The Effect of Disability Insurance on Work Activity: Evidence from a Regression Kink Design

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Alexander Gelber
UC Berkeley and NBER

Timothy Moore
George Washington University and NBER

Alexander Strand
Social Security Administration

Abstract

We study the effect of U.S. Social Security Disability Insurance (DI) payments on beneficiaries’ earnings and other measures of work activity. Around the “bend points” of the formula linking Average Indexed Monthly Earnings (AIME) to the Primary Insured Amount (PIA), the marginal replacement rate discontinuously changes, allowing us to use a Regression Kink Design (RKD) to study the effect of the size of DI payments on earnings and work activity. Using Social Security Administration administrative data on the universe of new DI beneficiaries from 1996 to 2008, we document a modest effect of DI payment amounts on average earnings and other measures of work activity. Placebo tests examining the period prior to DI application show no evidence of an “effect” of DI payments on earnings. In a baseline specification, the estimates imply that as DI payments rise by one dollar, average earnings fall by three cents.

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I. Introduction

The effect of disability insurance on beneficiary work activity is a question of fundamental importance to optimal disability insurance design. Policy-makers are interested in the extent to which Social Security Disability Insurance (SSDI or DI) causes beneficiaries to work less. If higher disability insurance payments discourage beneficiary work activity, then policies that reduce payments may encourage beneficiaries to supplement their DI payments with wage income, so that their total income is still sufficient for their needs. Moreover, if DI beneficiaries become more likely to work in order to increase their total income, then it increases their retention of work skills and may increase participation in SSA return-to-work initiatives like the Ticket to Work program, and ultimately increase the chances of an individual exiting DI and relying on labor force participation for their income.

A difficulty in estimating the connection between the level of DI benefits and work activity is that benefit levels can affect the type of individuals who apply for and receive DI (Autor and Duggan, 2003). If the beneficiaries receiving different levels of payments are also different, it is impossible to know whether any differences in work activity are due to benefit rules or differences across beneficiaries. In this paper, we seek to overcome this challenge by using changes in policy rules that affect the level of DI benefits, but should not affect the types of individuals who are receiving DI where those changes occur.

Specifically, we examine the “bend points” in the schedule determining the relationship between an individual’s previous earnings and the DI payments they receive. Monthly DI payments are based on an individual’s Primary Insurance Amount (PIA), which is in turn a function of average earnings, known as Average Indexed Monthly Earnings (AIME). The PIA is based on a progressive formula that replaces AIME at a higher rate for beneficiaries with low average earnings. The formula linking AIME to PIA changes around the “bend points.” In particular, below a threshold level of the AIME, the marginal replacement rate is 90 percent; between this

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2 See Muller (2008) for a discussion of how AIME is calculated, and how wage indexing has affected AIME calculations over time.
3 As we describe later in greater detail, the AIME is a measure of average earnings over an individual’s highest-earning years, and the PIA is an individual’s monthly DI benefit.
threshold and the next, the marginal replacement rate is 32 percent; until the next, 15 percent; and then there are caps on payments that create a zero percent marginal replacement rate for some beneficiaries. We examine whether the relationship between average earnings and AIME changes at the bend points, as we would expect it to if the level of DI benefits affects average earnings. If DI benefits affect average earnings, then the relationship between average earnings and AIME should be kinked at the bend points just as the relationship between PIA and AIME is.

Earnings could respond to DI payments: if DI payments are lower, beneficiaries might need to make up the lost income by earning more. This could be true in several respects. First, DI payments could influence whether beneficiaries choose to exit DI (including by having monthly earnings that result in the suspension of DI payments). Second, DI payments could influence how often beneficiaries choose to participate in the Trial Work Period (TWP). Third, SSDI beneficiaries are able to earn up to the Substantial Gainful Activity (SGA) limit without penalty, which is $1,070 per month in 2014. Thus, DI payments could also affect average earnings among beneficiaries who choose to remain on DI.

Econometrically, we use a Regression Kink Design (RKD) to study the effect of DI payments on beneficiaries’ average earnings and other indicators of work activity. The RKD is a method that in our context essentially studies whether the relationship between average earnings and AIME is also kinked at the bend points of the formula.

