NBER WORKING PAPER SERIES

HEALTH, HUMAN CAPITAL AND DOMESTIC VIOLENCE

Nicholas W. Papageorge
Gwyn C. Pauley
Mardge Cohen
Tracey E. Wilson
Barton H. Hamilton
Robert A. Pollak

Working Paper 22887
http://www.nber.org/papers/w22887

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 2016

We gratefully acknowledge helpful comments from: Anna Aizer, Elizabeth Ananat, David Bishai, Christopher Carpenter, John Cawley, Ying Chen, Stephanie Deluca, Kathryn Edin, Emmanuel Garcia, Wayne Roy-Gayle, Seth Gershenson, Gizem Kosar, Ali Khan, Giulia La Mattina, Robert Mofitt, Daniel Rees, Victor Ronda, Todd Stinebrickner, Erdal Tekin and Matthew Wiswall along with participants at the IZA's 6th Annual Meeting on the Economics of Risky Behaviors, Royal Holloway, the 2014 North American Summer Meetings of the Econometric Society, the 2015 ASSA meetings, and the 2015 Southern Economics Association meetings. The usual caveats apply. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

At least one co-author has disclosed a financial relationship of potential relevance for this research. Further information is available online at http://www.nber.org/papers/w22887.ack

NBER working papers are circulated for discussion and comment purposes. They have not been peer-reviewed or been subject to the review by the NBER Board of Directors that accompanies official NBER publications.

Health, Human Capital and Domestic Violence
Nicholas W. Papageorge, Gwyn C. Pauley, Mardge Cohen, Tracey E. Wilson, Barton H. Hamilton, and Robert A. Pollak
NBER Working Paper No. 22887
December 2016
JEL No. I12,J24

ABSTRACT

We study the impact of health shocks on domestic violence and illicit drug use. We argue that health is a form of human capital that shifts incentives for risky behaviors, such as drug use, and also changes options outside of violent relationships. To estimate causal effects, we examine chronically ill women before and after a medical breakthrough and exploit differences in these women's health prior to the breakthrough. We show evidence that health improvements induced by the breakthrough reduced domestic violence and illicit drug use. Our findings provide support for the idea that health improvements can have far-reaching implications for costly social problems. The policy relevance of our findings is compounded by the fact that both domestic violence and illicit drug use are social problems often seen as frustratingly impervious to interventions. One possible reason is that the common factors that drive them, such underlying health or labor market human capital, are themselves very persistent over time. Our study provides a unique test of this hypothesis by examining what happens when factors underlying violence or drug use exogenously shift due to a medical technological advancement. Our findings suggest that both violence and drug use could be reduced by improving women's access to better healthcare.

Nicholas W. Papageorge
Department of Economics
Johns Hopkins University
521 Wyman Building
3400 N. Charles Street
Baltimore, MD 21218
and IZA
papageorge@jhu.edu

Gwyn C. Pauley
Schaeffer Center for Health Policy & Economics
University of Southern California
635 Downey Way
VPD 2nd Floor
Los Angeles, CA 90089
gwyn.pauley@gmail.com

Mardge Cohen
Department of Medicine
Rush University and Stroger Hospital
1653 W. Congress Parkway
Chicago, IL 60612
mardge.cohen@gmail.com

Tracey E. Wilson
SUNY Downstate Medical Center
School of Public Health
450 Clarkson Avenue, Box 43
Brooklyn, NY 11203
Tracey.Wilson@downstate.edu

Barton H. Hamilton
Olin Business School
Washington University in St. Louis
Campus Box 1133
One Brookings Dr.
St. Louis, MO 63130
hamiltonb@wustl.edu

Robert A. Pollak
Washington University in St. Louis
Arts and Sciences
and the Olin Business School
Campus Box 1133
1 Brookings Drive
St. Louis, MO 63130-4899
and IZA
and also NBER
pollak@wustl.edu

1 Introduction

Domestic violence is tragic, rampant and costly. In the U.S., there are about 4.5 million instances of domestic abuse each year, and about 22% of women will be physically assaulted by an intimate partner at least once in their lives (Tjaden and Thoennes, 2000). The annual cost of domestic violence—including direct medical expenditures and losses to productivity—is estimated at $5.8 billion.[1]

By counting productivity losses along with direct healthcare expenditures, these costs highlight two important relationships. The first is the well-established relationship between domestic violence and poor labor market outcomes. This relationship reflects how factors such as low education or drug abuse can increase the likelihood of violence and simultaneously discourage successful employment. It also reflects causality in both directions. Abuse can deter human capital accumulation or undermine a woman's success at work. In the other direction, women with few resources, poor labor market prospects or low earnings have fewer options outside of violent partnerships (Browne et al., 1999; Swanberg and Macke, 2006; Aizer, 2010).

Less understood is the relationship between health and domestic violence. Poor health and chronic illness have been shown to be associated with abuse, once again reflecting how underlying factors (e.g., lack of education and drug abuse) contribute to both (Black et al., 2011). Mechanically, this relationship is also causal, at least in one direction: violence, by its nature, potentially damages health. Scant attention has been paid to causality in the opposite direction: we know virtually nothing about the impact of health shocks on a woman's likelihood of suffering abuse.

This study is the first to establish that health improvements can reduce domestic violence. We show that, for a group of low-income and chronically ill women, a breakthrough medical innovation led to reductions in domestic violence of roughly 10%. To explain this finding, we appeal to two broad ideas in economics. First, health is a form of human capital (Grossman, 1972; Becker, 2007). Second, higher levels of human capital enable women to leave abusive partners if, for example, they face better options outside of violent partnerships. Since risky behaviors are also linked to human capital, we also assess the impact of the same medical innovation on illicit drug use. We show that the medical breakthrough we study led to decreases in illicit drug use of about 15%. We appeal to similar reasoning to explain this finding. Health is a form of human capital and women with more human capital face stronger

[1]Further costs accrue through spillover effects in classrooms (Carrell and Hoekstra, 2010), intergenerational persistence (Pollak, 2004), emotional duress and compromised quality of life. The above estimate also does not include costs to the justice system or social services and so annual expenditures probably amount to a gross under-estimation of the true economic costs of domestic violence.

incentives to avoid risky behaviors with negative future consequences, such as illicit drug use.

Our empirical findings provide support for the idea that health shocks can have far-reaching implications for costly social problems. The policy relevance of our findings is compounded by the fact that both domestic violence and illicit drug use have been frustratingly impervious to a variety of interventions (see e.g., Bowlus and Seitz (2006) on cyclicality of violence). One possible reason is that some factors that drive violence or drug use, such as underlying health or labor market human capital, are themselves often persistent over time. The medical innovation we study provides a unique opportunity to test this hypothesis because we can examine what happens when factors underlying violence or drug use shift exogenously. Our findings suggest that both violence and drug use could be reduced with interventions that improve women's access to better health or otherwise enhance their human capital.[2]

Estimating the causal impact of health on domestic violence and drug use is difficult, due to possible reverse causality or omitted third factors. To identify causal effects, we therefore examine the impact of a medical innovation that provides plausibly exogenous variation in women's current and expected health trajectories. We study a sample of women who are either infected with HIV or uninfected but at risk (henceforth: *HIV+* or *HIV−*, respectively) both before and after the introduction of a medical innovation known as HAART, which treats HIV.[3] The sample is from a longitudinal study providing rich information on objective health measures, domestic violence, illicit drug use (such as crack cocaine and heroin) along with sociodemographic variables. Two key features of HIV make it an appropriate setting for our study. First, the introduction of HAART was unanticipated, providing a quasi-experiment that allows us to identify a causal effect of positive shocks to health. Second, the severity of HIV infection coupled with the effectiveness of HAART resulted in effect sizes large enough to detect nuanced relationships between medical innovation, drug use and violence. Untreated HIV leads to immune system deterioration (known as AIDS) after which fairly routine infections cause grave symptoms, illness and death.[4] HAART effectively transformed HIV infection from a virtual death sentence into a manageable, chronic condition, reducing

[2]An important question is whether negative shocks to women's human capital, perhaps through reduced access to healthcare, could lead to increases in domestic violence. This would hold if the impacts of positive and negative shocks are symmetric, which would be difficult to formally test using our data.

[3]HIV stands for Human Immunodeficiency Virus. Without treatment, a newly infected HIV+ individual lives an average of 11 years. HAART stands for highly active anti-retroviral treatment. There is no vaccine or cure for HIV, but HAART is the current standard treatment. In general, 1996 is marked as the year when two crucial clinical guidelines that comprise HAART came to be commonly acknowledged. First, protease inhibitors (made widely available towards the end of 1995) would be an effective HIV treatment. Second, several anti-retroviral drugs taken simultaneously could indefinitely delay the onset of immune system decline among HIV+ patients.

[4]AIDS stands for Acquired Immunodeficiency Syndrome.

mortality rates by over 80% within two years of its introduction (Bhaskaran et al., 2008). The introduction of HAART can therefore be used to understand the impact of positive health shocks, in this case on illicit drug use and domestic violence.

Identifying causal effects by exploiting the introduction of a medical innovation requires that we construct treatment and control groups. The aim is to separate the impact of the innovation from other contemporaneous changes that may have affected violence or drug use. To construct treatment and control groups, we distinguish women based on the their immune system health prior to HAART introduction. The measure of immune system health we use is objective, coming from blood samples collected by medical professionals from individuals in our sample.[5] Our treatment group consists of HIV+ women who were just beginning to experience immune system deterioration when HAART was introduced. For these women, an effective treatment for HIV was urgent since they faced imminent declines in physical health and longevity. However, they had not yet experienced the debilitating physical health effects or low survival rates of full-blown AIDS, which means they are comparable to relatively healthier women, whom we use as control groups. In particular, we identify the causal impact of HAART using a difference-in-differences approach, comparing pre- versus post-HAART behavior changes among women in the treatment group to the responses of two control groups.[6] The first control group consists of HIV+ women who were relatively healthy before the introduction of HAART. The second control group is a subsample of socio-demographically similar women who were uninfected with HIV. Identification of a causal effect relies on pre-HAART trends in outcomes being the same across our treatment and control groups, and we perform several checks to show that this is the case.

The distinction we make between treatment and control groups is based on the idea that the treatment group consisted of women who expected to have AIDS sooner than women in the control groups, but who were still comparable to healthier women since they had not yet experienced the debilitating effects of AIDS. Therefore, any responses to HAART introduction would be comparatively large for the treatment group, which is helpful for identifying causal effects. Previous work supports the idea that the impact of an intervention on outcomes like violence can change dramatically depending on pre-treatment characteristics. For example, studying the effect of cash transfers on violence, Angelucci (2008) finds that wealth and behavior measured prior to the intervention effectively determine whether transfers re-

[5] As will be explained below, we distinguish women based on their pre-HAART minimum white blood cell counts, which is a measure of immune system health.

[6] An alternative approach would be to focus solely on women who actually use HAART, though medication choice is endogenous. In results available from the corresponding author, we show that HAART usage reduces violence if we use HAART introduction as an instrumental variable for HAART usage. One benefit of our approach is that we do not only focus on users, so we can capture how introduction of HAART affected non-users through, for example, changes in expectations over future health induced by HAART introduction.

duce violence.[7] Nonetheless, the distinction between treatment and control groups does not rule out the possibility that women in our control groups (relatively healthy HIV+ women and at-risk HIV− women) benefitted from HAART.[8]

Having established that HAART introduction substantially reduced violence and illicit drug use, we turn to exploring some possible mechanisms. First, we address whether HAART affected both violence and drug use independently or affected one of these solely through its impact on he other. Though it is difficult to say definitively with the data we have, we provide some evidence that HAART affected both outcomes even after we control for the correlation between drug use and violence via joint estimation. Second, we examine whether our results are explained by contemporaneous changes in mental or physical health (measured as depressive symptoms or physical ailments associated with AIDS, respectively). We find no evidence of relative improvements to mental or physical health for women in our treatment group after HAART. Our findings on physical health may seem puzzling since HAART improved the health of sick women. Here again it is crucial to understand that women in the treatment group, though they had experienced drops in white blood cell counts, had not yet become sick enough to experience symptoms associated with AIDS. Thus, HAART-induced shifts in violence and drug use are attributed to better underlying health, which is associated with improved future health, well-being and longevity; in fact, that women in the treatment group did not see appreciable reductions in symptoms after HAART underscores why they are comparable to our control groups consisting of healthier women. Third, we explore whether the impact of HAART on violence and drug use can be explained by changes in labor market outcomes. We show some evidence of rises in employment among women in the treatment group relative to the control groups after HAART. We do not claim to have isolated the precise mechanisms linking employment to HAART, drug use or violence. However, improvements to labor market outcomes are consistent with the view that HAART amounted to an exogenous shift to women's human capital, which improved women's outcomes on a variety of dimensions, including drug use, violence and employment.

Finally, we note that our focus on low-income, HIV+ women does not mean that our results cannot be generalized. Domestic violence and drug use are not limited to women who are HIV+. Additionally, HIV is similar to many other chronic conditions (e.g: diabetes) in that it is harmful or deadly when untreated, but manageable when effectively treated. Further, chronic illness is not only a widespread phenomenon, but one that is associated

[7]More generally, Anderberg and Rainer (2011) predict that employment will affect violence in a way that depends heterogeneously and non-monotonically on a woman's marginal earnings.

[8]Chan et al. (2016) show that HAART benefits individuals at risk of HIV infection because it is available in case they become infected and need it.

with poverty.[9] Therefore, our focus on low-income, HIV+ women helps us to understand how chronically ill women with limited resources respond to and benefit from a medical breakthrough.

The remainder of this paper is organized as follows: Section 2 introduces the data set used in this project and presents a preliminary data analysis. Section 3 discusses how we link health to illicit drug use and domestic violence, first conceptually and then empirically. Section 4 presents our main econometric results concerning the effect of HAART on violence and drug use. Section 5 examines some possible mechanisms explaining why better health reduces drug use and violence. Section 6 concludes.

2 Data

In this section, we introduce the data set used in our analysis, the Women's Intra-Agency HIV Study. We include a discussion of data on health status in the context of HIV. We also discuss construction of our analytic sample and provide summary statistics regarding violence, drug use, and health.

2.1 The Women's Intra-Agency HIV Study

We employ a unique data set from the Women's Interagency HIV Study (WIHS). The study was initiated to investigate the impact of HIV on women in the United States, and the sample was selected to include both HIV+ and HIV− women. Participants were recruited from a variety of places, including: HIV primary care clinics, hospital-based programs, research programs, community outreach sites, women's support groups, drug rehabilitation programs, HIV testing sites and referrals from enrolled participants (Barkan et al., 1998). The study began in 1994, and a second cohort was added to the sample in 2001-2002. Each woman in the sample was enrolled in one of six clinical consortia, located in: Bronx/Manhattan, New York; Washington DC; San Francisco/Bay Area; Los Angeles/Southern California/Hawaii; Chicago, IL; and Brooklyn, New York. Semi-annual interviews are ongoing for both HIV+ and HIV− women. These two groups of women were recruited similarly and were matched on demographic and risk factors. For example, both groups of women reported having engaged in risky behaviors, such as intravenous drug use or unprotected sex, prior to selection

[9] According to the Centers for Disease Control and Prevention, nearly 50% of adults in the U.S. suffer from a chronic condition, about one quarter of whom experience significant limitations in daily activities. For more on this point, see http://www.cdc.gov/chronicdisease/resources/publications/aag/chronic.htm. For research linking chronic illness to poverty, see Lowry et al. (1996) and Newacheck (1994).

into the study. Women were compensated for participation with monetary remuneration, gift packs, bathing and laundry facilities, meals, transportation and access to dental care at some sites. In addition, services such as HIV counseling, health assessments, health education and referral to clinical trials, primary care and social services were provided. For more information on the WIHS, see Barkan et al. (1998).[10]

The WIHS data set is well-suited for use in assessing the causal effect of medical innovation on domestic violence and illicit drug use for several reasons. First, the panel structure of the data allows us to follow women over time. Importantly, the WIHS started interviewing women in October 1994, before HAART became widely available in late 1996. This means we observe women before and after the unanticipated medical advance and can control for pre-treatment characteristics. For women in our main analysis, there were about four visits before the introduction of HAART. Second, there was a second cohort added in 2001-2002, after the introduction of HAART. Although not included in our main sample, we use this second cohort in a series of robustness checks to assess the potential effects of participation in the study. Simply participating in WIHS can be beneficial to the participants, and we use the second cohort to separate the experimental effect from the effect of medical innovation.[11] Third, the data set includes a rich set of behavioral, socio-demographic and health variables. Information is elicited on employment, income, housing status, relationship and marital status, sexual behaviors, illicit drug use, and medication use.[12] Fourth, because the HIV− women in the study are similar on many dimensions, but not directly affected through a health improvement by the advent of HAART, we can use them as one of our

[10]Data in this manuscript were collected by the Women's Interagency HIV Study (WIHS). The contents of this publication are solely the responsibility of the authors and do not represent the official views of the National Institutes of Health (NIH). WIHS (Principal Investigators): UAB-MS WIHS (Michael Saag, Mirjam-Colette Kempf, and Deborah Konkle-Parker), U01-AI-103401; Atlanta WIHS (Ighovwerha Ofotokun and Gina Wingood), U01-AI-103408; Bronx WIHS (Kathryn Anastos), U01-AI-035004; Brooklyn WIHS (Howard Minkoff and Deborah Gustafson), U01-AI-031834; Chicago WIHS (Mardge Cohen), U01-AI-034993; Metropolitan Washington WIHS (Mary Young), U01-AI-034994; Miami WIHS (Margaret Fischl and Lisa Metsch), U01-AI-103397; UNC WIHS (Adaora Adimora), U01-AI-103390; Connie Wofsy Women's HIV Study, Northern California (Ruth Greenblatt, Bradley Aouizerat, and Phyllis Tien), U01-AI-034989; WIHS Data Management and Analysis Center (Stephen Gange and Elizabeth Golub), U01-AI-042590; Southern California WIHS (Alexandra Levine and Marek Nowicki), U01-HD-032632 (WIHS I - WIHS IV). The WIHS is funded primarily by the National Institute of Allergy and Infectious Diseases (NIAID), with additional co-funding from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), the National Cancer Institute (NCI), the National Institute on Drug Abuse (NIDA), and the National Institute on Mental Health (NIMH). Targeted supplemental funding for specific projects is also provided by the National Institute of Dental and Craniofacial Research (NIDCR), the National Institute on Alcohol Abuse and Alcoholism (NIAAA), the National Institute on Deafness and other Communication Disorders (NIDCD), and the NIH Office of Research on Women's Health. WIHS data collection is also supported by UL1-TR000004 (UCSF CTSA) and UL1-TR000454 (Atlanta CTSA).

