Medical Innovation and Disability Insurance: A Case Study of HIV Antiretroviral Therapy

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Abstract: This study examines how medical innovation, as a catalyst for health improvements, affects the Social Security Disability Insurance (SSDI) program. The effect is identified by antiretroviral drugs released in late 1995 and early 1996 to treat HIV/AIDS. The data come from the 831 Disability file, which is derived from administrative data on SSDI applications. The results suggest that the medical innovation decreased applications and awards, but did not substantially increase program exits for work. The findings suggest that improving health may be effective at reducing benefit receipt, particularly among existing workers.

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I. Introduction

During the past three decades, the Social Security Disability Insurance (SSDI) program more than tripled in size, reaching 8.95 million disabled worker beneficiaries in 2014.[1] This growth not only threatens the program's fiscal solvency (Autor and Duggan 2006), but raises doubt about whether beneficiaries are truly incapable of work.[2] To address these issues, several policies have been enacted, and many more proposed, to decrease benefit receipt. While most policies and proposals focus on changing benefit supply, few proposals focus on improving health. Nonetheless, policies to improve health may be effective at reducing the size of the SSDI program, since health not only increases labor productivity, but decreases the likelihood of qualifying for disability benefits.

Health improvements often arise from medical innovation. Therefore, this study examines how medical innovation, as a catalyst for health improvements, affects the SSDI program. The net effect on benefit receipt is ambiguous. On one hand, health improvements increase labor productivity, thereby decreasing benefit demand.[3] On the other hand, health improvements may decrease mortality, thereby decreasing program exits through death. Moreover, if medical innovation leads to new medical treatments that are accessible through public health insurance, then innovation could increase the value of disability benefit receipt. This is because beneficiaries of disability benefits may be categorically eligible for Medicare and Medicaid.

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[1] Beneficiary data come from the Social Security Administration's Annual Statistical Supplement 2013 (Table 5.D3).
[2] Studies on the employment effects of SSDI benefits include Bound (1989); Chen and van der Klaauw (2008); French and Song (2014); Parsons (1980); Singleton (2012); and von Wachter, Song, and Manchester (2011).
[3] For a review of the literature on health and earnings, see Currie and Madrian (1999).

To explore these issues, this study focuses on a specific yet effective medical innovation: the release of antiretroviral drug in late 1995 and early 1996 to treat the human immunodeficiency virus (HIV). HIV causes acquired immunodeficiency syndrome (AIDS). By weakening the immune system, HIV increases the likelihood of cancers, opportunistic infections, and ultimately death. By 1995, AIDS became the eighth leading cause of death, accounting for 50 thousand deaths that year (CDC National Vital Statistics 1998).

Health outcomes dramatically improved after the release of antiretroviral drugs. In combination, antiretroviral drugs formed a highly active antiretroviral therapy (HAART). The change in AIDS-related deaths is illustrated in Figure 1.[4] In just three years, from 1995 to 1998, AIDS-related deaths decreased by 63.5 percent, with nearly all of the decline attributable to HAART (Duggan and Evans 2008). HAART also increased the capacity and propensity to work (Goldman and Bao 2004).

This study examines how the release of HAART affected the SSDI program. The data come from the 831 Disability file, which is derived from administrative data on applications to the SSDI program. The file contains demographic characteristics of the applicant and details of the application. These data are merged with the Summary Earnings record, which reports administrative data on earnings from 1980 to 1999, and to the Numident, which reports dates of birth and death.

The empirical analysis yields several findings. First, HAART had an immediate and persistent effect on HIV-related applications and awards. By 1997, HAART reasonably decreased applications by 35.2 percent and awards by 36.7 percent. The identification assumption is that, in the absence of HAART, applications and awards would have continued

[4] Data on HIV-related deaths come from the Center for Disease Control's HIV Surveillance Report (various years).

along their pre-existing trends. Second, HAART decreased mortality among existing beneficiaries. For example, among awardees in 1995, HAART decreased mortality in 1996 by 7.5 percentage points. The identification strategy uses the 1994 cohort as a comparison group, which was exposed to HAART one year later since benefit award. Third, HAART did not substantially increase employment among existing beneficiaries, suggesting that HAART did not increase program exits for work. For example, among awardees in 1995, HAART increased substantial gainful activity in 1996 by just 1.0 percentage point. The identification strategy again uses the 1994 cohort as a comparison group.

The analysis also examines the effect of HAART by socioeconomic status, measured by pre-application earnings. The results suggest that the effect of HAART was greater at higher levels of earnings. For example, in 1997, applications with earning between $0 to $10 thousand decreased by 20.8 percent, whereas applications with earnings of $20 thousand or more decreased by 59.7 percent. One possible reason is that HAART was most recommended at only advanced stages of HIV/AIDS and that, among applicants, health was negatively associated with socioeconomic status. Another possible reason is that higher socioeconomic status is associated with greater access to health insurance, which decreases the relative value of Medicare and Medicaid.

The study also examines the effect of HAART on SSDI expenditures.[5] To estimate the effect, the analysis approximates actual expenditures and predicted expenditures had HAART not been released. By 1999, HAART actually increased expenditures by $43.6 million. This increase reflects the decline in mortality among existing beneficiaries, with no corresponding increase in program exits.

[5] The effect of HAART on Medicaid expenditures is examined by Duggan and Evans (2008).

The results suggest that policies to improve health may be effective at reducing benefit receipt. Policies include expanding access to health insurance, encouraging preventive care, and incentivizing medical innovation, particularly for health conditions associated with work-limiting disabilities. As this study shows, such policies may be more effective at reducing program entry, rather than increasing program exit. This may reflect the difficulties that beneficiaries face when returning to the labor market, such as securing employment and accessing health care. Additionally, such policies may be more effective among workers of higher socioeconomic status, who may have greater earnings potential, despite poorer health.