Using Social Security Administration administrative data on the universe of disability insurance recipients from 1996 to 2010, we document a visible but modest effect of DI payments on average earnings and other measures of work activity. We begin with a graphical analysis. A figure of average earnings against AIME shows a noticeable kink at the first bend point, where the marginal replacement rate falls from 90 percent to 32 percent. In particular, the slope of this relationship between average earnings and AIME increases noticeably around the first bend point, corresponding to the fall in the marginal replacement rate at this point, which suggests that

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4 See Card, Lee, Pei, and Weber (2012) for the development of the RKD.
5 Of course, the effect on average earnings could obscure heterogeneity across groups. For example, individuals with severe disabilities could find it difficult to vary their earnings no matter what their SSDI benefit level.
a decrease in DI payments leads to increased average earnings. We find similar patterns for the probability of a TWP, indicating that a reduction in DI benefits also increases this measure of work activity. Regression analysis confirms that increases in DI payments lead to reduced average earnings. In a baseline specification, the estimates imply that if the marginal change in disability payments increases by one dollar, beneficiaries decrease their average earnings by three cents.

In order for the research design to be valid, it is important to establish that beneficiaries located on either side of the bend points look similar. Graphs of the number of DI beneficiaries against AIME are not noticeably kinked at the bend points (and regression analysis confirms that this is so). The distribution of characteristics – including the fraction of DI beneficiaries that are male, the fraction in each race category, and the average age when filing for DI – are also not noticeably kinked around the bend points, and regression analysis confirms that changes in slope around the bend points are negligible in these graphs. In total, these analyses suggest that any changes in earnings should be due to the bend points, not differences in the types of beneficiaries on either side of the bend points.

Moreover, in the “baseline” period prior to DI receipt, the relationship between average earnings and AIME does not show a kink at the first bend point, as one might expect. Moreover, we find that the kink in beneficiaries’ average earnings appears at the time that beneficiaries start to receive DI. Nonetheless, it is worth noting that from the pre-application period to the period receiving DI, individuals also may suffer the onset of disability (and become subject to the SGA limit), which presumably should change the distribution of average earnings substantially even in the absence of DI payments (though there is no presumption that this should lead to the kink we observe).

The paper complements important existing literature on the effect of DI payments on work activity. Gruber (2000), Autor and Duggan (2003), Chen and van der Klaaw (2008), and Maestas, Mullen and Strand (2013) find substantial negative effects of DI payments on work activity. We add to these studies by using a new identification strategy that takes advantage of administrative microdata on the full population of U.S. DI beneficiaries, in combination with
discontinuities in the formula determining PIA that allow both clear graphical documentation of the responses and estimates of the earnings impact of a dollar of extra DI benefits. Because we study marginal changes in DI benefits, we are able to estimate a precise effect of DI benefits on average earnings, which is an important policy parameter as policy-makers contemplate changes to OASDI benefits such as chain-weighting of cost of living increases, progressive price indexing, and other reforms. Our estimate of the elasticity of average earnings with respect to DI payments is modest, in contrast with previous studies that have found large impacts of DI on work decisions. However, our estimates also apply to a different population—those already on DI—than those previous studies have examined. Thus, our estimates are not directly comparable to those in previous studies, as we focus on the marginal effect of DI payments on earnings while on DI. Most of these previous studies look at the effect of gaining eligibility to DI on earnings, or how the level of DI payments affects claiming behavior.

The remainder of the paper is structured as follows. Section II describes the policy environment. Section III explains our identification strategy. Section IV describes the data. Section V shows our graphical analysis of the data. Section VI presents our estimates. Section VII concludes.

II. Policy Environment

As described above, the PIA is the monthly payment due to a DI beneficiary. This depends on an individual’s AIME. The formula used to calculate the PIA from the AIME is designed to provide a higher benefit-to-earnings ratio for workers with relatively low earnings. For SSDI beneficiaries who become eligible in 2013, the PIA is calculated as: 90 percent of the first $791 of AIME, plus 32 percent of the next $3,977 of AIME, plus 15 percent of AIME over $4,768.6

A graphical representation of this schedule is shown in Figure 1. The formula creates so-called “kinks” in the graph at $792, where the marginal replacement rate declines from 90 percent to 32 percent, and at $4,769, where the marginal replacement rate declines from 32 percent to 15

percent. (The maximum family benefit rules can also cap a beneficiary’s SSDI payments.) The kink points are adjusted every year, and depend on changes to the National Average Wage Index.

These marginal changes in the PIA-to-AIME ratio can have strong effects on the average replacement rates provided by SSDI, especially around the first bend point. In Figure 2 we show the PIA-to-AIME ratio for values of AIME between $700 and $900. The average replacement rate is a constant 90 percent between $700 and $791 of AIME, then decreases to less than 83 percent at $900 of AIME. There are also noticeable changes in average replacement rates around the other bend points.

