the marginal tax rate on earnings far away from the exemption threshold, and the overall intensive margin effects of the policy change could 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.

I evaluate the overall effects of the policy change in AISH on the labor supply using a DD framework. I use beneficiaries of the ODSP as a control group and implement a DD comparison by estimating (11).[22] Table C.1 in Appendix C presents the estimated effects on earnings and labor force participation. Table C.2 presents the estimates by family status, age, gender, disability type and location of residence. I find that individuals who already work, work more, and those who did not work, start working.

I also investigated the effects of the policy change in AISH on labor supply of the benefit recipients using a Regression Discontinuity Design (RDD). I explored the sharp discontinuity in the increase in work incentives at the month of the policy change. I document that large incentives to work could induce beneficiaries to increase their labor supply both in intensive and extensive margins (Zaresani, 2018). I further investigate the effects of the policy change on the number new entrants into the program using the RDD framework of (Zaresani, 2018). Figure D.1 in Appendix D plots the trend in the number of new entrants into the program by relative month to the policy change. The estimated effects are presented in Table D.1. The estimates suggest that the policy change did not result in more entries into the program.

[22] More details on the DD analysis are provided in Appendix C.

I further explore the policy change in AISH to estimate the elasticity of labor force non-participation with respect to the Participation Tax Rate (PTR) (Kostol and Mogstad, 2014).[23] Labor participation defined as a dummy which turns on for earnings above the exemption threshold. PTR for earnings z is defined as $1 - \frac{I_0 - I_z}{z}$ where I_0 and I_z denote income respectively with 0 and z earnings. The income is the net-of-tax earnings and DI allowances added together. Figure E.1 shows that the PTR after the policy change is lower for both beneficiaries with and without dependent. Table E.1 presents the estimated elasticities. The estimates suggest that a 10% reduction in the PTR decreases the labor force non-participation by 11.4% for those with no dependent and by 3.3% for those with dependent.

Policies designed to increase labor supply will work if the work incentives are large enough to offset the adjustment costs. Accounting for adjustment costs then might explain the disparate findings on the effects of an increase in work incentives on the labor supply of beneficiaries of DI programs. These findings have important implications for designing policies and targeting heterogeneous groups in DI programs to increase the labor supply.

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Tables

Table 1: Summary statistics

	AISH		ODSP	
	Before	After	Before	After
<u>*Labor market statistics*</u>				
Positive earnings (%)	48.1	48.4	9.9	9.4
Mean monthly earnings (2012 C$)	255	285	50	55
	(420)	(470)	(235)	(245)
Mean monthly net benefits (2012 C$)	1,160	1,530	1,020	1,015
	(120)	(150)	(470)	(460)
Number of new DI awards	1,215	636	8,440	9,965
<u>*Individual characteristics*</u>				
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 when entered program	28.8	29.1	33.2	33.1
	(11.1)	(11.4)	(11.8)	(11.9)
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
Metropolitan area resident (%)	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 for the data from the AISH and ODSP. The "Before" denotes April 2010–March 2012 and "After" denotes April 2012–March 2014. Mean monthly earnings and DI allowances are inflation-adjusted (2012 C$) and rounded to the closest five according to the confidentiality guidelines of the Statistics Canada. The metropolitan area of Alberta are Calgary and Edmonton and Ontario's are Toronto and Ottawa.The standard deviation of the continuous variables are provided in the parenthesis.

Table 2: Estimted earnings elasticity and heterogeneous adjustment costs from the static model

	Bunching at \$400 kink before policy change	Earnings response at \$400 kink before policy change	Bunching at \$400 after policy change	Bunching at \$800 kink after policy change	Earnings response at \$800 kink after policy change	Earnings elasticity	Heterogeneous Adjustment costs $\phi = \phi_1 + \alpha\phi_2$	
	b_{10}	Δz_1^*	b_{11}	b_2	Δz_2^*	e	ϕ_1	ϕ_2
Base estimate	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)
A. 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)
B. 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)
C. 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)
D. Location of residence								
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 earnings elasticity with respect to net-of-tax rate and heterogeneous adjustment costs from the static model specified in Section 3.2.1. The bootstrapped standard errors are in the parenthesis.

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

Table 3: Estimated elasticity of earnings and heterogeneous adjustment costs from the dynamic model

	Earnings elasticity	Heterogeneous adjustment costs $\phi(\alpha) = \phi_1 + \alpha\phi_2$	
	e	ϕ_1	ϕ_2
Base estimate	0.161***	18.795***	-0.024***
	(0.013)	(5.326)	(0.012)
A. Age			
18-34	0.150***	32.939***	-0.058***
	(0.005)	(1.651)	(0.003)
35-49	0.150***	17.922***	-0.023***
	(0.003)	(2.165)	(0.004)
B. Gender			
Male	0.156***	28.606***	-0.047***
	(0.017)	(2.865)	(0.008)
Female	0.150***	19.602***	-0.026***
	(0.005)	(2.261)	(0.005)
C. Disability type			
Neurological	0.150***	32.974***	-0.055***
	(0.000)	(4.145)	(0.009)
D. Location of residence			
Metropolitan area	0.225	25.778	-0.032
	(0.167)	(91.841)	(4.15)

Note: This table presents the estimated earnings elasticity with respect to net-of-tax rate and heterogeneous adjustment costs from the dynamic model specified in Section 3.2.2. Each time period represents a three month period; overall 16 time periods in four years including two years before and two years after the policy change. There is not enough variation in bunching for those above 50 years old, those with Psychotic and Mental conditions and those residing in non-metropolitan areas and therefore estimation of a dynamic model is not possible.The estimated probability of drawing a positive adjustment costs π_js are presented in Figure 10. The bootstrapped standard errors are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

Table 4: Estimated income effect of the policy change

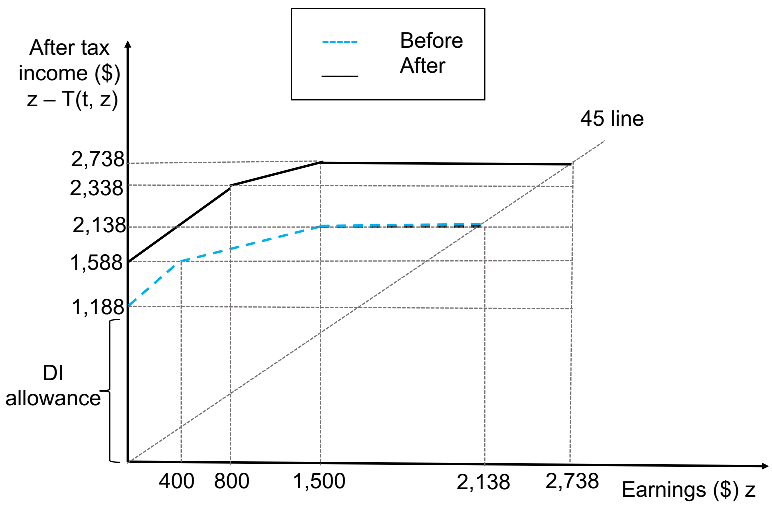
	No dependent				With dependent
	(1)	(2)	(3)	(4)	(5)
AISH × Post	-1.61	4.74***	-4.99	18.97	-4.76
	(1.23)	(1.22)	(12.48)	(10.40)	(11.12)
AISH	44.66***	37.36***	-133.79***	-81.01***	2.21
	(0.81)	(0.83)	(8.23)	(7.19)	(6.67)
Sample	$0 < earnings \leq 300$ 12 months before policy change	$0 < earnings \leq 300$ 6 months before policy change	$earnings \geq 900$ 12 months before policy change	$earnings \geq 900$ 6 months before policy change	$0 < earnings \leq 850$ 6 months before policy change
Individual co-variates	Yes	Yes	Yes	Yes	Yes
Mean in AISH before policy change	138.76 (103.65)	135.59 (118.55)	1,248.98 (421.28)	1,140.49 (492.57)	307.25 (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 presents the estimated effects of the policy change in AISH on labor supply of individuals with dominant income effects from a DD comparison specified in (11). The control group in each column is the corresponding group from ODSP. The included individual co-variates are sex, age, age entered into the DI program, disability type and the location of residence. Robust standard errors are in the parenthesis. Small, negative and insignificant estimates suggest that the income effects of the policy change are negligible.
$*p < 0.10, **p < 0.05, ***p < 0.01$

Figures

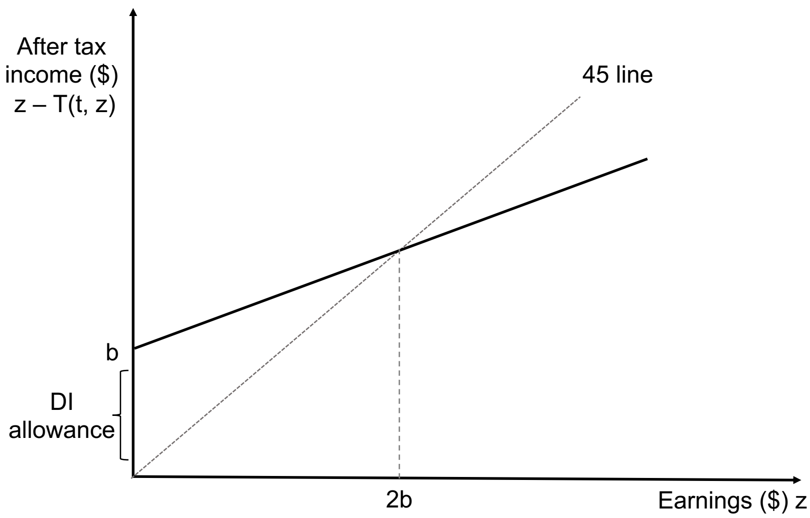
Figure 1: Budget constraints

(a) AISH



Note: This figure plots the budget constraint of AISH beneficiaries with no dependent before and after the policy change.The horizontal axis represents the monthly earnings, and vertical axis is the after tax income. The implicit marginal taxes at each bracket are respectively zero, 50% and 100%.

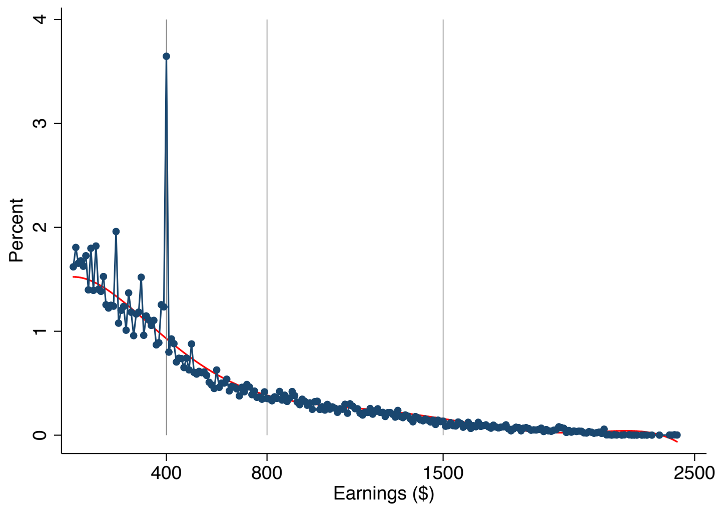
(b) ODSP



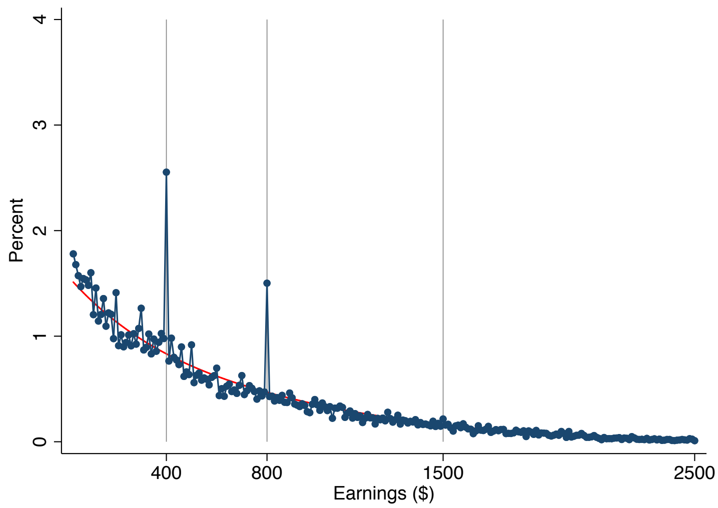
Note: This figure plots the budget constraint of ODSP beneficiaries. The horizontal axis represents the monthly earnings, and the vertical axis is the after tax income. b denotes the monthly DI allowances which depends on the family size; ranging from C$1,086 to C$1,999. The implicit marginal tax on all earnings is 50%.