The study has two important limitations. First, there is no obvious quasi-experimental comparison group for individuals with HIV/AIDS, so the empirical strategy must rely on pre-existing trends and outcomes for identification. While not ideal, the identification assumptions appear reasonable, and the qualitative results are informative, if not precisely identified. Second, the study examines the effects of HAART overall, but does not identify the importance of specific mechanisms, such as improved health or increased value of public health insurance. Nonetheless, this study highlights how medical innovation, as a catalyst for health improvements, could affect the SSDI program.

II. Background

A. Social Security Disability Insurance

The Social Security Disability Insurance (SSDI) program provides cash benefits to individuals with work-preventing disabilities. To qualify, an applicant must satisfy three criteria. First, an applicant must be younger than the normal retirement age, which ranges from 65 to 67 depending on year of birth. Beyond the normal retirement age, workers apply for retirement

benefits through Social Security's Old Age program. Second, an applicant must have a sufficient work history, based on past earnings subject to Social Security taxation. Specifically, an applicant must satisfy a duration-of-work test, which requires sufficient earnings from age 21 to the age of disability onset, and a recent-work test, which requires sufficient earnings during ten years preceding disability onset. Finally, an applicant must satisfy the disability standard, which requires the inability to engage in substantial gainful activity. [6] In 2016, substantial gainful activity was defined as the ability to earn $1,130 per month.

The benefit amount, referred to as the primary insurance amount (PIA), is a progressive function of past earnings. To calculate the PIA, past annual earnings and adjusted to current dollars using an average wage index. The highest earnings are then averaged and divided by twelve, yielding the average indexed monthly earnings (AIME).[7] The AIME is then converted to the PIA using a progressive, piece-wise linear function. In 2016, the PIA equals 90 percent of the AIME from $0 to $856, 32 percent of the AIME from $856 to $5,157, and 15 percent of the AIME beyond $5,157.

The generosity of benefits can be characterized by the wage replacement rate, which equals the benefit amount divided by current wages. In 2002, the median replacement rate for males aged 50 to 61 was 45.9 percent (Autor and Duggan 2006). At the 10th and 90th percentile, the replacement rate was 23.7 percent and 64.0 percent, respectively.

Disabled workers may qualify for other benefits, in addition to the PIA. First, SSDI beneficiaries become categorically eligible for Medicare two years after benefit award.

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[6] More fully, the disability standard requires inability to engage in substantial gainful activity because of a medically identifiable physical or mental impairment that has lasted, or is expected to last, for a continuous period of 12 months or that is expected to result in death

[7] One year of earnings may be dropped from the benefit calculation for every five calendar years after age 21, with a maximum of five drop-out years.

Medicare covers inpatient hospital care, hospice care, home health care, and, starting in 2006, prescription drugs. Second, disabled workers may qualify for additional benefits through Supplemental Security Income (SSI), a separate disability insurance program administered by the Social Security Administration. The benefit is designed to supplement other sources of income, and eligibility is limited to the aged, blind, and disabled who have low income and assets. Third, in most states, SSI beneficiaries are categorically eligible for Medicaid at the time of benefit award. Although Medicaid coverage varies by states, most programs cover inpatient and outpatient hospital care, long-term care, and prescription drugs. Given these additional benefits, a disabled worker could qualify for SSDI, SSI, Medicare, and Medicaid.

B. Program Growth and Public Policy

During the past three decades, the SSDI program more than tripled in size, from 2.66 million disabled worker beneficiaries in 1985 to 8.95 million in 2014. This growth not only threatens the program's fiscal solvency – described by Autor and Duggan (2006) as a "fiscal crisis unfolding" – but raises doubt about whether beneficiaries are truly incapable of work.

To address these issues, Congress enacted several policies to decrease benefit receipt, but the long-run success of these policies has been limited. For example, in 1980 to 1983, Continuing Disability Reviews were used more frequently to reevaluate the disabilities of existing beneficiaries, thereby increasing the benefit terminations. However, the policy created a public backlash, and many terminated beneficiaries were reinstated on appeal. Similarly, in 1996, benefits were disallowed for alcohol and drug addiction. However, approximately half of terminated beneficiaries requalified for a different disability (Moore 2015). And, in 1999, Congress enacted the Ticket to Work program, which allows beneficiaries to retain Medicare coverage while attempting to work. However, participation in the Ticket-to-Work program has

been low. In January 2016, 13.8 million beneficiaries were eligible for the program, but only 0.34 million tickets were utilized.[8]

From the experience of these policies, two broad recommendations for future policy have emerged. Policy may be more effective at decreasing program entry, rather than increasing program exit; and policy may be more politically feasible at decreasing benefit demand, rather than restricting benefit supply. For example, Autor and Duggan (2006) suggest expanding public or private health insurance, independent of disability insurance programs. This could potentially reduce disability benefit receipt, to the extent that workers apply for disability benefits to obtain Medicare or Medicaid. Another promising strategy is to improve population health, thereby increasing labor productivity and decreasing the likelihood of qualifying for benefits. Such policies may be more effective – and politically feasible – compared to policies that restrict benefit supply alone.

C. HIV Antiretroviral Therapy

This study examines how medical innovation, as a catalyst for health improvements, affects the SSDI program. To identify the effect, the study focuses on the release of antiretroviral drugs to treat the human immunodeficiency virus (HIV). HIV causes acquired immunodeficiency syndrome (AIDS). By weakening the immune system, AIDS increases the likelihood of opportunistic infections, cancers, and ultimately death. In 1981, when HIV was first reported in the US (CDC 2001), the virus was untreatable, and AIDS was rapidly fatal (Institute of Medicine 2010). By 1995, AIDS cases reached 215 thousand, and deaths reached 50 thousand – the eighth leading cause of death that year (CDC National Vital Statistics 1998).

[8] Participation data for the Ticket to Work Program is accessible at www.ssa.gov/work/tickettracker.html.

Health outcomes dramatically improved after the release of antiretroviral drugs. The most effective drugs were released in late 1995 and early 1996, including Epivir and certain protease inhibitors. In combination, antiretroviral drugs formed a highly active antiretroviral therapy (HAART). By the end of 1996, nearly 60 percent of HIV/AIDS patients used at least one new antiretroviral drug (Duggan and Evans 2008). The change in AIDS-related deaths is illustrated in Figure 1. In just three years, from 1995 to 1998, AIDS-related deaths decreased by 63.5 percent, with nearly all of the decline attributable to new antiretroviral drugs (Duggan and Evans 2008). Moreover, HAART increased employment among patients with HIV/AIDS, specifically patients who were employed when HAART was initiated (Goldman and Bao 2004).