[11]Results of this robustness check are discussed further in Section 4.3.

[12]Although we observe if the participants are in a relationship, we do not observe the length of the relationship.

control groups.

To quantify health, we use a common measure of immune system functionality: *CD4 count*, defined as the number of white blood cells per mm^3 of blood. CD4 count is measured using plasma samples, which are collected by medical professionals. This ensures that the health measure that we use is objective rather than self-reported. Counts between 500 and 1,500 are normal among healthy people. For HIV+ individuals, lower counts indicate that immune deterioration has commenced, with counts below 200 signaling high susceptibility to common illnesses (a condition known as AIDS). Monitoring CD4 cells allows individuals to track their immune system health, with lower CD4 reflecting a weaker immune system, sometimes known as immunosuppression. Guidelines recommend starting HAART as CD4 counts decrease, especially once the CD4 count reaches 350 (Mocroft and Lundgren, 2004; AIDSinfo, 2014).

The analytic sample includes all women from the first WIHS cohort who answered questions about outcomes including domestic violence, employment, and illicit drug use, as well as all of the controls that we include.[13] The first cohort of the WIHS data set includes 2,623 women who participated in the study for up to 33 visits. This amounts to 63,223 person visits. However, our main analytic sample consists of 18,019 person visits from 1,663 individuals. The majority of this attrition occurs because, starting in the 10th visit, questions about domestic violence were only asked every other visit, on even number visits. Once we account for the change in timing of domestic violence questions, this brings the count to just 39,975 person visits. However, 53 women stay in the sample just one visit prior to their death, and we do not include them in our sample. Further, if women did die during the study period, the last visit is a record of this, and once we eliminate these visits our total number of individuals is 2,570 and 39,292 person visits. When we trim observations that are missing basic information such as exact date of visit, CD4 count before the introduction of HAART, or age, we are left with 29,819 observations from 2,550 individuals.[14] Last, we trim observations that are missing information about domestic violence, employment, income, drug use, or relationship status and find that there are 18,016 person observations from 1,324 individuals.[15] While we do find that women who are less healthy in terms of a lower CD4 count are more likely to be missing observations, as shown in Table A1 in Appendix A, the actual changes in the probability of missing an outcome are quite small. Further, and more importantly, there is no difference between the treatment and control groups in terms of how CD4 count affects the probability of having a missing outcome. Thus, we find that

[13] See Section 4 for a list of controls.

[14] This large drop happens because the date of the visit is missing.

[15] When we impute missing variables, our results change very little. Thus, we choose to simply drop observations that are missing information.

health may affect missing outcomes, but not differentially across groups. Finally although we use an unbalanced panel, 77% of our sample stayed in the study for all 33 visits.[16] These 33 visits occurred between October, 1994 and April of 2010.

Our measure of domestic violence indicates whether women reported experiencing any of three forms of violence in the six months prior to their interview: physical abuse, sexual abuse, or coercion by an intimate partner or spouse. We classify the woman as having experienced coercion if a partner threatened to hurt or kill her or prevented her from leaving or entering her home, seeing friends, making telephone calls, getting or keeping a job, continuing her education, or seeking medical attention. Moreover, it is important to note that we do not require that women report being in a relationship in order to report domestic violence. Indeed, many women report not being in a relationship at visits t and $t+1$ and also report violence between the same two visits. This might occur if a woman has a short-term intimate partner who abuses her. Because we do not condition experiencing domestic violence on being in a relationship, we bypass problems that arise if HAART affected selection into a long-term partnership such as marriage.

2.2 Summary Statistics

Summary statistics for the analytic sample (along with various sub-groups discussed below) are found in Table 1. For now, we focus on the full analytic sample (Column 1) and on black women (Column 2). We will discuss descriptive statistics for our treatment group and two control groups (Columns 3-5) once we have introduced them in Section 3. According to Table 1, women in our sample are not highly educated, live in low-income households, are not likely to be employed, are largely minorities, and are more likely to be unmarried in comparison to the average American woman at a comparable age. About 65% of women in our sample are black. Further, 65% graduated high school, which is lower than the national average of about 80% for females from all races and 71% for black females (Heckman and LaFontaine, 2010). Before the introduction of HAART, 47% of our sample lived in households with observed maximum yearly incomes below $12,000, 39% were employed and 29% were married.

Clearly, the sample used in our analysis is not nationally representative. Nevertheless, it is appropriate and well-suited to studying domestic violence. Low income, under-employed,

[16] We include in our sample all women who are not missing information, regardless if they die during the study. In a conservative robustness check, discussed further in Section 4.3, we re-run our analyses excluding all women who die early in the study and find that our results do not change for most specifications. Given these results, we do not believe that survival bias is driving our main empirical results. Excluding women who die is effectively non-randomly removing individuals from our sample, i.e., we may be removing women who are more likely to suffer domestic violence.

and non-white women are more likely to experience domestic violence during their lifetime than the average American woman. Turning to violence, we see that 6% of the analytic sample reported experiencing sexual abuse between 1993 (one year prior to the start of the survey) and the introduction of HAART (September 1996). During this same period, women experienced physical abuse, coercion, and domestic violence at much higher rates: 16%, 26% and 29%, respectively. Compared nationally, these numbers are quite high. For example, the National Intimate Partner and Sexual Violence Survey found that the 12 month prevalence of physical violence was just 4%. When looking at rape, physical violence, and/or stalking, there is a 12 month prevalence of 5.9%.[17]

Similarly, we find that reported drug use is higher among women in our sample than nationally. According to the National Survey on Drug Use and Health, 9.4% of individuals ages 12 and older used illicit drugs in the past month, most of this being driven by marijuana use. For cocaine, just .6% of individuals reported using in the past month. For stimulants, this prevalence is .5%, and for heroin use it is just .1% (SAMSHA, 2014). Although we do not have estimates of 30-day prevalence, we do find that women in our sample have much higher rates of drug use that cannot be fully explained by the longer time period of recall. For example, 28% of our sample used stimulants and 14% of our sample used heroin between one year before the start of the survey and the introduction of HAART.

Much of our analysis considers black women separately. Nationally, this group of women is more likely to report domestic violence. Lifetime prevalences of rape, physical violence, and/or stalking are estimated to be 43.7% for black women and 34.6% for Non-Hispanic white women (Black et al., 2011). Black women also suffer domestic violence at higher rates than the white women in our sample: 30% of black women reported experiencing domestic violence between one year prior to the start of the survey and the introduction of HAART, compared to just 23% of white women. Patterns of drug use in comparisons of black women in our sample to other women are more nuanced. For example, 30% of black women reported having used stimulants prior to the introduction of HAART, compared to 24% of white women. However, 13% of black women in the sample reported having used heroin during this time period, compared to 18% of white women in our sample. The black women in our sample have, on average, less education than the white women. They also come from less well-off households: 49% had maximal pre-HAART incomes below $12,000 compared to 25% of white women. It should be noted that identifying as black is not a risk factor for experiencing domestic violence in and of itself. Rather, we think of identifying as black as a marker for a constellation of social determinants that increase risk of domestic violence.

[17]Over a woman's lifetime, these numbers are 32.9% and 35.6% (Black et al., 2011).

3 Conceptual Framework and Identification

In this section, we outline how we relate health to domestic violence and drug use. Section 3.1 provides a conceptual framework. Section 3.2 discusses empirical challenges and our identification strategy, which exploits an exogenous medical innovation and a difference-in-differences approach. We also define and discuss our treatment and control groups here. Section 3.3 provides evidence of the validity of our identification strategy.

3.1 Conceptual Framework

To conceptually link health to drug use and violence, we draw on two key ideas from economics. First, health is a form of human capital (Grossman, 1972). Second, individuals with higher levels of human capital face different costs associated with drug use and violence. The reasoning is that human capital extends life, improves well-being and raises labor market productivity. As a result, incentives to avoid drug use and violent partners become stronger since women not only have more to live for, but also have more options outside of violent partnerships. In the context of HIV, HAART extended life and improved health of HIV+ women. We hypothesize that HAART would therefore lead to lower illicit drug use and domestic violence among HIV+ women.

A potential problem with this conceptual framework is that it presumes that women have some control over both violence and drug use. In the case of illicit drug use, addiction may mean that women are unable to change their behavior even in the face of a strong shift in incentives, such as a positive health shock. Rooted in the idea of rational addiction (Becker and Murphy, 1988), we assume that women make rational choices regarding their drug use, weighing the benefits or consequences of continued use. This assumption is supported by clinical evidence showing that illicit drug use is responsive to shifts in incentives (Hart et al., 2000).[18] Finally, it is consistent with the idea, discussed in sociology, of *desisting*, which posits that individuals choose to avoid (or desist from) risky behaviors like drug use after important life events, such as having children, that give them more to live for (Laub and Sampson, 2001). We hypothesize that HAART incentivized desisting from illicit drug use by endowing women with longer and healthier lives, thus making illicit drug use a relatively

[18]For example, Hart et al. (2000) report that regular crack smokers asked, in an experimental setting, to choose between crack and payments to be made several weeks later (and who have no other access to the drug until the following day) regularly opt for the delayed payment, especially when the amount of crack they forego is fairly small. For earlier evidence against the hopelessness of addiction, see Robins (1993), who studies rapid recovery from heroin addiction among Vietnam veterans upon their return home. One interpretation of her findings consistent with our conceptual framework is that these veterans faced stronger incentives to avoid heroin following a positive shock to their lifespan.

more costly option.

The application of our conceptual framework to domestic violence is more delicate. The concern is that the assumption that women can "choose" abuse perpetrated by a violent partner can erroneously be perceived as "blaming the victim" for her own abuse. When relating domestic violence to human capital, we draw upon the resource theory of domestic violence. Often attributed to Gelles (1976), the idea is that women with more resources have better options outside of abusive partnerships and are therefore more likely to leave violent partners. For example, if a woman's outside option is homelessness, she may find it safer to remain with a potentially violent partner. The resource theory of domestic violence helps to explain why women with higher education or more income are more likely to avoid violence. The theory has been used to motivate bargaining theories of domestic violence. In bargaining models, women with better outside options have higher threat points. Because of this, they can credibly threaten to leave partners and therefore essentially bargain for less violence. Resource and bargaining theories of domestic violence have been used to explain why unilateral non-fault divorce has reduced domestic violence (Stevenson and Wolfers, 2006), why cash transfers to poor women can reduce abuse (Bobonis et al., 2013; Angelucci, 2008; Pronyk et al., 2006), and why abuse is associated with poor labor market outcomes (Bowlus and Seitz, 2006; Anderberg and Rainer, 2011) and a larger gender wage gap (Aizer, 2010).[19] In our case, we do not take a position on intra-partnership bargaining. Rather, we argue simply that HAART improved health, which effectively boosted women's human capital. Therefore, women had more resources to leave violent partners and better options outside of violent partnerships.

Our conceptual framework does not presume a relationship between violence and drug use even though they could be causally linked.[20] One possibility is that better health induces lower illicit drug use, which in turn reduces violence. This would make sense if drug use encourages violence, which has some support in medical literature, especially in the case of stimulants, such as crack cocaine (Phil and Peterson, 1993; Volavka, 2008). Alternatively, less violence can lead to lower drug use, for example, if women who no longer suffer abuse are less prone to drug use as a coping mechanism (El-Bassel et al., 2005). It is also possible that

[19]Results reported in Alvira-Hammond et al. (2014) suggest that the relationship between labor market prospects and lower domestic violence extend to adolescents. Also related, but in a different medical context, Johnson and Pieters (2016) examine violence among women diagnosed with cancer. In our framework, a cancer diagnosis could be seen as a negative health shock, which could affect the likelihood that women experience violence. The authors focus on a different relationship, arguing that violence can affect health of women with cancer diagnoses by influencing how they seek treatment.

[20]Though they do not take a position on causality, Cohen et al. (2000) use the same data set we use to show that poorer women who use drugs are more likely to be abused. They describe this correlation as a "continuum of risk".

health independently drives reductions in both drug use and violence. Though it is difficult to empirically disentangle these possibilities, we revisit them in Section 5, which provides a discussion of possible mechanisms underlying our key empirical findings. For now, we hypothesize that better health would reduce violence and illicit drug use. We now turn to a discussion of how we test these hypotheses.

3.2 Identifying the Impact of Health on Violence and Drug Use

In relating health to drug use and violence using observational data, selection problems are formidable since health is endogenous. Women in our sample who are in relatively poor health are likely to exhibit a number of other qualities, many of which are unobserved to the econometrician, and which are likely to affect illicit drug use or violence. Thus, correlations between CD4 counts, domestic violence, and drug use cannot be interpreted as causal. For example, there may be reverse causality and simultaneity if drug use or violence affects health. There could also be additional factors that affect all three. Examples of such factors include poverty and mental health problems, both of which we can control for. More concerning are unobserved and negative transitory shocks that act as stressors that could undermine health and also make violence more likely. Examples include unanticipated job losses, legal problems, financial losses, evictions, or deaths in the family.

In fact, when we look at simple correlations using regression analysis, we find that the relationships between health and violence or illicit drug use are complex and ambiguous. Table 2 shows naive reduced form models for the full sample, HIV+ sample, and HIV− sample.[21] Some relationships accord with our priors. HIV+ women with higher CD4 counts are less likely to use both stimulants and heroin. However, other relationships are not in accordance with our priors. For example, there is a positive correlation between CD4 and domestic violence in the full sample. Further, there may be non-linearities in the relationship between health and violence, which complicates estimation of causal effects. To explore this further, we also focus on women whose CD4 counts were observed to be below 200 at least once and compare them before and after their first period exhibiting AIDS-level CD4 counts. We see that they are less likely to report abuse in periods where their counts are actually below 200, as shown in Table 3. This could mean that their illness has become so acute that they are effectively too sick to be abused. Given these patterns, all of which threaten the validity of comparing low-CD4 count HIV+ women to healthier women, our analysis does not use low-CD4 count women as a treatment group.[22]

[21] We also show that better health is associated with higher rates of employment, which is consistent with the idea that health is a form of human capital. We explore this point further in Section 5.