III. Identification Strategy

Recent work has shown that under certain conditions, a change in the slope of treatment intensity can be used to identify local treatment effects by comparing the relative magnitudes of the kink in the policy rule and the induced kink in the outcome variable (Card, Lee, Pei, and Weber 2009). This is called a Regression Kink Design. (In our context, the “treatment” is the level of DI benefits, and the “treatment effect” is the effect of the level of DI benefits on work activity.) The intuition behind this estimator is as follows. Suppose hypothetically that higher SSDI benefits cause beneficiaries to earn less on average. An extra dollar in AIME leads to a larger change in PIA just below a bend point than just above it. If higher benefits cause beneficiaries to earn less on average, then an extra dollar in AIME should cause a relatively small decrease in average earnings just below the first bend point, but an extra dollar in AIME should cause a relatively large decrease in average earnings just above the first bend point. By comparing the change in average earnings as AIME increases for ostensibly identical beneficiaries just below and above the bend points, we can estimate the effect of SSDI benefits on labor force activity. If the change in the relationship between AIME and labor force activity just below and above the bend point is large, then we will infer that DI benefit levels have a large effect on average earnings. Similarly, if the change in the relationship between AIME and labor force activity is small, we will infer that DI benefit levels have a small effect on average earnings.
Mathematically, we want to estimate the marginal effect of SSDI benefits (B) on work activity (Y). Benefits depend on average prior earnings (A). Using the RKD, we can estimate the marginal effect of benefits on work activity around a kink point $A_0$ using the following equation:

$$E\left[ \frac{\partial Y}{\partial B} \mid A = A_0 \right] = \frac{\lim_{A \to A_0^+} \frac{\partial E[Y|A = A_0]}{\partial A} - \lim_{A \to A_0^-} \frac{\partial E[Y|A = A_0]}{\partial A}}{\lim_{A \to A_0^+} \frac{\partial B(A)}{\partial A} - \lim_{A \to A_0^-} \frac{\partial B(A)}{\partial A}}$$

That is, the marginal effect we estimate is the change in the slope of the relationship between work activity and prior earnings divided by the change in the slope of relationship between benefits and prior earnings (at the kink point). In words, we will estimate the difference in the slope of the work activity-AIME relationship just to the left and right of a bend point, divided by the difference in the slope of the PIA-AIME relationship just to the left and right of a bend point.

Identification of the effect of DI benefits on earnings relies on two assumptions. First, the direct marginal effect of AIME on the outcome should be smooth. The second condition requires that the derivative of the conditional probability density function is continuous for all errors at the kink so that density of the unobserved heterogeneity evolves smoothly with AIME at the kink. In our context, this essentially means that in the absence of DI, the graph of average earnings against AIME should be smooth around the bend points. We show that this is so by demonstrating that average earnings prior to applying for DI is smooth around the bend points.

Because the denominator above is deterministic, estimation of the change in slope only relies on the estimation of the numerator, which is the change in the slope of the conditional expectation function of the outcome given AIME at the kink. This can be done by running polynomial models of the form:

$$E(Y|A=A_0)=\beta_0+\beta_1(A_0-k)+\beta_2(A_0-k)D$$

where in our context $Y$ is a measure of work activity, $A$ is AIME, $A_0$ is the level of AIME in the region of the bend point, $D = 1[A \leq k]$ is an indicator for being above the kink threshold, $h$ is the bandwidth size, $|A_0-k| \leq h$, and the change in the slope of the graph of average earnings against AIME at the bend point is given by $\beta_2$. We can estimate this regression for the two types of work
activity we have identified as being of interest: wage earnings and probability of engaging in a TWP.\(^7\)

Implementing this regression requires choices about bandwidth and bin size. At the lower bend point, the AIME of $791 constrains the bandwidth to a value less than that (given that we seek to use a symmetric bandwidth). In practice, there are almost no observations below an AIME of $100, as beneficiaries with such low earnings are unlikely to have sufficient quarters of coverage to meet the DI standards. Therefore, we use a bandwidth of $675 at the lower bend point. Our main bin size is $75, which means there are nine such bins on either side of the bend point; this level of aggregation is necessary to create bins with reasonable numbers of observations at low AIME values. We have a broader range of possible bandwidth values at the upper bend point. We selected $1500 as our primary bandwidth, and maintained our primary bin size of $75. We examine the robustness of our analysis by estimating regressions using different bandwidths and bin sizes.