Disability insurance programs were important throughout the HIV/AIDS epidemic: the SSDI program provides Medicare coverage, the SSI program provides Medicaid coverage, and both programs provide cash benefits. To medically qualify for either program, an applicant must be medically diagnosed with HIV and exhibit at least one opportunistic infection such as shingles, pneumonia, and certain skin cancers (Institute of Medicine 2010). An applicant who does not meet these criteria could still qualify for benefits based on vocational factors such as age, educational attainment, and work skills. In 1994, before the release of HAART, 33,000 new awards for SSDI benefits were attributable to HIV/AIDS, comprising five percent of all awards that year.[9]

This study examines how HAART affected the SSDI program. On one hand, HAART should increase benefit receipt by increasing labor productivity and decreasing the likelihood of

[9] The figure is derived from the Annual Statistical Report on the Social Security Disability Insurance Program, 2000 (Table 18). In 1994, 36,087 new SSDI awards for disabled workers were attributable to infectious and parasitic diseases, but approximately 3,394 awards were not attributable to HIV/AIDS. To calculate the latter estimate, the number of awards for infectious and parasitic diseases was averaged across years 1985 to 1989, when new awards for HIV/AIDS had been categorized as “other”.

benefit award. On the other hand, HAART could increase benefit receipt by increasing the value of Medicare and Medicaid, which are categorically linked to SSDI and SSI, respectively. Additionally, HAART could increase benefit receipt by decreasing program exits through death. Thus, the net effect of HAART on benefit receipt is ambiguous.

III. Data

A. Disability Research File

The empirical analysis focuses on four outcomes: applications, awards, mortality, and employment. The data come from the 831 Disability file, which is derived from administrative data on applications to the SSDI program. The file contains basic demographic characteristics of the applicant, including age, sex, race, and educational attainment. The file also contains details of the application, including the date of file, type of disability, and award outcome. The 831 file is updated weekly to include new applications and to amend previous applications. The 831 file for this study contains applications from 1992 to 2000.

The 831 is merged to two additional files: the Summary Earnings Record (SER) and the Numident. The SER reports annual earnings from 1980 to 1999 subject to Social Security taxation. These data are derived from W-2 forms filed with the Internal Revenue Service. The Numident reports an applicant's date of birth and, if applicable, date of death. These data are derived primarily from vital statistics of the Center for Disease Control and Prevention.

To derive the population of interest, three restrictions are imposed on the 831. First, the file is restricted to applicants who report HIV as the primary or secondary disability. In this way, the file includes applicants who may have reported HIV as a primary disability before the release of HAART, but as a secondary disability after the release of HAART. Second, the file is

restricted to disabled workers, thus excluding disabled spouses and widows. Third, the file is restricted to ages 25 to 54, thus excluding applicants nearing retirement. The remaining file contains approximately 250 thousand observations.

B. Applicants

Summary statistics of applicants are reported in the first column of Table 1. Because HAART may have affected the composition of applicants, Table 1 is restricted to applicants in 1994, just before the release of HAART. The data contain the universe of applicants, so the table does not report sampling errors.

The table reveals several notable patterns. First, applicants were overwhelming male (88.3 percent). This reflects that males had higher rates of HIV/AIDS and were more likely to be insured for SSDI benefits. Second, applicants had substantial earnings just prior to application. From 1991 to 1993, average annual earnings was $14.7 thousand, well above the annualized measure of substantial gainful activity of just $6 thousand.[10] Third, 67.4 percent of applicants concurrently filed for SSI benefits, which provides both cash benefits and Medicaid coverage. Fourth, HIV/AIDS was the primary condition for most applicants (92.1 percent), and most cases were symptomatic (78.7 percent). Fifth, applicants exhibited extremely high rates of death. In particular, 24.0 percent of applicants were deceased within just one year of application, and 40.9 percent were deceased within two years of application. Finally, 78.5 percent of applicants were awarded benefits (70.5 percent), with nearly all awarded at the initial level, rather than on appeal.

Table 1 also reports summary statistics by educational attainment: less than a high school diploma, high school diploma, and a college degree. To do so, the file must be restricted to applicants with non-missing data on educational attainment (82.0 percent of the full sample).

[10] From 1991 to 1998, substantial gainful activity was defined as the ability to earn $500 per month.

Summary statistics for the restricted file, reported in column two, are similar to those of the original file, reported in column one. Summary statistics by educational attainment are reported in the last three columns.

As shown, applicants with a college degree had higher pre-application earnings, but were in poorer health at the time of application. Compared to applicants with no high school diploma, applicants with a college degree were more likely to report HIV-related symptoms (92.2 percent versus 74.1 percent) and to be deceased within two calendar years of application (50.3 percent versus 31.1 percent). Despite poorer health, applicants with a college degree earned $26.4 thousand just prior to application, compared to just $8.1 thousand among applicants with no high school diploma. These findings suggest that education may moderate the effects of health on earnings, thereby facilitating and encouraging employment at later stages of disease.

C. Awardees

Summary statistics of awardees are reported in Table 2. To compare awardees to applicants in Table 1, summary statistics are reported separately by year of award, from 1992 to 1995. As shown, awardees had poorer health than applicants, but had greater pre-application earnings. Among awardees in 1994, 96.6 percent had symptomatic HIV, and pre-application earnings were $17.1 thousand (Table 2). Among applicants, these figures are 83.9 percent and $14.7 thousand, respectively (Table 1).

IV. Results

A. Applications

The effect of HAART on HIV-related applications is examined graphically in Figure 2. Using data from the 831, the figure plots the number of HIV-related applications annually from

1992 to 2000. As shown, applications decreased steadily during the early 1990s, but decreased sharply in 1996 and 1997, just after the release of HAART. Applications decreased thereafter, but at a much lower rate. These patterns suggest that HAART had an immediate and persistent effect on HIV-related applications.

