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How Much Do Outside Options Matter? The Effect of Subsidized Health Insurance on Social Security Disability Insurance Benefit Receipt☆

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ABSTRACT

New government health insurance programs may affect participation in existing safety-net benefits that provide health insurance as a secondary aim. We examine whether the outside options for health insurance made available by the Affordable Care Act affected Social Security Disability Insurance (DI) application decisions. Using the universe of U.S. individual income tax records spanning 2007-2016, we first estimate the effect of Medicaid expansions using a state difference-in-differences identification strategy, but find small and statistically insignificant estimates. However, when we estimate the effect of being eligible for high vs. low Marketplace subsidies based on geography, we find some evidence consistent with subsidies increasing DI claiming among those with prior access to Employer Sponsored Insurance, and decreasing DI claiming otherwise. Overall, we find suggestive evidence that outside options for health insurance do matter, though magnitudes are small and results are statistically precise only for Marketplace coverage.

Introduction

Since 2005, the number of disabled workers in the U.S. who receive Social Security Disability Insurance (SSDI, or DI for short) has risen over 28%, from 6.53 Million to 8.38 Million in 2019 (SSA, 2020a). DI provides cash benefits and health insurance; the health insurance benefit is especially valuable to the DI population because of high healthcare needs. As lawmakers consider policies to address the rising DI rates (Autor, 2015), it is important to have a better understanding of how individuals' behaviors are guided by health insurance provision. The largest expansion in public subsidies for health insurance for the under-age-65 population since the inception of Medicaid, the Affordable Care Act (ACA) provides us with an opportunity to improve our understanding of the role of health insurance in DI applications. In this paper, we test the importance of health insurance in two ways. First, subsidized health insurance may hasten DI application for those with ESI on the job, as for them the two-year waiting period for DI health insurance provision makes the DI application itself burdensome. Second, for those work-

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ers who do not have ESI, subsidized health insurance as an outside option may reduce applications for DI, as one can earn more in cash wages than is replaced by DI's cash benefit. This second incentive is reflected in discussions that occurred prior to the ACA's major insurance expansions in the context of growing DI rolls: Kennedy and Blodgett (2012) write in the New England Journal of Medicine that "Adults with potentially work-limiting disabilities residing in these {expansion} states will be able to obtain Medicaid without first obtaining SSI through disability eligibility.. . . ACA will reduce HIMDE (Health Insurance Motivated Disability Enrollment), addressing one major source of disability-program growth." Thus far, however, ACA-related research on disability applications has not been able to separately examine these two considerations, as such research would require information on baseline income and relevant health insurance options.

We examine behavioral responses to the increased availability of health insurance following the ACA on participation in the Social Security Disability Insurance program,[1] using a panel data set of the universe of U.S. tax records spanning 2007-2016. Through our analysis, we find suggestive evidence that outside options for health insurance matter, though magnitudes are small and results are not always statistically precise. More specifically, we find small and statistically insignificant estimates when we study the effect of Medicaid expansions using a state DD identification strategy. However, when we estimate the effect of being eligible for high vs. low Marketplace subsidies based on geography, we find some evidence consistent with subsidies increasing DI claiming among those with prior access to ESI, and decreasing DI claiming otherwise.

The ACA is estimated to have reduced the uninsured population by about 12.8 million (Carrasquillo and Mueller, 2018), while potentially decreasing the price of coverage for millions more. This is especially true for non-elderly adults with disabilities, given their high likelihood of qualifying for ACA subsidies due to the lower income that accompanies poor health status (Deaton, 2002) and because of the community rating rules of the ACA. DI beneficiaries are also eligible for health coverage through Medicare, but only after a 29-month waiting period from the established onset of the disabling condition (or 24 months from entitlement of cash benefits). This creates the potential for interactions between these two social programs. DI program participation could increase as a result of the ACA, as the ACA allows individuals to withstand the long wait for health benefits after applying for DI. But DI program participation could also decrease, as attaining health insurance is no longer tied to enrollment in that program. We hypothesize these effects will depend on whether individuals have access to health insurance while working that they could lose by exiting employment to pursue DI benefits.[2]

This paper contributes to a large literature studying the effects of health insurance availability on disability program participation. Depending on the data sources, some past studies have focused on DI, which applies to individuals with sufficient work history (and thus greater resources) while others focus on SSI, which is more relevant for those with fewer resources. Maestas, Mullen and Strand (2014) examine the impacts of the Massachusetts reform on DI (including concurrent Supplemental Security Income) claims and find decreases in DI claims in counties with low pre-reform health insurance coverage and increases in DI claims in counties with high pre-reform coverage. The published literature that examines the impacts of Medicaid expansions on SSI applications (Burns and Dague, 2017, Soni et al., 2017, Baicker et al., 2014) generally finds that Medicaid expansions reduce SSI applications, though Chatterji and Li (2017), Anand et al. (2019) and Schmidt et al. (2020) find mixed evidence. Thus, there is no clear consensus from the literature on the effects of health insurance expansions on either DI or SSI applications.

The literature on disability applications and health insurance expansion are part of a broader literature studying the relationship between health insurance, labor supply and program participation. Health insurance tied to program participation or to work could create a "lock." DI may have been a valuable source of new health insurance, especially for those leaving small firms, those working less than full time or those without working spouses, any of whom may have had difficulty in finding employer-sponsored health insurance while working. Thus, ACA coverage can release this lock for those who earlier sought DI at the margin for its health insurance provision.

Our paper offers several contributions to the literature on health-related social program interactions. First, while almost all prior studies have used the Current Population Survey (CPS, ~150 thousand individuals a year) or the American Community Survey (ACS, ~3 million households a year), our data set contains the population of U.S. tax records, covering the entire tax-paying population of the U.S. (roughly 140 million returns or 290 million individuals a year). Large sample sizes are necessary to distinguish statistically insignificant but potentially economically meaningful effects from true zeros. Furthermore, our data contain precise income measures used for determining program benefits eligibility. The Modified Adjusted Gross Income (MAGI) measure is not available in the CPS or ACS, and its omission could lead to attenuation bias when the treatment group is not accurately identified. The large sample size and richness of our data also allow us to examine effects in subpopulations that are affected to greater degrees: those with employer health insurance at baseline relative to those without. Our methods of identification are otherwise standard and have been used in the prior literature: we test these hypotheses comparing disability program participation for individuals in states and counties that experienced a greater extent of coverage availability under the ACA to states that did not, after the ACA to

[1] Note that this paper studies Social Security Disability Insurance, but not Supplemental Security Income (SSI), as SSI receipt is not observable in our tax data.

[2] Although COBRA continuation coverage is available to workers who leave a job that provided health insurance, this coverage is short lived (typically 18 months) and at unsubsidized premiums which are often unaffordable for non-employed workers.

before the ACA. We do this by asking whether the policy changes led to a greater fraction of DI beneficiaries with income in ranges that qualified for ACA health insurance subsidies, which allows us to judge the differential behavioral response of those whose incentives changed under the policy.

We find suggestive evidence that there is indeed an interaction between these two programs. The ACA's insurance expansion appears to have increased DI participation for those who did have ESI and decreased DI participation for those who did not. However, the effects are small in magnitude, and only present for ACA insurance expansions through the Marketplace, not for Medicaid expansion. The fact that Medicaid expansion produced statistically insignificant and small estimates indicates that health insurance was not impactful in DI application decisions on the margin for those at very low levels of income, which makes sense, since DI applications (the only disability program we can study in tax data) apply more to those with greater resources, for whom the Marketplace program is more relevant than Medicaid. However, even in the higher Marketplace income ranges, our results indicate fairly modest DI responses to health insurance relative to the literature.

Background

The U.S. labor force participation rate among the 25-54 year old male population has fallen from 97% in 1967 to 88% in 2017 (CBO, 2018). While the female labor force participation rate has increased dramatically over the same time period, those increases have halted more recently, with the rate falling from 75% in 2007 to 74% in 2017. Over time, the rate of employer-provided health insurance among the non-elderly population has declined substantially, from 66.7% in 1998 to 58.3% in 2018 (Petersen-KFF, 2020 Fig 1). Over the last several decades, both enrollment in the DI program and cost of the program to taxpayers have increased, escalating from 2.7 million DI recipients in 1970 to 9.9 million in 2019 (SSA, 2020b), causing the number of disabled workers as a share of all workers to triple from 1970 to 2013 (Schwabish, 2016). Because the ACA greatly expanded access to health insurance, it is important to examine the consequences for DI resulting from the ACA.

Disability benefits in the U.S. take two main forms: Social Security Disability Insurance (DI) and Supplemental Security Income (SSI). Our study examines the unique health-insurance-related features of DI, as tax data only enable us to identify DI outcomes, but because a sizable number of DI beneficiaries are also SSI beneficiaries,[3] and SSI and DI have the same medical criteria, describing the context around SSI is important. The DI program serves those with substantial recent work history, whereas SSI eligibility is based on meeting income or asset thresholds. The amount of a DI benefit is determined by a formula that takes into account history of earnings and is generally higher than SSI benefit amounts; unlike for SSI, there are no state supplements to federal DI, making DI an entirely federal program. Participation in either disability program also confers health insurance. All DI-eligible individuals are able to receive Medicare, but only after a 29-month waiting period from the established onset of the disabling condition (or 24 months from entitlement of cash benefits). In many states SSI automatically confers Medicaid eligibility, with no waiting period (Wagner, 2015).