**IV. Data**

We use linked administrative data from the 2010 version of the Ticket Research File (TRF). The TRF is a compilation of multiple administrative data sources, including the Master Beneficiary Record, Supplemental Security Record, 831 File, Numident File, and Disability Control File. The TRF contains information on the universe of disability beneficiaries with at least one month of current-pay status between 1996 and 2010, including information on their AIME and PIA. The data sources that are used to construct the TRF also provide information on each beneficiary’s demographic characteristics (including age, race, and gender); DI program activity (including path to allowance and disability payments); and work activity (such as engaging in a TWP) (Hildebrand et al., 2012). Annual taxable earnings from the W-2 forms are obtained by linking to the Detailed Earnings Record (DER).

\(^7\) In order to generate conservative standard errors, we average data within each bin and run the regression using the aggregated data, weighting bins by the number of observations in each bin.
We examine only DI beneficiaries who are not dually-eligible for Supplementary Security Income (SSI). Because SSI payments are reduced for DI benefits on a dollar for dollar basis (after the application of a small unearned income exclusion), total DI and SSI payments are often near the SSI Federal Benefit Rate. Thus, we would not expect to observe differences in work incentives for the dually-eligible group. We also impose several sample restrictions to aid our analysis and restrict our sample to beneficiaries who: (1) entered the DI program between 1996 and 2008, so we could observe their activity after beginning to receive their disability benefits; (2) have an AIME value that is never recalculated, so that we can hold AIME fixed; (3) are between ages 30 and 55 when they apply for DI, as those who are younger than 30 have more complex AIME calculations and older workers qualify for retirement options over time; and (4) have an actual PIA that is within five dollars (in 2013 dollars) of an estimated PIA that is based on the bend points associated with their date of eligibility, in order to increase the accuracy of the PIA. The final restriction removes seven percent of the sample.

Table 1 shows summary statistics. We use data on 212,473 and 584,848 observations around the first and second bend points, respectively. Average PIA is $786 around the first bend point and $1,837 around the second bend point. Average pre-application earnings 1–3 years before applying is $11,002 around the first bend point and $42,499 around the second bend point. Meanwhile, the respective averages for post-award earnings 0–2 years after first receiving DI are $356 and $2,862 at lower and upper bend points, respectively, while the equivalent averages 3–5 years after first receiving DI are $211 and $1,110. Post-award earnings are therefore dramatically lower than pre-application earnings on average, as we would expect (because people may suffer the onset of disability in the meantime, and are subject to the SGA limit after going on DI).

Around the first bend point, 56 percent of observations are awarded DI through an initial Disability Determination Services (DDS) determination; nine percent are awarded after a DDS-level reconsideration of their case; and 35 percent are awarded eligibility at the hearings stage. Around the first bend point, 0.55 percent of the sample engages in a TWP, whereas 2.5 percent of the sample engages in a TWP near the second bend point. Around the second bend point, a

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8 The current PIA-AIME formula was established in 1978. PIA may sometimes be determined by older formulas, or be adjusted because of the consolidation of earnings or periods of prior disability eligibility. See Muller (2008) for more details.
somewhat higher percentage (61 percent) is awarded at the DDS stage and a somewhat lower percentage (30 percent) is awarded at the hearings stage, with 8 percent at the reconsideration stage. Average age when applying in the two samples is 45.34 and 47.70, respectively. Interestingly, 27.6 percent of observations are from male DI beneficiaries around the first bend point, whereas 70.7 percent of observations are male around the second bend point.

V. Graphical Analysis
We begin our empirical analysis with several figures that show the graphical patterns driving our results. Appendix Figure 1 shows that as expected, measured PIA in the dataset shows kinks at the bend points in AIME, in precisely the ways the policy dictates.

Figure 3 shows that the number of observations appears continuous around the bend points, and that the slope of this line also appears continuous around the bend points. This suggests that individuals do not appear to locate their AIME strategically to take advantage of changes in the marginal replacement rate around the bend points. There are two reasons to think this should be the case. First, individuals apply after they become disabled so may find it difficult to choose their employment in order to change their earnings history, particularly given that the AIME is normally based on a long earnings history. Second, the calculation of the AIME on the basis of an applicant’s earnings history is complex, implying that it is likely to be difficult for applicants to accurately estimate their AIME and, therefore, where their earnings history will put them in relation to the bend points.

Appendix Figures 2 and 3 show that the distributions of covariates (fraction male, age when applying, fraction black, and hearings allowances) appear to be relatively smooth around the bend points in level and slope. This again suggests that populations to the left and right of the bend points are comparable. This helps in establishing that differences in earnings behavior to the left and right of the bend points should be related to the effect of DI benefit levels, as opposed to the effect of differing population characteristics.