To quantify the effect, it is necessary to predict how applications would have evolved in the absence of HAART. One method is linear extrapolation, where the linear trend in applications before HAART is extrapolated to after HAART. This method assumes that, in the absence of HAART, applications would have continued along the pre-existing trend. This assumption is more realistic if the pre-existing trend is estimated and extrapolated locally, immediately before and after HAART. If the assumption is true, the effect of HAART can be measured by the difference between projected and actual applications.

To estimate the effect of HAART in 1997, the linear trend from 1993 to 1995 is used to estimate counterfactual applications in 1997. From 1993 to 1995, applications decreased annually by 2,186, reaching 31,264 in 1995. If this trend had continued, applications in 1997 would have reached 26,892. Actual applications, however, reached 17,435. Thus, if the identification assumption is true, then HAART decreased HIV-related applications in 1997 by 9,457, or 35.2 percent. Again, there is no sampling error associated with this estimate, since the DRF contains the universe of applications.

A concern with the estimator is that systemic factors, and not HAART, decreased HIV-related applications. For example, the unemployment rate decreased throughout the mid-1990s, which may have decreased all applications, including those related to HIV/AIDS. If so, the estimate above would overstate the causal effect of HAART.

To address this concern, Figure 2 plots the number of all SSDI applications annually from 1992 to 2000. As shown, applications trended downward from 1994 to 1998, but did not decrease sharply after 1995. Thus, although systemic factors may have decreased HIV-related applications, they cannot account for the sharp decrease in applications when HAART was released.

B. Awards

The effect of HAART on awards is determined by the number of applications and the award rate. The annual award rate for HIV-related applications is plotted in Figure 3. As shown, the award rate decreased steady during the early 1990s, but decreased slightly more when HAART was introduced. Specifically, the rate decreased by 9.9 percentage points from 1993 to 1995 and by 14.4 percentage points from 1995 to 1997, a relative decrease of 4.5 percentage points.

The lower award rate, combined with fewer applications, led to fewer benefit awards. The causal effect of HAART is estimated using the linear extrapolation method described above. To estimate the number of awards each year, the number of HIV-related applications in Figure 2 are factored by the annual award rate for HIV-related applications in Figure 3. From 1993 to 1995, benefit awards decreased annually by 3,257, reaching 21,353 in 1995. If this trend had continued, awards would have reached 14,839 in 1997. Actual awards, however, reached 9,397. Thus, HAART reasonably decreased the number of HIV-related awards by 5,442, or 36.7 percent.

C. Mortality

Next, the analysis examines how HAART affected benefit receipt among existing beneficiaries. On one hand, HAART may have decreased benefit receipt by enabling

beneficiaries to return to work. On the other hand, HAART may have increased benefit receipt by decreasing exits through death. Thus, the net effect on program exit is ambiguous.

To examine the effect on mortality, the left panel of Table 3 reports mortality outcomes among awardees. The estimates are reported separately by year of award and year since award, with zero corresponding with the calendar year of benefit award. Each estimate is the cumulative share of beneficiaries, by year of award, who are deceased by the end of each calendar year. The shaded region corresponds to years 1995 and earlier, before the release of HAART.

The 1995 cohort is considered the last cohort before the release of HAART. As shown, mortality was initially high, with 40.4 percent of the cohort deceased by the end of 1996. However, mortality was much lower thereafter, equaling 6.8 percent in year two, 3.0 percent in year three, and 3.5 percent in year four. The sharp decrease in mortality suggests that HAART may have decreased program exits through death.

To identify the effect, it is necessary to predict how mortality would have evolved in the absence of HAART. One method is to use earlier cohorts as comparison groups, since earlier cohorts were exposed to HAART at later years since award. For example, the 1994 cohort can be used as a comparison group for the 1995 cohort. Neither cohort was exposed to HAART in year zero; but, in year one, the 1995 cohort was exposed to HAART, while the 1994 cohort was not. The identification assumption is that, in the absence of HAART, mortality of both groups would have been similar. If so, the effect of HAART can be measured by the difference in mortality between the two groups.

The validity of the identification assumption can be assessed in Tables 2 and 3. In both tables, health appears to have worsened across cohorts. In Table 2, symptomatic HIV increased

from 94.0 percent in 1992 to 97.0 percent in 1995; in Table 3, mortality in year zero increased from 17.1 percent in 1992 to 20.6 percent in 1995. This implies that, in the absence of HAART, mortality among later cohorts would have been higher than earlier cohorts. If so, the estimated effects of HAART on mortality – measured as the difference in mortality between cohorts – would biased downward in magnitude.

The identification assumption appears most reasonable for the cohorts in 1994 and 1995. Respectively, symptomatic HIV was 96.6 percent and 97.0, and mortality in year zero was 19.8 percent and 20.6 percent. By year one, the 1995 cohort was exposed to HAART, while the 1994 cohort was not. As shown, mortality increased to 47.9 percent among the 1994 cohort, but only 40.4 percent among the 1995 cohort. Thus, among the 1995 cohort, HAART reasonably decreased year-one mortality by 7.5 percentage points.

Using the same methodology, the table reveals two general findings. First, the effect on mortality appears greater after many years of treatment. For example, by year three since award, the 1995 cohort had three years of HAART exposure, while the 1992 cohort had none. In that year, the difference in mortality reached 20.5 percentage points. Stated above, this estimate is likely biased downward in magnitude, since year-zero mortality was greater among the 1995 cohort.

Second, the effect on mortality appears smaller among earlier cohorts, which were exposed to HAART several years after benefit award. For example, by year three since award, the 1993 cohort had one year of HAART exposure, while the 1992 cohort had none. In that year, the difference in mortality was just 3.1 percentage points. However, in this case, the estimate is likely biased upwards in magnitude, since year-zero mortality was slightly lower among the 1993 cohort.