Those with disabling health conditions are one and a half times more likely to lack access to private coverage relative to the population without disabling conditions (Kennedy et al., 2017), and prior to the ACA, there was limited access to public health insurance for low-income adults in poor health unless they received it through a disability insurance program. The ACA allows states the option of increasing Medicaid eligibility for adults aged 19-64 years up to 138% of the federal poverty line (FPL). Prior to the ACA, some states provided limited eligibility for parents, but for childless adults, the income eligibility threshold was close to 0% FPL. By February 2015, 27 states expanded Medicaid using the ACA's provisions, while the other states opted out of this provision. In all states, those with higher income levels, up to four times the federal poverty level, could access subsidies for insurance purchased through a Health Insurance Marketplace if they did not have access to employer-sponsored insurance. In states that expanded Medicaid, eligibility for these subsidies begins where eligibility for Medicaid ends, at 138% FPL. However, in non-expansion states, eligibility for these subsidies begins at 100% FPL.

In theory, all ACA insurance expansions (including the young adult provision, the employer mandate and the individual mandate) could affect DI application decisions. Although there are some ways to isolate effects even in those other expansion provisions (such as comparing relevant age ranges for the young adult provision), DI applications are not very common at younger ages. Thus, we focus on ACA Medicaid and Marketplace expansions.

We exploit two sources of variation. The first is cross-state variation in Medicaid expansions, which allows us to compare low-income individuals who are eligible for Medicaid in one state to low-income individuals in another state who are not eligible. Traditionally, "notch" studies of Medicaid expansions have not used income to define the treatment group, because of concern that individuals might distort their incomes downward to meet and maintain eligibility requirements. However, no such stark and discontinuous work disincentive exists in the ACA Medicaid expansions, because those who are above 138% FPL receive generous subsidies that phase out gradually. Nevertheless, we treat income as endogenous, and our identification strategy uses a method that does not rest on income manipulation assumptions.

The second source of identification for our study is geographic variation in health care access related prices, a technique used in prior studies to examine impacts on insurance coverage (Frean et al., 2017). This variation allows us to examine impacts of Marketplace expansions. Because of the close connection between health insurance

[3] The exact number varies by year; for example, in 2013 the number was 21%, but in 2019 it was 11% (Social Security Administration, 2015 and SSA 2020c Chart 12).

and asset protection, the population relevant for Marketplace insurance may be more elastic to health insurance subsidies in terms of their labor decisions than those with lower resources and income.

Conceptual Framework

The ACA introduces new insurance pathways and changes program incentives by releasing "DI lock" (making it less likely that individuals apply for DI) and but also by reducing the cost of the two-year wait for DI-related Medicare coverage, a feature used to prevent moral hazard (making DI applications more likely). To be more concrete, consider the following conceptual model of the decision faced by a worker to apply for Social Security Disability Insurance (DI) benefits or continue working. If one chooses not to apply for DI and works instead, she receives a stream of wages w and the value of any health insurance h_0 (the maximum value among her choice set consisting of one or more of the following: employer-sponsored insurance, private insurance, Medicaid available for low-income adults, or none), net of costs, for the next R-a years, where a is the individual's age and R is her retirement age. For simplicity, we assume that R is fixed, that there is no discounting and that the individual lives until at least age R with certainty; we also abstract from the availability of spousal insurance by assuming the agent is single. If, on the other hand, she chooses to apply for DI and does not work, $w = 0$ and the set of health insurance options available does not include ESI. If she is successful in her DI application (with some probability p) she receives a stream of benefits b and the net value of any health insurance available during the two-year waiting period h_1 (private insurance, Medicaid available for low income adults, Medicaid available through SSI participation if she meets the non-medical in addition to the medical criteria, or none) and Medicare m after the first two years. If her application is unsuccessful (with probability 1-p), then we assume she returns to the same state of the world in which she did not apply for benefits (abstracting from any potential changes in motivation from applying for benefits in the first place).[4]

That is, an individual will apply for DI if:

$$p[(R\text{-}a)b + 2h_1 + (\text{R-a-2})\text{m}] + (\text{1-p})(\text{R-a})(\text{w} + \text{h}_0) > (\text{R-a})(\text{w} + \text{h}_0).$$

Rearranging terms we get the following expression:

$$[p(R\text{-}a)(b\text{-}w) + (R\text{-}a\text{-}2)m] + p(2h_1 - (\text{R-a})\text{h}_0) > 0.$$

Note that the first term (in brackets) does not depend on the ACA, at least to a first order approximation. However, the ACA could affect the second term through its effect on *h1* or *h0*.

Consider a worker who has access to ESI when working and who is not eligible for SSI according to the non-medical criteria. Her decision to apply for DI depends on the relative values of ESI (h_0) and the health insurance available to her during the two-year waiting period for Medicare benefits (h_1). Absent the ACA, if private health insurance is unaffordable or unavailable and she is not eligible for Medicaid, then $h_1 = 0$. If the ACA enables her to buy private health insurance, however, or she becomes eligible for Medicaid through an expansion (depending on her state of residence), then under the ACA $h_1 > 0$. This increase in the value of health insurance during the waiting period implies that an individual with this option set is more likely to apply for DI under the ACA. Note that if instead she was eligible for SSI (in addition to DI), then she would receive Medicaid during the waiting period and $h_1 > 0$; in this case, the ACA does not affect her health insurance options, and therefore does not affect her likelihood of applying for and receiving disability insurance benefits one way or the other.

In a similar manner, we could consider a worker *without* access to ESI who is uninsured in the event that she does not receive DI. First consider an applicant who is not eligible for SSI in the event she is determined to be disabled. In a world without the ACA, $h_0 = h_1 = 0$. In a world with the ACA, $h_0 = h_1 > 0$. In either case, $h_0 = h_1$. Therefore, the ACA does not affect the applicant's likelihood of applying for DI. If, on the other hand, the applicant *was* eligible for SSI, then the ACA changes the calculation: in a world without the ACA, $h_0 = 0$ and $h_1 > 0$. Assuming the value of Medicaid for low-income adults (or reduced cost insurance through the exchange) is roughly equivalent to the value of Medicaid based on SSI eligibility, then in a world with the ACA $h_0 = h_1 > 0$. In this case, the ACA expands the option set for individuals who do *not* apply for DI, and so the ACA *reduces* the likelihood that this individual applies for DI.

Intuitively, health insurance tied to program participation or to work creates a "lock" that is alleviated by the ACA. The ACA release of "job lock" for those eligible for ESI but not SSI encourages DI applications. The release of "SSI lock" for those ineligible for ESI but eligible for SSI discourages DI applications. Those for whom the ACA does not release either job lock or SSI lock should not experience a change in their DI application incentives.

We summarize in Table 1 the predicted effect of the ACA on DI receipt conditional on the individual's health insurance option set. The upshot of this table is that for those with ESI who are not eligible for SSI, the ACA predicts greater likelihood of DI applications, while for someone who does not have ESI currently, the ACA would imply less likelihood of DI application.

Prior Literature

In descriptive work on health insurance coverage among those in disability programs, Rupp and Riley (2012) link administrative data across DI, SSI, Medicare and Medicaid to examine how health insurance evolves before and

[4] In reality, the disability determination process is not instantaneous but can take several months, especially if the applicant is initially denied and appeals. During this time the applicant foregoes earnings, and ultimately successful concurrent applicants forgo Medicaid available through SSI participation, which cannot be recovered. Newly entitled beneficiaries enduring long processing times receive back payments for foregone cash benefits (up to 12 months). Adding processing time to the model does not change the direction of the implied effect of the ACA on disability insurance applications conditional on the health insurance option set.

Table 1
Predicted Effects of the ACA on DI Applications.

Case – HI option while working and DI/SSI eligibility	Before ACA, HI if working	Before ACA, HI during WP if apply for DI	After ACA, HI if working	After ACA, HI during WP if apply for DI	Predicted effect on DI application
ESI, eligible for DI only	ESI	None	ESI	Reduced cost insurance not tied to work/DI	More DI (1)
ESI, eligible for DI and SSI	ESI	Medicaid	ESI	Medicaid	–
No ESI, eligible for DI only	None	None	Reduced cost insurance not tied to work/DI	Medicaid or reduced cost insurance not tied to work/DI	Depends on relative value of reduced cost insurance (e.g., no effect if = Medicaid)
No ESI, eligible for DI and SSI	None	Medicaid	Medicaid	Medicaid	Less DI (2)

Notes: HI = Health Insurance, WP = Waiting Period. This table applies only to individuals who would be eligible for insurance assistance under the ACA (through Marketplace subsidy/ Medicaid expansion); if not eligible, then all cells would indicate no effect on DI because ACA does not affect them.

after disability program entry. They find, using monthly data, that at first the SSI-only group has higher insurance than the DI group, but that as the 24-month period ends, the gap narrows. However, Rupp and Riley's data does not include measures of private coverage. Gruber and Kubik (2002) use the Health and Retirement Survey, which allows them to consider all sources of coverage, and find that private coverage appears high during the wait period for DI such that there are no major dips in coverage rates after DI application, although rates of applying for DI are much higher among those who have alternative sources of coverage than just through their own employer. The implication they draw from their results is that eliminating the waiting period for Medicare related to DI would substantially increase DI applications, which adds to the impetus for our current study. Rupp and Riley (2012) and Gruber and Kubik (2002) are purely descriptive, but speak to the importance of health insurance to the population applying for disability insurance programs and thus the possibly large response in application rates to changes in health insurance policy. The next section discusses the policy-based causal effects literature that tests these predictions.