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9 AIME calculations are based on earnings beginning the year after an individual turns 21. Sixty percent of SSDI entrants are aged 50 years or older, so have a relevant earnings history that lasts 28 or more years (SSA 2011).
Figures 4 and 5 starkly show our primary empirical results, displaying a noticeable change in work behavior near the first bend point. Figure 4 shows that average earnings when first receiving DI to two years after first receiving DI is strongly kinked near the first bend point. The graph of average earnings against AIME slopes up noticeably to the right of the kink, whereas it is close to flat to the left of the kink. This corresponds to a fall in the slope of the graph of PIA vs. AIME when moving from the left to the right of the first bend point. Thus, these results suggest that falling DI benefits cause an increase in average earnings. Around the first bend point, the location of the change in slope of the earnings-AIME relationship is approximately two bins to the right of where the bend point lies. (After these two bins, the slope is noticeably higher to the right of the kink than to the left.) Other evidence suggests this could be an anomaly, though there is still a possibility that it represents a lack of response to DI payments very near the kink rather than statistical noise. However, we emphasize that if it reflects a lack of response to DI payments, this supports still further our contention that DI payments affect earnings modestly (if at all). The graph for the second bend point shows that average earnings are kinked—with a steeper slope to the right of the bend point than to the left—but less strongly than around the first bend point. Intuitively, there would be a weaker change in slope at the second bend point, because the change in the marginal replacement rate is much smaller at the second bend point (a reduction of 17 percentage points compared to a reduction of 58 percentage points at the first bend point). Similarly, Figure 5 shows that average earnings three to five years after first receiving DI is strongly kinked near the first bend point and slightly kinked around the second bend point. The changes in slope around the bend points, particularly for the second bend point, are even more noticeable than in Figure 4, perhaps because beneficiaries may have taken time to make adjustments such as finding a job with their desired earnings.

Figure 6 shows that the kinked pattern of average earnings around the lower bend point does not appear in the period before people apply for DI. In fact, average earnings have an extremely similar slope to the left and right of the bend point in this “baseline” period. In three separate periods—1–3 years prior to applying for DI, 4–6 years prior, and 7–9 years prior—the slope is consistently flat around the first bend point. Thus, the kink in earnings around the first bend point appears only when individuals go on DI (and persists once they are on DI). This provides stronger evidence that the kink in earnings is a causal effect of DI benefits, rather than an artifact.
of the earnings distribution. Similarly, Figure 7 shows that average earnings are essentially flat around the second bend point, demonstrating that the kink in earnings around the second bend point also appears only when individuals go on DI (and persists once they are on DI). Any alternative explanation of why there is a kink in the post-allowance earnings would have to explain why a kink in the earnings distribution would show up around both the first and second bend points, at the time individuals go on DI (but not prior), and persist at least several years afterward.

Figure 8 shows the probability of engaging in a TWP in the first 36 months after being awarded DI benefits as a function of AIME around the bend points. It shows that that a noticeable kink in this graph appears around the first bend point, although no noticeable change in slope appears at the second bend point (where the change in the marginal replacement rate is smaller). This again suggests that falling DI benefits cause an increase in the probability of engaging in a TWP around the first bend point.

VI. Regression Analysis

This section performs regressions that build on the graphical analysis. Table 2 shows our main estimates. We report the coefficient $\beta_2$ from the regression equation above, representing the change in slope of the outcome variable at the bend point in question. The slope of post-allowance average earnings 0–2 years after allowance increases substantially (by 0.21) going from the left to the right of the first bend point. This change is statistically significant at the 1 percent level. This implies a modest effect of DI benefits on average earnings. The change in slope of PIA (as a function of AIME) is 0.58 at the same bend point (since the slope of this function to the left of the bend point is 0.9, the slope to the right is 0.32, and $0.9 - 0.32 = 0.58$). However, we must put benefits in yearly terms, in order to be comparable to the yearly earnings outcome we investigate. The change in slope of yearly benefits as a function of AIME is 6.96, 12 times as large as the change in slope (0.58) of the PIA vs. AIME relationship (since the PIA is received for 12 months of the year). Thus, the estimates imply that a dollar of extra DI benefits causes a decrease in average earnings of three cents (where three cents $= 0.21/6.96$). Similar modest effects of DI benefits are found for average earnings 3–5 years later; for the probability
of engaging in a TWP at the first bend point; and for average earnings in both periods at the second bend point.¹⁰

Note that the slope of the graphs of average earnings against AIME in Figures 4 and 5 appear to change sharply around the bend point, whereas the effect of three cents on the dollar appears small. The reason for this discrepancy is two-fold. First, the graphs show the effect of AIME—which is a monthly measure—on yearly average earnings. Making an apples-to-apples comparison by showing the effect of AIME on monthly average earnings would show effects twelve times as small. Second, we used a symmetric bandwidth in the regressions, which limits us to examining the same range of data to the left and right of the first bend point. This implies that to the right of the kink we use a smaller range of data in estimating the regressions than is shown in the figures. The change in slope around the first bend point is somewhat smaller within this smaller range of data than is shown in the figure. In future work, we will run further analysis based on an asymmetric bandwidth, with a larger range of data examined to the right of the first bend point than to the left.