[22] Nonetheless, in results available from the corresponding author, we use this group as a robustness check

In light of these difficulties, we now turn to a discussion of our identification strategy. First, we note that the aim is to identify how a marginal change in health affects domestic violence and drug use. To illustrate, denote the propensity to suffer domestic violence as V and health as H. We aim to estimate:

$$\frac{dV}{dH}. \tag{1}$$

To achieve identification, our approach leverages variation in health status at the time of HAART introduction along with the fact that HAART was an unanticipated innovation. The passage of time from the pre- to the post-HAART era affects our outcomes (domestic violence, employment, and illicit drug use) through the impact of HAART availability on health (H) both directly and indirectly. For violence, this can be written as follows:

$$\Delta V^g = \left[\Delta H^g \times \frac{\partial V}{\partial H}^g\right] + \left[\Delta X^g \times \frac{\partial V}{\partial X}^g\right] \tag{2}$$

where Δ is the change in a variable from the pre-HAART to the post-HAART eras and g indexes groups distinguished by pre-HAART health status. The first expression on the right-hand-side of equation (2) is the effect of HAART introduction on health (the health shock) multiplied by the effect of health on violence. The second expression captures other avenues through which the passage of time between the pre- and post-HAART eras affected violence, including secular trends and omitted factors (together denoted X). To identify the causal effect of HAART, we compute the difference-in-differences, relying on variation in how women respond to exogenous shifts in medical technology depending on their health status at the time of the innovation.

Identification of causal effects requires appropriate selection of treatment versus control groups. Our treatment group consists of women who were beginning to exhibit HIV-induced immune system deterioration, which typically precedes full-blown AIDS, but who had not yet exhibited AIDS-level CD4 counts. These are women whose minimum CD4 count prior to HAART was between 300 and 399. We refer to the treatment group as the *salient group*, as the introduction of HAART was particularly pertinent for this group. As discussed above, the most basic current guidelines recommend beginning HAART when the CD4 count reaches 350, and our salient group encompasses this number. However, since women in the salient group have yet to reach CD4 counts where they would experience physical illness due to AIDS they are more comparable to healthier women, whom we use as controls.

Using HAART introduction as the treatment, we compare how domestic violence and drug use evolved after the introduction of HAART in the salient group and the two control

that our results are not driven by interaction with the medical community.

groups. The control groups consist of women in relatively good health: HIV+ women with CD4 counts that never dipped below 400 prior to HAART introduction and HIV− women. In this context, $\Delta H^g = 0$ for the two control groups, while $\Delta X \times \frac{\partial V}{\partial X}$ is nearly the same for the salient group and the control groups. Indeed, we find that CD4 counts increased for the salient group as compared to both of our control groups after the introduction of HAART, as shown in Table 4.[23] This design effectively treats CD4 dipping below 400 just prior to HAART introduction (and thus being in the salient group) as independent of domestic violence and drug use.[24]

We base our use of control groups on the idea that they are affected by the introduction of HAART less than women who need to take it sooner.[25] Relatively healthy HIV+ women are a good control group since they are similar to the salient group in many dimensions, but were not in imminent danger of becoming gravely ill at the time of HAART introduction. Though less obviously comparable, HIV− women in our sample are also a reasonable control group. They were chosen to be in the WIHS study in part due to being observably similar to the HIV+ women in the sample, both demographically and in their reports of risky behaviors. In most cases, our results using the two control groups are similar. Finally, we note that our identification strategy does not rule out that at-risk HIV− women or relatively healthy HIV+ women, both of whom serve as control groups in our analysis, could also respond to HAART introduction. Even though they are not directly and immediately affected by the new technology as much as the salient group, they are likely affected by it in expectation.[26]

Before assessing the validity of our approach, we return to Table 1, which provides summary statistics for our treatment group and the two control groups in Columns (3)-(5). Prior to the introduction of HAART, 28% of the salient group had used stimulants (defined as crack or cocaine), compared to 30% of the high CD4 count women and 36% of the HIV− women had. The higher rate of stimulant use by HIV− women is mainly driven by cocaine use rather than crack. Heroin use prior to HAART was very similar for the three groups: 18% for the salient group, 16% for the high CD4 count women, and 17% for HIV− women. Although drug use was similar prior to HAART, employment was less so. 38% of the salient group reported being employed at any point before HAART was introduced, while 44% of

[23] See Section 4 for the basic empirical framework underlying this model.

[24] Although the women in the study have regular contact with the medical community and are aware of their health status, the treatment and control groups are defined based on their pre-HAART health and therefore do not change after the introduction of HAART.

[25] If we repeat the analysis from Table 2 using the salient group, we do find negative relationships between health and violence.

[26] Chan et al. (2016) show that HIV− gay men shift their risky sex behavior in respond to HAART. This behavioral change is used to quantify how at-risk, uninfected men benefit in expectation from HAART introduction.

the high CD4 count women and 56% of the HIV− women did. Although rates of domestic violence are similar across our comparison groups, HIV+ women with high CD4 counts prior to HAART and HIV− women experienced more domestic violence than our salient group. In particular, 27% of the salient group experienced domestic violence before the introduction of HAART, while 33% of the high CD4 count women, and 37% of the HIV− women did. It should be noted that both the high CD4 count women and the HIV− women were more likely to suffer sexual abuse, physical abuse, and coercion than our salient subsample. However, the mean differences in outcomes between the groups do not threaten the validity of difference-in-differences as long as the trends in domestic violence and other outcomes are similar. We discuss the parallel trends requirement next.

3.3 Assessing the Validity of the Research Design

Identification using the difference-in-differences approach relies on the assumption that the path of the outcome variables for the salient group of HIV+ women and the control groups would not be systematically different in the absence HAART introduction. Specifically, this means that the introduction of HAART should be the only factor that drove the salient group to experience a change in an outcome variable, such as a relative reduction in domestic violence. To confirm this, we first argue that HAART was an unexpected medical breakthrough. Second, we study pre-HAART trends in our outcome variables and show that they are not different for the salient group and our control groups.[27]

The validity of our research design relies on HAART being an unanticipated innovation. For evidence of this, we turn to questions used to compute the CES-D scale, which is used to asses whether women are likely to be depressed.[28] One question asks women whether they were hopeful about the future in the week leading up to their interview. We consider the probability that women in the sample answered "most or all of the time" to this question, and plot this before and after the introduction of HAART in Panel 1a of Figure 1. There are two reasons that this figure suggests that HAART was not anticipated. First, HIV+ women experienced a jump in hopefulness right at the introduction of HAART. Before this, the percentage of HIV+ women who reported being hopeful was relatively flat. If they had anticipated HAART, they might have reported more hopefulness earlier. Second, HIV−

[27] In Section 4.3, where we present a number of robustness checks, we show findings from an event study, which confirms that there was no difference in pre-HAART outcomes for the treatment and control groups for each of our outcomes. Although the event study can be used to show that pre-HAART trends are not driving our results, we see it as alternative specification and thus present it as a robustness check once we have discussed our main results.

[28] CES-D is a depression screening test and stands for the Center for Epidemiological Studies Depression scale.

women did not experience such a jump. If some other factor drove the increase in hopefulness, then this would be reflected by a jump in the hopefulness of HIV− women.[29] This supports the idea that HIV− women, though they conceivably benefit from HAART in expectation, are less affected by the breakthrough.

Next, we discuss pre-HAART trends among our treatment and control groups. In a series of figures, we plot the pre-HAART trends in outcomes for the salient group and two control groups and show that there is no pre-HAART trend in outcomes. This indicates that HAART is the driving force in the difference in outcomes. Plotting the pre-HAART trends in domestic violence, stimulant use, and heroin use shows that the salient group and two control groups were comparable prior to the introduction of HAART. As shown in Panel 1b, the trends in domestic violence were quite similar. Turning to illicit drug use, we see that the trends in both stimulant use (Panel 1c) and heroin use (Panel 1d) are very similar for the salient group and HIV+ high CD4 count women. Together, Panels 1b-1d show that there is no real trend in outcomes prior to the introduction of HAART.[30]

Finally, we note two additional concerns that might threaten the validity of our research design. First, one might be worried that another shift (e.g., a government program or policy change) had an impact on the salient group, but not on the comparison groups (or vise-versa). An obvious candidate is the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA), which reformed welfare and was signed into law in August of 1996, right at the time HAART was introduced. However, given that the comparison groups are similar among socio-demographic characteristics, including income and education, it is unlikely that welfare reform affected the control group differently than the salient group.[31] A second concern might be that domestic violence is drastically under-reported. By some measures, 50% of violent episodes go un-reported (Greenfeld et al., 1998). However, this would affect our results only if there were a shift in the magnitude of mis-reporting that only affected the salient group and, moreover, if this shift coincided with the introduction of HAART. Though we cannot rule out this possibility, we believe that it is unlikely.

[29] See Ostrow et al. (1989) or Detels et al. (2001) for use of the CES-D scale score data in the context of an HIV study.

[30] In results available upon request from the corresponding author, we also show that outcomes do not systematically differ for the salient and control groups in the visits leading up to HAART. If anything, the salient group has higher outcomes prior to HAART, which would suggest that our results are biased towards zero.

[31] Unfortunately, we cannot test this assumption more directly since our data only contain information about welfare participation after the introduction of HAART.

4 Main Results

In this section, we present our main findings. We show that the salient group experienced reductions in domestic violence and illicit drug use that the control groups did not. We also perform several robustness checks, including showing that using a placebo HAART introduction had no effect on violence or drug use. We also show that our results are robust to estimation using propensity score matching.

4.1 Health and Domestic Violence

In order to test if the salient group experienced a reduction in domestic violence after the introduction of HAART, we use a difference-in-differences approach. We estimate probit models where the dependent variable is an indicator of whether a woman experienced domestic violence since her last visit, using the following specification:

$$V_{it+1} = X_{it}\beta + HAART_t\alpha + Salient_i\delta + HAART_t \times Salient_i\gamma + \epsilon_{it} \tag{3}$$

where V_{it+1} indicates if the woman reported violence at $t+1$, which she experienced between periods t and $t+1$. X_{it} is a vector of individual i's characteristics at time t, $HAART_t$ is an indicator variable for HAART being available at time t.[32] $Salient_i$ is a dummy variable indicating if the woman is in the salient group. X_{it} includes basic controls: age, age squared, and age cubed at time t, as well as indicator variables for race and site of study. Additionally, in some specifications we control for whether or not the woman experienced domestic violence prior to the introduction of HAART.[33] The coefficient of interest is γ, which indicates if the salient group responded differently to the introduction of HAART than the control groups. To control for serial correlation, all specifications are clustered at the individual level (Bertrand et al., 2004).

We find that the salient group experienced a reduction in domestic violence that the control groups did not, as shown in Table 5. We present our results in two panels, one for

[32]We use lagged HAART availability to account for the fact that domestic violence and other outcomes are measured since the last visit. For example, consider visits that occurred in September of 1996, the same time as HAART was introduced. At this visit, women were asked about violence that they had experienced in the last six months, roughly the time since their previous visit. However, HAART was not available to them during this time period and therefore they would not have experienced any benefits of this medical innovation.

[33]Although we could also control for other demographic and behavioral controls, such as relationship status, income, and drug use, we acknowledge that these might also change with the introduction of HAART and so we leave them out of our specifications. In results available from the corresponding author, we show that main results are robust to the inclusion of these additional variables

each control group. We show three specifications for both our main sample and the sample consisting of only black women. Specifically, Column 2 includes the interaction, but no other controls, Column 3 includes the basic controls described above, and in Column 4 we add whether or not the woman experienced domestic violence prior to the introduction of HAART. Our preferred specification is the second column.

First, we compare the salient group to the high CD4 count HIV+ women. Our finding that the salient group experienced a decrease in domestic violence that otherwise similar women did not is robust to this change. It is also interesting that HAART availability is associated with a decline in domestic violence, as shown in the first row of each panel of Table 5. This is consistent with secular declines in domestic violence during this time period (Catalano, 2012).

It is important to note that Table 5 presents coefficients from probit models which are difficult to interpret. In Table A2 of Appendix A, we show the marginal effects for the interaction coefficient γ. We follow Ai and Norton (2003) and Norton et al. (2004) and report the average marginal effect and average z-score for the interaction. We also show the marginal effects for the subsample of women who experienced domestic violence prior to the introduction of HAART. Although this is a non-random group, it is a group that is determined before the introduction of HAART. We find that the decrease in violence is particularly strong for these women.

Computing marginal effects, we find that the salient group experienced a rather large decrease in violence due to the introduction of HAART. Specifically, the decline for the full sample was between 1.4-2.3 percentage points, depending on the specification. Although at first glance this effect appears small, this amounts to a decrease in domestic violence of 5-9%. When we restrict the sample to black women, our point estimates are larger and more precisely estimated. We find that black women in the salient group experienced a decline in domestic violence between 2.7-3.8 percentage points as compared to black women in the high CD4 HIV+ group. This is equivalent to a decrease in violence of between 9 and 13%.

In assessing the magnitude of these declines, it is difficult to find direct comparisons since our study is novel in linking medical innovation and domestic violence. Instead, we compare our findings to research on how policy interventions, shifts of women's resources or other natural experiments affect violence. Studies assessing the impact of legislation on violence have found that abuse rates are stubbornly persistent, despite new laws. Heaton (2012) finds that Sunday liquor laws have no effect on domestic violence, while Iyengar (2009) reports that mandatory domestic violence arrest laws actually lead to an increase in intimate partner homicides. More closely related to our study are changes to women's earnings, both

absolutely and relative to men's. A key example is Aizer (2010), who shows reductions in violence of about 9% that is explained by a 20-year decline in the male-to-female wage gap. In a recent paper, Cesur and Sabia (2016) show that combat veterans are between three and six percentage points more likely to be violent than veterans who were not assigned to combat zones.

Alternatively, one can look at experimentally assigned conditional cash transfers. Among poor Mexican women, Angelucci (2008) shows relatively modest declines in domestic violence, some of which can be explained by lower alcohol usage among transfer recipients. On the high end in terms of the magnitude of causal effects, Bobonis et al. (2013) report that recipiency of a conditional cash transfer targeting women is associated with a decrease in domestic violence of about 40%. The authors consider data from a program in Mexico called *Oportunidades*, which offers substantial cash transfers to families whose children are in school that amount to about 10% of their average monthly expenditures. We should note that our results are somewhat difficult to compare since they also find an increase in intimidation and threats, which may be evidence of substitution among different forms of abuse.[34]

Next, we compare the salient group to HIV− women. Table 5 shows that there is no difference in domestic violence incidents between the salient group and HIV− women. The coefficient γ is negative in most specifications, but we estimate large standard errors. However, when we restrict our sample to black women, we find that the salient group experienced a relative reduction in the probability of reporting domestic violence of 1.9-2.4 percentage points. Again, this reduction is far from trivial; it amounts to a decrease in violence of 6-8%. It should also be noted that across all specifications, the main coefficient γ is relatively stable. This is further evidence that HAART is driving the change in domestic violence and that our results are not dependent on pre-existing trends in violence that differ between the salient and control groups.[35]

As discussed in Section 2, black women suffered domestic violence at higher rates than other women in the sample. For ease of exposition, we run separate regressions for black women in our sample. However, in a separate analysis, we consider heterogeneous effects and re-estimate equation 3 including an interaction between black, HAART availability, and an indicator for being in the salient group. Although the coefficient on the triple interaction is negative, it is not statistically significant for the high CD4 HIV+ women, as shown in Table A3 of the Appendix A. However, for HIV− women, the triple difference interaction is

[34]In contrast, we find evidence that all forms of abuse, including coercion, decreased. These results are available upon request from the corresponding author.

[35]Adding extra controls in columns (2) and (3) should only serve to decrease the standard error of our estimates and not to change the coefficients.

always statistically significant at the 1% level, indicating that black women from the salient group were affected more by the introduction of HAART.

4.2 Drug Use

Next, we turn to the study of how the introduction of HAART affected use of stimulants and heroin. Similar to our study of domestic violence, we estimate models of the following form:

$$B_{it+1} = X_{it}\beta^B + HAART_t\alpha^B + Salient_i\delta^B + HAART_t \times Salient_i\gamma^B + \epsilon^B_{it}, \qquad (4)$$

where B_{it+1} refers to individual i's behavior (e.g., drug use) reported at time $t+1$. Again, $HAART_t$ is an indicator for HAART availability at time t and $Salient_i$ indicates if individual i is in the salient group. X_{it} includes the same basic controls discussed above: age, age squared, age cubed, race and site indicators.