D. Substantial Gainful Activity

To examine the effect of HAART on employment, the right side of Table 3 reports rates of substantial gainful activity. Because a worker must be unable to engage in SGA to qualify for SSDI benefits, engaging in SGA reveals an intent to exit the program through work. Table 3 reports annualized rates of SGA by year of award and year since award. Rates of SGA are calculated as the share of beneficiaries whose annual earnings exceed 12 times the monthly SGA threshold. SGA is calculated annually, rather than monthly, since the SER reports earnings annually.

Among the 1995 cohort, SGA in year zero is 25.4 percent. This rate includes earnings before benefit award, since year zero is the calendar year of benefit award. The first full calendar year after benefit award is year one. In that year, SGA is substantially lower at 3.6 percent. SGA increases slightly thereafter, reaching 4.6 percent in year two, 5.8 percent in year three, and 5.3 percent in year four. The increase in SGA suggests that HAART may have increased program exit for work.

To identify the effect, earlier cohorts are again used as comparison groups for later cohorts. The assumption is that, in the absence of HAART, SGA would have evolved similarly across groups. As discussed, the identification assumption is most reasonable for the cohorts in 1994 and 1995, which had similar rates of symptomatic HIV and mortality in year zero. As shown in Table 3, SGA in year zero was also similar for both groups.

In year one, the 1995 cohort was exposed to HAART, but the 1994 cohort was not. In that year, SGA was slightly greater among the 1995 cohort: the rates were 2.6 percent and 3.6 percent among the 1994 and 1995 cohort, respectively. The difference suggests that HAART increased SGA by 1.0 percentage points. This difference increased to 2.6 percentage points in

year two and to 3.0 percentage points in year three. The results suggest that HAART may have increased program exit for work, but the effect on employment is smaller than the effect on mortality.

V. Additional Considerations

A. Effects by Socioeconomic Status

An important consideration is whether the effect of HAART varies by socioeconomic status. The effect should vary for two reasons. First, socioeconomic status is correlated with access to private health insurance, which may decrease the relative value of Medicare and Medicaid. Second, according to medical research, HAART was most effective at advanced stages of HIV/AIDS, and applicants of higher socioeconomic status exhibited the poorest health. For both reasons, the effect of HAART should be greater among individuals of higher socioeconomic status.

To evaluate this prediction, Table 4 reports SSDI applications by pre-application earnings. The first row reports all applications related to HIV/AIDS, and the subsequent rows report applications by three earnings categories: $0 to $10 thousand, $10 thousand to $20 thousand, and greater than $20 thousand. In each row, the table reports the number of applications in 1993 and 1995 and the change in applications between these two years. For 1997, the table reports predicted applications, actual applications, and the difference between the two. Again the identification assumption is that, in the absence of HAART, applications would have continued along their pre-existing trend. Thus, predicted applications in 1997 equal actual applications in 1995 plus the change in applications from 1993 and 1995. If the identification

assumption is true, the effect can be measured by the difference between projected and actual applications.

As predicted, the effect of HAART on applications appears greater among workers of higher socioeconomic status. Overall, HAART decreased HIV-related applications in 1997 by an estimated 35.2 percent. The estimate is greater among the highest earnings category (59.7 percent) and smaller among the lowest earnings category (20.8 percent).

To evaluate the prediction for program exit, Table 5 reports mortality and substantial gainful activity by pre-application earnings. Panel A corresponds to the lowest earnings category, and panel C corresponds to the highest earnings category.

In general, the effect of HAART on mortality appears greater among workers with higher pre-application earnings. The immediate effect can be measured by comparing the cohorts in 1994 and 1995 in year one since award. As shown, the difference in mortality is 5.9 percentage points in panel A, 7.4 percentage points in panel B, and 9.5 percentage points in panel C. The long-run effect can be measured by comparing the cohorts in 1992 and 1995 in year four since award. In this case, the difference in mortality is 17.3 percentage points in panel A, 24.1 percentage points in panel B, and 26.8 percentage points in panel C.

The effect of HAART on substantial gainful activity also appears greater among workers with higher pre-application earnings. Again, the long-run effect can be measured by comparing the cohorts in 1992 and 1995 in year four since award. As shown, the difference in substantial gainful activity is 2.3 percentage points in panel A, 4.5 percentage points in panel B, and 5.1 percentage points in panel C.

B. Tightened Eligibility Standards

According to the analysis, HAART had an immediate and persistent effect on HIV-related applications. However, it remains unclear whether this effect is due to benefit demand, benefit supply, or both. This distinction is important, since previous policies focus on changing benefit supply, rather than benefit demand. In this case, benefit supply could have decreased if the Social Security Administration tightened eligibility standards for HIV/AIDS after the release of HAART. In turn, tightened eligibility standard could have discouraged would-be applicants from applying. Thus, the decline in HIV-related applications may be attributable to benefit supply, rather than benefit demand.

To test for changes in eligibility standards, as a measure of benefit supply, the analysis examines whether the likelihood of benefit award had changed after HAART, holding applicant characteristics constant. As shown in Figure 3, the award rate decreased by 9.9 percentages points from 1993 to 1995 and by 14.4 percentage points from 1995 to 1997, a relative decrease of 4.5 percentage points. This suggests that eligibility standards may have tightened after HAART. However, the regression adjusted difference – controlling for age, sex, race, state-fixed effects, and pre-application earnings – is just -0.22 percentage points. The smaller estimate reflects that the decrease in applications was among individuals who were most likely to be awarded benefits, namely workers of higher socioeconomic status. Taken together, the results suggest that eligibility standards were not tightened after the release of HAART.

C. Expenditures

The effect of HAART on benefit receipt directly affects program expenditures. The effect on expenditures is estimated in Table 6. Panel A reports estimated expenditures by award cohort and year of award. The estimates assume that beneficiaries receive the PIA each month, starting with the month of benefit award and ending with the month of death, if applicable.