Meanwhile, the “baseline” period regressions show no significant change in the slope of average earnings prior to DI application around the first bend point. Indeed, the coefficients are negative, indicating a small decrease in the slope around the first bend point. This is true in all three periods examined (1–3, 4–6, and 7–9 years prior to DI application). Around the second bend point, the regressions do show a change in slope, although in percentage terms these changes in slope imply very small effects of $100 in extra AIME (0.27%, 0.31%, and 0.34%, respectively, in the three baseline periods). In percentage terms these changes are much smaller than those implied by the regressions in the period after DI receipt. Nonetheless, these baseline results at the second bend point do represent some cause for skepticism about the results at the second bend point.

Table 3 shows how these results vary as we vary the bandwidth and bin size. The results are nearly identical as we vary the bin size from $50 to $100 (under all of the bandwidths we have

¹⁰ It is unsurprising that the magnitude of the coefficients is often larger at the second bend point than at the first, because the absolute level of mean earnings is much larger at the second bend point.
tried). The point estimates fall somewhat as we lower the bandwidth, though they remain in the same range and statistically significant.

Appendix Table 1 shows the change in slope of the covariates shown in Table 1 around the bend points. They show very small changes in slope that are typically insignificant. Moreover, differences in the slope of these demographics to the left and right of the bend point would be worrisome only insofar as they affect the slope of earnings—and such an effect presumably should show up in the baseline period (and in fact does not).

VII. Conclusion

A key policy question regarding SSDI is the extent to which disability insurance payments affect beneficiaries’ work activity, as higher benefit levels could discourage work activity. We investigate an important aspect of this question: how disability benefits affect beneficiaries’ annual wage earnings and probability of engaging in a TWP. We examine whether the relationship between average earnings and AIME changes at the bend points, as we would expect it to if the level of DI benefits affects average earnings. If DI benefits affect average earnings, then the relationship between average earnings and AIME should be kinked at the bend points just as the relationship between PIA and AIME is. Accordingly, we use the newly-developed RKD technique that examines whether beneficiaries’ average earnings behavior changes just around the bend points created by the conversion of the PIA to the AIME. We find graphical evidence that the graph of average earnings against AIME is kinked around the bend points in the formula relating PIA to AIME, consistent with an effect of DI benefits on average earnings of DI beneficiaries.

Corresponding regression evidence shows that a dollar of extra DI benefits leads on average to three cents less in average earnings in a baseline specification. This is an important policy parameter as policy-makers contemplate changes to OASDI benefits such as chain-weighting of cost of living increases, progressive price indexing, and other reforms. We find that this effect is quite small, in contrast with the general findings of other literature that have tended to find large effects. While we do not have direct evidence on the reasons for the small effect, one might think
it unsurprising that SSDI beneficiaries might not be very responsive to incentives (for example because their disability prevents them from working, or because the SGA limit prevents them from attaining high earnings).

These results are preliminary and must be subjected to more scrutiny before concluding that DI has an effect on the work activity of DI beneficiaries. In future work, we plan to investigate other, more flexible specifications, and other outcomes such as the probability of exiting DI due to medical improvement. We also hope to perform further analysis to more robustly establish that there is a kink in average earnings around bend points. The “baseline” results around the second bend point represent potential cause for skepticism about whether we have found an effect at the second bend point, and we plan to investigate this further along with the modest changes in slope of the covariates. Finally, we will perform an analysis of the heterogeneity of the effects in different population groups, such as among beneficiaries who have different types of impairments (as the type of impairment could affect an individual’s elasticity with respect to DI benefits).

In order to understand the welfare implications of changing the level of DI benefits, it will also be important to understand how they affect the health of DI beneficiaries. In future work, we plan on examining whether mortality changes discontinuously around the bend points.