Figure 2: Distribution of monthly earnings of AISH beneficiaries

(a) Before the policy change



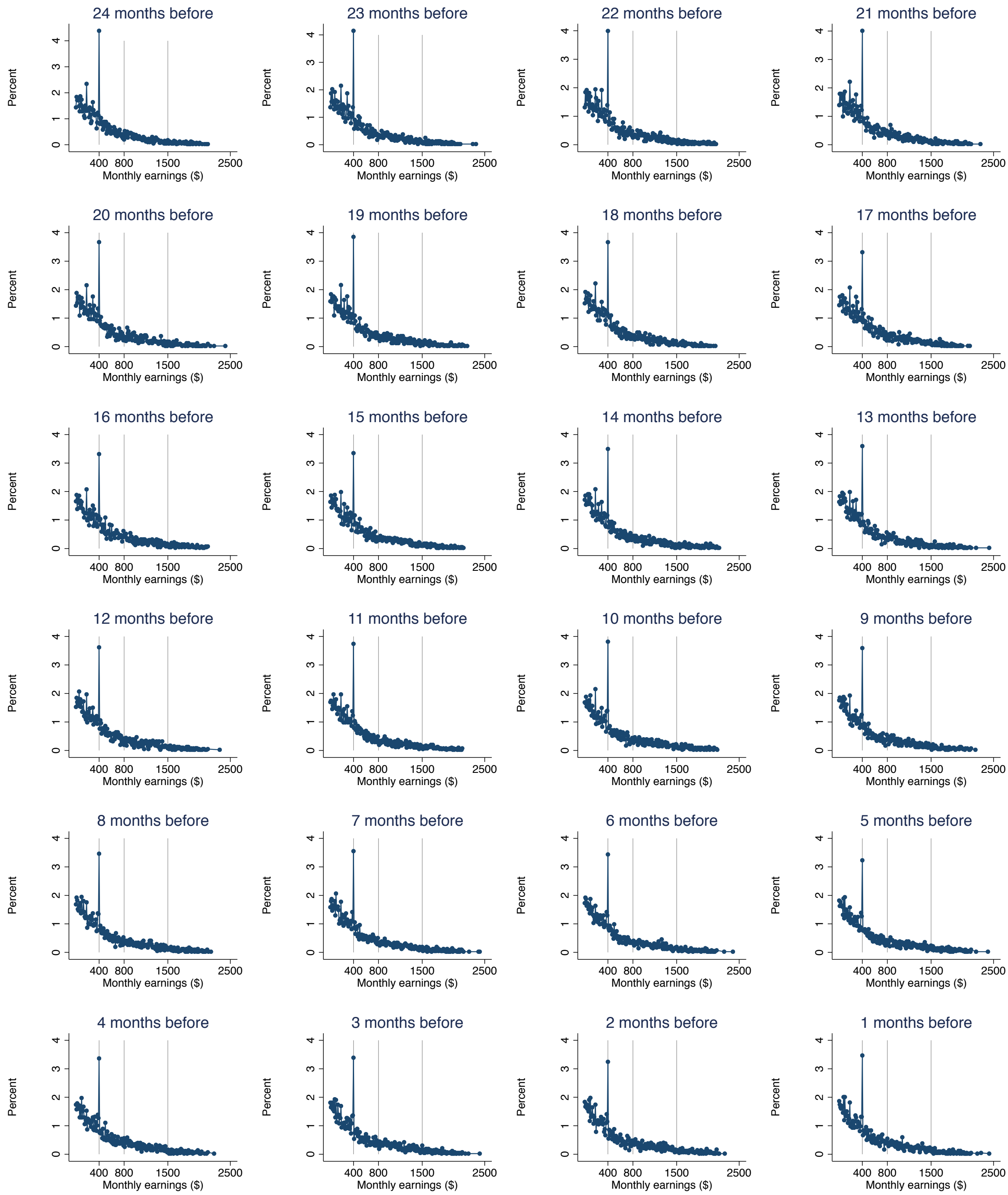
(b) After the policy change



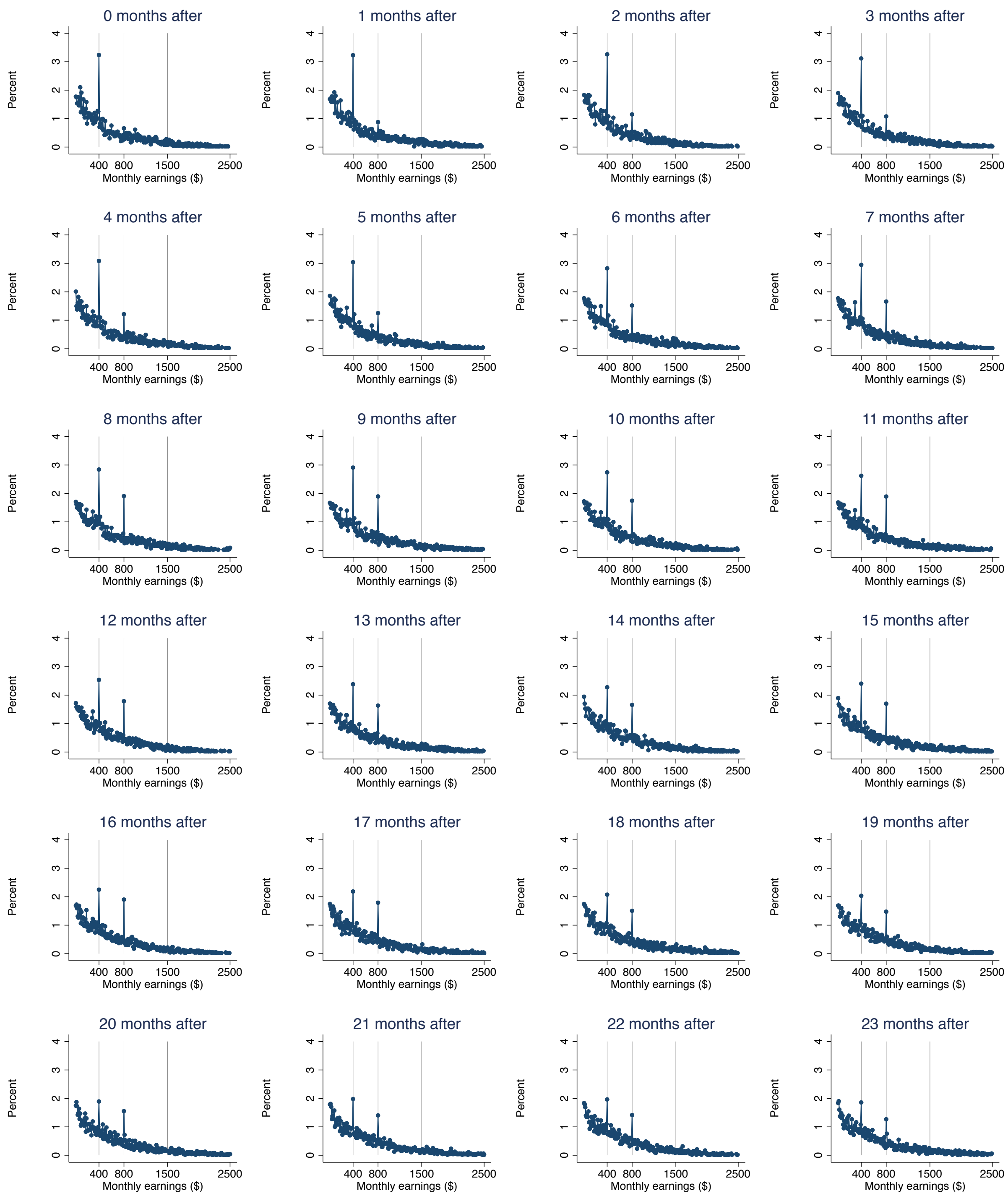
Note: This figure plots the distribution of the monthly earnings of AISH beneficiaries. Panel (a) plots the pooled data from April 2010–March 2012 (“before policy change”) and Panel (b) plots the pooled data from April 2012–March 2014 (“after policy change”). The red line is the fitted polynomial degree $D = 6$ with bin size ($\delta = 10$) and excluding three bins at each side of the kink ($l = u = 3$). There is sharp bunching at the exemption thresholds.

Figure 3: Dynamics of the earnings distribution of AISH beneficiares

(a) Before the policy change



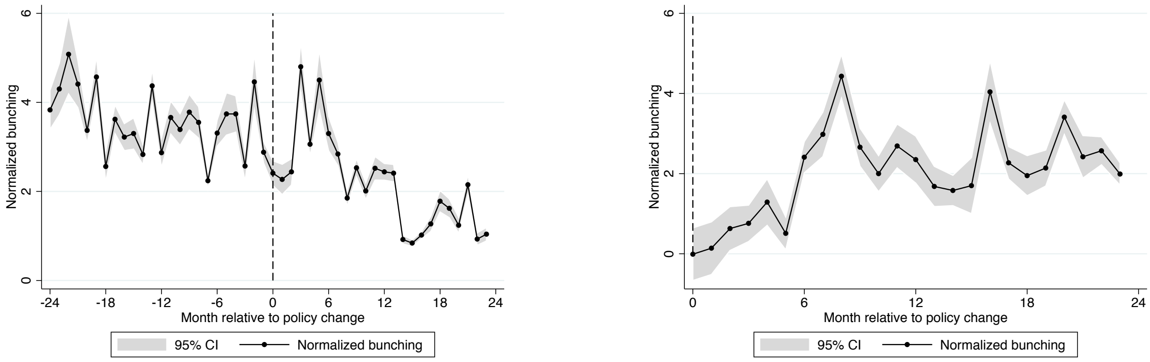
(b) After the policy change



Note: This figure plots the distribution of the monthly earnings of AISH beneficiaries before and after the policy change with bin size $\delta = \$10$. There is bunching at the exemption threshold every month before the policy change. The bunching gradually moves 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 either before or after the policy change.

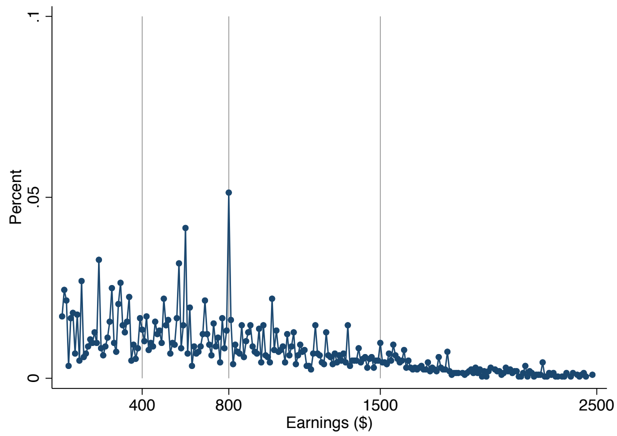
Figure 4: Duynamics of the bunching at the exemption threshoulds

(a) At C$400 exemption threshould (b) At C$800 exemption threshould



Note: This figure plots the estimated bunching at the old and new exemption thresholds by the month relative to the policy change using the procedure explained in Section 4 in Appendix B. The estimation parameters are set to $\delta = 10$, $D = 6$ and $l = u = 3$. Bunching at the C$400 threshold is quite stable before the policy change but then gradually decreases in the months following the policy change. There is no bunching at C$800 before the policy change and the bunching gradually increases in the months following the policy change. The 95% Confidence Intervals (CI) from bootstrapped standard errors are shown in gray.

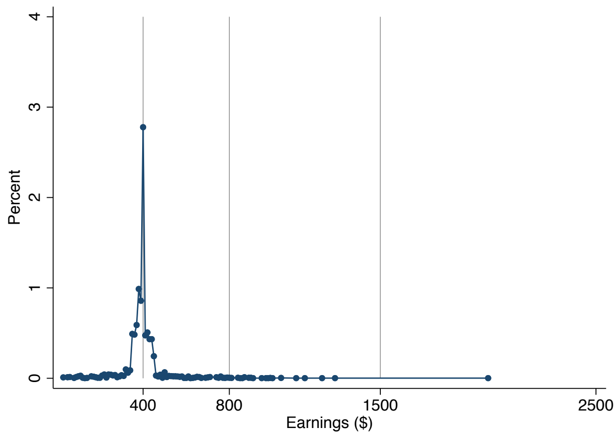
Figure 5: Distribution of monthly earnings of AISH beneficirats who entered into the program after the policy change



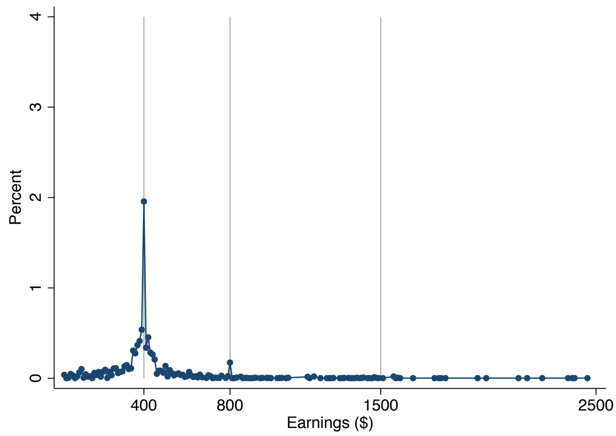
Note: This figure plots the earnings distribution of AISH beneficiaries who entered into the program after the policy change in AISH. No clear bunching at the former exemption threshold suggests that the bunching at the former threshold in Panel (b) of Figure 2 is not caused by thresholds from other programs.