In one of the first papers investigating the connection between health insurance and disability program participation, Yelowitz (1998) finds that increases in SSI-connected Medicaid generosity lead more people to enter SSI. This is as expected, as this represents an *increase*, rather than a *decrease* in the relative value of SSI that would occur through expansion in non-SSI Medicaid. In a paper that examines coverage effects of expansions of SSI-tied Medicaid, Wagner (2015) studies state expansions that provided Medicaid to those on SSI with incomes below 100% FPL. She finds a very high rate of crowd-out of private insurance on the order of 50% or 100%, also demonstrating the importance of health insurance to the disabled population and consistent with the Gruber and Kubik (2002) results suggestive of high crowd-out of insurance by coverage tied to disability programs. The 2008 average income level for disabled individuals to receive Medicaid was 87% of FPL. Wagner takes advantage of Medicaid expansions for disabled populations in 8 states between 1998 and 2003; states had the option since OBRA 1986 to increase the level to 100% FPL, but even as of 2008 the average was 87% of FPL, which indicates that subsidy increases through the ACA represent a very large increase in generosity beyond SSI-linked Medicaid.

Interactions Between ACA or ACA-Like Policies and Policies for the Disabled

In contrast to the early set of SSI-related Medicaid expansions, the more general public health insurance expansions (Massachusetts reform, ACA and other general insurance expansions) operate through different mechanisms.

In research that examines the effect of non-SSI-Medicaid expansion, Burns and Dague (2017) examine Medicaid expansions from 2001-2013 using ACS data and find a 7% decline in SSI participation of childless adults following the average expansion. Using SSA administrative totals at the county level, Soni et al. (2017) find that SSI participation decreased by about 3 percent after 2014 in Medicaid expansion states. These results are as expected in our model, since beneficiaries now have access to health benefits outside of SSI; ambiguous predictions only apply to DI participation.

The relationship between health insurance and DI found in the existing literature has not been as clear as with SSI. Maestas et al. (2014) study the Massachusetts (MA) health reform, which is similar in structure to the ACA. They examine DI and SSI in MA counties relative to counties outside of MA, and find more inflows into DI with SSI in counties with low baseline uninsurance (thus a larger dose of expansion). But they find that applications for DI alone increased everywhere, even in counties with low coverage rates; they were not able to test whether this result represents the net impact as a result of offsetting effects for those with and without ESI, which is an area our research helps advance.

In another study using ACA expansion variation with mixed results, Anand et al. (2019) study effects of Medicaid expansion in 2014 on applications to DI and SSI using SSA administrative data on applications for benefits. Their DD study design is to find within-state geographical units that look similar in expansion and non-expansion states, to solve problems with non-parallel trends at the state level. After propensity matching PUMAs in control and treatment

states based on disability application trends and baseline values of other characteristics, they perform a unit-by-unit analysis. That is, they comment on the effect of Medicaid on SSI and DI in each state, finding that in some states there are declines and in other states there are increases. There is also a mixed picture, depending on the state, regarding whether it is SSI or DI applications that are affected. They conclude that a fruitful direction for further work would be learning from state officials why each state may have displayed a different effect, although they also caution that the choice of different control groups for each state may affect these results.

Another ACA-disability program study, conducted with the ACS, uses a different identification method: Schmidt et al. (2020) examine the impact of Medicaid expansion on SSI and DI using county border pairs between states with and without 2014 ACA Medicaid expansion. They find no significant effects on applications to either SSI or DI. Chatterji and Liu (2017) examine the effect of Medicaid expansion in four early-ACA-expansion states on disability outcomes. They use SSA aggregates and CPS data on SSI and DI outcomes (applications, awards, new entry, stock), with a DD method and synthetic controls. The early expanders are the treatment states and the late expanders (who expanded after January 2014) are the control states. They find a reduction in SSI beneficiaries in Connecticut, but no other outcome or states exhibited any convincing pattern of results indicating whether Medicaid expansion systematically affected outcomes.

Other literatures related to our work include the effect of the ACA on labor markets: Kaestner et al. (2017); Gooptu et al. (2016); Levy, Helen and Buchmueller (2016) and Heim et al. (2015) find little evidence that work behavior changes in the general population as a result of health insurance. Further, Dillender et al. (2016) do not find effects of the ACA insurance expansion on part-time work. The literature on effects of the ACA on health insurance is also relevant, as it considers the "first stage" of the mechanisms at play: substantial coverage changes. Many papers show clear effects (e.g. Simon et al., 2017),[5] however the size of the DD at the state level (difference in coverage rates between expansion and non-expansion states) is not extremely large because the ACA increased coverage rates in all parts of the U.S. quite substantially, compromising the power of DD-style identification strategies (Black et al., 2019).

In summary, there has been much economic interest in disability programs and health insurance policy because of clear overlaps and connected incentives in the different social benefits they provide. Although results so far have been mixed with respect to which of the multiple incentives are stronger on net, the literature and theoretical considerations forecast that using a large and rich data source like the U.S. tax database should provide a substantial opportunity to examine ACA expansions and disability program decision making.

Data

We test hypotheses from our model using data from the population of U.S. tax returns spanning 2007-2016. These data are advantageous relative to other possible sources, such as the Current Population Survey or SSA administrative data, for a number of reasons. First, the exact measure of income relevant for provisions of the ACA (namely, Modified Adjusted Gross Income, or MAGI) comes directly from individuals' tax returns, and so it is measured without errors in the tax data. Second, as we discuss below, though information on which workers have ESI is limited, the tax data include a reliable proxy for ESI access, namely whether the individuals' employer offers an employer-sponsored pension plan. Moreover, the tax data contain administrative third-party reports of disability benefit receipt, which are subject to less misreporting than are self-reported measures. Finally, the potential sample sizes are substantially larger than can be found in survey data, and so it is possible to focus in on small subsets of the population without sacrificing precision.

In tax data, DI benefit receipt is reported on Form SSA-1099. On this form, the Social Security Administration reports the amounts and types of benefits (e.g., old age or disability insurance) that were received from the Social Security Administration in a given tax year. Thus, if some amount of DI benefits is reported on this form, we know that the individual was a DI recipient in that year.[6] In addition, this form contains the recipient's address, from which we can observe their state of residence. However, SSI receipt is not reported in tax data, and so our study is limited to DI participation.

We combine the information from the SSA-1099 forms with other information collected on tax forms, including income and presence of children (from Form 1040), wages and the presence of an employer-sponsored retirement plan (from Form W-2) and age (from the DM1 file). To focus on those who were not eligible for Medicare, and who could not gain private health insurance through a parent's plan, we cut the sample to those aged 27-64 in each year. In order to exactly observe FPL, we limit the sample to the 98% of individuals who filed a 1040. Using the resulting dataset, we then identify new DI recipients as those who had no SSA-1099 with DI benefits in year t-1, but did have DI benefits in year t.

To examine the impact of the ACA on DI claiming, we first identify which portions of the ACA (Medicaid expansions, Premium Tax Credit subsidies, or neither) applied to each individual in our dataset.

Medicaid expansion eligibility depends on the individual's state of residence. Thus, using information on state of residence from SSA-1099, we infer whether some-

[5] This paper estimates that following the ACA, the probability of having any insurance increased by 6.5 percentage points (12%) for childless adults and 4.4 percentage points (8%) for all adults. The probability of having Medicaid increased 8.7 percentage points (68%) for childless adults and 6.8 percentage points (40%) for all adults.

[6] Note there is a five-month waiting period between the individual's onset date and when he or she begins receiving cash benefits. In practice, this waiting period has already lapsed before many new beneficiaries are determined medically eligible for benefits.

one resided in a state that did not expand Medicaid (No Expansion), a state that expanded Medicaid in 2014 (ACA Expansion – our treatment group), or a state that expanded Medicaid prior to 2014 (Early Expansion).

Both Medicaid and Premium Tax Credit eligibility depend on income (in particular, MAGI) relative to the Federal Poverty Line (FPL). We calculate MAGI directly from the 1040 form, and compare this to the FPL that would apply given their marital status and number of children reported on the form.