Panel B reports predicted expenditures had HAART not been introduced. These predictions are based on three observations of actual expenditures in panel A. First, from the 1992 to 1995 cohort, year-zero expenditures decreased an average of eight percent. This trend is extrapolated to cohorts 1996 through 1999. Second, from year zero to one, expenditures of the 1994 cohort increased 30.1 percent. This increase is used to predict year-one expenditures for cohorts 1995 and later. Finally, after year one, expenditures of the 1992 and 1993 cohorts decreased annually by approximately 36 percent. This decrease is used to predict expenditures in year two and later, from calendar years 1996 through 1999.

The effect of HAART on expenditures is calculated as the difference between actual expenditures, in panel A, and predicted expenditures, in panel B. The differences, reported in Panel C, reveal two general findings. First, HAART had a positive effect on expenditures among earlier award cohorts, from 1992 to 1995. This reflects increased expenditures due to fewer program exits through death. Second, HAART had a negative effect on program expenditures among later award cohorts, starting with the cohort in 1996. This decrease reflects fewer applications and awards related to HIV. To calculate the net effect by 1997, the figures are summed across all cohorts and years. According to this calculation, HAART increased program expenditures by $43.6 million.

It is important to note that expenditure estimates do not account for program exit through improved health and work capacity. If benefits had been terminated, then expenditures in panel A would be overstated, and the estimates in panel C serve as upper bounds to the effects of HAART on expenditures. However, the release of HAART did not increase substantial gainful activity among existing beneficiaries (Table 3), so the bounds in panel C may be close approximations to the true effect.

VI. Conclusion

This study examines how HAART, a new therapy released in late 1995 and early 1996 to treat HIV/AIDS, affected the SSDI program. The results suggest that HAART substantially decreased HIV-related applications and awards, but did not substantially increase program exits among existing beneficiaries. In fact, HAART decreased mortality among existing beneficiaries, thereby increasing benefit receipt. By 1999, HAART increased program expenditures by an estimated $43.6 million, attributable to decreased mortality among existing beneficiaries.

The results suggest that policies to improve health may be effective at reducing benefit receipt. Policies include expanding access to health insurance, encouraging preventive care, and incentivizing medical innovation, particularly for health conditions associated with work-limiting disabilities. As this study shows, such policies may be more effective at reducing program entry, rather than increasing program exit, and may be more effective among workers of higher socioeconomic status. Additionally, policies to improve health affect benefit demand and, thus, may be more politically feasible than policies to tighten benefit supply.

The goal to decrease the size of the SSDI program is motivated by the program's growth during the past three decades. By 2014, the number of disabled worker beneficiaries reached 8.95 million, and benefit expenditures reached $141.6 billion. This growth has raised questions about whether the program targets the disabled population effectively. Central to these questions is whether disabled worker beneficiaries are truly unable to work and, if so, whether the inability to work is due to health versus non-health factors, such as the demand for low-skilled labor. As this study shows, health is an important determinant of SSDI receipt, and policies to improve

health may decrease benefit receipt and increase employment, particularly among workers who have not yet exited the labor market.

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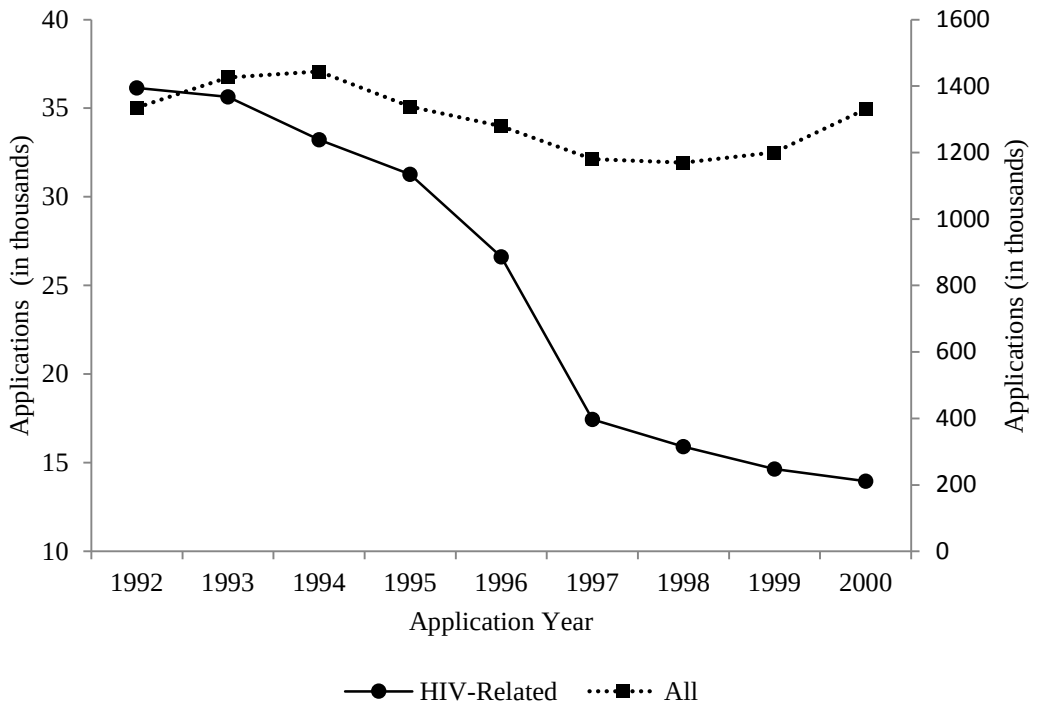

Figure 2: Applications for SSDI Disabled Worker Benefits
The data come from the 831 Disability file. The file is restricted to applicants who were aged 25 to 54. Data on all SSDI applications come from the Social Security Administration (accessed at www.ssa.gov/oact/STATS/table6c7.html on April 14, 2015).