Figure 6: Earnings distribution of individuals bunching at the old exemption threshold

(a) Before policy change



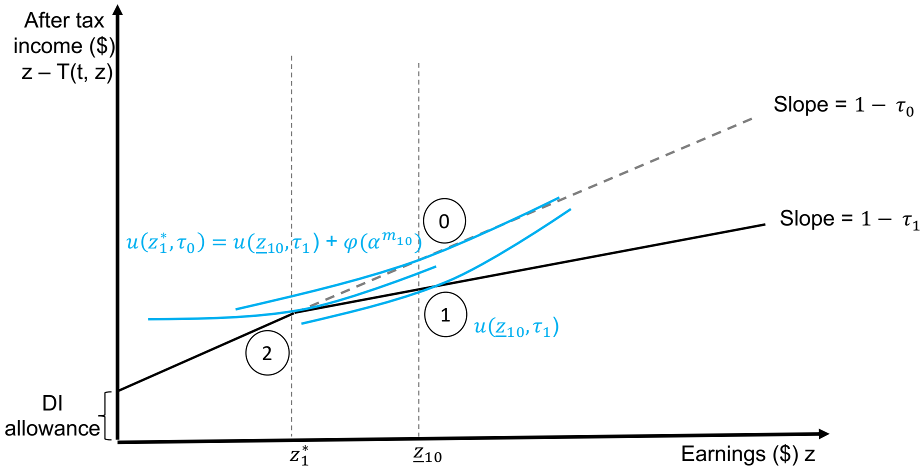
(b) After policy change



Note: This figure plots the earnings distribution of individuals whose earnings during one year prior to the policy change has been between C$350 and C$450 at least 6 times. The figure suggests that individuals who bunch at the former exemption threshold are those who also bunched at the threshold before the policy change.

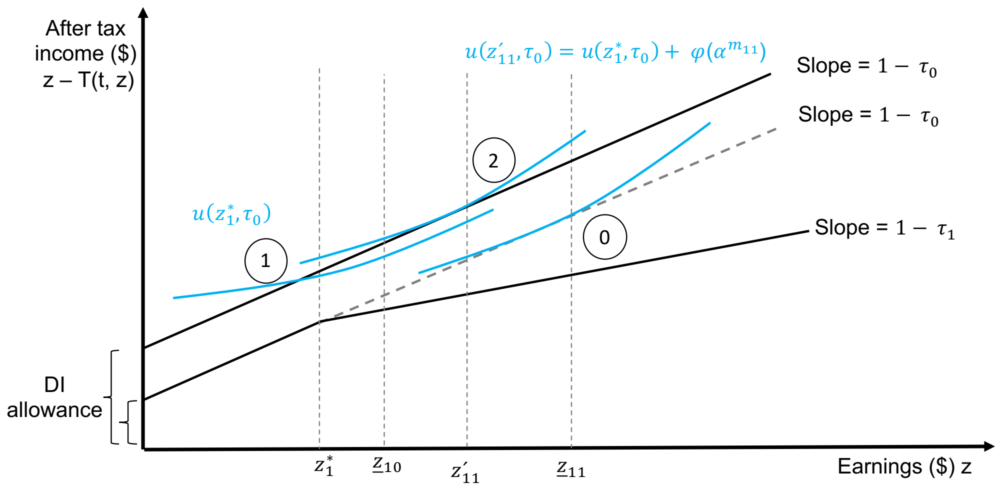
Figure 7: Earnings reponses of marginal buncher

(a) Introducing an exemption threshould



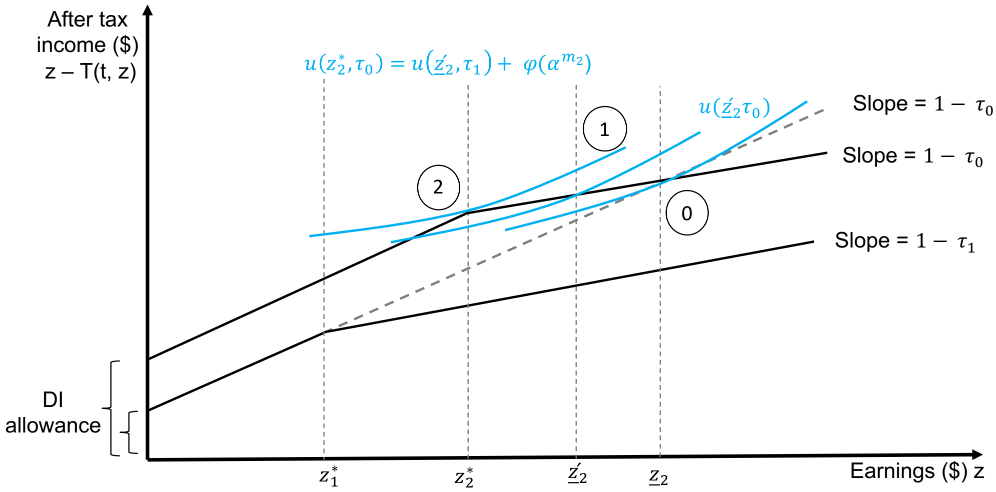
Note: This figure illustrates the change in the earnings of a marginal buncher at the exemption threshold z_1^* with ability $\alpha^{m_{10}}$ and initial earnings $\underline{z}_{10}$. A marginal buncher is indifferent between staying at $\underline{z}_{10}$ with higher marginal taxes or enduring adjustment costs $\phi(\alpha^{m_{10}})$ and bunching at z_1^* with lower marginal taxes.

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



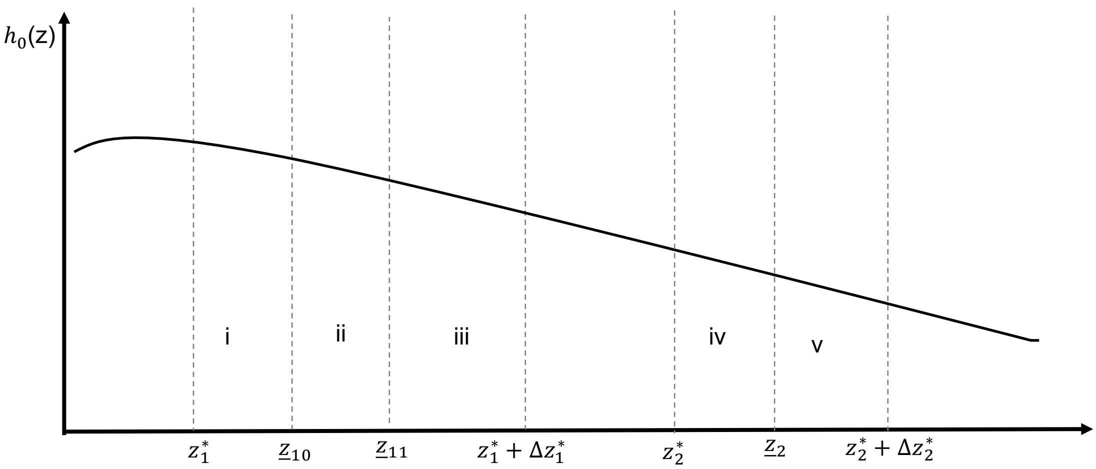
Note: This figure illustrates the change in the earnings of a marginal buncher at the former exemption threshold at z_1^* after the policy change with ability $\alpha^{m_{11}}$ and initial earnings $\underline{z}_{11}$. When the exemption threshold at z_1^* is introduced, the marginal buncher bunches at the threshold. When a policy change increased the exemption threshold to z_2^*, the marginal buncher is indifferent between continuing to bunch at z_1^* or enduring adjustment costs $\phi(\alpha^{m_{11}})$ and increasing her earnings to z'_{11}.

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



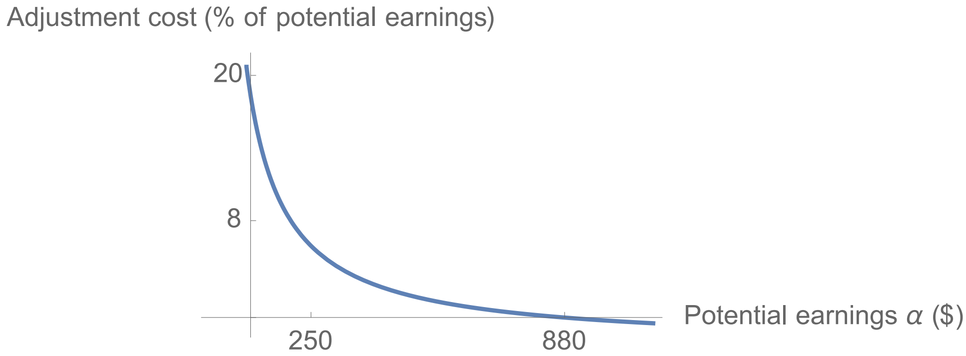
Note: This figure illustrates the change in earnings of a marginal buncher at the new exemption threshold at z_2^* with ability α^{m_2} and initial earnings $\underline{z}_2$. After introducing an exemption threshold at z_1^*, she decreases her earnings to $\underline{z}_2'$. When the exemption threshold is increased to z_2^*, she is indifferent between continuing to bunch at $\underline{z}_2'$ or enduring adjustment costs $\phi(\alpha^{m_2})$ and bunching at z_2^*.

Figure 8: Counter-factual earnings with a flat tax



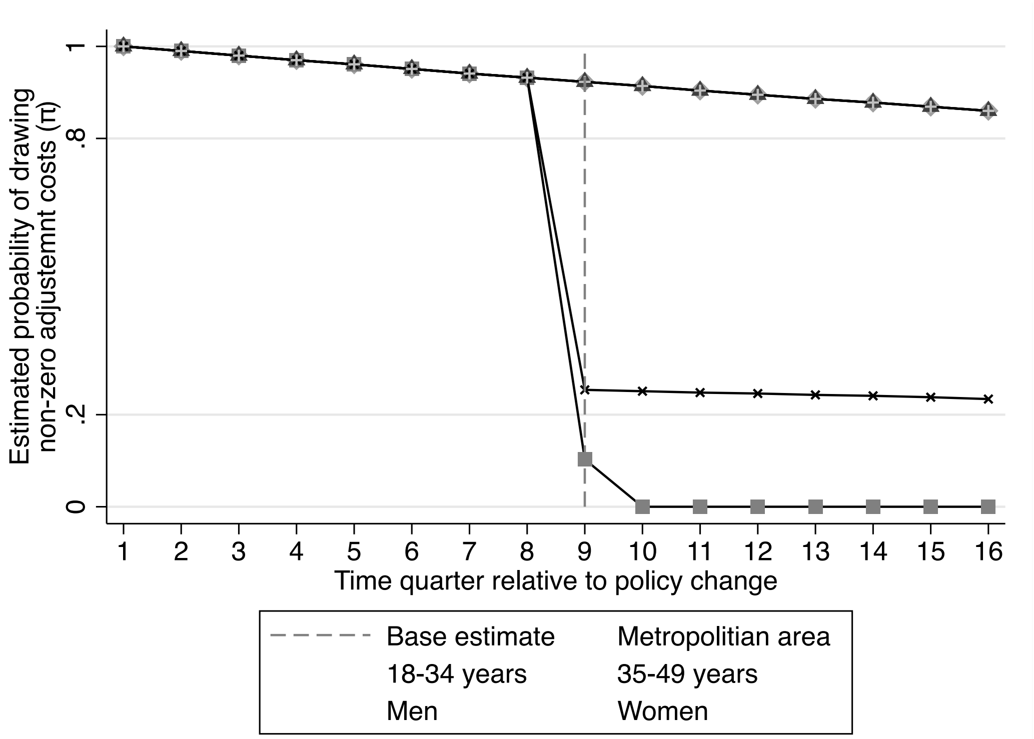
Note: This figure illustrates the counter-factual distribution of earnings and bunching ranges at z_1^* and z_2^* kinks. The bunching range at z_1^* kink in the absence of adjustment costs is $i + ii + iii$. If individuals face adjustment costs the bunching range is decreased to $ii + iii$. Bunching at z_1^* after the policy change which increased the exemption threshold to z_2^* from z_1^* is ii. The bunching ranges at z_2^* kink without and with adjustment costs are respectively $iv + v$ and v.