We find limited evidence that the salient group decreased their use of stimulants compared to HIV+ high CD4 count women. The results for the full sample are only statistically significant under the most basic specification with no controls, as shown in Table 6. Although γ^B is always negative when we restrict the sample to black women, we cannot rule out the possibility that there is no effect. However, when we compare the salient group to HIV− women, we find similar outcomes that are more precisely estimated. For the full sample, we find that the salient group experienced relative decreases in the use of stimulants between 7 and 13%. For the subsample of black women, we find larger results, between 11 and 16%.[36]

Next, we consider heroin use. We find that the salient group decreased their use of heroin compared to the high CD4 count HIV+ women, as shown in Table 7. The results are fairly robust and are always significantly different from 0. However, when we restrict the sample to only include black women, we find that the decrease is only significant in the most basic specification. The estimated effects amount to a decrease of between 11 and 17% for the full sample and 23% for black women. Results for HIV− women are similar: women in the salient group significantly decreased their use of heroin by between 10 and 13% relative to this control group. However, results for HIV− black women are not significant unless we control for pre-HAART heroin use.

Again, contextualizing our results is challenging. Part of this is due to the lack of findings on how policy affects drug use. The WIHS is somewhat unique in that it asks about illicit

[36]We calculate and report marginal effects for each outcome in the text, but for brevity only present a table with marginal effects for domestic violence. Additional marginal effects tables are available from the corresponding author.

drug use over time. One related study, Corman et al. (2013), examines the effect of welfare reform on the drug use of women who are at risk of being on welfare. They find that self-reported illicit drug use in the past year (excluding marijuana) fell by about 18% after welfare reform, which changed work incentives for women.

4.3 Robustness Checks

In this section, we discuss results from four robustness checks. First, we construct a placebo for HAART introduction. The variable is equal to 1 after October 1995, which is roughly the second half of the pre-HAART visits. Because this is a placebo intervention, there is no reason to believe that the salient group would have different outcomes in comparison to our treatment groups. Tables A4 - A6 in Appendix A show that this is indeed the case. For each outcome (domestic violence, stimulant use, heroin use, and employment), the interaction between the salient group and the placebo HAART interaction is never significant. Results from this test provide strong evidence that HAART affected health and thus outcomes for the salient group.[37]

Next, we test that survival bias is not driving our results. To do this, we restrict our sample to women who were in the study for at least 15 visits, which is about 7.5 years. As shown in Appendix A, Tables A7 - A9, our results are not driven by survival bias. In fact, if anything, it appears that our findings on drug use are stronger. Even when we exclude women who died or left the study early, our main findings remain. About 95% of our sample stayed in the study for at least this period of time.

Third, we exploit the fact that we observe multiple periods before and after the introduction of HAART and conduct an event study. For each outcome, we show that all groups had similar trends prior to the introduction of HAART in comparison to our control groups. However, after the introduction of HAART, the salient group responded differently than our control groups. For example, consider domestic violence. We estimate the following model:

$$V_{it+1} = X_{it}\beta^V + Salient_i\delta^V + \sum_{p=-2}^{3}[HAART_p\alpha_p^V + HAART_p \times Salient_i\gamma_p^V] + \epsilon_{it}, \qquad (5)$$

where p is an index for six periods, such that $HAART_0$ corresponds to the period HAART was first introduced. Specifically, $HAART_0$ is the period spanning September 1996 to September

[37] In another test, we show that our results are not driven by simply participating in the WIHS study. We accomplish this by comparing violence and drug use trajectories for women in our analytic sample versus women in the second cohort who entered the sample after HAART was introduced. Results from this test are available from the corresponding author.

1997. Figure A1 in Appendix A shows the coefficient of the interaction for the periods leading up to HAART and the periods after the introduction of HAART. For each outcome, we expect that coefficients on dummies for periods -2 and -1 (the times prior to HAART) should not be significant and negative. Indeed, we find that this is the case. However, coefficients γ_1^V, γ_2^V, and γ_3^V, are always negative, indicating that the salient group experienced a reduction in violence after the introduction of HAART. For each outcome, we see the same pattern.

The fourth main robustness check that we perform is to employ a propensity score analysis. We follow Imbens (2015) and construct normalized differences of our covariates in order to show that there is overlap between our treatment and control groups. To test that baseline characteristics are similar between groups, Imbens (2015) suggests a rule of thumb that normalized differences be below .25.[38] The majority of our coefficients are below 0.1, as shown in Table A10, found in Appendix A. Next, we estimate treatment effects using inverse probability weights. Figure A2 shows that the propensity scores for the salient group and the HIV+ high CD4 group have good overlap.[39] We find that there are no differences between the salient group and control groups pre-HAART, as shown in Table A11. However, after the introduction of HAART, we find results very similar to those from our main difference-in-differences specifications.

5 Mechanisms

In this section, we further explore possible mechanisms explaining why health improvements lowered drug use and violence. Section 5.1 examines the relationship between illicit drug use and violence. Section 5.2 considers the roles of both physical and mental health improvements. Section 5.3 studies potential HAART-induced improvements in labor market outcomes and explores whether they play a role in explaining or main estimates.

5.1 Relating Drug Use and Violence

Now we return to the question discussed in Section 3, where we introduced our conceptual framework. In theory, the finding that HAART reduced both drug use and violence is

[38]The one coefficient that fails this proposed cut-off is the difference between employment of the salient group and the HIV− control group. This suggests that the salient and the HIV− control group may not be comparable for studying the impact of HAART on employment. For this reason, we relegate estimates on employment to Section 5, where we provide some speculative evidence on possible mechanisms explaining our main results.

[39]We do not present figures from other outcomes, as they are very similar. However, these are available upon request from the corresponding author.

consistent with several possible mechanisms. One possibility is that HAART affected both independently. Another possibility is that HAART only affected violence through its impact on drug use. The idea is that by lowering drug use, violence mechanically declined. Alternatively, HAART may have reduced violence, which led women to avoid drugs more often, perhaps experiencing less need for drugs to cope with violence. It would be difficult to distinguish among these possibilities given available data. However, we believe that we can make some progress on the question.

In one set of results, we allow drug use and violence to be jointly determined. In effect, doing so controls for the correlation between drug use and violence. We show that our basic results are qualitatively similar even when we control for this correlation, as shown in Appendix A, Tables A12 - A15. They are especially strong for results where we use healthier HIV+ women as the control group. These results therefore suggest that, even when we control for the correlation between the two outcomes, HAART appears to have an independent effect on both violence and illicit drug use. In other words, one is not simply the by-product of the other.[40]

Second, we note that different drugs appear to have different relationships with abuse. In Table 8, we present results from a regression of violence on drug use, income, employment, and our usual set of controls. Importantly, we separate heroin use from stimulant use. We find that, whereas use of stimulants (such as crack cocaine) are associated with more violence, use of heroin is in fact associated with less violence. This result is unexpected. However, it has some basis in medical literature that studies the impact of drug use on violence, which highlights how heroin has a pacifying or sedating effect on users.[41] The negative coefficient on heroin use helps to bolster the argument that HAART had independent effects on both violence and drug use. The reasoning is as follows. Suppose HAART only affected heroin use and had no impact on violence except through its correlation with drug use. Then, we might expect violence to rise if heroin use went down. Instead, we see both decline. Though this evidence is speculative, these empirical patterns are consistent with the idea that HAART had an independent impact on both violence and illicit drug use.

[40]It is worth mentioning that results on joint estimation are not robustness tests of main results. Rather, they serve to examine whether HAART had effects on two different outcomes once we have controlled for correlation among the two outcomes (versus, for example, having a direct effect on one outcome that affects the other).

[41]See Boles and Miotto (2003) or Volavka (2008) on pharmacologically-induced violence. For the effects of heroin, see, in particular, Jaffe and Jaffe (1999). An underlying and important assumption in relating illicit drug use to domestic violence is that intimate partners are likely to use the same drugs. This assumption has broad empirical support from a variety of fields. See, for example, Vanyukov et al. (1996) for a review of this literature.

5.2 Mental and Physical Health Improvements

We now consider two alternative mechanisms which could help to explain our findings: mental and physical health. Starting with mental health, it might be the case that a positive shock in expected health due to the arrival of a new medical technology leads women to exhibit better mental health. If so, we might expect women to perceive better options outside of violent partnerships and to refrain from illicit drug use.[42] In Table 9, we use the same difference-in-differences approach as in our main analysis to study depression as the outcome variable. To measure depression, we use the CES-D Score, which is a widely-used measure of depression (with higher numbers being associated with a higher likelihood of depression). We find little evidence that mental health can explain the links between HAART introduction, domestic violence, and illicit drug use. Further, in results available upon request from the corresponding author, we show that controlling for mental health does not change our main results.

Another possible mechanism is physical health. We have already documented that women in the salient group experienced large increases in their immune system health (CD4 count) in comparison to our control groups. This rise in CD4 count may have translated to improvements in how women felt after HAART, which could presumably lead to declines in domestic violence or illicit drug use. In Table 10, we assess whether women in the salient group exhibit shifts relative to control groups in the probability of experiencing at least one symptom, where symptoms we consider include: fever, memory problems, numbness, weight loss, mental confusion and night sweats. We again return to the original difference-in-differences empirical design. We find little evidence of post-HAART relative declines in reporting at least one of these symptoms for women in the salient group after HAART.[43] In fact, when we use healthy HIV+ women as the control group, the sign is positive. This is not surprising since, at the time it was introduced, HAART had severe side effects, and so side effects may have simply replaced symptoms, meaning that women would feel about the same even if their underlying health had improved.[44]

In other words, women simply feeling better, measured by a lack of physical ailments, does not appear to be an important mechanism generating our main results.[45] Our findings

[42] A correlation between depressive symptoms and exposure to violence is reported in Johnson et al. (2014), albeit among adolescents. A related view is that lower illicit drug use can improve mental health, which previous research has shown can lead to declines in violence (Devries et al., 2013).

[43] We also tested individual symptoms along with the total the number of symptoms using a Poisson count and found no difference between the salient and control groups.

[44] In related work, Papageorge (2016) shows that HAART side effects among HIV+ men replaced some of the symptoms of HIV, at least among the sickest patients, so that average reports of physical ailments remained about the same even if underlying health improved dramatically.

[45] It is worth reiterating the idea that these results on symptoms bolster the argument that women in the

here are perhaps counterintuitive since we argue that a medical innovation affected behavior without affecting symptoms. Recall, in Table 4, we do show relative rises in CD4 count among the salient group after HAART. However, women in the salient group, despite lower CD4 counts at the time of HAART introduction, had yet to experience the symptoms of AIDS. This means that HAART-induced reductions in violence and illicit drug use do not appear to be driven by contemporaneous improvements in how they feel physically as measured by symptoms.[46] Instead, our findings on symptoms suggest that much of the role of HAART in affecting drug use and violence operated through its impact on underlying health, which affected longevity and expected future well-being.

5.3 Employment and Income

Until now, we have shown evidence that HAART reduced both illicit drug use and domestic violence. Moreover, though intuitively appealing, the idea that direct physical and mental health improvements (as measured by symptoms and the CESD score, respectively) led to declines in violence and drug use is not borne out by our data. In this section, we consider changes to labor market outcomes induced by HAART. The idea is that improved labor market prospects might help to explain why women face stronger incentives to desist from drug use or perceive better options outside of violent partnerships. Further, our conceptual framework relies on the idea that health is a form of human capital and that women with more human capital are less likely to use illicit drugs and suffer abuse. Showing evidence of HAART-induced improvements in labor market outcomes would help to support idea that health is a form of human capital.

To assess HAART-induced differences in labor market outcomes, we return to the difference-in-differences specification shown earlier. We consider employment at the time of visit as the labor market outcome of interest. Results are presented in Table 12 in the same format as results on domestic violence presented in Table 5. Estimates show that, for at least one comparison group, the salient group became relatively more likely to be employed after HAART. Table 12 shows that compared to HIV+ high CD4 count women, the salient group was more likely to be employed, except when we control for employment pre-HAART. Black women in the salient group became much more likely to be employed relative to black women in the HIV+ high CD4 count group for all of our specifications. Marginally, this amounts to a increase in the probability of employment for the salient group of about 2.5-5 percentage

salient group are comparable to the two control groups in that, despite having lower CD4 counts, they are not physically ill prior to the introduction to HAART.

[46] In results available from the corresponding author, we use the low CD4 HIV+ women to show that our findings are not driven by increased interaction with the medical community after HAART was introduced.

points, or 7-13% for the full sample and 15-19% for the black women subsample. However, as Table 12 shows, the salient group was no more likely to be employed than HIV− women.[47]

Our findings on employment are broadly consistent with those in Goldman and Bao (2004), who also study HAART and employment. They show that HAART use increased the probability that HIV+ individuals kept working by 37%. Our results are smaller for at least two reasons. First, we do not condition on HAART use as they do and only rely on HAART introduction (similar to an intent-to-treat analysis). Second, their finding conditions on working at the time of HAART introduction while ours does not. Indeed, individuals in our sample are not highly educated and do not exhibit strong ties to the labor market before the introduction of HAART. Perhaps more comparable to our setting, Goldman and Bao (2004) find no effect of HAART on the likelihood of returning to work, conditional on not working prior to HAART introduction. Compared to their estimates for non-workers, our findings on employment are relatively large.[48]

Though our results on labor market outcomes provide support for the idea that HAART boosted women's labor market human capital, the precise mechanism connecting our findings is difficult to identify. We are able to verify that women with better labor market prospects are better able to avoid abusive partnerships. Among women in the study, we use individual level fixed effects and find that income and employment are associated with lower rates of violence. We show this using a linear probability model where we regress domestic violence on employment in the same period, income, various sets of sociodemographic measures, and individual fixed effects. In the final specification with the largest set of controls, including health, socio-demographics and risky behaviors, we find that being employed lowers the likelihood of being abused by 0.8 percentage points, as shown in Table 11.

We are also able to verify that drug use and violence are negatively correlated with employment among women in our sample.[49] However, there are several conceptual frameworks that could explain why HAART would lower drug use and violence and also have an impact on employment and income. For example, reductions in drug use and violence would presumably make working easier. Alternatively, it could be that health improvements improve labor

[47] An important caveat to all labor market results presented in this section is that some normalized difference for employment is above the threshold of .25 proposed by Imbens (2015). For the salient vs HIV− women, we find a normalized difference of .37, meaning that treatment and control groups my not be comparable for employment outcomes.

[48] Our results on employment are broadly consistent with literature considering how HAART affected labor market outcomes in developing countries, specifically in the continent of Africa. For example, Thirumurthy et al. (2008) find that antiretroviral therapy is associated with an increased attachment to the labor force, in terms of both participation and hours, for patients in western Kenya. Habyarimana et al. (2010) document patterns of absenteeism in Botswana and provide evidence that an increase in CD4 count decreases illness-related absence from work.

[49] These results are shown in Appendix A, Tables A16 and A17.

market outcomes directly and women with better labor market prospects see higher costs of drug use and have more resources to leave partners. Even further, if HAART improves labor market prospects, it could incentivize further investments in human capital. In the case of poor women with HIV, avoiding drug use could therefore be seen as an investment in future earnings (Becker and Murphy, 1988).[50] Given the data we have, we are unable to distinguish among these mechanisms; indeed, it is possible that all of them play a role. However, our findings on labor market outcomes help to bolster the conceptual framework we have proposed to understand our empirical findings. HAART improved women's lives on a number of dimensions, including domestic violence, illicit drug use and, as our final estimates suggest, labor market prospects. The broad underlying mechanism is that a new medical technology, by improving health, boosted women's human capital.

6 Conclusion

We have shown evidence that a medical innovation lowered domestic violence by 10% and reduced drug use by 15% among a group of chronically ill, low-income women. Our empirical results illustrate the far-reaching implications of medical innovation, which links our findings to those in Goldin and Katz (2002), who study the impact of the birth control pill on women's employment and marriage. Our findings also suggest that policies that enhance women's human capital, such as access to better healthcare technology, can affect some of the most frustratingly persistent social problems. By isolating a novel source of value in pharmaceutical innovation, our findings also have implications for policies affecting how biomedical research dollars should be allocated. For example, ignoring the link between abuse and poor health can lead to under-investments in medical innovations aimed at groups made vulnerable by poor health, including poor women, the elderly, and individuals who are chronically ill.

A limitation of our research is that there is a single shock, but multiple outcomes. Hence, it is difficult to offer more than suggestive evidence regarding specific mechanisms. Still, we have shown evidence consistent with the broad idea that HAART functioned as an increase in women's human capital with possible benefits along several dimensions. The idea that medial innovation can increase human capital suggests that effects on violence and drug use are potentially long-lasting as they shift the underlying factors making these problems persistent. This potentially stands in contrast to policies such as cash transfers that alleviate violence

[50]This is related to work showing that higher life expectancy induces further investments in labor market human capital, which is a basic result of human capital theory with broad empirical support (Ben-Porath, 1967; Black et al., 2007; Jayachandran and Lleras-Muney, 2009; Oster et al., 2013; Yi et al., 2014).

in the short-run. An important area for future research could compare the effectiveness and the long-run impacts of policies affecting violence and drug use. For example, a dynamic model of violence and human capital accumulation coupled with longitudinal data would permit comparisons of the impact of short-term interventions versus long-term policies or technology shifts that affect violence and risky behaviors, such as illicit drug use.