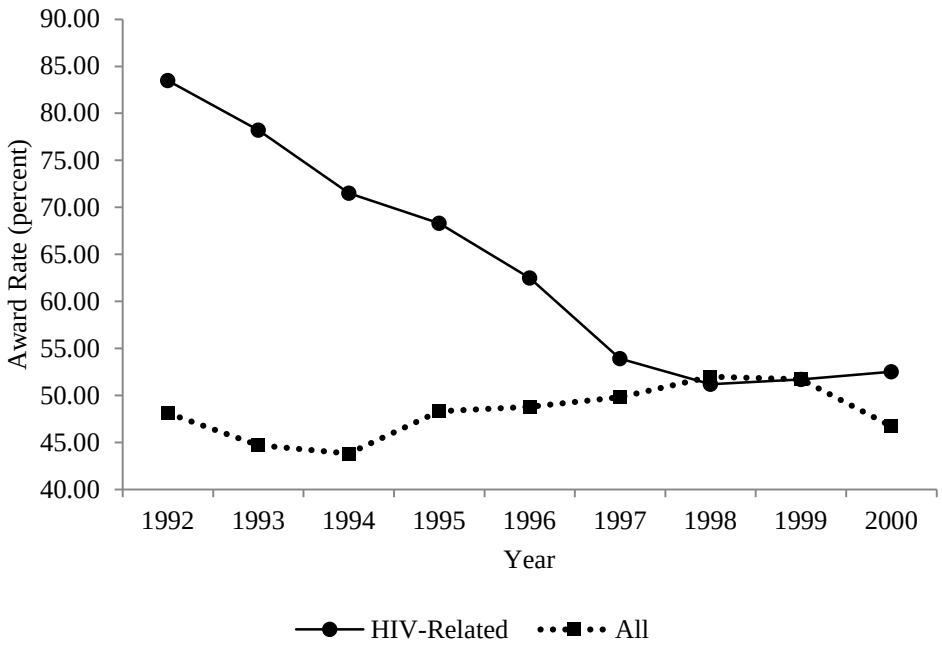

Figure 3: HIV-related Award Rates
The data come from the 831 Disability file. The file is restricted to applicants who were aged 25 to 54. The award rates reflect the decision of the Disability Determination Services and, thus, do not account for appeals. Data on all SSDI applications come from the Social Security Administration (accessed at www.ssa.gov/oact/STATS/table6c7.html on April 14, 2015).

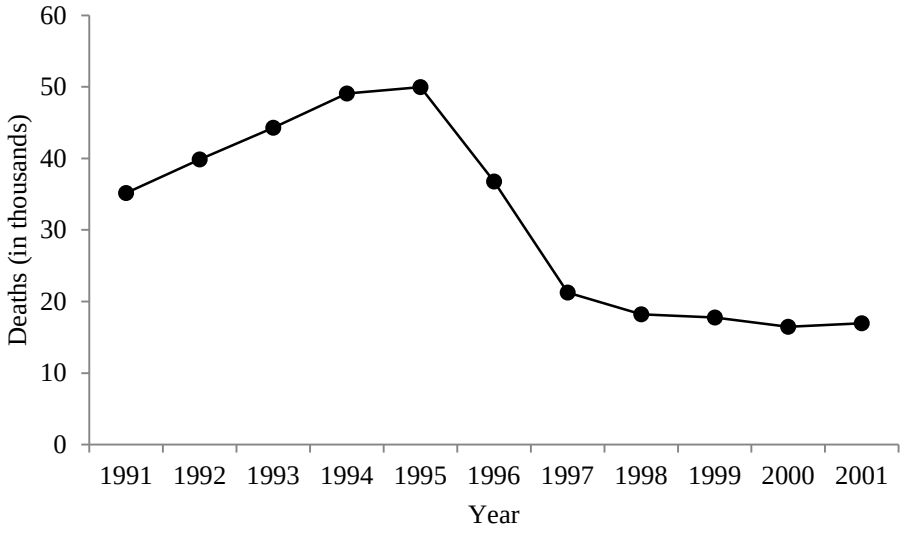

Figure 1: Deaths related to HIV/AIDS
The data come from the Center for Disease Control's HIV Surveillance Report (various years).

Table 1

Summary Statistics of SSDI Applicants Related to HIV/AIDS in 1994

		Education			
	All	All	Less than High School Diploma	High School Diploma	College Degree
Age (years)	36.9	36.8	36.7	36.4	39.2
Male	88.3	87.6	83.8	87.3	95.2
Race: Black	34.0	36.4	45.9	36.8	18.3
Race: Other	13.9	12.0	18.8	10.3	9.3
Pre-application earnings ($1000)	14.7	14.3	8.1	13.9	26.4
Dual application: SSDI and SSI	67.4	70.8	85.0	71.5	43.7
Primary HIV	92.1	91.4	89.2	91.7	93.4
Symptomatic HIV	83.9	82.5	74.1	83.4	92.2
Primary Symptomatic HIV	78.7	76.9	68.0	77.8	87.1
Death in one year	24.0	22.8	16.7	23.0	31.5
Death in two years	40.9	39.4	31.1	39.9	50.3
Award: initial	70.5	69.4	56.7	70.5	85.8
Award: initial and reconsideration	78.5	78.4	68.1	79.3	91.0
Award: OHA appeal	12.3	12.6	17.0	12.4	6.4
Observations	33225	27255	5895	17848	3512

The data come from the 831 Disability file. The data are restricted to applicants who applied for benefits in 1994, who were aged 25 to 54, and who reported HIV as the primary or secondary. Pre-application earnings are calculated as the average annual earnings during the three calendar years prior to the calendar year of application. All figures are in percentage points unless otherwise noted. No sampling errors are report, since the data represent the universe of applications.

Table 2

Summary Statistics of SSDI Awardees Related to HIV/AIDS

Year of Award	1992	1993	1994	1995
Age (years)	36.4	36.7	37.1	37.5
Male	91.5	90.7	90.5	89.1
Race: Black	27.6	29.2	29.4	31.1
Race: Other	12.1	12.4	12.4	12.5
Pre-application earnings ($1000)	16.0	16.2	17.1	17.3
Dual application: SSDI and SSI	63.7	64.0	65.8	65.2
Primary HIV	91.8	92.3	91.7	91.1
Symptomatic HIV	94.0	95.8	96.6	97.0
Observations	30427	26855	23360	22249

The data come from the 831 Disability file. The data are restricted to applicants who were aged 25 to 54 and who reported HIV as the primary or secondary. Pre-application earnings are calculated as the average annual earnings during the three calendar years prior to the calendar year of application. All figures are in percentage points unless otherwise noted. No sampling errors are report, since the data represent the universe of applications.