Since the DI claiming response to the ACA may differ depending on whether an individual has access to employer-sponsored insurance (ESI), we identify which individuals had ESI in the year prior to claiming DI. Unfortunately, information on the receipt of ESI is not available in tax data until 2012, and even then is only required for employees of large firms (those with more than 250 employees). Thus, as a proxy for having ESI, we use information on whether the individual had an employer-sponsored retirement plan reported on a W-2 form, since the two are highly correlated and information on employer-sponsored retirement plan coverage is available in all years of our sample. In the CPS and the Medical Expenditure Panel Survey (MEPS), of families where at least one parent reported receiving an employer-sponsored retirement plan, more than 90% were also covered by ESI. For this reason, we treat reporting a retirement plan as a proxy for availability of health insurance. Since we find that approximately 20% of families in the MEPS who did not have employer-sponsored retirement plans were also covered by ESI, not contributing to a retirement plan is a weaker proxy for lack of health insurance.[7] Because, as noted below, our specifications stratify based on the availability of ESI in the prior year, although our data begins in 2007, the first year available for estimation is 2008.

Sample statistics for our estimation sample, consisting of those who are newly on DI, are presented in Table 2. The average age in our sample is 53 years, and roughly half of the sample is female. Average Modified Adjusted Gross Income is just over $52,000, while 32.5% of the sample were likely to be covered by ESI (as indicated by our proxy for ESI) in the year prior to claiming disability. About 23% of the sample comes from states that expanded Medicaid prior to 2014, while 29% come from states that expanded Medicaid in 2014 as part of the implementation of the ACA. Finally, 44% of individuals in the sample have income between 138% and 400% of the Federal Poverty Line, which would make them eligible for a Premium Tax Credit.

Table 2
Sample Statistics.

	Mean	St. Dev.
Individual Characteristics		
Modified Adjusted Gross Income	52,236.78	119,150.30
Female	0.503	0.500
Age	53.10	9.05
Proxy for Employer Sponsored Insurance	0.325	0.469
Income Relative to Federal Poverty Line		
MAGI < 100% FPL	0.173	0.378
138% FPL < MAGI < 400% FPL	0.442	0.497
138% FPL < MAGI < 200% FPL	0.123	0.328
200% FPL < MAGI < 250% FPL	0.092	0.289
250% FPL < MAGI < 300% FPL	0.085	0.278
300% FPL < MAGI < 400% FPL	0.142	0.350
Medicaid Expansion Status		
Prior to 2014	0.232	0.422
In 2014	0.293	0.455
Medicare Cost Relative to Median		
Below	0.502	0.500
Year		
2008	0.114	0.318
2009	0.123	0.329
2010	0.132	0.338
2011	0.129	0.335
2012	0.119	0.324
2013	0.110	0.313
2014	0.098	0.298
2015	0.092	0.289
2016	0.082	0.274
N	4,866,371	

Notes: Data from 2007-2016 extract of 1040 filers, U.S. Tax Returns.

Empirical Strategy

Our two empirical approaches are tied to our working hypotheses on how the ACA might interact with the decision to apply for DI, and how those effects might differ depending on prior income and ESI coverage. First, we examine the impact of Medicaid expansions on the share of new DI beneficiaries who have baseline incomes that would make them eligible for Medicaid in expansion states. Second, we examine the differential impact of low- vs. high-cost subsidies on the share of new DI beneficiaries who are eligible for the subsidies.

Impact of Medicaid Expansions

Prior to the ACA, among low-income individuals without ESI, some may have applied for DI in order to obtain health insurance. Since the ACA's Medicaid expansions provide alternative ways for low-income individuals to get health insurance, we would expect to see *declines* in the fraction of low-income new DI claimants in Medicaid expansion states relative to non-expansion states. However, prior to the ACA, some low-income individuals who did have ESI may have refrained from applying for DI because they would need to undergo a waiting period without a job and so without their ESI. Since the ACA provides an alternative way to obtain health insurance, we would expect to see *increases* in the fraction of low-income new DI claimants who did have ESI in the prior year.

To examine whether this is the case, we use a difference-in-differences strategy, estimating whether the fraction of newly disabled who have low-income (which we define as <100% FPL) declined in expansion states. Although those

[7] We also checked the quality of this proxy in the tax data among those in large firms 2012 and after, when large firms were required to report whether they offered ESI. In this subsample, 90% of those with a retirement plan were also covered by ESI, which is very close to the fraction in the CPS and the MEPS. Among those without a retirement plan 48% had ESI, which is higher than in the MEPS, but this is likely due to larger employers being generally more likely to offer ESI to their employees.

in expansion states are eligible for Medicaid if they have income up to 138% FPL, those in non-expansion states become eligible for Marketplace subsidies at 100% FPL. Thus, we use 100% FPL as the cutoff for low income status to prevent eligibility for subsidies from contaminating the comparison across states. [8]

We cut the sample to include only those who are newly disabled, and estimate models of the form:

$$y_{i,s,t} = \alpha + \beta\, Expansion_s + \gamma Post_t + \delta Expansion_s * Post_t + \tau_t + \eta_s + \Gamma X_i + e_i \quad (1)$$

The dependent variable denotes whether the newly disabled individual i living in state s at time t had income that was below 100% FPL in the year of newly claiming DI.[9] *Expansion* denotes whether they resided in a Medicaid expansion state, and *Post* indicates whether the observation comes from a year after the expansion (2014). The coefficient on the interaction between *Expansion* and *Post*, δ, is an estimate on the differential share of low-income individuals among new DI recipients in Medicaid expansion states compared to other states. τ denotes a time fixed effect, η denotes a state fixed effect, the vector X contains other demographic variables and e is an error term.

Since the hypothesized sign of δ differs depending on whether the individual had ESI in the prior year, we estimate two forms of this equation. In the first, the dependent variable denotes that the individual's income is below 100% FPL and that they previously had ESI, while in the second, the dependent variable denotes that the individual's income was below 100% FPL and that they did not previously have ESI. In the first specification, a positive coefficient would be consistent with the effect hypothesized above (implying that the ACA led to an increase in DI claims among low-income people who had ESI), while in the second, a negative coefficient would be hypothesized (implying that the ACA led to a decrease in DI claims among those who did not have ESI, and may have claimed DI to get health insurance).

We include year fixed effects, state fixed effects, and a control for the change in the labor market conditions (state unemployment rate) from the baseline year to the next year. We control for demographic characteristics in X (including age, age-squared, and gender), and in alternative models, we test heterogeneity of the impact by these characteristics (such as how effects differ for females vs. males, married vs. single, etc.).

Appendix Fig. A1 depicts our research design by examining graphically whether there appears to be a change in the fraction of new DI claimants who are low income in Medicaid expansion states. In Panel A, we divide the sample of newly disabled into those from non-expansion states, states that expanded Medicaid in 2014 and states that expanded Medicaid prior to 2014, and graph the trend in the share of new DI claimants who had income below 100% FPL. Although the share of low-income new DI claimants declines in Medicaid expansion states after 2014, it appears to decline just as much in non-expansion states. This graph, then, suggests that the ACA Medicaid expansion did not lead to a differential change in low-income DI claimants overall.

We then graph the share of low-income new DI claimants who previously had ESI (in Panel B), and the share of low-income new DI claimants who previously did not have ESI (in Panel C). Again, these shares are graphed separately depending on whether and when the state expanded Medicaid. In Panel B, there is an increase in low-income new DI claimants who previously had ESI in Medicaid expansion states after 2014, though similar trends are seen in the non-expansion states after 2014. In Panel C, there is a decrease in low-income new DI claimants who did not previously have ESI in Medicaid expansion states after 2014, but again, similar trends are seen in the non-expansion states after 2014. Together, these figures suggest that the ACA Medicaid expansion did not lead to differential changes in low-income DI claimants.

Table A1 presents the results from pre-trends tests of the Medicaid expansion specification in (1), which show no differential pre-trends among ACA expansion states compared to non-expansion states during the pre-period, bolstering our difference-in-differences methodology.[10]

Impact of Premium Tax Credits

To test our hypotheses directly, we again use a difference-in-differences strategy, but we now compare those from counties with a low versus high health insurance costs after the implementation of the ACA, since people in low-cost counties should be more affected by the availability of Marketplace insurance and subsidies than those from high-cost counties. We again cut the sample to include new DI claimants, and estimate models of the form:

$$y_{i,s,t} = \alpha + \beta\, LowCost_i + \gamma Post_t + \delta LowCost_i * Post_t + \tau_{t,m} + \eta_s + \Gamma X_i + e_i \quad (2)$$

In this specification, the dependent variable denotes whether the newly disabled individual's income in the year of newly claiming DI was between 138-400% FPL. *LowCost* denotes whether they resided in a county with lower than median costs, and all other variables are defined as above.

The coefficient on the interaction between *LowCost* and *Post*, δ, is an estimate on the differential share of moderate income individuals among the new DI recipients in counties with low costs relative to counties with high costs. Note, however, that the hypothesized sign of δ differs depending on whether the individual had ESI in the prior year. Thus, we estimate two forms of this equation. In the first, the dependent variable denotes that the individual's income was between 138-400% FPL and that they previ-

[8] We also ran specifications that varied the income threshold from 90% FPL up to 110% FPL. The estimated effects of the ACA expansion did not significantly differ when different income cutoffs were used.