References

Ai, Chunrong and Edward C Norton, "Interaction Terms in Logit and Probit Models," *Economics Letters*, 2003, *80* (1), 123–129.

AIDSinfo, "Guidelines for the Use of Antiretroviral Agents in HIV-1-Infected Adults and Adolescents," http://aidsinfo.nih.gov/guidelines 2014.

Aizer, Anna, "The Gender Wage Gap and Domestic Violence," *American Economic Review*, 2010, *100* (4), 1847–1859.

Alvira-Hammond, Marta, Monica A Longmore, Wendy D Manning, and Peggy C Giordano, "Gainful Activity and Intimate Partner Aggression in Emerging Adulthood," *Emerging Adulthood*, 2014, *2* (2), 116–127.

Anderberg, Dan and Helmut Rainer, "Domestic Abuse: Instrumental Violence and Economic Incentives," Mimeo, CESifo Working Paper Series 2011.

Angelucci, Manuela, "Love on the Rocks: Domestic Violence and Alcohol Abuse in Rural Mexico," *The BE Journal of Economic Analysis & Policy*, 2008, *8* (1), 1935–1682.

Barkan, Susan E, Sandra L Melnick, Susan Preston-Martin, Kathleen Weber, Leslie A Kalish, Paolo Miotti, Mary Young, Ruth Greenblatt, Henry Sacks, and Joseph Feldman, "The Women's Interagency HIV Study," *Epidemiology*, 1998, *9* (2), 117–125.

Becker, Gary S, "Health as Human Capital: Synthesis and Extensions," *Oxford Economic Papers*, 2007, *59* (3), 379–410.

_ **and Kevin M Murphy**, "A Theory of Rational Addiction," *Journal of Political Economy*, 1988, *96* (4), 675–700.

Ben-Porath, Yoram, "The Production of Human Capital and The Life Cycle of Earnings," *Journal of Political Economy*, 1967, *75* (4), 352–365.

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan, "How Much Should We Trust Differences-in-Differences Estimates?," *Quarterly Journal of Economics*, 2004, *119* (1), 249–275.

Bhaskaran, K, O Hamouda, M Sannes, and et al, "Changes in the Risk of Death after HIV Seroconversion Compared with Mortality in the General Population," *Journal of the American Medical Association*, 2008, *300* (1), 51–59.

Black, Michele C, Kathleen C Basile, Matthew J Breiding, Sharon G Smith, Mikel L Walters, Melissa T Merrick, Jieru Chen, and Mark R Stevens, "The National Intimate Partner and Sexual Violence Survey: 2010 Summary Report," Technical Report, Centers for Disease Control and Prevention 2011.

Black, Sandra, Paul Devereux, and Kjell G Salvanes, "From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes," *Quarterly Journal of Economics*, 2007, *122* (1), 409–439.

Bobonis, Gustavo J, Melissa González-Brenes, and Roberto Castro, "Public Transfers and Domestic violence: The roles of Private Information and Spousal Control," *American Economic Journal: Economic Policy*, 2013, *5* (1), 179–205.

Boles, Sharon M and Karen Miotto, "Substance Abuse and Violence: A Review of the Literature," *Aggression and Violent Behavior*, 2003, *8* (2), 155–174.

Bowlus, Audra J and Shannon Seitz, "Domestic Violence, Employment, and Divorce," *International Economic Review*, 2006, *47* (4), 1113–1149.

Browne, Angela, Amy Salomon, and Shari S Bassuk, "The Impact of Recent Partner Violence on Poor Women's Capacity to Maintain Work," *Violence Against Women*, 1999, *5* (4), 393–426.

Carrell, Scott E and Mark L Hoekstra, "Externalities in the Classroom: How Children Exposed to Domestic Violence Affect Everyone's Kids," *American Economic Journal: Applied Economics*, 2010, *2* (1), 211–228.

Catalano, Shannan M, *Intimate Partner Violence, 1993-2010*, US Department of Justice, Office of Justice Programs, Bureau of Justice Statistics, 2012.

Cesur, Resul and Joseph J Sabia, "When War Comes Home: The Effect of Combat Service on Domestic Violence," *Review of Economics and Statistics*, 2016, *98* (2), 209–225.

Chan, Tat Y., Barton H. Hamilton, and Nicholas W. Papageorge, "Health, Risky Behaviour and the Value of Medical Innovation for Infectious Disease," *Review of Economic Studies*, 2016, *83* (4), 1465–1510.

Cohen, Mardge, Catherine Deamant, Susan Barkan, Jean Richardson, Mary Young, Susan Holman, Kathryn Anastos, Judith Cohen, and Sandra Melnick, "Domestic Violence and Childhood Sexual Abuse in HIV-Infected Women and Women at Risk for HIV.," *The American Journal of Public Health*, 2000, *90* (4), 560–565.

Corman, Hope, Dhaval M Dave, Dhiman Das, and Nancy E Reichman, "Effects of Welfare Reform on Illicit Drug Use of Adult Women," *Economic inquiry*, 2013, *51* (1), 653–674.

Detels, R, P Tarwater, JP Phair, J Margolick, SA Riddler, and A Muñoz, "Effectiveness of Potent Antiretroviral Therapies on the Incidence of Opportunistic Infections Before and after AIDS Diagnosis," *AIDS*, 2001, *15* (3), 347–355.

Devries, Karen M, Joelle Y Mak, Loraine J Bacchus, Jennifer C Child, Gail Falder, Max Petzold, Jill Astbury, and Charlotte H Watts, "Intimate Partner Violence and Incident Depressive Symptoms and Suicide Attempts: A Systematic Review of Longitudinal Studies," *PLOS Medicine*, 2013, *10* (5).

El-Bassel, Nabila, Louisa Gilbert, Elwin Wu, Hyun Go, and Jennifer Hill, "Relationship Between Drug Abuse and Intimate Partner Violence: a Longitudinal Study Among Women Receiving Methadone," *American Journal of Public Health*, 2005, *95* (3), 465–470.

Gelles, Richard J, "Abused Wives: Why Do They Stay?," *Journal of Marriage and the Family*, 1976, *38* (4), 659–668.

Goldin, C and LF Katz, "The Power of the Pill: Oral Contraceptives and Women's Career and Marriage Decisions," *Journal of Political Economy*, 2002, *110* (4), 730–770.

Goldman, Dana P and Yuhua Bao, "Effective HIV Treatment and The Employment of HIV+ Adults," *Health Services Research*, 2004, *39* (6p1), 1691–1712.

Greenfeld, Lawrence A, Michael R Rand, Diane Craven, Patsy A Klaus, Craig A Perkins, Cheryl Ringel, Greg Warchol, Cathy Maston, and James Alan Fox, "Violence by Intimates: Analysis of Data on Crimes by Current or Former Spouses, Boyfriends, and Girlfriends," Technical Report, US Department of Justice Washington, DC 1998.

Grossman, M., "On the Concept of Health Capital and the Demand for Health," *Journal of Political Economy*, 1972, *80* (2), 223–255.

Habyarimana, James, Bekezela Mbakile, and Cristian Pop-Eleches, "The Impact of HIV/AIDS and ARV Treatment on Worker Absenteeism Implications for African Firms," *Journal of Human Resources*, 2010, *45* (4), 809–839.

Hart, Carl L, M Haney, RW Foltin, and MW Fischman, "Alternative Reinforcers Differentially Modify Cocaine Self-Administration by Humans," *Behavioural Pharmacology*, 2000, *11* (1), 87–91.

Heaton, Paul, "Sunday Liquor Laws and Crime," *Journal of Public Economics*, 2012, *96* (1), 42–52.

Heckman, James J and Paul A LaFontaine, "The American High School Graduation Rate: Trends and Levels," *The Review of Economics and Statistics*, 2010, *92* (2), 244–262.

Imbens, Guido W, "Matching Methods in Practice: Three Examples," *Journal of Human Resources*, 2015, *50* (2), 373–419.

Iyengar, Radha, "Does the Certainty of Arrest Reduce Domestic Ciolence? Evidence from Mandatory and Recommended Arrest Laws," *Journal of Public Economics*, 2009, *93* (1), 85–98.

Jaffe, JH and AB Jaffe, "Neurobiology of Opiates and Opioids," in M. Galanter and H.D. Kleber, eds., *Textbook of Substance Abuse Treatment*, American Psychiatric Press Washington, DC 1999, pp. 11–19.

Jayachandran, Seema and Adriana Lleras-Muney, "Life Expectancy and Human Capital Investments: Evidence from Maternal Mortality Declines," *Quarterly Journal of Economics*, 2009, *124* (1), 349–397.

Johnson, Wendi L, Peggy C Giordano, Monica A Longmore, and Wendy D Manning, "Intimate Partner Violence and Depressive Symptoms during Adolescence and Young Adulthood," *Journal of Health and Social Behavior*, 2014, *55* (1), 39–55.

Johnson, Wendy A and Huibrie C Pieters, "Intimate Partner Violence among Women Diagnosed with Cancer," *Cancer Nursing*, 2016, *39* (2), 87–96.

Laub, John H and Robert J Sampson, "Understanding Desistance from Crime," *Crime and Justice*, 2001, *28*, 1–69.

Lowry, Richard, Laura Kann, Janet L Collins, and Lloyd J Kolbe, "The Effect of Socioeconomic Status on Chronic Disease Risk Behaviors among US Adolescents," *Journal of the American Medical Association*, 1996, *276* (10), 792–797.

Mocroft, Amanda and Jens D Lundgren, "Starting Highly Active Antiretroviral Therapy: Why, When and Response to HAART," *Journal of Antimicrobial Chemotherapy*, 2004, *54* (1), 10–13.

Newacheck, Paul W, "Poverty and childhood chronic illness," *Archives of Pediatrics & Adolescent Medicine*, 1994, *148* (11), 1143–1149.

Norton, Edward C, Hua Wang, and Chunrong Ai, "Computing Interaction Effects and Standard Errors in Logit and Probit Models," *Stata Journal*, 2004, *4* (2), 154–167.

Oster, Emily, Ira Shoulson, and E Dorsey, "Limited Life Expectancy, Human Capital and Health Investments," *American Economic Review*, 2013, *103* (5), 1977–2002.

Ostrow, DG, A. Monjan, J. Joseph, M. VanRaden, R. Fox, L. Kingsley, J. Dudley, and J. Phair, "HIV-Related Symptoms and Psychological Functioning in a Cohort of Homosexual Men," *American Journal of Psychiatry*, 1989, *146* (6), 737.

Papageorge, Nicholas W., "Why Medical Innovation is Valuable: Health, Human Capital, and the Labor Market," *Quantitative Economics*, 2016, *7* (3), 671–725.

Phil, R. and J Peterson, "Alcohol/Drug Use and Aggressive Behavior," in S. Hodgins, ed., *Mental Disorder and Crime*, Crime and Mental Disorder Advanced Study Institute Sage 1993, pp. 263–283.

Pollak, Robert A, "An Intergenerational Model of Domestic Violence," *Journal of Population Economics*, 2004, *17* (2), 311–329.

Pronyk, Paul M, James R Hargreaves, Julia C Kim, Linda A Morison, Godfrey Phetla, Charlotte Watts, Joanna Busza, and John DH Porter, "Effect of a Structural Intervention for the Prevention of Intimate-Partner Violence and HIV in Rural South Africa: A Cluster Randomised Trial," *The Lancet*, 2006, *368* (9551), 1973–1983.

Robins, Lee N, "Vietnam Veterans' Rapid Recovery from Heroin Addiction: A Fluke or Normal Expectation?," *Addiction*, 1993, *88* (8), 1041–1054.

SAMSHA, "Results from the 2013 National Survey on Drug Use and Health: Summary of National Findings," Technical Report, U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality 2014.

Stevenson, Betsey and Justin Wolfers, "Bargaining in the Shadow of the Law: Divorce Laws and Family Distress," *Quarterly Journal of Economics*, 2006, *121* (1), 267–288.

Swanberg, Jennifer E and Caroline Macke, "Intimate Partner Violence and the Workplace Consequences and Disclosure," *Journal of Women and Social Work*, 2006, *21* (4), 391–406.

Thirumurthy, Harsha, Joshua Graff Zivin, and Markus Goldstein, "The Economic Impact of AIDS Treatment Labor Supply in Western Kenya," *Journal of Human Resources*, 2008, *43* (3), 511–552.

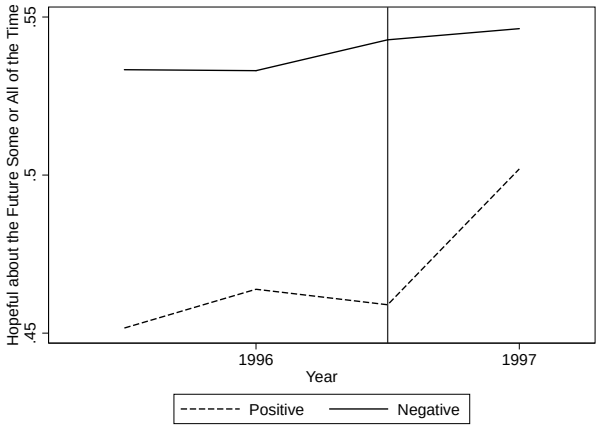
Tjaden, Patricia and Nancy Thoennes, "Full Report of the Prevalence, Incidence, and Consequences of Violence Against Women," Technical Report, U.S. Department of Justice 2000.

Vanyukov, MM, MC Neale, HB Moss, and RE Tarter, "Mating Assortment and the Liability to Substance Abuse," *Drug and Alcohol Dependence*, 1996, *42* (1), 1–10.

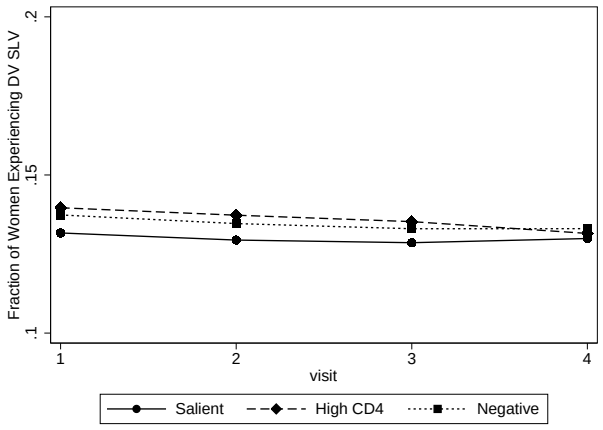
Volavka, Jan, *Neurobiology of Violence*, 2 ed., American Psychiatric Publishing, 2008.

Yi, Junjian, James J Heckman, Junsen Zhang, and Gabriella Conti, "Early Health Shocks, Intrahousehold Resource Allocation, and Child Outcomes," Technical Report, National Bureau of Economic Research 2014.