Figure 9: Estimated heterogeneous adjustment costs



Note: This figure plots the estimated heterogeneous adjustment costs as a percentage of the potential earnings (ability denoted by α) using the model specified in Section 3.2. The estimated parameters are presented in Table 2. The estimated adjustment costs rang from zero to 20% of the potential earnings. The estimated adjustment costs for individuals with average potential earnings of C$250 is about 8% of their monthly earnings.

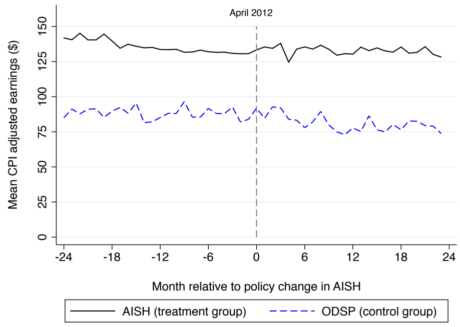
Figure 10: Estimated probabilities of drawing non-zero adjustment costs



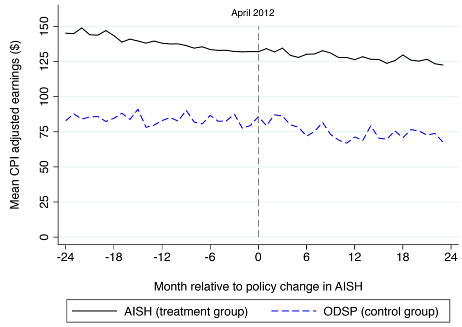
Note: This figure plots the estimated probabilities of drawing non-zero adjustment costs ($\pi_j s$) for sub-samples with enough variation in bunching from the dynamic model specified in Section 3.2.2. The corresponding estimated earnings elasticity and heterogeneous adjustment costs are presented in Table 3.

Figure 11: Trends in monthly earnings of AISH and ODSP beneficiaries with likely dominant income effecsts

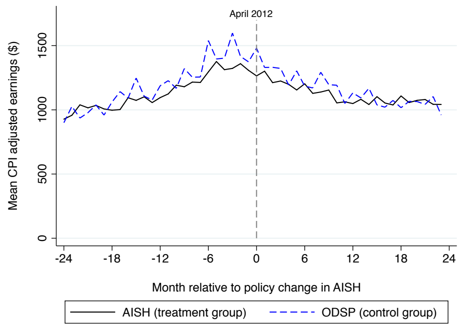
(a) Monthly earnings less than $300 for six months before the policy change



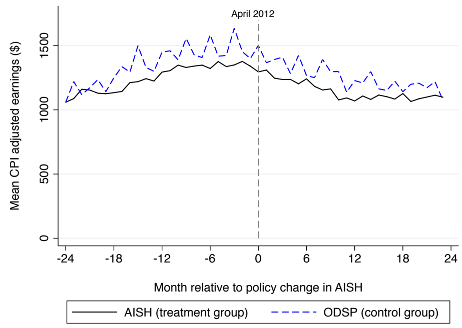
(b) Monthly earnings less than $300 for one year before the policy change



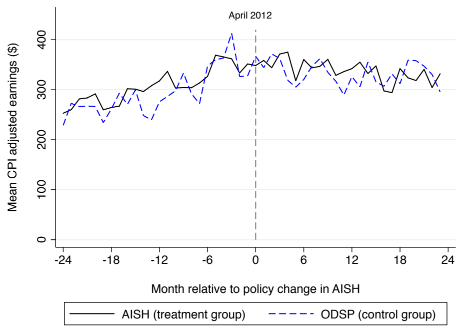
(c) Monthly earnings above $900 for six months before the policy change



(d) Monthly earnings above $900 for one year before the policy change



(e) Monthly eearnings less than $850 for six months before the policy change (with dependent)



Note: This figure plots the trends in the monthly earnings of AISH and ODSP beneficiaries with likely dominant income effects.

Appendix: For on-line publication

A Social assitance programs in Canada

Federal programs The Federal Government of Canada provides a wide range of social assistance programs including 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).[24]

AISH Verification of the financial assets of the benefit recipients in AISH is based on an honour system. Each benefit recipient must declare any monetary assets (i.e., saving accounts, bonds) by submitting a monthly bank statement of the banking account into which their DI allowance is deposited. Once individuals enter into the program, there is no limit on how much they can work. Most of the AISH beneficiaries are not eligible for the Federal DI program. The health benefits of AISH include a bi-yearly dental check-up and cleaning, one routine eye exam and a new pair of eyeglasses every two years, essential diabetic supplies for those who require a special diet (C$41), ambulance service and Alberta Aides to Daily Living (AADL).[25]

After Alberta's 2012 provincial election, the new premier of Alberta decided to shift the ministry responsible for AISH program from Seniors (which it is now part of the new Health ministry) to the new Human Services ministry, and implement the new policy in AISH. In July 2008 the second earnings threshold in AISH was increased by C $500 to C$1,500 for DI recipients with no dependent and to C$2,500 for those with dependent.

In addition to AISH, the Provincial Government of Alberta 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).[26]

ODSP The ODSP did not have an exemption threshold from 2006 to 2013 (the period of my analysis) and all earnings were subject to an implicit 50% marginal taxes. An exemption threshold of $200 for monthly earnings was introduced in September 2013. Earnings above the exemption threshold are still subject to 50% marginal tax rate.[27]

[24] For more information on federal government's DI programs see: `http://www.fcac-acfc.gc.ca/Eng/forConsumers/lifeEvents/livingDisability/Pages/Federalp-Prestati.aspx`, Accessed on Feb 29, 2016. For more information on provincial DI programs see, `http://www.fcac-acfc.gc.ca/Eng/forConsumers/lifeEvents/livingDisability/Pages/Resource-Ressourc.aspx`, Accessed on Feb 29, 2016.

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

[26] More information on Alberta's DI programs: `http://www.humanservices.alberta.ca/disability-services/pdd.html`, Accessed at May 26, 2016.

[27] 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.

B Adjustment costs

B.1 A conceptual framework

In this section using a model borrowed from Chetty et al. (2011), I show how adjustment costs might affect individuals' labor supply decisions when a policy change increases work incentives.

Assume that individuals with ability α choose their earnings z to maximize their utility $u(c, z; \alpha)$. c denotes consumption which is net-of-tax earnings $z - T(z; \tau)$ and DI allowance b added together and 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 an 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 B.1 illustrates an individual with initial earnings at z^* and ability α. If she does not face any adjustment costs when changing her earnings, she increases her earnings to z'.

Suppose now that individuals face adjustment costs when changing their earnings. Adjustment cost 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 B.1 illustrates an individual with initial earnings z^* in $(\underline{z}, \bar{z})$ around z^* where $\underline{z}$ and $\bar{z}$ are described as below who might not change their earnings in response to the tax reduction above the kink:

$$u(c, z^*; \alpha) - u(c, \underline{z}; \alpha) = \phi(\alpha) \quad \text{with } \underline{z} < z^* \tag{B.1}$$

$$u(c, z^*; \alpha) - u(c, \bar{z}; \alpha) = \phi(\alpha) \quad \text{with } \bar{z} > z^* \tag{B.2}$$

For individuals who do not adjust their earning, the utility gain from increasing earnings is not large enough to offset the adjustment costs. Those with initial earnings above $\bar{z}$ might increase their earnings as their utility gain might offset the adjustment costs that they face.

Panel (c) of Figure B.1 illustrates a case where the monthly DI allowance is increased by ψ in addition to a reduction in the marginal tax rate above z^*. If the income effects of the policy change are negligible, then increases in the allowance might offset the adjustment costs and therefore more people might increase their earnings.[28]

This simple framework illustrates that work incentives induced by a policy change would result in an increase in labor supply only if the induced work incentives are large enough to offset the adjustment costs.

B.2 A model with no adjustment costs

I begin with a model with no adjustment costs, which is a base for my model with heterogeneous adjustment costs (Saez, 2010). This model explores an assumed proportional relationship between earnings elasticity and bunching at a kink. It assumes that individuals differ only in their ability to work, denoted by α, and choose their earnings z to maximize their iso-elastic utility specified in (10).[29]

The utility maximizer level of earnings for an individual with ability α under a linear marginal tax τ_0 is $z_\alpha = \alpha(1 - \tau_0)^e$. Setting $\tau_0 = 0$ implies $z_\alpha = \alpha$, denoting ability as potential (counter-factual) earnings. Ability is the only source of heterogeneity in the model which is

[28] In Section 5, I provide evidences from DD analysis suggesting that income effects of the policy change in AISH are negligible.

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

assumed to have a smooth distribution; implying a smooth distribution of earnings with linear taxes.

There is a kink at z^* when the marginal tax on earnings above z^* is increased to τ_1 from τ_0. The smooth distribution of ability implies that individuals with ability $\alpha \in [\frac{z^*}{(1-\tau_0)^e}, \frac{z^*}{(1-\tau_1)^e}]$ who would have located in the bunching range $(z^*, z^* + \Delta z^*]$ in the absence of the kink, bunch in a neighbourhood of z^*. Δz^* is the earnings response range at the z^* and is defined as:

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

Suppose $h_0(.)$ is the counter-factual distribution of earnings (without a kink at z^*). Bunching at z^* denoted by B^* is the area under the counter-factual distribution of earnings in the bunching range. Assuming that $h_0(.)$ in the bunching range is uniform:

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

Section B.3 in Appendix B provides a method to estimate counter-factual earnings and bunching at a kink. Δz^* and B^* together define an earnings elasticity as $e = \frac{\Delta z^*/z^*}{(\tau_1-\tau_0)/(1-\tau_0)}$. I estimate earnings elasticities from this model with no adjustment costs to illustrate how they differs from estimates form my model with heterogeneous adjustment costs. More details on empirical implementation are presented in Section B.4 and the estimates are presented in Table B.2 in Appendix B.

B.3 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 empirical distribution of earnings $h(.)$, excluding an eye ball picked range around the kink. I first divide the observed monthly earnings into z_i bins with width δ where p_i is portion of individuals with earnings in the 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 of $Q = [Q^l, Q^u]$ of z^* by estimating the following regression:

$$p_i = \sum_{d=0}^{D} \beta_d (z_i - z^*)^d + \sum_{j=-l}^{l} \gamma_j \mathbb{1}\{z_i - z^* = \delta j\} + \epsilon_i \tag{B.5}$$

where $\mathbb{1}(.)$ is the indicator function denoting dummies for the bunching bins around the kink in the range of $[z^* - \delta l, z^* + \delta u]$. 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 isolate the effects of the bunching bins on the estimated counter-factual distribution of earnings. The estimated $h_0(.)$ is the fitted value from (B.5) where the contribution of the bunching bins around the kink is excluded and is defined as $\widehat{p_i} = \sum_{d=0}^{D} \beta_d (z_i - z^*)^d$. An initial estimate of bunching at z^* is:

$$B = \delta \sum_{j=l}^{u} (p_j - \widehat{p_j}) = \delta \sum_{j=l}^{u} \gamma_j \tag{B.6}$$

However (B.6) 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 had 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. I also shift the estimated counter-factual earnings distribution around the new kink at z_2^* to the left. To do this, I estimate the following equations recursively where n denotes the iteration counter:

$$\begin{aligned} p_i \cdot (1 + \mathbb{1}\{i > u_1\} \frac{\widehat{B}_1^{n-1}}{\sum_{q>u_1} p_q}) &= \sum_{d=0}^{D} \beta_d^n (z_i - z_1^*)^d + \sum_{j=l_1}^{u_1} \gamma_j^n \mathbb{1}\{z_i - z_1^* = \delta j\} + \epsilon_i \\ p_i \cdot (1 + \mathbb{1}\{i < l_2\} \frac{\widehat{B}_2^{n-1}}{\sum_{q<l_2} p_q}) &= \sum_{d=0}^{D} \beta_d^n (z_i - z_2^*)^d + \sum_{j=l_2}^{u_2} \gamma_j^n \mathbb{1}\{z_i - z_2^* = \delta j\} + \epsilon_i \end{aligned} \tag{B.7}$$

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 $B^n = \delta \sum_{j=l}^{u} (p_j - \widehat{p}_j) = \delta \sum_{j=l}^{u} \gamma_j^n$. The estimated counter-factual distribution of earnings at z^* using (B.7) is $h_0(z)$:

$$\begin{aligned} h_0(z) &= \sum_{d=0}^{D} \beta_d (z - z^*)^d \\ h_0(z^*) &= \beta_0 \end{aligned} \tag{B.8}$$

I normalize the estimated bunching B by dividing it by the counter-factual mass at z^* bin from (B.8) to obtain a comparable measure of bunching within the kinks. The normalized bunching b at z^* is defined as:

$$\widehat{b} = \frac{B}{\delta h_0(z^*)} = \frac{B}{\delta \beta_0} \tag{B.9}$$

B.4 Emprical implementation of the models

Model with no adjustment costs (Saez, 2010):

I use the method explained in Section B.3 to estimate bunching at the kink. I fit a degree 6 ($D = 6$) polynomial to the binned distribution of earnings ($\delta = \$10$) around the kink excluding three bins on each side of the kink ($l = u = 3$) using the regression specified in (B.7). Panel (**??**) of Figure **??** plots the fitted polynomial. I then estimate the bunching at the kink from (B.6). I back up Δz_1^* from (B.4) by feeding in the estimated B and $h_0(z_1^*)$. Substituting Δz^* in $e = \frac{\Delta z^*/z^*}{(\tau_1 - \tau_0)/(1-\tau_0)}$ results into the elasticity of earnings with respect to net-of-tax at the kink defined as below where τ_0 and τ_1 denote the marginal tax rates below and above the kink.

$$e = \frac{\ln(1 + \frac{\delta b}{z_1^*})}{\ln(\frac{1-\tau_0}{1-\tau_1})} \tag{B.10}$$

I use the distribution of earnings pooled from March 2010 to March 2012 around the exemption threshold at $z_1^* = \$400$ to estimate earnings elasticity with no adjustment costs. I estimate the standard errors using the method explained in Section 4.2 to make an inference about the estimations. The estimates are presented in Table B.2.