References


**Figure 1** Relationship of Primary Insurance Amount to Average Indexed Monthly Earnings

![Figure 1](image)

**Figure 2** Replacement Rate (Ratio of Primary Insurance Amount to Average Indexed Monthly Earnings) Around the First “Bend Point”

![Figure 2](image)
Figure 3: Observations around the Bend Points

A. Lower Bend Point

B. Upper Bend Point
Figure 4: Average Annual Earnings in the Three Years after SSDI Allowance

A. Lower Bend Point

B. Upper Bend Point
Figure 5: Average Annual Earnings in Three to Five Years after SSDI Allowance

A. Lower Bend Point

B. Upper Bend Point
Figure 6: Average Earnings Prior to Applying for SSDI in Relation to the Lower Bend Point
Figure 7: Average Earnings Prior to Applying for SSDI in Relation to the Upper Bend Point
Figure 8: Fraction with a Trial Work Period in the Three Years after SSDI Allowance

A. Lower Bend Point

B. Upper Bend Point
Table 1: Summary Statistics of Sample around the Bend Points

<table>
<thead>
<tr>
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<th>Lower Bend Point Sample</th>
<th>Upper Bend Point Sample</th>
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<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Dev.</td>
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<td>Average Indexed Monthly Earnings</td>
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<td>Primary Insurance Amount</td>
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<td></td>
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<td>Pre-Application Earnings: 4–6 Years Before</td>
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<tr>
<td>Male</td>
<td>45.34</td>
<td>7.012</td>
</tr>
<tr>
<td>Race: White</td>
<td>0.7433</td>
<td>0.4368</td>
</tr>
<tr>
<td></td>
<td>0.1377</td>
<td>0.3446</td>
</tr>
<tr>
<td>Black</td>
<td>0.1199</td>
<td>0.3238</td>
</tr>
<tr>
<td>Other Race</td>
<td>0.5594</td>
<td>0.4964</td>
</tr>
<tr>
<td>Path to Allowance: Initial DDS Allowance</td>
<td>0.0864</td>
<td>0.2809</td>
</tr>
<tr>
<td></td>
<td>0.3542</td>
<td>0.4783</td>
</tr>
<tr>
<td>Observations</td>
<td>212,473</td>
<td></td>
</tr>
</tbody>
</table>

These are the regression samples, so the Lower Bend Point Sample includes DI beneficiaries within $675 of the first bend point, and the Upper Bend Point Sample includes DI beneficiaries within $1500 of the second bend point.

* We have access to W-2 earnings until 2011, so to examine post-award earnings three to five years after allowance we limit the sample to those entering the DI program by 2006. This reduces the number of observations to 193,530 in the Lower Bend Point sample, and 536,023 in the Upper Bend Point sample.
Table 2: Estimates of the Earnings Effects and Program Outcomes, Local Linear Models, $75 Bins

<table>
<thead>
<tr>
<th>Work-related Outcomes</th>
<th>Estimated Kink Effect of $100 in AIME (%) (± 95% CI)</th>
<th>Upper Bend Point [Bandwidth: -$1500, $1500]</th>
<th>Estimated Kink Effect of $100 in AIME (%) (± 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave. Annual Post-Allowance Earnings, 0–2 Years After</td>
<td>0.2097 (0.0628) 8.13% [2.16, 14.1]</td>
<td>0.3326 (0.0397) 1.04% [0.78, 1.30]</td>
<td></td>
</tr>
<tr>
<td>Ave. Annual Post-Allowance Earnings, 3–5 Years After</td>
<td>0.0405 (0.0682) 2.17% [-5.92, 10.26]</td>
<td>0.2259 (0.0290) 1.94% [1.39, 2.48]</td>
<td></td>
</tr>
<tr>
<td>Trial Work Period, Within Three Years of Starting SSDI (x 1000)</td>
<td>0.0156 (0.0036) 132% [-98, 362]</td>
<td>0.0003 (0.0009) 0.11% [-0.64, 0.86]</td>
<td></td>
</tr>
</tbody>
</table>

Pre-Application Earnings

| Ave. Pre-Application Earnings, 1–3 Years Before | -0.3480 (0.5554) -0.357% [-1.56, 0.85] | 1.266 (0.2489) 0.27% [0.16, 0.38] |
| Ave. Pre-Application Earnings, 4–6 Years Before | -2.483 (0.5869) -1.91% [-2.85, -0.98] | 1.767 (0.1980) 0.31% [0.24, 0.38] |
| Ave. Pre-Application Earnings, 7–9 Years Before | -1.315 (0.4289) -1.13% [-1.89, -0.36] | 2.063 (0.1556) 0.34% [0.29, 0.39] |
Table 3: Estimates of the Earnings Effects Zero to Two Years after SSDI Allowance, Varying Bandwidth and Bin Size