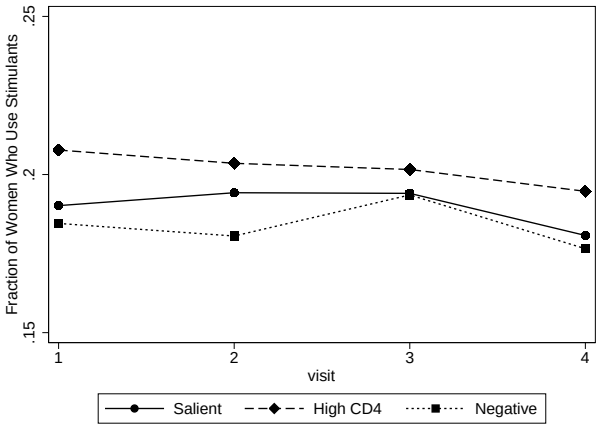
7 Figures and Tables



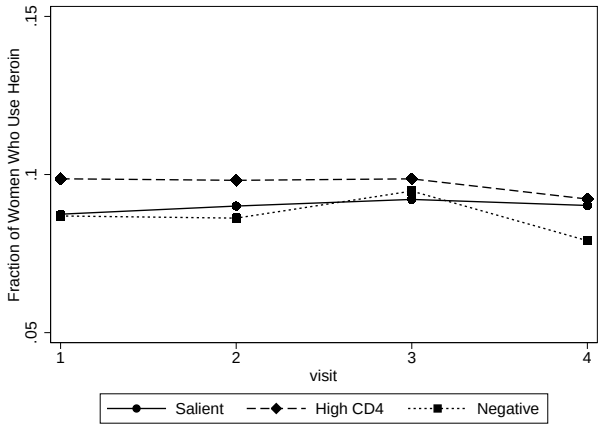
(a) Hopefulness



(b) Domestic Violence



(c) Stimulant Use



(d) Heroin Use

Figure 1: Evidence on the validity of using a difference-in-differences approach to compare treatment and control group outcomes before and after HAART. Panel 1a compares reports of hopefulness about the future before and after HAART for HIV+ and HIV− women. Panels 1b-1d show evidence of pre-HAART parallel trends for domestic violence, stimulant use and heroin use, respectively

Table 1: Summary Statistics

	(1) Full Sample	(2) African American	(3) Salient Group	(4) High CD4 HIV+	(5) HIV−
Average Age	41.68	42.02	42.30	41.14	41.33
Black	0.65	1.00	0.67	0.63	0.65
Hispanic	0.19	0.00	0.20	0.21	0.20
White (Non-Hispanic)	0.13	0.00	0.12	0.13	0.13
Other	0.02	0.00	0.01	0.03	0.02
Education:					
High school grad	0.65	0.65	0.63	0.59	0.68
Some college	0.34	0.32	0.33	0.29	0.39
College grad	0.08	0.06	0.10	0.07	0.11
Pre-HAART Income:					
≤ 6000	0.17	0.21	0.17	0.17	0.19
6000-12000	0.30	0.29	0.33	0.32	0.24
12001-18000	0.16	0.16	0.13	0.14	0.17
18001-24000	0.10	0.11	0.11	0.10	0.10
24001-30000	0.08	0.08	0.07	0.09	0.08
> 30000	0.18	0.15	0.19	0.17	0.22
Employed pre-HAART	0.40	0.38	0.38	0.44	0.56
Married pre-HAART	0.29	0.25	0.32	0.25	0.31
Lives with kids at base line	0.50	0.50	0.51	0.47	0.46
Risky Behaviors Pre-HAART:					
Ever smoked	0.64	0.68	0.66	0.70	0.68
Abstainer	0.56	0.55	0.56	0.51	0.50
Light drinker	0.29	0.27	0.28	0.28	0.34
Moderate drinker	0.16	0.17	0.17	0.18	0.17
Heavy drinker	0.08	0.09	0.07	0.10	0.09
Ever used crack	0.20	0.23	0.22	0.22	0.22
Ever used cocaine	0.19	0.20	0.17	0.21	0.27
Ever used pot	0.31	0.30	0.32	0.33	0.37
Ever used heroin	0.14	0.13	0.18	0.16	0.17
Ever used hard drugs	0.31	0.33	0.33	0.32	0.40
Ever used stimulants	0.28	0.30	0.28	0.30	0.36
Symptoms:					
Memory Problems pre-HAART	0.32	0.31	0.31	0.37	0.21
Numbness pre-HAART	0.41	0.43	0.39	0.42	0.20
Weight Loss pre-HAART	0.36	0.36	0.33	0.27	0.21
Mental Confusion pre-HAART	0.19	0.18	0.17	0.20	0.13
Night Sweats pre-HAART	0.39	0.40	0.35	0.41	0.22
Domestic Violence:					
Experienced sex abuse	0.06	0.07	0.05	0.10	0.08
Experienced physical abuse	0.15	0.15	0.17	0.18	0.22
Experienced coercion	0.26	0.28	0.26	0.27	0.34
Experienced domestic violence	0.29	0.30	0.27	0.33	0.37
Observations	1324	863	166	263	275
Person Visits	18019	11746	2477	4194	4069

The full sample includes all women from the first cohort who answered questions about domestic violence, employment, and illicit drug use, as well as all controls used. The salient group is defined as having a minimum pre-HAART CD4 count between 300 and 399. High CD4 refers to minimum pre-HAART CD4 count greater than or equal to 400. Income is measured as yearly household income. Light, moderate and heavy drinking means < 3, 3-13 and > 13 drinks per week, respectively. Hard drugs are defined as crack, cocaine, heroin, or (illicit) methadone. Stimulants are crack or cocaine. Domestic violence is defined as physical or sexual abuse or coercion by an intimate partner or spouse. Coercion indicates that the partner threatened to hurt or kill the subject or prevented her from: leaving or entering her home, seeing friends, making telephone calls, getting or keeping a job, continuing her education, or seeking medical attention.

Table 2: Relationship Between Health, Drug use, and Employment

	Full Sample	HIV+	HIV−
Domestic Violence			
Log CD4	.057**	.027	.059
	(.026)	(.028)	(.151)
Obs.	15491	13573	1918
Stimulant Use			
Log CD4	-.013	-.065***	-.103
	(.025)	(.024)	(.158)
Obs.	15491	13573	1918
Heroin Use			
Log CD4	-.022	-.074**	-.250
	(.032)	(.032)	(.173)
Obs.	15491	13573	1918
Employment			
Log CD4	.247***	.233***	.060
	(.025)	(.027)	(.139)
Obs.	15491	13573	1918

This table shows estimates from probit regressions relating health to domestic violence, illicit drug use and employment. Each specification is clustered at the individual level and includes controls for age at visit, age squared, age cubed, race dummies, and site dummies.

Table 3: Domestic Violence Statistics by time of AIDS Diagnosis

	(1) Last visit pre AIDS	(2) First visit with AIDS
Sexual Abuse	0.01	0.01
Physical Abuse	0.05	0.04
Coercion	0.10	0.09
Domestic Violence	0.12	0.09
Observations	738	1927

The sample is restricted to HIV+, low CD4 count women from the first cohort before HAART was introduced. AIDS is defined as having CD4 count less than or equal to 200.

Table 4: Difference-in-differences: CD4 Count

	[1]	[2]	[3]
Panel A: Salient vs High CD4 HIV+ Women			
Panel A.1: Full Sample			
HAART available	-79.954***	-76.853***	-83.157***
	(12.862)	(13.379)	(11.982)
Salient Group	-252.887***	-246.656***	-101.567***
	(14.087)	(14.575)	(18.794)
Salient × HAART	138.403***	138.227***	147.277***
	(21.876)	(21.713)	(21.263)
Average CD4 Count pre-HAART	.	.	.554***
			(.075)
Obs.	6485	6485	6485
Panel A.2: Black			
HAART available	-90.780***	-87.699***	-87.188***
	(17.333)	(17.685)	(15.589)
Salient Group	-268.441***	-267.032***	-111.558***
	(17.397)	(19.029)	(24.180)
Salient × HAART	143.650***	142.313***	149.597***
	(26.076)	(25.886)	(25.013)
Average CD4 Count pre-HAART	.	.	.538***
			(.090)
Obs.	4160	4160	4160
Panel B: Salient vs HIV− Women			
Panel B.1: Full Sample			
HAART available	13.865	-3.715	-6.059
	(18.369)	(19.485)	(14.311)
Salient Group	-627.925***	-638.543***	-110.991***
	(24.549)	(25.558)	(22.036)
Salient × HAART	44.584*	47.757*	62.926***
	(25.506)	(25.195)	(21.990)
Average CD4 Count pre-HAART	.	.	.843***
			(.032)
Obs.	6342	6342	6342
Panel B.2: Black			
HAART available	29.277	13.848	1.946
	(22.482)	(24.425)	(17.096)
Salient Group	-632.405***	-640.253***	-120.036***
	(30.607)	(32.251)	(27.423)
Salient × HAART	23.593	22.745	47.693*
	(29.748)	(30.094)	(25.529)
Average CD4 Count pre-HAART	.	.	.837***
			(.042)
Obs.	4236	4236	4236
Basic Controls	N	Y	Y

Difference-in-differences estimates are presented where the outcome variable is CD4 count. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual level.

Table 5: Difference-in-differences: Domestic Violence

	[1]	[2]	[3]
Panel A: Salient vs High CD4 HIV+ Women			
Panel A.1: Full Sample			
HAART available	-.365***	-.235***	-.232***
	(.075)	(.085)	(.090)
Salient Group	-.061	-.023	.014
	(.116)	(.116)	(.102)
Salient × HAART	-.201*	-.213*	-.242*
	(.117)	(.121)	(.128)
Experienced V pre-HAART	.	.	.842***
			(.090)
Obs.	6671	6671	6671
Panel A.2: Black			
HAART available	-.411***	-.321***	-.344***
	(.092)	(.098)	(.105)
Salient Group	-.004	.039	.090
	(.140)	(.141)	(.125)
Salient × HAART	-.273*	-.289*	-.323**
	(.145)	(.148)	(.159)
Experienced V pre-HAART	.	.	.913***
			(.109)
Obs.	4281	4281	4281
Panel B: Salient vs HIV− Women			
Panel B.1: Full Sample			
HAART available	-.527***	-.469***	-.435***
	(.074)	(.080)	(.085)
Salient Group	-.121	-.130	-.030
	(.114)	(.116)	(.102)
Salient × HAART	-.042	-.037	-.104
	(.118)	(.121)	(.132)
Experienced V pre-HAART	.	.	1.008***
			(.087)
Obs.	6528	6528	6528
Panel B.2: Black			
HAART available	-.469***	-.376***	-.343***
	(.093)	(.101)	(.105)
Salient Group	.061	.072	.174
	(.138)	(.143)	(.129)
Salient × HAART	-.214	-.261*	-.326**
	(.146)	(.151)	(.161)
Experienced V pre-HAART	.	.	.937***
			(.098)
Obs.	4376	4376	4376
Basic Controls	N	Y	Y

Difference-in-differences estimates are presented where the outcome variable is having experienced domestic violence since the last visit. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual level.

Table 6: Difference-in-differences: Use of Stimulants

	[1]	[2]	[3]
Panel A: Salient vs High CD4 HIV+ Women			
Panel A.1: Full Sample			
HAART available	-.203***	-.304***	-.266***
	(.052)	(.058)	(.068)
Salient Group	.047	.074	.139
	(.098)	(.099)	(.091)
Salient × HAART	-.173**	-.131	-.136
	(.080)	(.084)	(.098)
Stimulant use pre-HAART	.	.	1.575***
			(.078)
Obs.	16253	16253	16253
Panel A.2: Black			
HAART available	-.246***	-.362***	-.308***
	(.068)	(.073)	(.083)
Salient Group	.091	.155	.239**
	(.126)	(.129)	(.116)
Salient × HAART	-.170	-.139	-.144
	(.105)	(.109)	(.123)
Stimulant use pre-HAART	.	.	1.494***
			(.100)
Obs.	9343	9343	9343
Panel B: Salient vs HIV− Women			
Panel B.1: Full Sample			
HAART available	-.176***	-.353***	-.244***
	(.055)	(.065)	(.074)
Salient Group	-.017	-.079	.036
	(.101)	(.104)	(.092)
Salient × HAART	-.197**	-.141	-.204**
	(.082)	(.091)	(.100)
Stimulant use pre-HAART	.	.	1.312***
			(.094)
Obs.	14885	14885	14885
Panel B.2: Black			
HAART available	-.204***	-.392***	-.271***
	(.068)	(.081)	(.094)
Salient Group	-.015	-.052	.119
	(.131)	(.140)	(.122)
Salient × HAART	-.207**	-.194	-.253*
	(.105)	(.120)	(.131)
Stimulant use pre-HAART	.	.	1.348***
			(.128)
Obs.	8801	8801	8801
Basic Controls	N	Y	Y

Difference-in-differences estimates are presented where the outcome variable is use of stimulants, which is defined as having used crack or cocaine in the last six months. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual level.

Table 7: Difference-in-Differences: Heroin Use

	[1]	[2]	[3]
Panel A: Salient vs High CD4 HIV+ Women			
Panel A.1: Full Sample			
HAART available	-.163***	-.273***	-.180**
	(.058)	(.068)	(.082)
Salient Group	.093	.125	.171
	(.113)	(.114)	(.114)
Salient × HAART	-.278***	-.244**	-.248*
	(.098)	(.104)	(.137)
Heroin use pre-HAART	.	.	1.790***
			(.123)
Obs.	16249	16249	16249
Panel A.2: Black			
HAART available	-.177**	-.396***	-.296***
	(.081)	(.085)	(.110)
Salient Group	.091	.131	.244
	(.147)	(.155)	(.157)
Salient × HAART	-.271*	-.197	-.231
	(.139)	(.148)	(.187)
Heroin use pre-HAART	.	.	1.742***
			(.149)
Obs.	9340	9340	9340
Panel B: Salient vs HIV− Women			
Panel B.1: Full Sample			
HAART available	-.183**	-.307***	-.160*
	(.074)	(.079)	(.090)
Salient Group	-.043	-.076	-.089
	(.117)	(.120)	(.108)
Salient × HAART	-.256**	-.246**	-.345**
	(.108)	(.117)	(.143)
Heroin use pre-HAART	.	.	1.572***
			(.123)
Obs.	14884	14884	14884
Panel B.2: Black			
HAART available	-.222**	-.411***	-.242*
	(.101)	(.113)	(.128)
Salient Group	-.027	.022	.012
	(.155)	(.164)	(.142)
Salient × HAART	-.223	-.260	-.378*
	(.152)	(.171)	(.194)
Heroin use pre-HAART	.	.	1.355***
			(.172)
Obs.	8801	8801	8801
Basic Controls	N	Y	Y

Difference-in-differences estimates are presented where the outcome variable is use of heroin in the last six months. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual level.

Table 8: Drug Use and Violence

	[1]	[2]	[3]
Heroin use	-.143***	-.141***	-.143***
Stimulant use	.144***	.142***	.119***
Age	-.010	-.010	-.009
Age squared	.00004	.00005	.00004
Age cubed	1.62e-07	1.54e-07	1.86e-07
Yearly income 6001-12000	.	-.007	-.007
Yearly income 12001-18000	.	-.009	-.009
Yearly income 18001-24000	.	-.005	-.004
Yearly income 24001-30000	.	-.015	-.015
Yearly income > 30000	.	.0001	.0005
Employed	.	.002	.002
Yearly income 6001-12000, employed	.	-.002	-.002
Yearly income 12001-18000, employed	.	-.002	-.002
Yearly income 18001-24000, employed	.	-.019	-.020
Yearly income 24001-30000, employed	.	.004	.004
Yearly income > 30000, employed	.	-.006	-.006
Married	.	.014*	.014*
Not married, lives with prtnr	.	.020***	.020***
Widowed	.	-.012	-.012
Divorced/Annuled	.	.005	.005
Separated	.	.009	.008
Other Marital Status	.	.003	.003
Used marijuana SLV	.	.	.018***
Never smoker	.	.	.031
Current smoker	.	.	.011
Light (lt 3 drinks/wk)	.	.	-.003
Moderate (3-13 drinks/wk)	.	.	.005
Heavier (gt 13 drinks/wk)	.	.	.026**
No. male sex prtnr SLV	.	.	.00005
Obs.	17906	17906	17906

Estimates are from regressions of violence on illicit drug use. The sample is restricted to women from the first cohort who answered questions about domestic violence, which is defined in Table 1. Each specification uses individual level fixed effects. We instrument heroin and stimulant use with previous period drug use in order to bypass the possibility of simultaneity. This avoids capturing responses to domestic violence (e.g., using drugs as a coping mechanism).

Table 9: Difference-in-Difference: CESD Score

	[1]	[2]	[3]
Panel A: Salient vs High CD4 HIV+ Women			
Panel A.1: Full Sample			
HAART available	-.283***	-.322***	-.333***
	(.065)	(.075)	(.074)
Salient Group	-.231**	-.241**	-.119
	(.116)	(.114)	(.109)
Salient × HAART	.039	.071	.059
	(.104)	(.105)	(.111)
Average CES-D Score pre-HAART	.	.	.054***
			(.005)
Obs.	14314	14314	14314
Panel A.2: Black			
HAART available	-.410***	-.466***	-.449***
	(.094)	(.109)	(.104)
Salient Group	-.247	-.269*	-.102
	(.165)	(.161)	(.151)
Salient × HAART	.091	.129	.115
	(.144)	(.146)	(.153)
Average CES-D Score pre-HAART	.	.	.051***
			(.007)
Obs.	8195	8195	8195
Panel B: Salient vs HIV− Women			
Panel B.1: Full Sample			
HAART available	-.235***	-.276***	-.289***
	(.063)	(.070)	(.072)
Salient Group	-.006	-.030	-.010
	(.110)	(.111)	(.106)
Salient × HAART	-.012	.002	-.002
	(.104)	(.105)	(.110)
Average CES-D Score pre-HAART	.	.	.058***
			(.006)
Obs.	13227	13227	13227
Panel B.2: Black			
HAART available	-.186**	-.230***	-.235***
	(.075)	(.087)	(.088)
Salient Group	.180	.169	.222
	(.153)	(.157)	(.144)
Salient × HAART	-.137	-.147	-.133
	(.132)	(.135)	(.143)
Average CES-D Score pre-HAART	.	.	.057***
			(.007)
Obs.	7793	7793	7793
Basic Controls	N	Y	Y

Difference-in-differences estimates are presented where the outcome variable is CES-D Scale Score, where higher values mean depression is more likely. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual level.