Model with fixed adjustment costs (Gelber et al., 2019):

Assume that individuals with initial earnings in the range of $(\underline{z}_{10}, z_1^* + \Delta z_1^*]$ bunch at the z_1^* kink with marginal taxes of τ_0 and τ_1 respectively below and above the kink. $\underline{z}_{10}$ is the utility maximizing earnings of a marginal buncher at z_1^* with ability $\alpha^{m_{10}}$. A marginal buncher at z_1^* kink is indifferent between staying at $\underline{z}_{10}$ where marginal taxes on the earnings are higher or enduring utility loss $\phi > 0$ and bunching at z_1^*. Using the utility function specified in (10) and the utility maximizing level of earnings $z_\alpha = \alpha(1-\tau)^e$:

$$\alpha^{m_{10}} = \frac{\underline{z}_{10}}{(1-\tau_0)^e} \tag{B.11}$$

Substituting (B.11) into (1) using the utility function specified in (10) results in an equation which implicitly defines $\underline{z}_{10}$ as a function of the elasticity of earnings e and adjustment costs ϕ:

$$(1-\tau_1)(\underline{z}_{10} - z_1^*) - \frac{1-\tau_0}{1+\frac{1}{e}}\left(\underline{z}_{10} - {z_1^*}^{1+\frac{1}{e}}\, \underline{z}_{10}^{-\frac{1}{e}}\right) + \phi = 0 \tag{B.12}$$

I use the distribution of earnings pooled from March 2010 to March 2012 (before the policy change) around the exemption threshold at $z_1^* = \$400$ to estimate bunching at the kink (B_{10}) using the method presented in Section B.3. I set the parameters as $\delta = \$10, D = 6, l = u = 3$. Feeding Δz_{10}^* from (B.3) and the estimated B_{10} into (2) results in:

$$\underline{z}_{10} = \left(\frac{1-\tau_0}{1-\tau_1}\right)^e z_1^* - \delta b_{10} \tag{B.13}$$

where b_{10} is defined in (B.9). Together (B.12) and (B.13) describe an equation of e and ϕ.

I also use bunching at z_1^* after the policy change to construct another equation of e and ϕ. Assume that individuals with initial earnings in the range of $(\underline{z}_{10}, \underline{z}_{11}]$ continue bunching at the former kink at z_1^*. $\underline{z}_{11}$ is the initial earnings of a marginal buncher at z_1^* with ability $\alpha^{m_{11}}$ defined below. A marginal buncher is indifferent between bunching at z_1^* or enduring adjustment costs ϕ and relocating to their utility maximizing level of earnings at $\underline{z}'_{11}$.

$$\alpha^{m_{11}} = \frac{\underline{z}_{11}}{(1-\tau_0)^e} \tag{B.14}$$

Feeding (B.14) into (3) using the utility function specified in (10) results in:

$$(1-\tau_0)\left(z_1^* - \frac{1}{1+\frac{1}{e}}\underline{z}_{11}^{-\frac{1}{e}}{z_1^*}^{1+\frac{1}{e}} - \frac{\underline{z}_{11}}{1+e}\right) + \phi = 0 \tag{B.15}$$

I use the distribution of earnings pooled from April 2012 to March 2014 (after the policy change) around the exemption threshold at $z_1^* = \$400$ to estimate bunching at the kink (B_{11}) using the method presented in Section B.3. I set the parameters as $\delta = \$10, D = 6, l = u = 3$. Panel (**??**) of Figure **??** shows the fitted polynomial. Feeding Δz_{11}^* from (B.3) and the estimated B_{11} into (4) results in:

$$\underline{z}_{11} = \underline{z}_{10} + \delta b_{11} \tag{B.16}$$

where b_{11} is defined in (B.9). Together (B.15) and (B.16) describe another equation of e and ϕ. I solve (B.12) , (B.13), (B.15) and (B.16) numerically to pin down the earnings elasticity e and fixed adjustment costs ϕ. I use the method explained in Section 4.2 to estimate standard errors and make an inference about the estimated parameters. The estimations are presented in Table B.3.

Model with heterogeneous adjustment costs:

Suppose that after the policy change which increased the exemption threshold from z_1^* to z_2^*, individuals with initial earnings in the range of $(\underline{z}_2, z_2^* + \Delta z_2^*]$ bunch at the $z_2^* = \$800$ kink where $\underline{z}_2 > z_2^*$. The marginal taxes below and above the kink are respectively τ_0 and τ_1. $\underline{z}_2$ is the initial earnings of a marginal buncher at z_2^* with ability α^{m_2} who is indifferent between staying at her optimal earnings before the policy change at $\underline{z}_2'$ or enduring adjustment costs ϕ and bunching at z_2^*. Since $\underline{z}_2$ is the utility maximizing earnings of a marginal buncher with flat tax τ_1, then using the utility function specified in (10) and the utility maximizing level of earnings $\underline{z}_2 = \alpha^{m_2}(1-\tau_0)^e$:

$$\alpha^{m_2} = \frac{\underline{z}_2}{(1-\tau_1)^e} \tag{B.17}$$

Feeding (B.17) into (5) using the utility function specified in (10) results into an equation which implicitly defines $\underline{z}_2$ as a function of the earnings elasticity e and adjustment costs ϕ:

$$(1-\tau_1)\left(\frac{\underline{z}_2}{1+e}\left(\frac{1-\tau_1}{1-\tau_0}\right)^e - z_2^*\right) + \frac{1-\tau_0}{1+\frac{1}{e}}\left(\underline{z}_2^{-\frac{1}{e}} z_2^{*1+\frac{1}{e}}\right) + \phi = 0 \tag{B.18}$$

I use the distribution of earnings pooled from April 2012 to March 2014 (after the policy change) around the exemption threshold at $z_1^* = \$800$ to estimate bunching at the kink (B_2) using the method presented in Section B.3. I set the parameters as $\delta = \$10, D = 6, l = u = 3$. Panel (**??**) of Figure **??** shows the fitted polynomial. Feeding Δz_2^* from (B.3) and the estimated B_2 into (6) results in:

$$\underline{z}_2 = \left(\frac{1-\tau_0}{1-\tau_1}\right)^e z_2^* - \delta b_2 \tag{B.19}$$

where b_2 is defined in (B.9). Together (B.18) and (B.19) define another equation of e and ϕ. I assume a linear adjustment costs as $\phi = \phi_1 + \alpha\phi_2$ that vary by individuals' ability α. I solve (B.12), (B.13), (B.15) and (B.16) numerically to pin down the earnings elasticity e and two parameters of the adjustment costs ϕ_1 and ϕ_2. I use the method explained in Section 4.2 to estimate standard errors and make an inference about the estimated parameters. The estimations are presented in Table 2.

B.5 Tables

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

Bin size ($)	Degree of fitted polynomial	Number of excluded bins at each side	Bunching at $400 kink before policy change	Bunching at $400 kink after policy change	Bunching at $800 kink after policy change
δ	D	$l = u$	b_{10}	b_{11}	b_2
			Panel A: Base 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 of fitted polynomial		
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 the number of 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 bunching at the kinks to the selected parameters using the procedure explained in Section 4 in Appendix B. The selected parameters include the bin size, degree of the fitted polynomial and the number of excluded 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 earnings elasticity with no adjustemnt costs

	Bunching b	Earnings response Δz^*	Earnings elasticity e
Base estimate	2.920***	29.000***	0.100***
	(0.209)	(2.274)	(0.008)
A. 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)
B. 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)
C. 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)
D. Location of residence			
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 earnings elasticities with respect to net-of-tax rate with no adjustment costs (Saez, 2010).The bootstrapped standard errors are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

Table B.3: Estimated earnings elasticity with fixed adjustment costs

	Bunching at \$400 kink before policy change b_{10}	Earnings response at \$400 kink before policy change Δz^*_{10}	Bunching at \$400 after policy change b_{11}	Earnings elasticity e	Adjustment costs ϕ
Base estimate	2.920***	62.605***	1.950***	0.210***	11.933***
	(0.209)	(6.028)	(0.110)	(0.019)	(0.972)
A. 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)
B. 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)
C. 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)
D. Location of residence					
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)

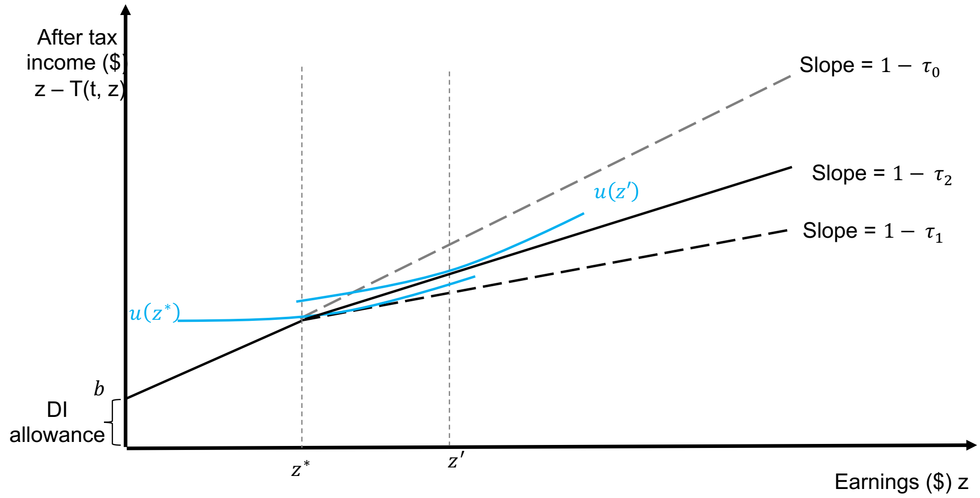
Note: This table presents the estimated earnings elasticities with respect to net-of-tax ratio with fixed adjustment costs (Gelber et al., 2019). The bootstrapped standard errors are in the parenthesis.

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

B.6 Figures

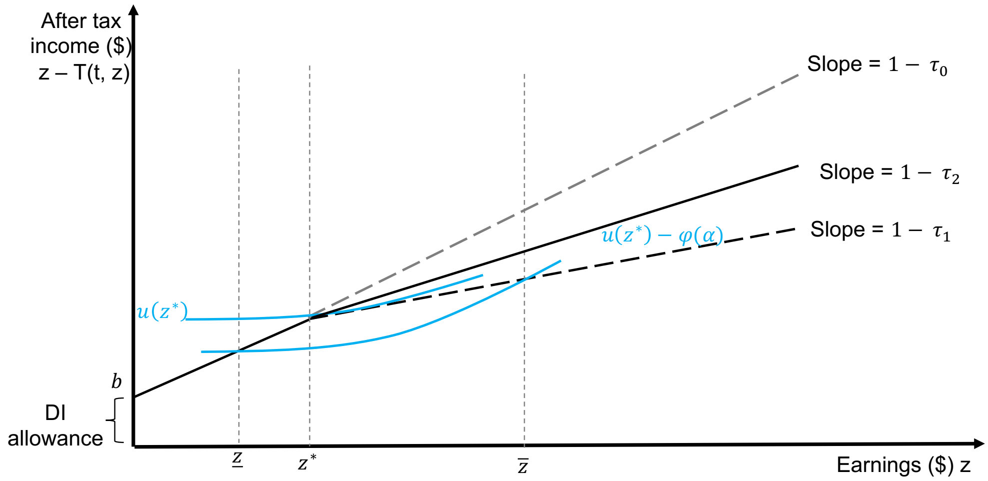
Figure B.1: Earnings responses and adjustment costs

(a) No adjustment costs



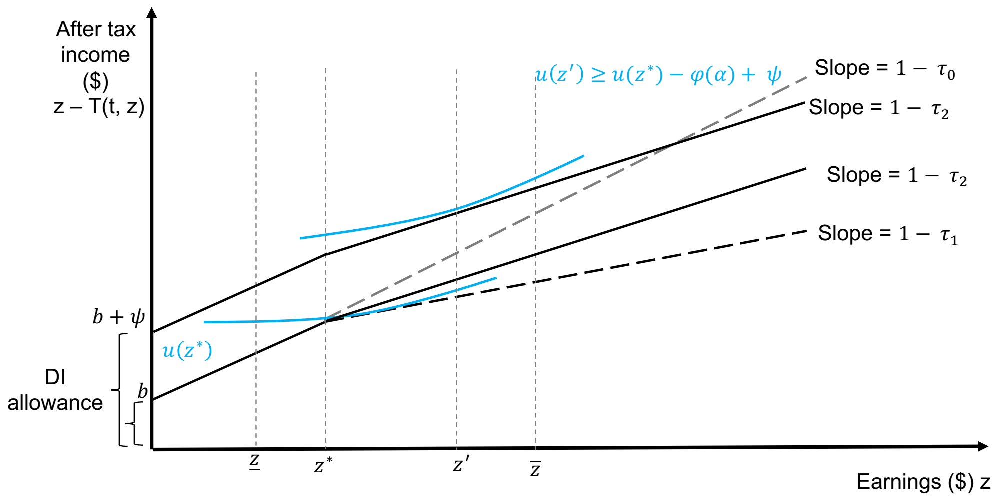
Note: This figure illustrates the changes in the earnings around the z^* kink where individuals face no adjustment costs when changing their earnings in response to a policy change which decreased the the marginal tax rate above the kink to τ_2 from τ_1. Then individuals with initial earnings at z^* increase their earnings to z' to obtain higher utility.