[9] Individuals from all states are included in these regressions.

[10] There is a marginally significant coefficient on the time trend for early expansion states, but this is not our subgroup of interest.

ously had ESI, while in the second, the dependent variable denotes that the individual's income was between 138-400% FPL and that they did not previously have ESI. In the first specification, a positive coefficient would be consistent with the effect hypothesized above (implying that the ACA led to an increase in DI claims among moderate-income people who had ESI), while in the second, a negative coefficient would be hypothesized (implying that the ACA led to a decrease in DI claims among those who did not have ESI, and may have claimed DI to receive health insurance).

To determine whether an individual resided in a low- or high-cost county, we use two approaches. In the first, we use the cost of the second-lowest-cost "silver plan" for a reference person. Although this measure is directly tied to the policy under study, the ACA, it does have the weakness that it largely reflects insurance companies' projections of costs in a completely new market, and those projections came with a high degree of uncertainty. Thus, in our second measure, we use the Dartmouth Atlas of Health Care measure of Medicare spending.[11] Although this measure is not tied to the ACA, we think that it is likely to be a better proxy for health costs in a particular region during the early stages of the ACA, as it reflects actual cost experiences in that area. In each of these measures, low- or high-cost status is driven only by geography, and not by the age or health condition of the individual.

Figs. A2 and A3 depict our research design by examining graphically whether there appears to be a change in the fraction of newly DI that are moderate income in low- versus high-cost counties. In Panel A, using the second-lowest cost "silver plan" (SLCSP) measure of cost in Fig. A2 and the Medicare spending measure of cost in A3, we divide the sample of newly disabled by the cost status (low versus high) of their county of residence, and graph the trend in the share of new DI claimants who had income below 138% FPL. In this panel in both figures, the share of moderate-income new DI claimants appears to decline slightly in high-cost counties, but a similar decline is seen in low-cost counties as well, suggesting that the ACA did not lead to a differential change in DI claimants overall.

We then graph the share of moderate-income new DI claimants who previously had ESI (in Panel B) and the share of moderate-income new DI claimants who previously did not have ESI (in Panel C). Again, these shares are graphed separately depending on Medicare costs (low versus high). In both panels of Fig. A2, where low-cost status is determined by the SLCSP, the trends are roughly parallel, again suggesting that the ACA did not lead to a change in DI claimants. In Fig. A3, however, in Panel B, after 2014 there is an increase in moderate-income new DI claimants who previously had ESI in low-cost counties, and this increase appears larger than that in high-cost counties. Similarly, in Panel C, there is a decrease in moderate-income new DI claimants who did not previously have ESI in low-cost counties after 2014, and this decline appears to be slightly larger than that in high-cost counties. Taken together, these graphs appear to suggest that the ACA may have led to an increase in moderate-income DI claimants who previously had ESI, and a slight decrease in moderate-income DI claimants who did not previously have ESI.

Table A2 presents the pre-trends tests when the cost of the SLCSP is used to divide counties into high and low cost, while Table A3 presents the pre-trends when Medicare costs are used to divide counties. Across both tables, no statistically significant coefficients were found, suggesting that pre-existing trends in low- and high-cost counties were not significantly different, regardless of how we separate the counties.

Since the ACA led to two sources of outside options for health insurance (Medicaid and Marketplace insurance), a natural question is which of these sources is likely to be more important for potential DI claimants. To shed some light on this question, we tabulated the distribution of income for DI beneficiaries in 2016, the last year of our data and after the ACA expansion occurred (Table A4). Interestingly, only 31% of DI beneficiaries had income under 100% FPL (defined below as low income for the purposes of Medicaid eligibility in expansion states); since a sizable number of DI recipients (up to one fifth, by SSA (2015)) are also on SSI and that those in this group who file a tax return are likely to have income less than 100% FPL, it may be that significantly less than 31% of DI recipients that are affected by the Medicaid expansion. However, 38% of DI beneficiaries fall in the Premium Tax Credit eligible range of 138-400% of FPL. Together, these suggest that the Marketplace expansions may influence behavior more than the Medicaid expansion.

Results

Impact of Medicaid Expansions

Table 3 presents the estimation results for the Medicaid expansion specification. Columns 1 and 2 present results for specifications in which the dependent variable denotes being a new DI claimant with income below 100% FPL who previously had ESI, while in Columns 3 and 4 the dependent variable denotes being a new DI claimant with income below 100% FPL who previously did not have ESI. Specifications in odd numbered columns do not include covariates, while specifications in even numbered columns do. The coefficients of interest are the interactions between residing in an ACA Medicaid expansion state in a post-reform year.

If the ACA Medicaid expansion led to an increase in DI claims among those who previously had ESI, we would expect these coefficients to be positive in Columns 1 and 2, as it would denote that the share of those with income below 100% FPL increased among expansion states relative to non-expansion states. Though some of the coefficients for the ACA expansion states in the post-period are positive across these specifications, the magnitudes are quite small, and none are statistically significant.

Similarly, if the ACA Medicaid expansion led to a decrease in DI claims among those who did not previously have ESI, we would expect the coefficients on the ACA Expansion x post-reform year interactions to be negative in Columns 3 and 4, as it would denote that the share of those with income below 100% FPL declined among expansion

[11] See http://www.dartmouthatlas.org/tools/downloads.aspx.

Table 3
Estimation Results, Medicaid Expansion Specifications.

Low Income with: (Income < 100% FPL)	ESI (1)	ESI (2)	No ESI (3)	No ESI (4)
ACA Expansion x 2014	−0.054	0.078	−0.017	−0.101
	(0.127)	(0.107)	(0.367)	(0.369)
ACA Expansion x 2015	−0.068	0.022	−0.137	−0.069
	(0.113)	(0.093)	(0.339)	(0.357)
ACA Expansion x 2016	−0.091	−0.044	−0.305	−0.132
	(0.142)	(0.078)	(0.312)	(0.350)
Early Expansion x 2014	−0.271*	−0.014	0.045	−0.279
	(0.157)	(0.114)	(0.433)	(0.471)
Early Expansion x 2015	−0.289*	−0.063	0.076	−0.091
	(0.156)	(0.112)	(0.490)	(0.595)
Early Expansion x 2016	−0.243**	−0.071	0.044	−0.065
	(0.118)	(0.080)	(0.449)	(0.524)
Covariates	No	Yes	No	Yes
Observations	4,758,341	4,758,341	4,758,341	4,758,341
R-squared	0.001	0.071	0.004	0.099

Notes: Data from 2007-2016 extract of 1040 filers, U.S. Tax Returns. Sample size is slightly less than in Table 2 (4,866,371) due to an omitted cluster. Robust standard errors are in parentheses. * indicates p = .10; ** p = 0.05, *** p = 0.01.

states relative to non-expansion states. Though all of the coefficients for the ACA expansion states in the post-period are negative in all specifications, the magnitudes are quite small, and none are statistically significant.

We estimated a number of additional specifications.[12] First, we stratified the sample by age (27-44, 45-54, and 55-64). For the youngest group, we find a significant but unexpectedly signed negative effect on DI claiming among those with ESI in 2016; all other coefficients are insignificant. For the older group, the results are very similar to those for the full sample.

Second, we split the sample by gender. For men, the estimated coefficients were small and insignificant among those with ESI, and wrongly signed and insignificant for all but one coefficient among those without ESI. Among women, the coefficients among those with ESI were again small and insignificant. However, among those without ESI, the coefficients were negative (as would be expected), and statistically significant for all years when covariates are not included. When covariates are included, the coefficients remain negative but decrease in size, with only the coefficient for 2016 remaining marginally significant, implying that the fraction of DI claimants with low income dropped by 0.7 percentage points following the passage of the ACA.

Third, we cut the sample to only include observations from 2012 and later among those who worked in large firms. As noted above, for these observations, we have information on whether the individual had ESI, and so do not have to rely on using retirement contributions as a proxy. However, cutting to this subsample results in only one pre-ACA year in the sample. In this specification, among those with ESI, the estimated coefficient for 2014 is significant and positive at 0.004, while in the same year among those without ESI, the estimated coefficient is negative and significant at −0.003. This implies an increase in claimants among those with ESI and a decrease in claimants among those without ESI. However, these coefficients are generally not statistically significant in subsequent years.

Overall, the results are generally consistent with the graphical trends above, suggesting that the ACA Medicaid expansion did not lead to a differential change in DI claims among low income individuals, though there may have been a decline in DI claims among women who did not have ESI.

Impact of Premium Tax Credits

We next examine whether the availability of health insurance through an ACA Marketplace led to a decline in DI claiming among those without ESI, and an increase among those with ESI, by estimating (2).