Table 10: Difference-in-Difference: Any Symptom

	[1]	[2]	[3]
Panel A: Salient vs High CD4 HIV+ Women			
Panel A.1: Full Sample			
HAART available	-.076	-.177***	-.113*
	(.058)	(.065)	(.067)
Salient Group	-.088	-.095	-.088
	(.103)	(.103)	(.092)
Salient × HAART	.067	.099	.096
	(.093)	(.093)	(.100)
Any Symptoms pre-HAART	.	.	1.018***
			(.077)
Obs.	6219	6219	6219
Panel A.2: Black			
HAART available	-.044	-.157*	-.081
	(.071)	(.081)	(.083)
Salient Group	-.067	-.080	-.093
	(.124)	(.127)	(.115)
Salient × HAART	.007	.054	.034
	(.113)	(.113)	(.121)
Any Symptoms pre-HAART	.	.	1.016***
			(.095)
Obs.	3951	3951	3951
Panel B: Salient vs HIV− Women			
Panel B.1: Full Sample			
HAART available	.023	-.116*	-.006
	(.061)	(.067)	(.068)
Salient Group	.539***	.530***	.378***
	(.105)	(.105)	(.093)
Salient × HAART	-.032	-.031	-.066
	(.095)	(.096)	(.103)
Any Symptoms pre-HAART	.	.	.946***
			(.077)
Obs.	5999	5999	5999
Panel B.2: Black			
HAART available	.024	-.111	-.015
	(.074)	(.082)	(.083)
Salient Group	.519***	.530***	.349***
	(.129)	(.128)	(.117)
Salient × HAART	-.061	-.071	-.093
	(.115)	(.117)	(.123)
Any Symptoms pre-HAART	.	.	.837***
			(.095)
Obs.	4016	4016	4016
Basic Controls	N	Y	Y

Difference-in-differences estimates are presented where the outcome variable is having any symptom, which is defined as experiencing any of the since the last visit: fever, memory problems, numbness, weight loss, mental confusion, or night sweats. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual level.

Table 11: Domestic Violence and Resources

	[1]	[2]	[3]	[4]	[5]
Employed	-.012***	.	-.011**	-.010**	-.008*
Yearly income 6001-12000	.	-.009*	-.008*	-.008*	-.007
Yearly income 12001-18000	.	-.016***	-.015**	-.015***	-.015***
Yearly income 18001-24000	.	-.011*	-.010	-.011	-.011
Yearly income 24001-30000	.	-.020***	-.018**	-.019**	-.020***
Yearly income > 30000	.	-.003	-.0006	-.002	-.004
Age	-.025***	-.025***	-.024***	-.025***	-.025***
Age squared	.0003	.0003	.0003	.0003	.0003*
Age cubed	-1.12e-06	-8.32e-07	-8.53e-07	-9.14e-07	-9.60e-07
Obs.	24896	25526	25526	25526	25526
Basic Controls	Y	Y	Y	Y	Y
Demographic Controls	N	N	N	Y	Y
Risky Behaviors	N	N	N	N	Y

OLS with individual level fixed effects estimates are presented where the outcome variable is experiencing domestic violence since the last visit, which is defined in Table 1. Basic controls include age, age squared, and age cubed. Demographic controls include indicator variables for marital status (never married omitted). Risky behaviors include indicator variables for drug use, cigarette smoking, alcohol use, and the number of male sex partners.

Table 12: Difference-in-Difference: Employment

	[1]	[2]	[3]
Panel A: Salient vs High CD4 HIV+ Women			
Panel A.1: Full Sample			
HAART available	.117***	.213***	.282***
	(.043)	(.054)	(.056)
Salient Group	-.145	-.144	-.112
	(.094)	(.093)	(.078)
Salient × HAART	.148*	.138*	.101
	(.079)	(.083)	(.099)
Employed pre-HAART	.	.	1.388***
			(.076)
Obs.	16336	16336	16336
Panel A.2: Black			
HAART available	.121**	.257***	.309***
	(.059)	(.072)	(.074)
Salient Group	-.173	-.242*	-.146
	(.125)	(.126)	(.105)
Salient × HAART	.220**	.226**	.226*
	(.110)	(.114)	(.130)
Employed pre-HAART	.	.	1.344***
			(.101)
Obs.	9395	9395	9395
Panel B: Salient vs HIV− Women			
Panel B.1: Full Sample			
HAART available	.216***	.400***	.475***
	(.052)	(.061)	(.065)
Salient Group	-.346***	-.349***	-.254***
	(.093)	(.094)	(.080)
Salient × HAART	.049	.003	-.061
	(.084)	(.089)	(.099)
Employed pre-HAART	.	.	1.073***
			(.077)
Obs.	14932	14932	14932
Panel B.2: Black			
HAART available	.221***	.489***	.546***
	(.070)	(.085)	(.090)
Salient Group	-.379***	-.378***	-.277**
	(.126)	(.127)	(.110)
Salient × HAART	.121	.070	.034
	(.116)	(.124)	(.133)
Employed pre-HAART	.	.	1.009***
			(.103)
Obs.	8828	8828	8828
Basic Controls	N	Y	Y

Difference-in-differences estimates are presented where the outcome variable is current employment. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual level.

Appendix A

In this section, we discuss the additional tables and figures from "Health, Human Capital and Domestic Violence." We discuss these findings in the order that they appear in the main text.

To test that observations are missing at random, we regress an indicator for the salient group, lagged CD4 count, and interaction between lagged CD4 and the salient group along with the basic controls discussed in Section 4 on missing visits. Table A1 shows the coefficients on the interaction. Although health is a significant predictor of missing a visit, we find that health does not have differential effects on the likelihood of missing a visit in the salient group versus the control groups.

We present the marginal effects of the interaction in Equation 3 in Table A2. We show results for all women in the sample, as well as a sample of women who experienced violence prior to the introduction of HAART. To test that black women were affected more by the introduction of HAART, we interact an indicator for the salient group with HAART availability and being black. Table A3 shows the findings from this triple interaction and is described in Section 4.1.

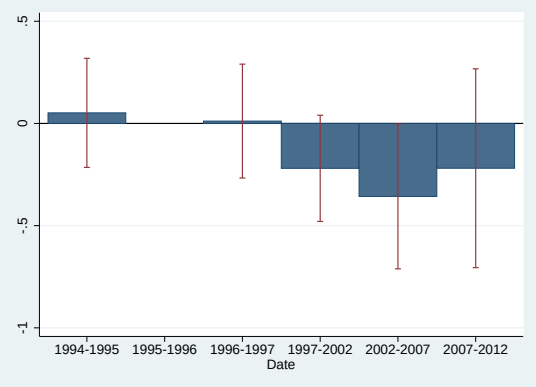
To provide further evidence that HAART was unexpected, we estimate equations (3) and (4) from the main text with a placebo for HAART introduction. Tables A4 - A6 report estimates for domestic violence, stimulant use and heroin, respectively. To test that our results are not driven by survival bias, we estimate models including only women who stayed in the survey for at least 15 visits (about 7.5 years). These results are shown in Tables A7 - A9. As a robustness check, we also conduct an event study. For each outcome of the main outcomes we study (domestic violence, stimulant use and heroin use), we regress dummies for the periods leading up the the introduction of HAART and the periods after HAART introduction, an indicator for the salient group, and interactions between the salient group and the lead/lag periods. We also include the basic controls discussed in Section 4. In Figure A1 we show results from the interactions between the salient group and the time periods, plotting coefficients. Importantly, we find that the periods leading up to HAART are never significantly negative, implying that our findings are not driven by trends that existed before the introduction of HAART.

As an additional robustness check, we also conducted our analysis using propensity score weighting. Table A10 shows the normalized differences for observable characteristics of the sample. Column 1 shows the normalized difference between the salient group and the HIV+ high CD4 count women and Column 2 shows the normalized differences between the salient and HIV− women. Given that these differences are all very small, we conclude that

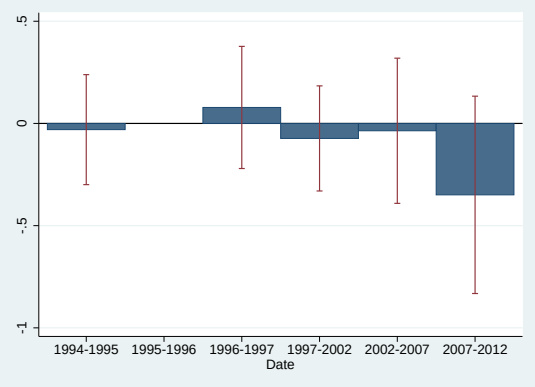
these groups are quite similar prior to HAART. In fact, the only outcome that is above the threshold suggested by Imbens (2015) (.25) is the difference in employment for the salient group and the HIV− women. Table A11 shows the results from our propensity score estimation. We estimate both a linear specification and a quadratic specification. Again, we follow the algorithm proposed by Imbens (2015) in choosing the controls for the propensity score matching. Table A11 shows that prior to HAART, the groups were very similar in terms of violence, stimulant use and heroin use. However, we find that the introduction of HAART had a significant impact on the salient group in comparison to the control groups. Propensity score matching requires that the two groups have good overlap of the score, and we show that this is the case in Figure A2. This figure shows the overlap in propensity score between the salient group and the HIV+ high CD4 count women for domestic violence. The figures for other outcomes are quite similar and are available upon request from the corresponding author.

Turning to mechanisms, we allow for the fact that drug use and domestic violence may be correlated and jointly estimate the impact of HAART on violence and stimulant use in Tables A12 and A13 and heroin use in Tables A14 and A15. Finally, Tables A16 and A17 show regressions examining the relationships amongst employment, health, and stimulant use and heroin use, respectively.

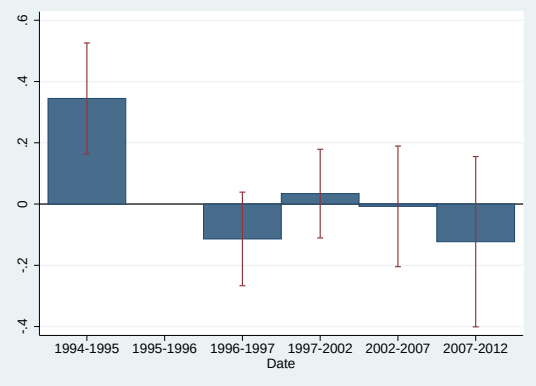
Supplemental Tables and Figures



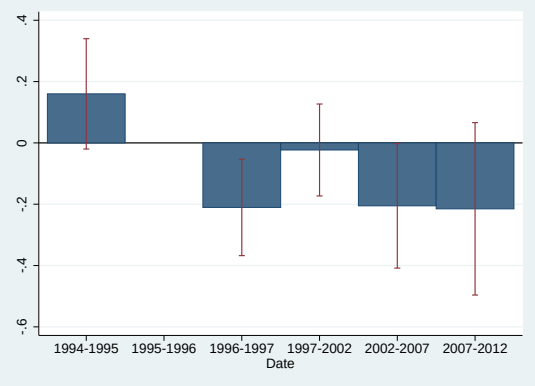
(a) Domestic Violence, HIV+ High CD4



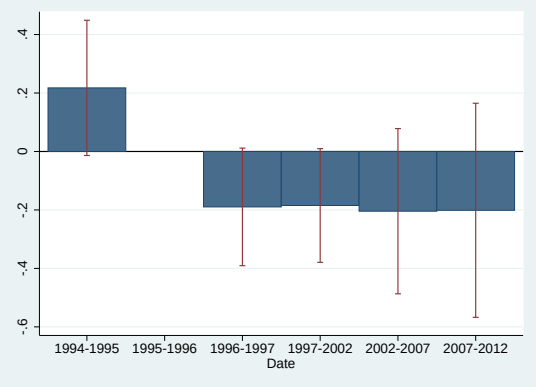
(b) Domestic Violence, HIV−



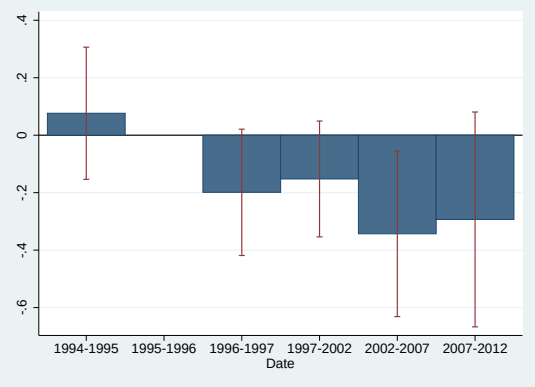
(c) Stimulant Use, HIV+ High CD4



(d) Stimulant Use, HIV−



(e) Heroin Use, HIV+ High CD4



(f) Heroin Use, HIV−

Figure A1: This figure shows coefficients of the interaction between the salient group and the periods leading up to and lagging HAART, as specified in Equation 5. Each bar represents the estimated coefficient and the red line represents the 90% confidence interval.

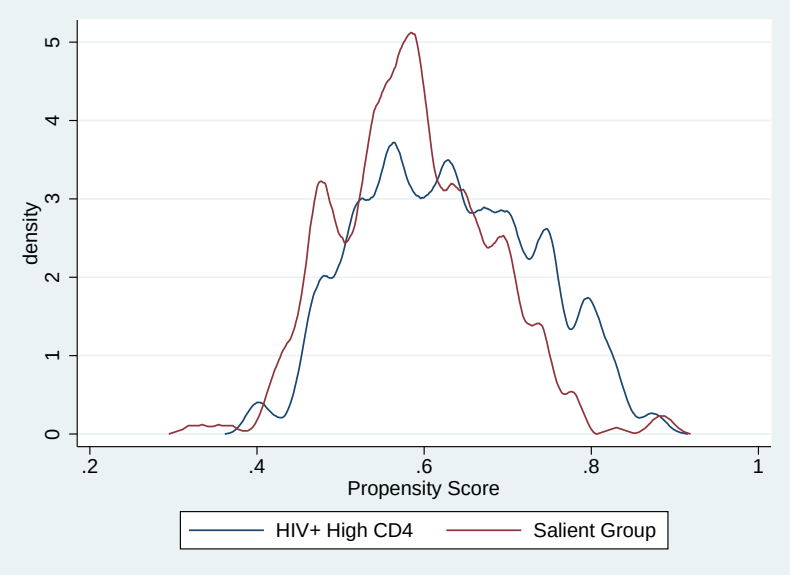


Figure A2: This figure shows overlap of the estimated propensity score using a linear specification for the salient group and for HIV+ high CD4 count women.

Table A1: Missing Outcomes

	Domestic Violence	Stimulant Use	Heroin Use	Employ-ment	Income
Salient Group	-.007	.033	.032	.028	.035
	(.052)	(.057)	(.057)	(.056)	(.026)
Logged cd4 count	-.009***	-.013***	-.012***	-.012***	.002*
	(.002)	(.002)	(.002)	(.002)	(.001)
Salient × CD4	.0007	-.006	-.006	-.005	-.006
	(.009)	(.010)	(.010)	(.009)	(.004)
Obs.	25849	25849	25849	25849	25849
Basic Controls	Y	Y	Y	Y	Y

OLS results are presented where the outcome variable is an indicator for missing an observation for the event listed. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual level.

Table A2: Marginal Effects of Difference-in-differences, Domestic Violence

	Full Sample			Experienced Violence Pre-HAART		
Controls	Mean Effect	Mean Z Score	Obs.	Mean Effect	Mean Z Score	Obs.
Panel A: Salient vs High CD4 HIV+ Women						
Panel A.1: Full Sample						
None	-0.014	-0.693	6629	-0.051	-1.085	1978
Basic	-0.019	-1.025	6629	-0.060	-1.276	1978
Pre-HAART DV	-0.023	-1.278	6629			
Panel A.2: Black						
None	-0.027	-0.992	4250	-0.107	-1.797	1410
Basic	-0.033	-1.257	4250	-0.104	-1.672	1410
Pre-HAART DV	-0.038	-1.499	4250			
Panel B: Salient vs HIV− Women						
Panel B.1: Full Sample						
None	0.011	0.566	6514	-0.030	-0.645	1967
Basic	0.009	0.537	6514	-0.027	-0.588	1967
Pre-HAART DV	-0.005	-0.205	6514			
Panel B.2: Black						
None	-0.026	-0.971	4353	-0.132	-2.224	1413
Basic	-0.029	-1.122	4353	-0.120	-1.986	1413
Pre-HAART DV	-0.040	-1.671	4353			

Marginal effects are computed for the impact of HAART on violence. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). The dependent variable is experiencing domestic violence. In all specifications, errors are clustered at the individual level. Mean Effect refers to the mean effect of the interaction coefficient. Mean Z Score refers to the mean z score for the interaction coefficient.