(b) With adjustment costs



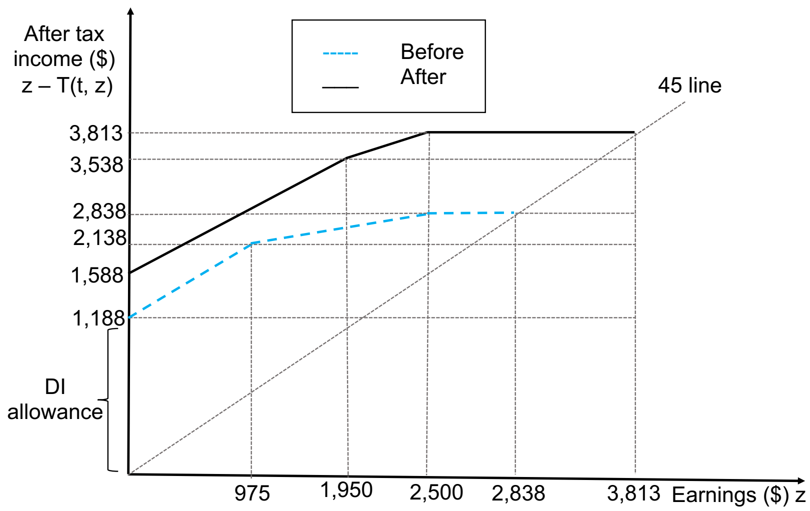
Note: This figure illustrates change in the earnings around the z^* kink where individuals with ability α face adjustment costs $\phi(\alpha) > 0$ when changing their earnings in response to a policy change which decreased the the marginal tax rate above the kink to τ_2 from τ_1. Individuals with earnings in the range of $[\underline{z}, \bar{z}]$ do not increase their earnings since the increase in their utility is not larger than the adjustment costs. $\underline{z}$ and $\bar{z}$ are defined in (B.1).

(c) With adjustment costs and increase in the allowances



Note: This figure illustrates changes in the earnings around the z^* kink where individuals with ability α face adjustment costs $\phi(\alpha) > 0$ when changing their earnings in response to a policy change which decreased the the marginal tax rate above the kink to τ_2 from τ_1. If the policy change also increases the DI allowances by ψ, then individuals with earnings in the range of $[\underline{z}, \bar{z}]$ increase their earnings if their utility gain is larger than adjustment costs. $\underline{z}$ and $\bar{z}$ are defined in (B.1).

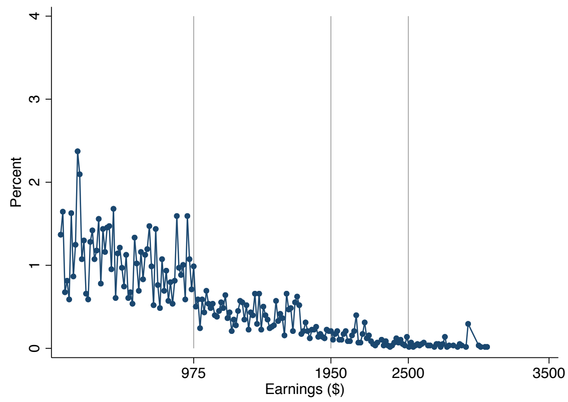
Figure B.2: Budget constraints of AISH beneficiaries with dependent



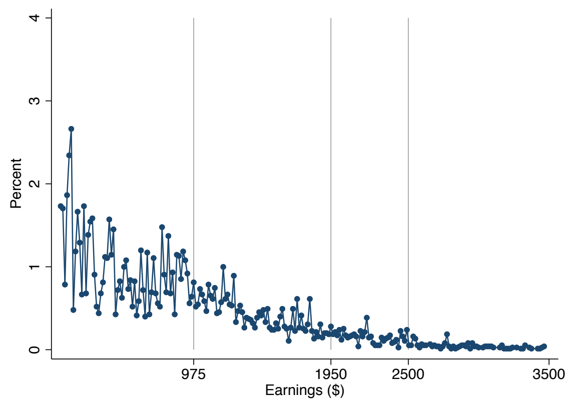
Note: This figure illustrates the budget constraints of AISH beneficiaries with dependent before and after the policy change. The horizontal axis represents the monthly earnings, and vertical axis is the after tax income. The implicit marginal taxes at each bracket are respectively zero, 50% and 100%.

Figure B.3: Distribution of monthly earnings of AISH beneficiaries with dependent

(a) Before the policy change



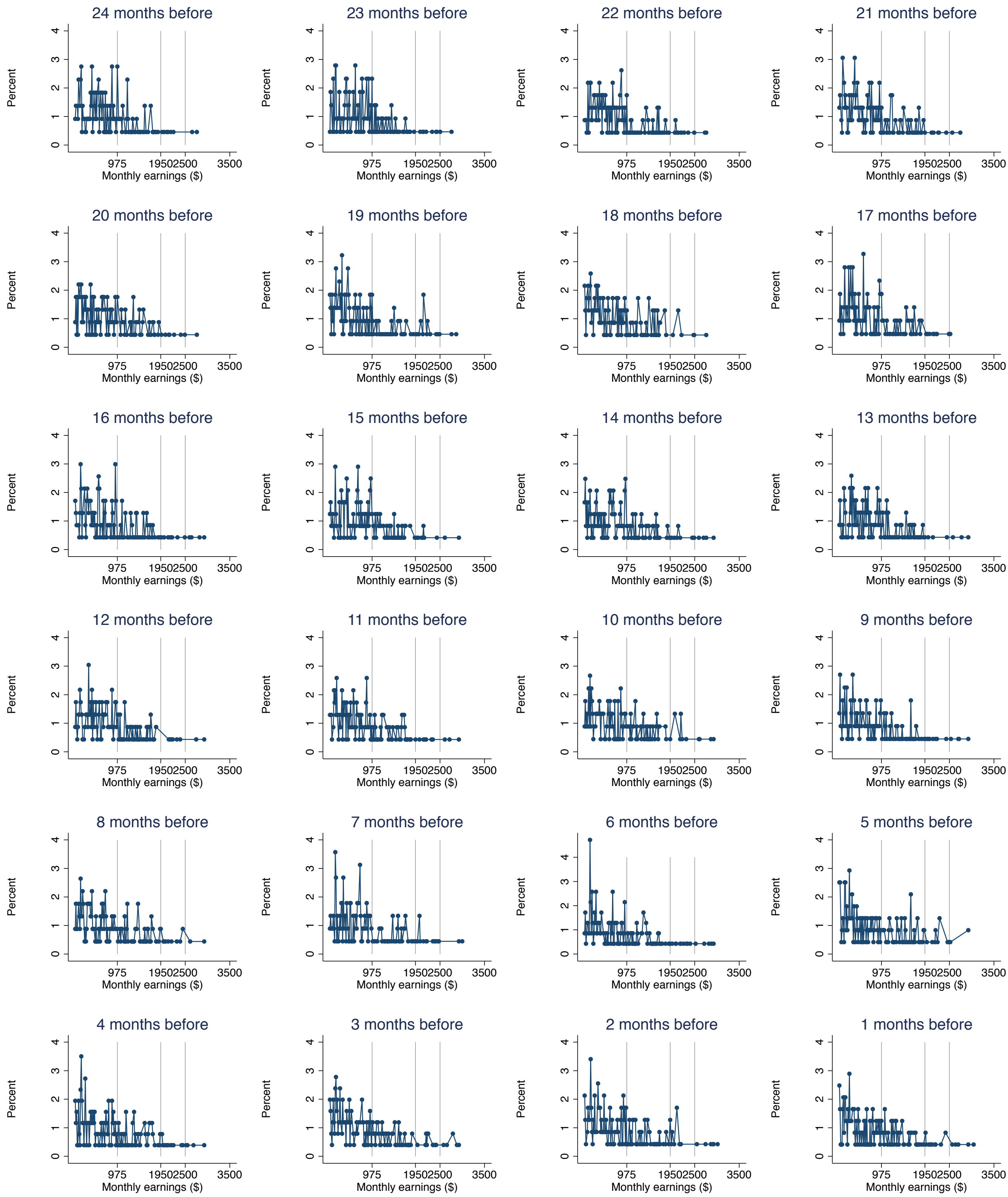
(b) After the policy change



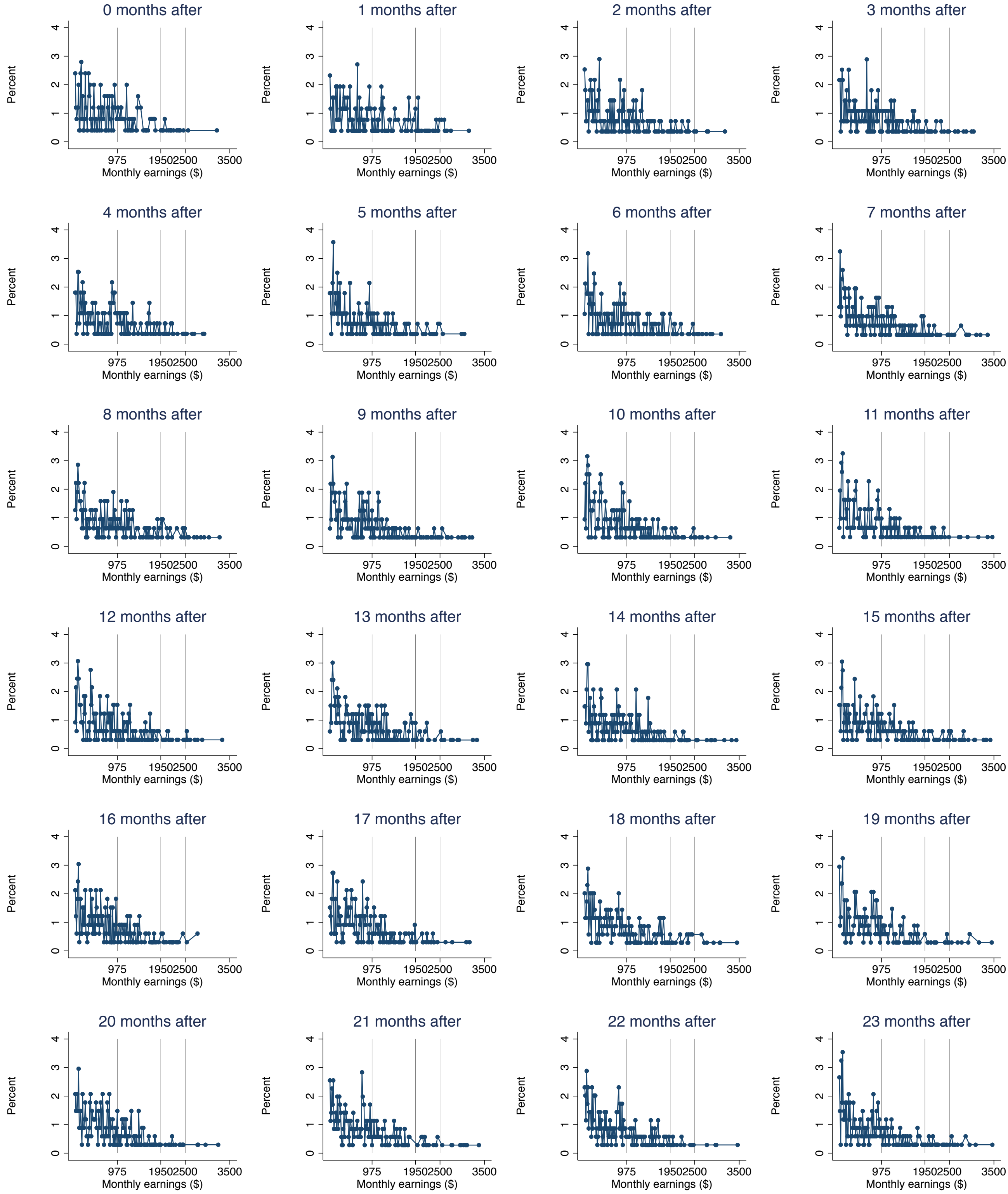
Note: This figure plots the distribution of the monthly earnings of AISH beneficiaries with dependent. Panel (a) plots the pooled data from April 2010–March 2012 (“before policy change”) and Panel and (b) plots the pooled data from April 2012–March 2014 (“after policy change”).