Table 4 contains estimation results when the SLCSP is used to split counties into those with high and low costs. The dependent variable denotes being a new DI claimant and having income between 138% and 400% FPL, and the coefficients of interest are the interactions between residing in a low-cost county in a post-reform year. Columns 1 and 2 present results among the sample who had (our proxy for) ESI, while Columns 3 and 4 present results among those who did not. If the availability of an ACA Marketplace plan led to an increase in claims among those with ESI and a decrease among those without ESI, and if living in a lower-cost area magnified that effect, we would expect to see positive coefficients in the first two columns and negative coefficients in the second two. However, the coefficients do not follow this pattern, and none are statistically significant. These results, then, would suggest that the availability of Marketplace insurance did not affect DI claiming among those with moderate income. However, as noted above, we think that this measure of costs may be a weak proxy for actual costs, given that it mainly reflects insurance companies' projections of costs in a completely new insurance market.

The results in Table 5, when Medicare Spending is used to divide counties into high and low cost, tell a differ-

[12] These results are available upon request from the authors.

Table 4
Estimation Results, Probability of Newly Disabled Being Moderate Income, Low Second Lowest Cost Silver Plan Specifications.

Moderate Income with: (138% FPL < Income < 400% FPL)	ESI (1)	ESI (2)	No ESI (3)	No ESI (4)
Low Cost x 2014	−0.182	−0.186	0.124	0.145
	(0.281)	(0.282)	(0.282)	(0.277)
Low Cost x 2015	−0.092	−0.095	0.048	0.067
	(0.263)	(0.264)	(0.351)	(0.345)
Low Cost x 2016	−0.279	−0.296	−0.231	−0.196
	(0.313)	(0.314)	(0.313)	(0.302)
Covariates	No	Yes	No	Yes
Observations	4,866,371	4,866,371	4,866,371	4,866,371
R-squared	0.002	0.003	0.002	0.003

Notes: Data from 2007-2016 extract of U.S. Tax Returns. Low Cost denotes that second lowest cost silver plan on the Marketplace in the individual's county of residence is below the median. Robust standard errors are in parentheses. * indicates p = .10; ** p = 0.05, *** p = 0.01.

Table 5
Estimation Results, Probability of Newly Disabled Being Moderate Income, Medicare Spending Specifications.

Moderate Income with: (138% FPL < Income < 400% FPL)	ESI (1)	ESI (2)	No ESI (3)	No ESI (4)
Low Cost x 2014	0.587**	0.564**	−0.459	−0.420
	(0.275)	(0276)	(0.286)	(0.286)
Low Cost x 2015	0.832***	0.802***	−0.546**	−0.493*
	(0.223)	(0.224)	(0.251)	(0.250)
Low Cost x 2016	1.081***	1.050***	−0.742***	−0.702***
	(0.292)	(0.291)	(0.262)	(0.258)
Covariates	No	Yes	No	Yes
Observations	4,865,903	4,865,903	4,865,903	4,865,903
R-squared	0.003	0.003	0.002	0.003

Notes: Data from 2007-2016 extract of U.S. Tax Returns. Low Cost denotes that the Dartmouth Atlas of Health Care measure of Medicare spending in the individual's county of residence is below the median. Sample size is slightly less than in Table 2 (4,866,371) due to a few counties missing Dartmouth Atlas data. Robust standard errors are in parentheses. * indicates p = .10; ** p = 0.05, *** p = 0.01.

ent story. Here, positive effects are found in the sample of those with ESI, and negative effects are found in the sample of those without ESI, consistent with the expectation that low-cost Marketplace Insurance would lead to an increase in DI claims among moderate income individuals who had ESI (since they would be more willing to leave their job and drop ESI if they had an alternative source of health insurance). It is also consistent with a decrease among moderate income individuals without ESI (since they would not have to claim DI in order to have a source of health insurance).[13,14]

As a robustness check, we estimated a specification in which we replaced the low-cost indicator with the ratio of Medicare spending in the individual's county to the national mean level of Medicare spending. These results in this specification were consistent with those in Table 5, in that lower spending is associated with higher levels of entry into DI among those with ESI, and lower levels of entry into DI among those without ESI.

To probe these results further, in Table 6, we examine whether the effects differ by the level of moderate income under consideration.[15] Because the ACA's Marketplace Premium Tax Credits are larger for those with lower incomes, and cost-sharing is larger for those with lower incomes, we might expect that the effects are larger for those with lower incomes. In this table, then, we divide the dependent variable into income subgroups.[16] In Panel A, the dependent variable denotes being a new DI claimant and having between 138% and 200% FPL, between 200% and 250% FPL in Panel B, between 250% and 300% FPL in Panel C, and between 300% and 400% FPL in Panel D. Consistent with this expectation, we find larger effects in Panel A among the lowest income group than we find among higher income groups in Panels B and C. However, we do find significant effects in Panel D among the highest income group. Taken together, these results appear to suggest that

[13] We re-ran these specifications with the sample restricted to the period 2012 to 2016 and to firms with ESI information. The results when states are divided according to the SLCSP are qualitatively similar to those in Table 4, though with marginally significant negative coefficients found for 2016 across columns 1-3. However, when states are divided according to Medicare spending, in contrast to Table 5, the results are generally insignificant, and are differently signed in some years. This may be because those who are in large firms are less likely to be on the margin of choosing DI, either perhaps because of more generous benefits or because these firms can accommodate disabilities better.

[14] We estimated specifications in which the sample was split by age group (27-44, 45-54, and 55-64). In those specifications, the positive coefficients on those with ESI were largest for the middle age group, and smallest for the oldest age group, though for those without ESI, the negative coefficients were largest for the oldest group. However, standard errors were too large to conclude anything definitive about differences across groups.

[15] We re-ran the pre-trends test for this specification, estimating whether the trend in the fraction of new DI claimants in each of these groups differed in low-versus high cost counties. In the ESI specification, all coefficients were zero to three decimal places, and all were statistically significant, with the exception of the group with income between 300-400% FPL. In the no-ESI specification, all coefficients were zero to three decimal places, and all were statistically significant with the exception of the group with income between 138-200% FPL. Thus, these specifications generally pass the pre-trends tests, though the two specifications that are exceptions should be viewed with caution.

[16] Note that the coefficients in these panels are smaller than the estimates presented in Table 5. Since all coefficients are estimated separately for the specifications, there is no guarantee that the disaggregated results will weight up to the aggregate results. However, it should be noted that the effect size in Table 5 is not robust to disaggregation by income group.

Table 6
Estimation Results, Probability of Newly Disabled Being Moderate Income, Medicare Spending Specifications - by Income Subsets.

A. Moderate Income with: (138% FPL < Income < 200% FPL)	ESI (1)	ESI (2)	No ESI (3)	No ESI (4)
Low Cost x 2014	0.158	0.168	−0.199*	−0.157
	(0.116)	(0.116)	(0.099)	(0.101)
Low Cost x 2015	0.297***	0.311***	−0.263***	−0.203**
	(0.101)	(0.100)	(0.094)	(0.089)
Low Cost x 2016	0.294**	0.307***	−0.342**	−0.296**
	(0.111)	(0.110)	(0.135)	(0.130)
Covariates	No	Yes	No	Yes
Observations	4,865,903	4,865,903	4,865,903	4,865,903
R-squared	0.001	0.001	0.001	0.004
B. Moderate Income with: (200% FPL < Income < 250% FPL)	**ESI (1)**	**ESI (2)**	**No ESI (3)**	**No ESI (4)**
Low Cost x 2014	0.125	0.124	−0.139	−0.125
	(0.087)	(0.087)	(0.091)	(0.091)
Low Cost x 2015	0.112	0.110	−0.164	−0.145
	(0.072)	(0.072)	(0.105)	(0.104)
Low Cost x 2016	0.237***	0.235***	−0.061	−0.046
	(0.068)	(0.068)	(0.090)	(0.090)
Covariates	No	Yes	No	Yes
Observations	4,865,903	4,865,903	4,865,903	4,865,903
R-squared	0.001	0.001	0.000	0.001
C. Moderate Income with: (250% FPL < Income < 300% FPL)	**ESI (1)**	**ESI (2)**	**No ESI (3)**	**No ESI (4)**
Low Cost x 2014	0.062	0.055	−0.141	−0.140
	(0.074)	(0.074)	(0.085)	(0.084)
Low Cost x 2015	0.121	0.110	−0.084	−0.083
	(0.078)	(0.077)	(0.109)	(0.110)
Low Cost x 2016	0.135	0.125	−0.089	−0.088
	(0.092)	(0.090)	(0.091)	(0.092)
Covariates	No	Yes	No	Yes
Observations	4,865,903	4,865,903	4,865,903	4,865,903
R-squared	0.001	0.001	0.000	0.001
D. Moderate Income with: (300% FPL < Income < 400% FPL)	**ESI (1)**	**ESI (2)**	**No ESI (3)**	**No ESI (4)**
Low Cost x 2014	0.242**	0.218*	0.020	0.002
	(0.108)	(0.109)	(0.167)	(0.167)
Low Cost x 2015	0.303***	0.270***	−0.034	−0.062
	(0.092)	(0.094)	(0.119)	(0.119)
Low Cost x 2016	0.415***	0.383***	−0.250*	−0.272*
	(0.131)	(0.130)	(0.141)	(0.141)
Covariates	No	Yes	No	Yes
Observations	4,865,903	4,865,903	4,865,903	4,865,903
R-squared	0.001	0.003	0.001	0.002

Notes: Data from 2007-2016 extract of U.S. Tax Returns. Low Cost denotes that the Dartmouth Atlas of Health Care measure of Medicare spending in the individual's county of residence is below the median. Sample size is slightly less than in Table 2 (4,866,371) due to a few counties missing Dartmouth Atlas data. Robust standard errors are in parentheses. * indicates p = .10; ** p = 0.05, *** p = 0.01.

the impact of the ACA Marketplace Insurance on DI claiming among those with moderate income is particularly acute among low-income individuals who have access to the largest subsidies, and higher-income individuals who may have more income available to purchase Marketplace insurance.