<table>
<thead>
<tr>
<th>Estimated Kink Effect of $100 in AIME (%) &amp; 95% CI</th>
<th>Estimated Kink Effect of $100 in AIME (%) &amp; 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A: Lower Bend Point Sample</strong></td>
<td><strong>B: Upper Bend Point Sample</strong></td>
</tr>
<tr>
<td>Coefficient from Table 2</td>
<td>Coefficient from Table 2</td>
</tr>
<tr>
<td>0.2097 (0.0628)</td>
<td>0.3326 (0.0397)</td>
</tr>
<tr>
<td>8.13% [2.16, 14.1]</td>
<td>1.04% [0.78, 1.30]</td>
</tr>
<tr>
<td>Bin Size of $50:</td>
<td>Bin Size of $50:</td>
</tr>
<tr>
<td>Coefficient with $700 Bandwidth</td>
<td>Coefficient with $1500 Bandwidth</td>
</tr>
<tr>
<td>0.2002 (0.0586)</td>
<td>0.3330 (0.0419)</td>
</tr>
<tr>
<td>7.71% [2.40, 13.0]</td>
<td>1.04% [0.77, 1.32]</td>
</tr>
<tr>
<td>Bin Size of $100:</td>
<td>Bin Size of $100:</td>
</tr>
<tr>
<td>Coefficient with $600 Bandwidth</td>
<td>Coefficient with $1200 Bandwidth</td>
</tr>
<tr>
<td>0.1600 (0.0636)</td>
<td>0.2458 (0.0532)</td>
</tr>
<tr>
<td>6.01% [5.06, 11.5]</td>
<td>0.76% [0.42, 1.11]</td>
</tr>
</tbody>
</table>

Notes:
- SE = Standard Error
- CI = Confidence Interval
Appendix Figures

Appendix Figure 1: Primary Insurance Amount as a Function of Average Indexed Monthly Earnings
Appendix Figure 2: Distribution of Covariates around the Lower Bend Point

A. Fraction Male

B. Age When Applying

C. Fraction Black

D. Hearings Allowances
Appendix Figure 3: Distribution of Covariates around the Upper Bend Point

A. Fraction Male

B. Age When Applying

C. Fraction Black

D. Hearings Allowances
### Appendix Table 1: Estimates of Bend Point Effects in Distribution of Covariates

<table>
<thead>
<tr>
<th></th>
<th>Lower Bend Point</th>
<th></th>
<th>Upper Bend Point</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated Kink</td>
<td>Effect of $100$ in AIME (%) &amp; 95% CI</td>
<td>Estimated Kink</td>
<td>Effect of $100$ in AIME (%) &amp; 95% CI</td>
</tr>
<tr>
<td>Percent Male</td>
<td>0.0088 (0.0025)</td>
<td>4.12% [1.48, 6.76]</td>
<td>0.0007 (0.0004)</td>
<td>-0.10% [-0.20, -0.004]</td>
</tr>
<tr>
<td>Age at Filing for SSDI</td>
<td>0.0024 (0.0007)</td>
<td>0.53% [0.18, 0.87]</td>
<td>-0.0043 (0.0006)</td>
<td>-0.09% [-0.12, -0.06]</td>
</tr>
<tr>
<td>Percent White</td>
<td>-0.0103 (0.0016)</td>
<td>-1.34% [-1.78, 0.91]</td>
<td>-0.0013 (0.0003)</td>
<td>-0.15% [-0.22, -0.09]</td>
</tr>
<tr>
<td>Percent Black</td>
<td>0.0042 (0.0017)</td>
<td>-3.72% [0.30, 7.13]</td>
<td>0.0011 (0.0002)</td>
<td>0.87% [0.45, 1.30]</td>
</tr>
<tr>
<td>Percent Other Race</td>
<td>0.0061 (0.0020)</td>
<td>4.87% [1.22, 8.51]</td>
<td>0.0023 (0.0015)</td>
<td>0.39% [-0.13, 0.90]</td>
</tr>
<tr>
<td>Percent Awarded at Initial Determination</td>
<td>0.0144 (0.0019)</td>
<td>2.66% [1.88, 3.44]</td>
<td>-0.0018 (0.0003)</td>
<td>-0.29% [-0.38, -0.19]</td>
</tr>
<tr>
<td>Percent Awarded at Reconsideration</td>
<td>0.0012 (0.0011)</td>
<td>1.41% [-1.36, 4.19]</td>
<td>0.0001 (0.0002)</td>
<td>0.17% [-0.24, 0.58]</td>
</tr>
<tr>
<td>Percent Awarded at Hearing</td>
<td>-0.0156 (0.0017)</td>
<td>-4.14% [-5.06, -3.23]</td>
<td>-0.0017 (0.0003)</td>
<td>-0.57% [0.35, 0.79]</td>
</tr>
</tbody>
</table>