Figure B.4: Dynamics of the earnings distribution of AISH beneficiares with dependent

(a) Before the policy change



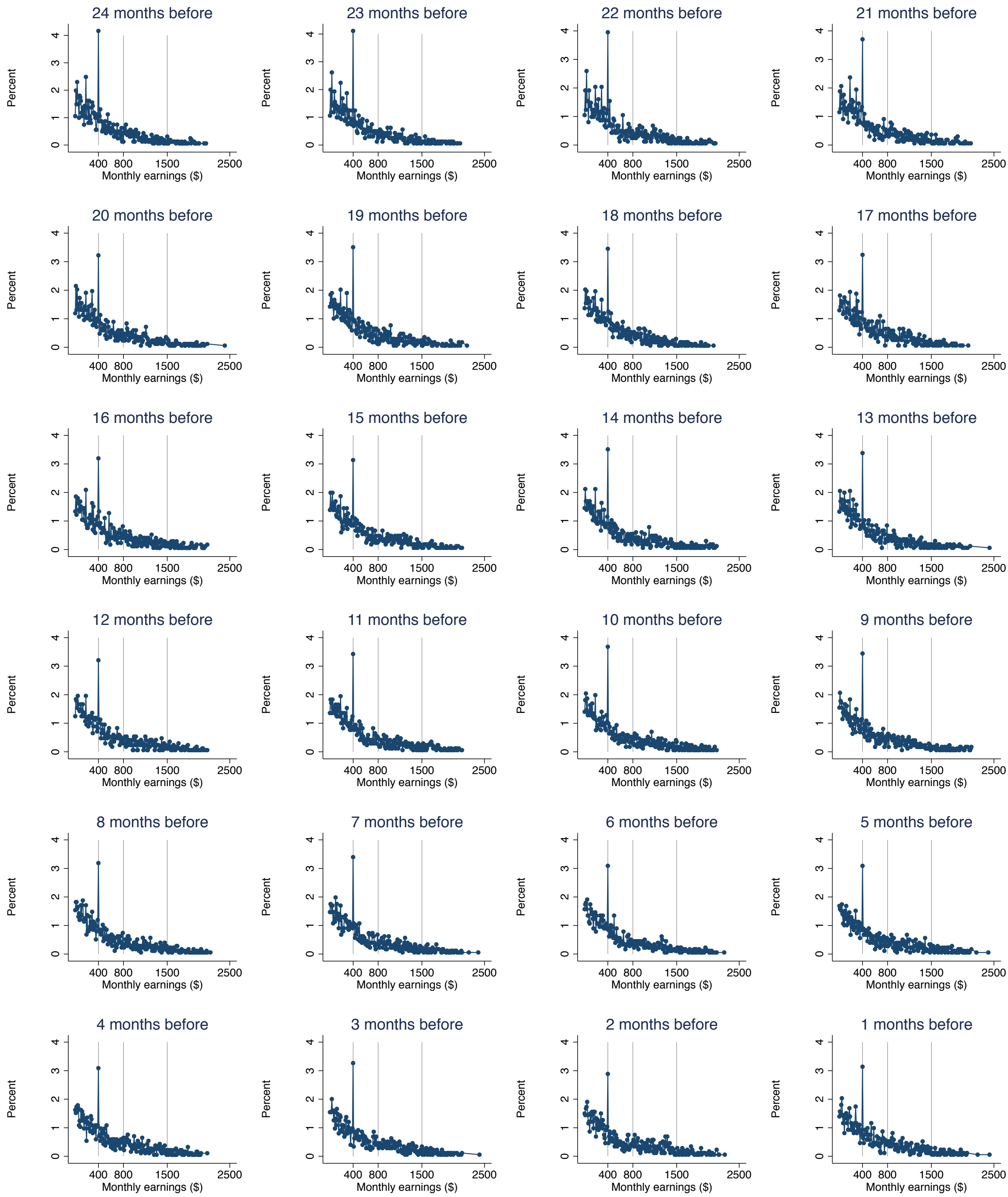
(b) After the policy change



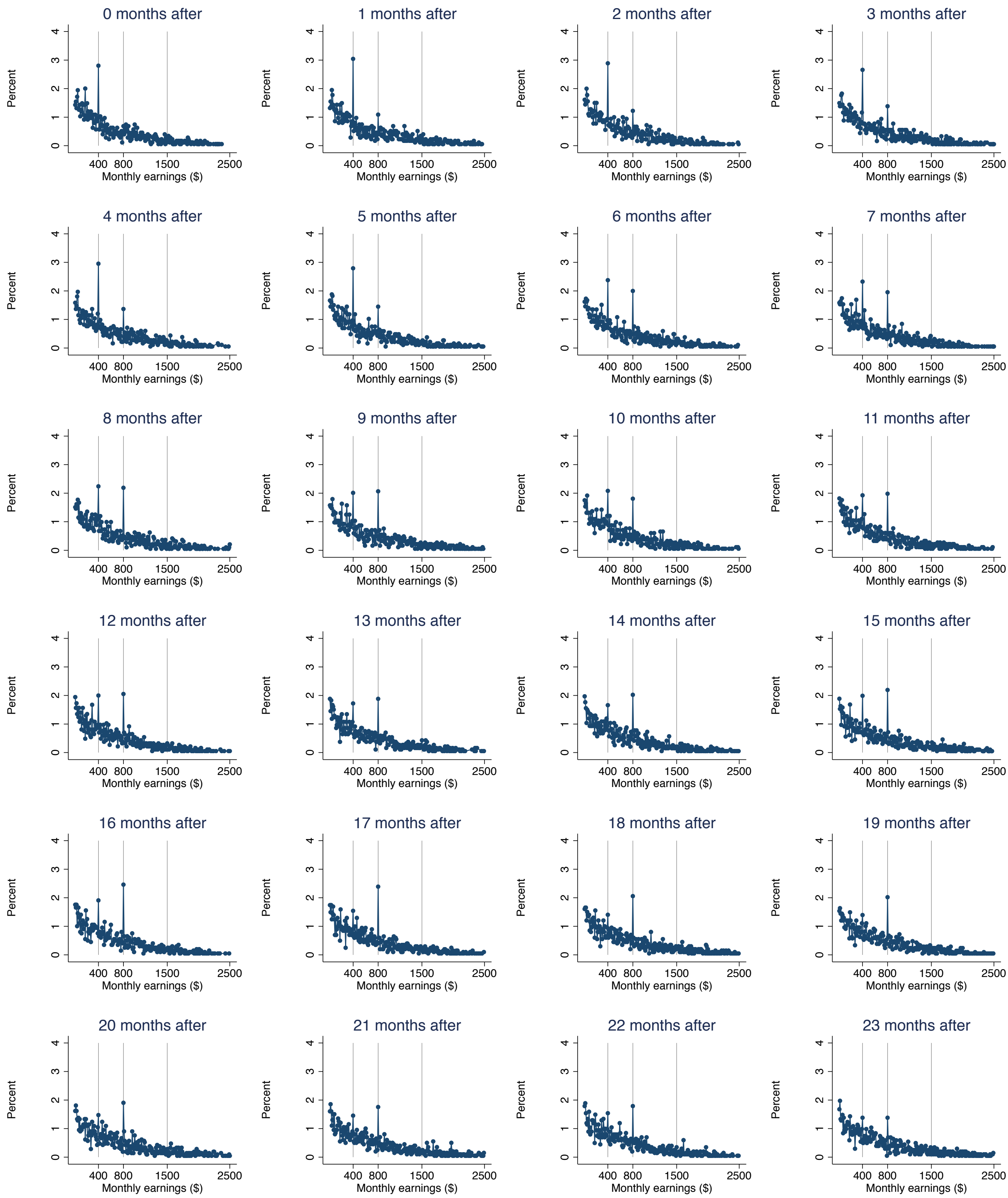
Note: This figure plots the distribution of the monthly earnings of AISH beneficiaries with dependent before and after the policy change. There is bunching at the exemption threshold every month before the policy change. The bunching gradually shifts to the new exemption threshold after the policy change, but still, some individuals continue bunching at the former threshold.

Figure B.5: Dynamics of the earnings distribution of youneg AISH beneficiares

(a) Before the policy change



(b) After the policy change



Note: This figure plots the distribution of the monthly earnings of 18-34 year-old AISH beneficiaries with no dependent before and after the policy change. There is bunching at the exemption threshold every month before the policy change. The bunching gradually moves to the new threshold in months following the policy change, disappearing completely after two years. This is consistent with the estimates from the dynamic model presented in Figure 10.

C Evaluating the effects of the policy change in AISH on labor supply

Identification strategy

Examining the overall effects of an increase in work incentives 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 increase in the work incentives from 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 it did not undergo 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 in Alberta but not in the ODSP 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 specified in (11).I use monthly inflation-adjusted earnings (2012$) and labor force participation as outcome variables. I define labor force participation as a dummy which switches on

To further explore the impact of the policy change in AISH over time, I generalize (11) by replacing $POST_t \times AISH_i$ with a full set of treatment and quarterly time interaction terms and estimate a regression of the form:

$$y_{it} = \alpha + \sum_{t=-8}^{t=7} \beta_t (q_t \times AISH_i) + \gamma AISH_{it} + X'_{it}\delta + \lambda_t + \epsilon_{it} \tag{C.1}$$

where q_t is a dummy which is one in quarter t relative to the policy change and zero otherwise. The pre-policy change interaction terms provide a pre-treatment specification test. 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.

Descriptive evidence and results

Descriptive evidence

The first panel of Table 1 presents the labor market statistics in AISH and ODSP during 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 earnings while less than ten percent of the beneficiaries in ODSP work. The 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 allowances, whereas ODSP does not have an exemption threshold and DI allowances are phased out starting from the first dollar of the earnings (see Figure 1).

To graphically assess the impact of the policy change in AISH on the the labor supply, I plot the 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 C.1. Panel (a) shows that the 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 earlier 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 the earnings neither in the labor force participation.

Results

My study sample for DD analysis includes 18–64 year beneficiaries of AISH and ODSP with non-physical disabilities. The pre-period in the base specification is April 2010 to March 2012, and the post-period is from April 2012 to March 2014. I present my main findings from estimating (11) in Table C.1. The effect of the policy change on earnings measures the intensive margins whereas the effect on the labor force participation measures the extensive margin effects.

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

The estimates presented in Table C.1 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 (C.1) in Figure C.2. 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 the 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 earlier two quarters are slightly larger than zero. This 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 individuals to find a new job rather 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 longer panel as presented in Table C.1. The estimated coefficients are significantly positive and gradually increase in the quarters following the policy change.

I present the estimated effects of the policy change on the labor supply for different subsamples in Table C.2. It is instructive to look at 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 (11) are shown in the first panel of Table C.2. 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% and 4.31% point compared to the corresponding 12.77% and 0.62% point increase for those with no dependent. There are also sizeable differences in the estimated effects of the policy change across age groups. The second panel shows that the increase in earnings of younger individuals (18–34 year) is more than twice the size of that for the middle-aged group (35–49 year) at 23% compared to 10%. The estimated effect on earnings of older individuals (50 years and older) is a quite small decrease in earnings (about 2%). The estimated effect on labor force participation of older individuals is, however, a relatively sizeable 4.07% point decrease, compared to a 4.21% point increase for the younger ones and 0.79% point decrease for the middle-aged group. The estimated effect on the labor force participation does not differ between males and females, but the increase in the earnings for males is slightly higher at 14% compared to 11% for females.

Individuals' health condition plays an essential role in the determination process for DI benefits. Panel (D) of Table C.2 shows the estimated effects of the policy change broken down by the type of disability. The increases in earnings of those with Psychotic and Neurological disabilities are relatively higher than for individuals with Mental disabilities at 15% and 12% compared to 7%. The change in labor force participation of individuals with Psychotic disabilities is more pronounced than for the others at 1.46% point increase compared to 0.07% and 0.05% 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 the labor force participation in metropolitan areas is higher. Employment opportunities in metropolitan areas might account for this finding.