Putting the results together, we find no effects for low income individuals, some effects for moderate income individuals, and these effects among moderate incomes tend to increase with income. What could explain this pattern of results? First, as we note above, significantly more DI recipients were likely to be eligible for Premium Tax Credits than were affected by the Medicaid expansion, which suggested that (as the results imply) the Marketplace might influence behavior more than the Medicaid expansion. In addition, we think that differential assets by income group may play a role. One reason that any source of health insurance is valued is that assets will be protected in the event of a medical condition that requires costly care, and this applies to outside options of insurance like Medicaid and Marketplace insurance. Those with higher levels of moderate income are likely to have more assets to protect, which

could lead them to place a greater value on ACA-provided outside options, and to respond more as a result.

Discussion and Conclusion

We examine the causal relationship between publicly funded health insurance and disability benefits. The ACA, the largest expansion in public subsidies for health insurance for the under-65 population since the inception of Medicaid, represents a new social safety net source of health insurance, and may influence participation in the existing disability safety net program, which provides health insurance in addition to cash benefits. As compared to Medicaid expansions, Marketplace subsidies in the ACA may be especially important for those who are potential DI beneficiaries, who tend to have incomes above Medicaid thresholds. Individuals with disabilities, who often have high health care needs, tend to place a high valuation on the public health insurance programs that accompany cash benefits (Livermore et al. 2001). However, DI has experienced rapid growth in enrollment in recent decades, and lawmakers are currently considering policies to stem further increases; this makes it even more important to understand how health insurance provision guides potential inflow behaviors.

We hypothesize that ACA insurance expansions may decrease reliance on the Social Security DI program for some potential beneficiaries by providing an alternative avenue for health insurance. On the other hand, disability program participation may also increase as ACA coverage makes DI's two-year waiting period for Medicare less costly. DI benefits are means tested, thus there is concern that participants' labor market behavior may be distorted. Despite programs like DI's "Ticket to Work" (and similar provisions for SSI under 1619(b) of the Social Security Act) that allow beneficiaries to maintain greater labor market connections while receiving benefits, there is still concern that people may be locked into disability programs for health insurance (Coe and Rupp, 2013), and it may be especially hard to find new jobs with generous benefits when leaving the program. Similar concerns exist on the entry side, in that the provision of health insurance may lead to higher rates of entry than otherwise. Both of these factors would lead to public spending on DI being higher than otherwise. Just as delinking jobs and health insurance may lead to increased efficiency in the job market, separating health insurance from DI may increase program efficiency.

Using data from the population of U.S. individual income tax returns from 2007-2016, we find the Medicaid expansion did not cause a measurable change in the fraction of new DI beneficiaries. However, when we examine the effects of the ACA Marketplace subsidies, we find suggestive evidence that larger subsidies increased DI participation among individuals with prior ESI and decreased DI participation among individuals without prior ESI.

These results imply that DI application behavior appears relatively unaffected by Medicaid expansions, perhaps because, as noted above, DI-only applicants are largely not likely to be under 100% FPL, the income range in which Medicaid expansion identifies the greatest change in access to health insurance.

Our results also imply that Marketplace subsidies do affect DI claiming behavior, and in the directions predicted by theory – an increase in DI applications for those now released by "job lock" and a decrease in DI applications for those who fall into the category of "Health Insurance Motivated Disability Enrollment (HIMDE)" (Kennedy and Blodgett (2012)). However, the effect sizes are small relative to the prior literature, suggesting that the ACA overall did not affect DI applications rates by quite the magnitude that the earlier literature anticipated.

Appendix A

Table A1
Pre-Trends Tests, Medicaid Expansion Specifications.

Low Income with: (Income < 100% FPL)	ESI (1)	ESI (2)	No ESI (3)	No ESI (4)
ACA Expansion x Time	−0.036 (0.026)	0.007 (0.022)	0.032 (0.082)	−0.031 (0.076)
Early Expansion x Time	−0.081** (0.032)	−0.022 (0.024)	−0.065 (0.081)	−0.159* (0.089)
Covariates	No	Yes	No	Yes
Observations	3,465,125	3,465,125	3,465,125	3,465,125
R-squared	0.005	0.050	0.005	0.050

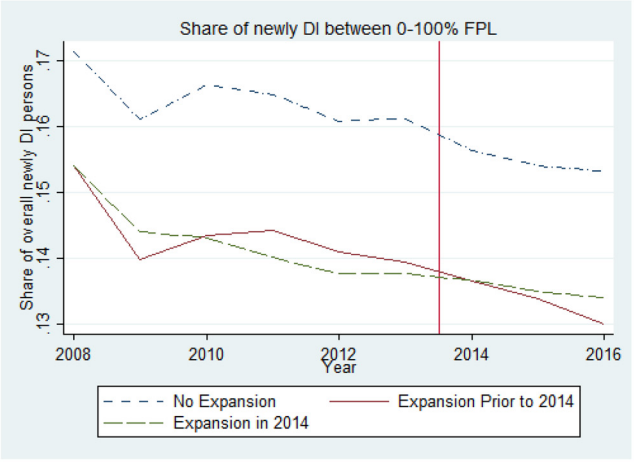
Notes: Data from 2007-2013 extract of 1040 filers, U.S. Tax Returns. Robust standard errors are in parentheses. * indicates p = .10; ** p = 0.05, *** p = 0.01.

Table A2
Pre-Trends Tests, Probability of Newly Disabled Being Moderate Income, Low Second Lowest Cost Silver Plan Specifications.

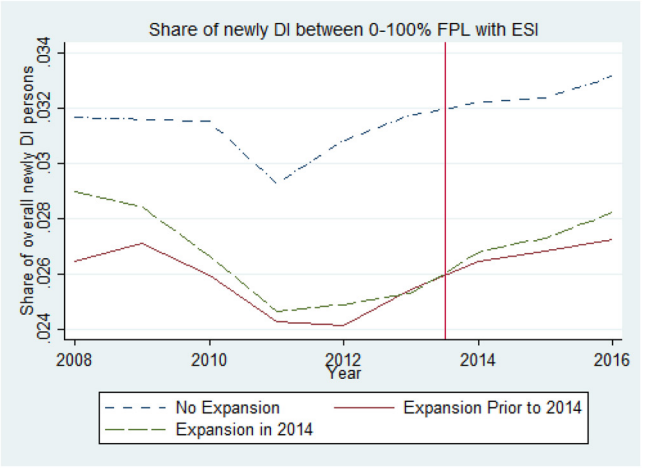
Moderate Income with: (138% FPL < Income < 400% FPL)	ESI (1)	ESI (2)	No ESI (3)	No ESI (4)
Low Cost x Time	0.005 (0.056)	0.005 (0.056)	0.013 (0.054)	0.016 (0.054)
Covariates	No	Yes	No	Yes
Observations	3,540,327	3,540,327	3,540,327	3,540,327
R-squared	0.002	0.003	0.002	0.003

Notes: Data from 2007-2013 extract of U.S. Tax Returns. Low Cost denotes that second lowest cost silver plan on the Marketplace in the individual's county of residence is below the median.
Robust standard errors are in parentheses. * indicates p = .10; ** p = 0.05, *** p = 0.01