Table 3

Mortality and Substantial Gainful Activity of SSDI Awardees Related to HIV/AIDS

	Mortality				Substantial Gainful Activity			
Year of Award	1992	1993	1994	1995	1992	1993	1994	1995
Year since Award								
0	17.1	16.3	19.8	20.6	21.7	23.8	25.7	25.4
1	42.8	43.2	47.9	40.4	2.3	2.6	2.6	3.6
2	61.2	61.0	60.9	47.2	1.6	1.9	2.0	4.6
3	72.0	68.9	65.4	51.5	1.5	1.7	2.8	5.8
4	76.8	71.6	68.1	55.0	1.5	2.1	3.2	5.3

The data come from the 831 Disability file merged to the Summary Earnings Record and the Numident. The data are restricted to awardees who were aged 25 to 54 and who reported HIV as the primary disability. Mortality is measured from the Numident, and substantial gainful activity is measured from the Summary Earnings Record. All figures are in percentage points. The shaded region corresponds to calendar years 1995 and earlier, before HAART was introduced.

Table 4

SSDI Applications by Pre-Application Earnings

				1997			
	1993	1995	Change	Predicted	Actual	Difference	Percent Difference
				(a)	(b)	(b)-(a)	[(b)-(a)]/(a)
All	35636	31264	-4372	26892	17435	-9457	-0.352
Pre-application earnings ($1000)							
$0 to $10	17191	15097	-2094	13003	10304	-2699	-0.208
$10 to $20	9157	7861	-1296	6565	4179	-2386	-0.363
Greater than $20	9288	8306	-982	7324	2952	-4372	-0.597

The data come from the 831 Disability file. The data are restricted to applicants who who were aged 25 to 54 and who reported HIV as the primary or secondary. Pre-application earnings are calculated as the average annual earnings during the three calendar years prior to the calendar year of application.

Table 5

Mortality and Substantial Gainful Activity of SSDI Awardees Related to HIV/AIDS

	Mortality				Substantial Gainful Activity			
Year of Award	1992	1993	1994	1995	1992	1993	1994	1995
A. Pre-Applications Earnings: $0 to $10 thousand								
Year since Award								
0	12.3	12.7	15.6	17.4	4.8	5.2	6.0	6.8
1	34.3	35.4	42.3	36.4	1.3	1.6	1.4	2.1
2	52.3	53.1	55.6	43.6	1.5	1.7	1.7	3.6
3	63.9	61.4	60.4	48.3	1.7	1.7	2.7	4.7
4	69.7	64.7	63.3	52.4	1.7	2.3	3.2	4.0
B. Pre-Applications Earnings: $10 to $20 thousand								
Year since Award								
0	17.7	16.0	20.5	20.8	2.2	24.0	25.8	25.2
1	44.1	44.6	48.4	41.0	2.4	2.7	2.7	3.4
2	63.6	63.6	61.8	47.7	1.9	2.1	2.4	5.3
3	74.8	71.8	66.9	51.8	1.7	2.1	3.2	6.7
4	79.1	74.3	69.7	55.0	1.6	2.4	3.6	6.1
C. Pre-Applications Earnings: Greater than $20 thousand								
Year since Award								
0	23.5	22.1	24.1	24.1	45.1	48.4	47.9	46.2
1	53.5	52.5	53.8	44.3	3.6	3.9	3.8	5.4
2	71.5	69.4	66.1	50.9	1.6	1.8	2.0	5.3
3	80.9	76.3	69.8	54.8	1.0	1.4	2.4	6.4
4	84.7	78.4	72.1	57.9	0.9	1.5	3.0	6.0

The data come from the 831 Disability file merged to the Summary Earnings Record and the Numident. The data are restricted to awardees who were aged 25 to 54 and who reported HIV as the primary disability. Mortality is measured from the Numident, and substantial gainful activity is measured from the Summary Earnings Record. All figures are in percentage points. The shaded region corresponds to calendar years 1995 and earlier, before HAART was introduced.

Table 6

SSDI Expenditures related to HIV/AIDS (in millions)

Year of Award	1992	1993	1994	1995	1996	1997	1998	1999
A. Actual Expenditures								
Year since award								
0	96.1	89.6	79.2	75.6	54.3	28.4	21.1	19.7
1	138.0	124.0	103.0	100.0	83.0	45.4	36.5	
2	88.9	78.0	64.9	77.8	72.2	40.3		
3	56.9	52.6	50.3	67.6	64.8			
4	40.6	42.6	43.5	60.5				
5	33.6	37.7	38.9					
6	29.8	34.3						
7	27.2							
B. Predicted Expenditures								
Year since award								
0	96.1	89.6	79.2	75.6	69.6	64.0	58.9	54.2
1	138.0	124.0	103.0	98.3	90.4	83.2	76.5	
2	88.9	78.0	65.9	62.9	57.9	53.2		
3	56.9	49.9	42.2	40.3	37.0			
4	36.4	31.9	27.0	25.8				
5	23.3	20.4	17.3					
6	14.9	13.1						
7	9.5							
C. Actual Minus Predicted Expenditures								
Year since award								
0	0.0	0.0	0.0	0.0	-15.3	-35.6	-37.8	-34.5
1	0.0	0.0	0.0	1.7	-7.4	-37.8	-40.0	
2	0.0	0.0	-1.0	14.9	14.3	-12.9		
3	0.0	2.7	8.1	27.3	27.8			
4	4.2	10.7	16.5	34.7				
5	10.3	17.3	21.6					
6	14.9	21.2						
7	17.7							

The data come from the 831 Disability file. The data are restricted to awardees who are aged 25 to 54 and who reported HIV as the primary disability. Actual expenditures are estimated from the Primary Insurance Amount. Predicted expenditures are calculated from pre-existing trends, discussed in the text. Expenditures are expressed in millions of dollars in 1994. The shaded region corresponds to calendar years 1995 and earlier, before HAART was introduced.