C.1 Tables

Table C.1: Estimated effects of the policy change in AISH on the labor supply

	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	Long panel	Long panel	Short panel	Long panel	Long panel	Short panel
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 DD analysis specified in (11). The long panel spans April 2010 to March 2014. The shorter panel covers October 2010 to September 2014. The included individual co-variates are sex, age, age DI awarded at, family structure, disability type and the location of residence. The earnings are inflation-adjusted (2012$). The robust standard errors are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

Table C.2: Heterogeneity of the effects of the policy change in AISH on labor supply

	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)		

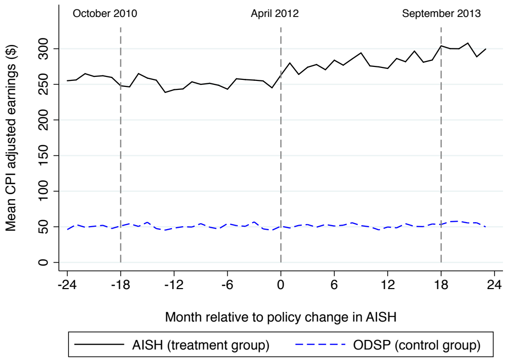
Notes: This table presents the heterogeneous effects of the policy change in AISH from a DD analysis specified in (11). The sample includes individuals with non-physical disabilities from April 2010 to March 2014. All estimates Include individual co-variates sex, age, age DI awarded at, family structure, disability type and the location of residence. The earnings are inflation-adjusted (2012$). The robust standard errors are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

‘

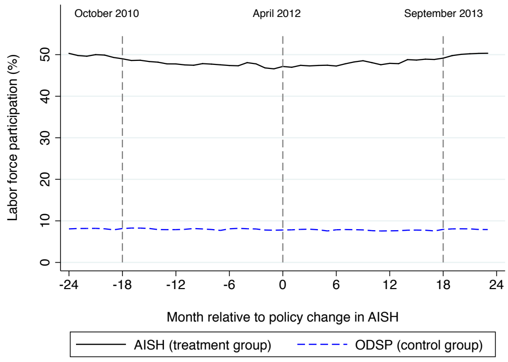
C.2 Figures

Figure C.1: Trends in the labor supply in AISH and ODSP

(a) Earnings



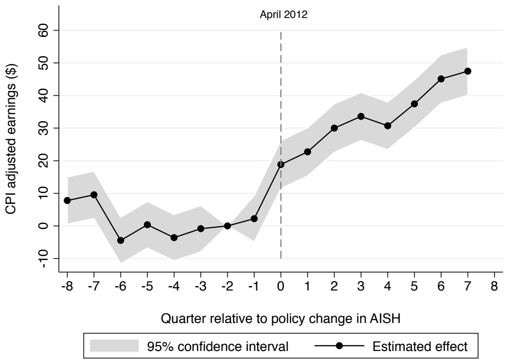
(b) Labor force participation



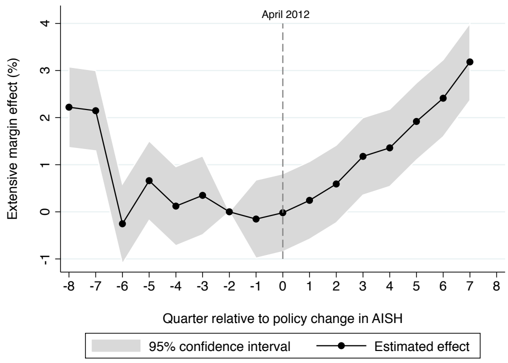
Notes: This figure plots the mean monthly earnings and labor force participation rate in the AISH and ODSP. The x-axis represents the month relative to the policy change in AISH. The labor force participation is defined as a dummy which switches on for positive earnings.

Figure C.2: Placebo test

(a) Earnings



(b) Labor force participation



Notes: This figure plots the estimated time trend coefficients (β_t) from (C.1). The gray area denotes the 95% confidence intervals.

D Induced entry effects of the policy change in AISH

Tables

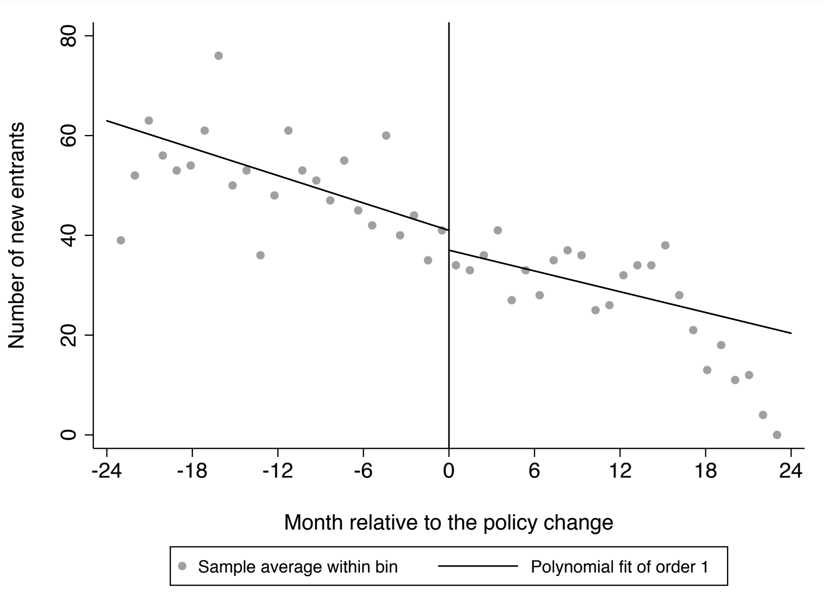
Table D.1: Estimated effects of the policy chnage in AISH on the number of new entrants

	Bandwidth		
	12 months	18 months	24 months
Estimated effect	-7.62*	-4.36	-1.42
on number of new entrants	(4.49)	(5.14)	(5.25)

Note: This table presents the estimated effects of the policy change in AISH on the number of the new entrants using a RDD model from (Zaresani, 2018). The robust standard errors are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

Figures

Figure D.1: Number of new entrants into AISH



Note: This figure plots the number of new entrants into AISH by the month relative to the policy change in AISH.

E Elasticity of labor force non-participation

The estimates from my DD analysis presented in Section C and RDD analysis (Zaresani, 2018) suggest that the policy change in AISH increased the labor supply both in intensive and extensive margins. I further explore the policy change in AISH to estimate the elasticity of labor force non-participation with respect to the

Participation Tax Rate (PTR) from work incentives induced by the policy change defined as below (Kostol and Mogstad, 2014):[30]

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

LP denotes labor participation defined as a dummy which turns on for earnings above the exemption threshold. $1-LP$ denotes non-participation rate. The PTR for earnings below the exemption threshold is zero and its defined as below for earnings above the exemption threshold:

$$PTR_z = 1 - \frac{I_0 - I_z}{z} \tag{E.2}$$

I_0 denotes the average disposable income (net of tax earnings and DI allowances) of non participants. I_z denotes the average disposable income of individuals with earnings z. ΔPTR is change in the average PTR before and after the policy change.[31] LP_{before} is the portion of labor participants before the policy change. $\Delta(1-LP)$ is the change in labor non-participation after the policy change compared to before the policy change.

Empirical implementation

I use the pooled AISH data from April 2010 to March 2012 as pre policy change and April 2012 to March 2014 as post policy change sample. I divide the monthly earnings 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 the portion of the individuals in each bin by (p_z^{before}) before the policy change:

$$\Delta PTR = \mathbb{E}_z[(PTR_z^{after} - PTR_z^{after})p_z^{before}] \tag{E.3}$$

I estimate standard errors using a non-parametric bootstrap by drawing 200 samples with replacement. For each bootstrapped sample, I then estimate the elasticities. The standard error of a parameter is the standard deviation of its bootstrapped parameters.

Results

Figure E.1 plots the 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 gradually for higher earnings. For any earnings level, PTR is lower after the policy change than that before the policy change. This figure also plots a smoothed density of earnings before and after the policy change. The figure suggests that a lower PTR is associated with higher density of earnings.

Table E.1 presents the estimated elasticity of labor non-participation with respect to PTR. The first column shows the estimate for individuals with no dependent. The estimated elasticity of non-participation with respect to PTR is 0.114;

[30]Kostol and Mogstad (2014) explore a policy change in Norwegian DI program where the marginal taxes on earnings above a threshold is decreased.

[31]This specification for estimating an elasticity of non-participation with respect to the PTR ignores the income effects, but the estimated elasticity could be interpreted as an effect of the policy change. In Section 5, I provide suggestive evidence that the income effects of the policy change on labor supply are negligible.

a ten percent reduction in PTR decreases labor non-participation by 11.4 percent. The second column shows the estimate for individuals with dependent. The estimated elasticity is 0.033, a 10% decrease in PTR decreases labor non-participation by 3.3%. My estimates are comparable to the estimates of Kostol and Mogstad (2014). Their estimated elasticity of non-labor participation exploring a policy change in the Norwegian DI program which decreased the marginal taxes above an exemption threshold, are 0.119 to 0.186.

E.1 Tables

Table E.1: Estimated elasticity of labor non-participation with respect to Participation Tax Rate (PTR)

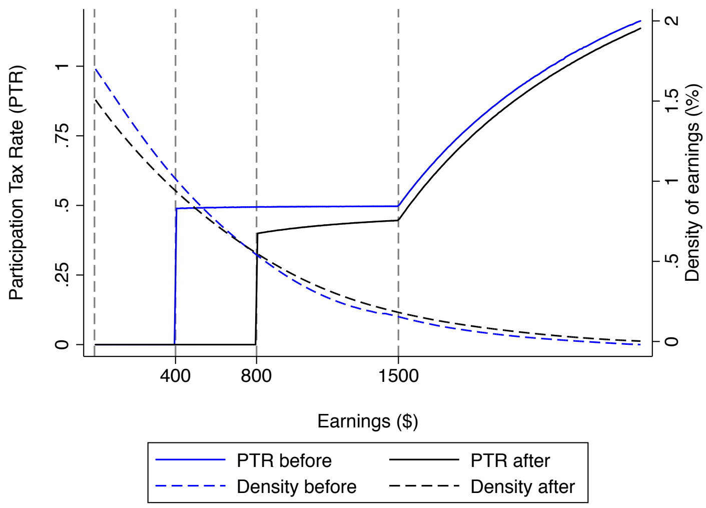
	No dependent	With dependent
$\Delta(1-LFP)$	-0.035	-0.030
	(0.001)	(0.003)
$(1-LFP_{before})$	0.747	0.879
	(0.001)	(0.002)
ΔPTR	-0.190	-0.204
	(0.001)	(0.002)
PTR_{before}	0.480	0.205
	(0.007)	(0.004)
$Elasticity(\epsilon)$	0.114***	0.033***
	(0.004)	(0.003)
Num. of Obs.	411,373	40,507

Note: This table presents the estimated elasticity of labor force non-participation with respect to Participation Tax Rate (PTR) using (E.1) by exploring the policy change in AISH. The bootstrapped standard deviations are in the parenthesis.
$*p < 0.10, **p < 0.05, ***p < 0.01$

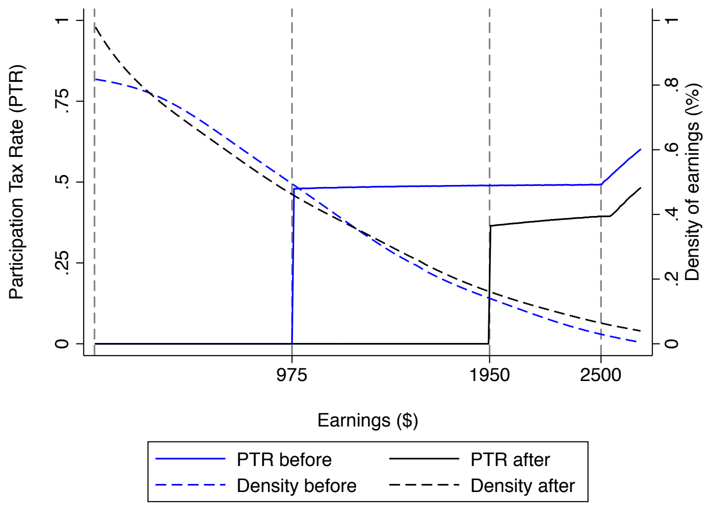
E.2 Figures

Figure E.1: Participation Tax Rate (PTR)

(a) No dependent



(b) With dependent



Note: This figure illustrates the Participation Tax Rate (PTR) in AISH for earnings levels, before and after the policy. The figure also plots the smoothed density of the earnings in AISH before and after the policy change.