A. All New DI Claimants



B. New DI Claimants with ESI



C. New DI Claimants without ESI

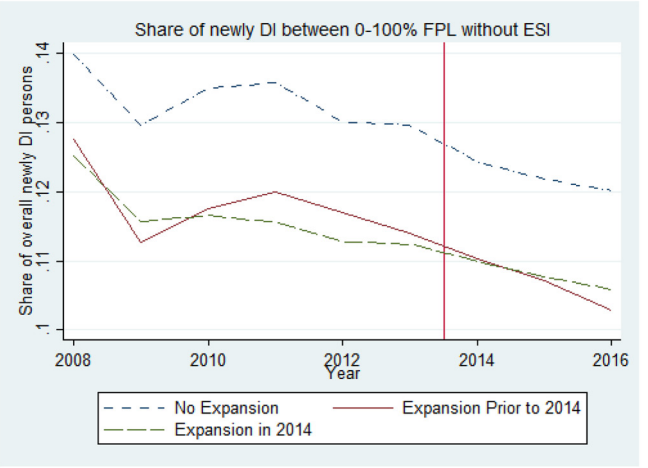
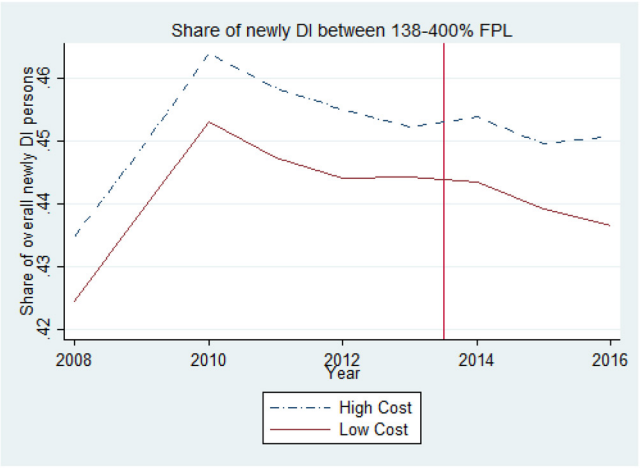
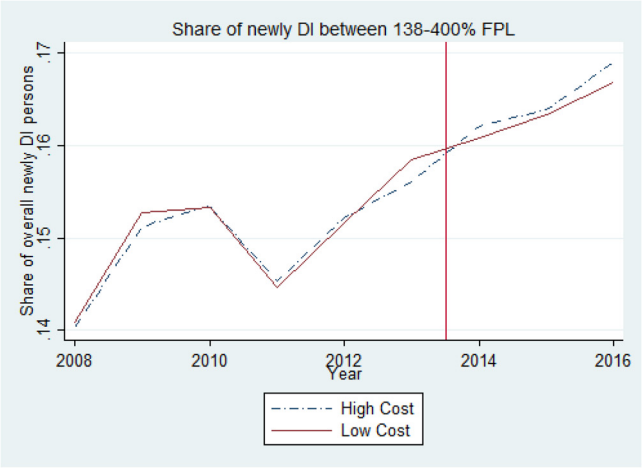


Fig. A1. Share of New DI Recipients that are Low Income, by Medicaid Expansion Status.
A. All New DI Claimants.
B. New DI Claimants with ESI.
C. New DI Claimants without ESI.
Notes: Authors tabulations from U.S. population of income tax returns, 1040 filers, 2007-2016.

A. All New DI Claimants



B. New DI Claimants with ESI



C. New DI Claimants without ESI

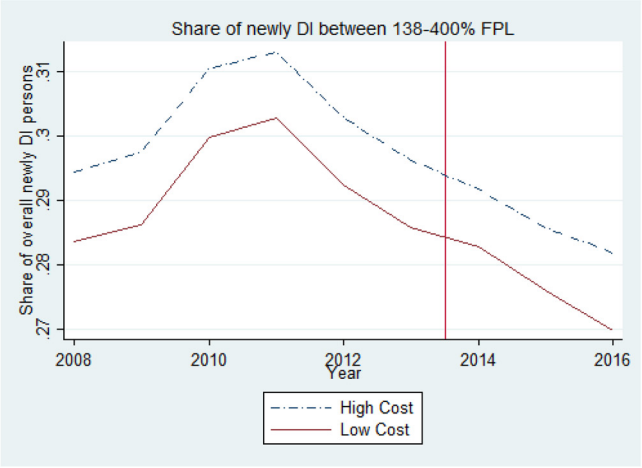
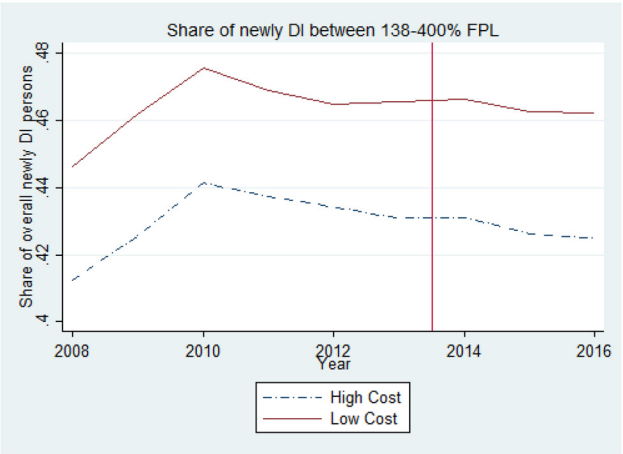
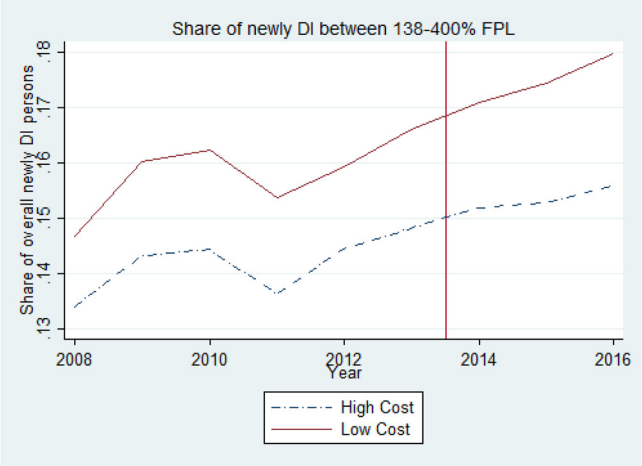


Fig. A2. Share of New DI Recipients that are Moderate Income, by Second Lowest Cost Silver Plan on Marketplace Cost Relative to Median.
A. All New DI Claimants.
B. New DI Claimants with ESI.
C. New DI Claimants without ESI.
Notes: Authors tabulations from U.S. population of income tax returns, 1040 filers, 2007-2016. Low Cost denotes that second lowest cost silver plan on the Marketplace in the individual's county of residence is below the median.

A. All New DI Claimants



B. New DI Claimants with ESI



C. New DI Claimants without ESI

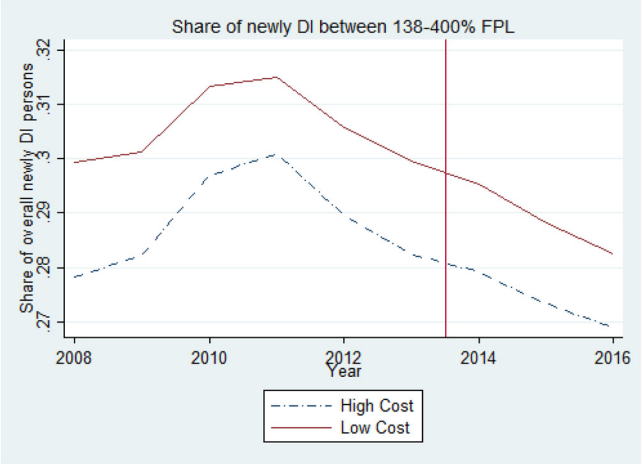


Fig. A3. Share of New DI Recipients that are Moderate Income, by Medicare Spending Relative to Median.
A. All New DI Claimants.
B. New DI Claimants with ESI.
C. New DI Claimants without ESI.
Notes: Authors tabulations from U.S. population of income tax returns, 1040 filers, 2007-2016. Low Cost denotes that he Dartmouth Atlas of Health Care measure of Medicare spending in the individual's county of residence is below the median.

Table A3
Pre-Trends Tests, Probability of Newly Disabled Being Moderate Income, Medicare Spending Specifications.

Moderate Income with: (138% FPL < Income < 400% FPL)	ESI (1)	ESI (2)	No ESI (3)	No ESI (4)
Low Cost x Time	0.052 (0.046)	0.045 (0.047)	−0.080 (0.052)	−0.073 (0.052)
Covariates	No	Yes	No	Yes
Observations	3,540,129	3,540,129	3,540,129	3,540,129
R-squared	0.002	0.003	0.002	0.003

Notes: Data from 2007-2013 extract of U.S. Tax Returns. Low Cost denotes that the Dartmouth Atlas of Health Care measure of Medicare spending in the individual's county of residence is below the median. Robust standard errors are in parentheses. * indicates p = .10; ** p = 0.05, *** p = 0.01

Table A4
Distribution of DI Beneficiaries' Income in 2016.

Income	Counts	Percent
Under 100	23,601	0.27
0-100% FPL	2,687,610	30.59
100-138% FPL	1,641,167	18.68
138-150% FPL	373,170	4.25
150-200% FPL	1,101,362	12.54
200-250% FPL	702,955	8.00
250-300% FPL	486,203	5.53
300-350% FPL	383,669	4.37
350-400% FPL	301,828	3.44
400-450% FPL	231,516	2.64
450-500% FPL	179,380	2.04
Above 500% FPL	673,470	7.67
Total	8,785,931	100.00

Notes: Data from the 2016 extract of U.S. Tax Returns. Robust standard errors are in parentheses. * indicates p = .10; ** p = 0.05, *** p = 0.01.

Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at https://doi.org/10.1016/j.jhealeco.2021.102437.

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