Table A3: Heterogeneity in Effects of HAART on Domestic Violence

	[1]	[2]	[3]
Panel A: Salient vs High CD4 HIV+ Women			
HAART available	-.275**	-.130	-.101
	(.128)	(.142)	(.147)
Salient Group	-.230	-.205	-.198
	(.202)	(.204)	(.170)
African American	.246	.474***	.296*
	(.153)	(.181)	(.167)
Salient × HAART	.004	.012	-.010
	(.186)	(.197)	(.206)
AA × HAART	-.135	-.153	-.194
	(.158)	(.165)	(.172)
Salient × AA	.223	.245	.284
	(.246)	(.247)	(.210)
Salient × AA × HAART	-.284	-.315	-.320
	(.236)	(.245)	(.259)
Obs.	6629	6629	6629
Panel B: Salient vs HIV− Women			
HAART available	-.660***	-.657***	-.620***
	(.117)	(.124)	(.138)
Salient Group	-.544***	-.567***	-.501***
	(.198)	(.201)	(.163)
African American	-.134	-.051	-.083
	(.147)	(.181)	(.166)
Salient × HAART	.389**	.465**	.439**
	(.178)	(.196)	(.216)
AA × HAART	.185	.269*	.261
	(.150)	(.151)	(.167)
Salient × AA	.602**	.624***	.667***
	(.242)	(.242)	(.204)
Salient × AA × HAART	-.605***	-.723***	-.780***
	(.230)	(.246)	(.269)
Obs.	6514	6514	6514
Basic Controls	N	Y	Y

Difference-in-differences estimates are presented where the outcome variable is experiencing domestic violence since the last visit. We also include dummy variables and interactions for women who are black to estimate heterogeneity in effects of HAART by race. Basic controls include age at visit, age squared, age cubed and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual level.

Table A4: Difference-in-Difference Using Placebo HAART, Domestic Violence

	[1]	[2]	[3]	[4]
Panel A: Salient vs High CD4 HIV+ Women				
Panel A.1: Full Sample				
Salient Group	-.127	-.119	-.135	-.113
	(.114)	(.138)	(.140)	(.136)
Pseudo-HAART	-.136*	-.130	-.143	-.136
	(.075)	(.099)	(.102)	(.112)
Salient × Pseudo-HAART	.	-.016	-.007	-.011
		(.148)	(.151)	(.171)
Experienced DVA pre-PseudoHAART	.	.	.	1.131***
				(.112)
Obs.	1423	1423	1419	1419
Panel A.2: Black				
Salient Group	.058	.071	.039	.070
	(.139)	(.170)	(.170)	(.162)
Pseudo-HAART	-.137	-.127	-.141	-.117
	(.090)	(.124)	(.124)	(.138)
Salient × Pseudo-HAART	.	-.025	.005	.018
		(.179)	(.180)	(.203)
Experienced DVA pre-PseudoHAART	.	.	.	1.043***
				(.136)
Obs.	919	919	919	919
Panel B: Salient vs HIV− Women				
Panel B.1: Full Sample				
Salient Group	-.122	-.110	-.135	-.113
	(.114)	(.139)	(.140)	(.136)
Pseudo-HAART	-.150**	-.141	-.143	-.136
	(.075)	(.100)	(.102)	(.112)
Salient × Pseudo-HAART	.	-.024	-.007	-.011
		(.149)	(.151)	(.171)
Experienced DVA pre-PseudoHAART	.	.	.	1.131***
				(.112)
Obs.	1419	1419	1419	1419
Panel B.2: Black				
Salient Group	.058	.071	.039	.070
	(.139)	(.170)	(.170)	(.162)
Pseudo-HAART	-.137	-.127	-.141	-.117
	(.090)	(.124)	(.124)	(.138)
Salient × Pseudo-HAART	.	-.025	.005	.018
		(.179)	(.180)	(.203)
Experienced DVA pre-PseudoHAART	.	.	.	1.043***
				(.136)
Obs.	919	919	919	919
Basic Controls	N	N	Y	Y

Difference-in-differences estimates (using a placebo for HAART) are presented where the outcome variable is experiencing domestic violence since the last visit. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual level.

Table A5: Difference-in-Difference Using Placebo HAART, Stimulants

	[1]	[2]	[3]	[4]
Panel A: Salient vs High CD4 HIV+ Women				
Panel A.1: Full Sample				
Salient Group	-.045	-.023	-.091	.033
	(.128)	(.146)	(.150)	(.148)
Pseudo-HAART	-.161**	-.144*	-.184**	-.124
	(.063)	(.078)	(.080)	(.095)
Salient × Pseudo-HAART	.	-.045	-.023	-.060
		(.132)	(.137)	(.175)
Used Stimulants pre-PseudoHAART	.	.	.	1.719***
				(.149)
Obs.	1423	1423	1419	1419
Black				
Salient Group	.004	.053	-.028	.130
	(.157)	(.173)	(.184)	(.173)
Pseudo-HAART	-.135*	-.096	-.172*	-.125
	(.073)	(.092)	(.096)	(.109)
Salient × Pseudo-HAART	.	-.100	-.062	-.103
		(.151)	(.162)	(.192)
Used Stimulants pre-PseudoHAART	.	.	.	1.672***
				(.183)
Obs.	919	919	919	919
Panel B: Salient vs HIV− Women				
Panel B.1: Full Sample				
Salient Group	-.046	-.024	-.091	.033
	(.128)	(.146)	(.150)	(.148)
Pseudo-HAART	-.159**	-.143*	-.184**	-.124
	(.063)	(.078)	(.080)	(.095)
Salient × Pseudo-HAART	.	-.044	-.023	-.060
		(.132)	(.137)	(.175)
Used Stimulants pre-PseudoHAART	.	.	.	1.719***
				(.149)
Obs.	1419	1419	1419	1419
Panel B.2: Black				
Salient Group	.004	.053	-.028	.130
	(.157)	(.173)	(.184)	(.173)
Pseudo-HAART	-.135*	-.096	-.172*	-.125
	(.073)	(.092)	(.096)	(.109)
Salient × Pseudo-HAART	.	-.100	-.062	-.103
		(.151)	(.162)	(.192)
Used Stimulants pre-PseudoHAART	.	.	.	1.672***
				(.183)
Obs.	919	919	919	919
Basic Controls	N	N	Y	Y

Difference-in-differences estimates (using a placebo for HAART) are presented where the outcome variable is stimulant use (crack or cocaine) since the last visit. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual.

Table A6: Difference-in-Difference Using Placebo HAART, Heroin

	[1]	[2]	[3]	[4]
Panel A: Salient vs High CD4 HIV+ Women				
Panel A.1: Full Sample				
Salient Group	-.031	.090	.075	.023
	(.145)	(.165)	(.172)	(.184)
Pseudo-HAART	-.057	.033	-.030	.048
	(.081)	(.083)	(.093)	(.122)
Salient × Pseudo-HAART	.	-.238	-.214	-.107
		(.183)	(.204)	(.279)
Used Heroin pre-PseudoHAART	.	.	.	1.934***
				(.167)
Obs.	1423	1423	1419	1419
Panel A.2: Black				
Salient Group	-.043	.129	.183	.157
	(.178)	(.210)	(.230)	(.238)
Pseudo-HAART	.050	.175*	.115	.195
	(.105)	(.103)	(.122)	(.155)
Salient × Pseudo-HAART	.	-.333	-.328	-.210
		(.245)	(.281)	(.346)
Used Heroin pre-PseudoHAART	.	.	.	1.801***
				(.224)
Obs.	919	919	919	919
Panel B: Salient vs HIV− Women				
Panel B.1: Full Sample				
Salient Group	-.032	.089	.075	.023
	(.145)	(.165)	(.172)	(.184)
Pseudo-HAART	-.056	.034	-.030	.048
	(.081)	(.083)	(.093)	(.122)
Salient × Pseudo-HAART	.	-.237	-.214	-.107
		(.183)	(.204)	(.279)
Used Heroin pre-PseudoHAART	.	.	.	1.934***
				(.167)
Obs.	1419	1419	1419	1419
Panel B.2: Black				
Salient Group	-.043	.129	.183	.157
	(.178)	(.210)	(.230)	(.238)
Pseudo-HAART	.050	.175*	.115	.195
	(.105)	(.103)	(.122)	(.155)
Salient × Pseudo-HAART	.	-.333	-.328	-.210
		(.245)	(.281)	(.346)
Used Heroin pre-PseudoHAART	.	.	.	1.801***
				(.224)
Obs.	919	919	919	919
Basic Controls	N	N	Y	Y

Difference-in-differences estimates (using a placebo for HAART) are presented where the outcome variable is heroin use since the last visit. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual.

Table A7: Difference-in-Difference: Domestic Violence, Women Who Did Not Die Within 7.5 Years of Study

	[1]	[2]	[3]
Panel A: Salient vs High CD4 HIV+ Women			
Panel A.1: Full Sample			
HAART available	-.389***	-.260***	-.252***
	(.077)	(.088)	(.092)
Salient Group	-.046	-.017	.021
	(.119)	(.120)	(.105)
Salient × HAART	-.216*	-.218*	-.249*
	(.119)	(.123)	(.129)
Experienced V pre-HAART	.	.	.824***
			(.091)
Obs.	6411	6411	6411
Panel A.2: Black			
HAART available	-.463***	-.373***	-.395***
	(.096)	(.102)	(.108)
Salient Group	-.002	.028	.072
	(.145)	(.146)	(.130)
Salient × HAART	-.283*	-.295**	-.332**
	(.148)	(.150)	(.161)
Experienced V pre-HAART	.	.	.909***
			(.113)
Obs.	4069	4069	4069
Panel B: Salient vs HIV− Women			
Panel B.1: Full Sample			
HAART available	-.551***	-.481***	-.447***
	(.076)	(.082)	(.086)
Salient Group	-.086	-.100	-.016
	(.118)	(.120)	(.105)
Salient × HAART	-.054	-.046	-.114
	(.119)	(.121)	(.132)
Experienced V pre-HAART	.	.	.964***
			(.085)
Obs.	6360	6360	6360
Panel B.2: Black			
HAART available	-.494***	-.405***	-.381***
	(.098)	(.107)	(.111)
Salient Group	.117	.110	.190
	(.145)	(.149)	(.135)
Salient × HAART	-.252*	-.287*	-.345**
	(.150)	(.154)	(.164)
Experienced V pre-HAART	.	.	.935***
			(.102)
Obs.	4226	4226	4226
Basic Controls	N	Y	Y

Difference-in-differences estimates are presented where the outcome variable is experiencing violence since the last visit. The sample is restricted to women who survived more than 7.5 years since commencement of the study. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual.

Table A8: Difference-in-Difference: Stimulant Use, Women Who Did Not Die Within 7.5 Years of Study

	[1]	[2]	[3]
Panel A: Salient vs High CD4 HIV+ Women			
Panel A.1: Full Sample			
HAART available	-.177***	-.290***	-.254***
	(.053)	(.058)	(.069)
Salient Group	.072	.100	.140
	(.104)	(.104)	(.097)
Salient × HAART	-.201**	-.191**	-.175*
	(.080)	(.082)	(.098)
Stimulant use pre-HAART	.	.	1.598***
			(.082)
Obs.	15848	15848	15848
Panel A.2: Black			
HAART available	-.210***	-.338***	-.280***
	(.068)	(.074)	(.086)
Salient Group	.145	.204	.260**
	(.135)	(.137)	(.126)
Salient × HAART	-.227**	-.223**	-.206*
	(.105)	(.106)	(.123)
Stimulant use pre-HAART	.	.	1.478***
			(.106)
Obs.	9035	9035	9035
Panel B: Salient vs HIV− Women			
Panel B.1: Full Sample			
HAART available	-.166***	-.376***	-.273***
	(.056)	(.067)	(.076)
Salient Group	-.013	-.069	.020
	(.106)	(.109)	(.097)
Salient × HAART	-.209**	-.164*	-.204**
	(.083)	(.090)	(.101)
Stimulant use pre-HAART	.	.	1.330***
			(.097)
Obs.	14600	14600	14600
Panel B.2: Black			
HAART available	-.200***	-.425***	-.310***
	(.069)	(.083)	(.096)
Salient Group	-.004	-.032	.104
	(.140)	(.148)	(.129)
Salient × HAART	-.231**	-.233**	-.260**
	(.105)	(.118)	(.131)
Stimulant use pre-HAART	.	.	1.345***
			(.131)
Obs.	8583	8583	8583
Basic Controls	N	Y	Y

Difference-in-differences estimates are presented where the outcome variable is stimulant use since the last visit. The sample is restricted to women who survived more than 7.5 years since commencement of the study. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual.

Table A9: Difference-in-Difference: Heroin Use, Women Who Did Not Die Within 7.5 Years of Study

	[1]	[2]	[3]
Panel A: Salient vs High CD4 HIV+ Women			
Panel A.1: Full Sample			
HAART available	-.173***	-.289***	-.213**
	(.061)	(.071)	(.086)
Salient Group	.091	.116	.125
	(.119)	(.120)	(.117)
Salient × HAART	-.292***	-.294***	-.267*
	(.100)	(.103)	(.137)
Heroin use pre-HAART	.	.	1.891***
			(.130)
Obs.	15845	15845	15845
Panel A.2: Black			
HAART available	-.212**	-.433***	-.350***
	(.084)	(.088)	(.113)
Salient Group	.080	.102	.145
	(.156)	(.159)	(.161)
Salient × HAART	-.296**	-.258*	-.252
	(.143)	(.147)	(.186)
Heroin use pre-HAART	.	.	1.841***
			(.164)
Obs.	9032	9032	9032
Panel B: Salient vs HIV− Women			
Panel B.1: Full Sample			
HAART available	-.135*	-.299***	-.170*
	(.076)	(.081)	(.095)
Salient Group	.006	-.035	-.082
	(.124)	(.129)	(.115)
Salient × HAART	-.328***	-.319***	-.410***
	(.110)	(.116)	(.144)
Heroin use pre-HAART	.	.	1.637***
			(.127)
Obs.	14600	14600	14600
Panel B.2: Black			
HAART available	-.158	-.409***	-.241*
	(.106)	(.119)	(.135)
Salient Group	.052	.087	.007
	(.167)	(.172)	(.153)
Salient × HAART	-.346**	-.387**	-.499**
	(.157)	(.170)	(.196)
Heroin use pre-HAART	.	.	1.454***
			(.180)
Obs.	8583	8583	8583
Basic Controls	N	Y	Y

Difference-in-differences estimates are presented where the outcome variable is heroin use since the last visit. The sample is restricted to women who survived more than 7.5 years since commencement of the study. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual.

Table A10: Normalized Differences

	(1) HIV+, Healthy Sample	(2) HIV − Sample
African American	0.08	0.06
Hispanic	-0.03	-0.02
White	-0.02	-0.02
Other race	-0.16	-0.14
Max income pre-HAART	-0.00	-0.08
Max inc pre-HAART < 6000	0.00	-0.06
Max inc pre-HAART 6001-12000	0.02	0.19
Max inc pre-HAART 12001-18000	-0.03	-0.10
Max inc pre-HAART 18001-24000	0.04	0.06
Max inc pre-HAART 24001-30000	-0.09	-0.07
Max inc pre-HAART > 30000	0.04	-0.07
Age at visit	0.19	0.14
Bronx	0.05	-0.04
Brooklyn	-0.07	-0.02
DC	0.24	0.06
LA	-0.09	-0.09
Less than HS	-0.08	0.13
HS graduate	0.08	-0.13
Some college	0.08	-0.14
College graduate	0.09	-0.03
Married pre-HAART	0.15	0.02
Lived with kids at baseline	0.09	0.09
Experienced DV pre-HAART	-0.13	-0.20
Stimulant use pre-HAART	-0.05	-0.15
Heroin use pre-HAART	0.07	0.03
Employed pre-HAART	-0.13	-0.37
Smokes	-0.09	-0.08
Drinks	-0.01	-0.12
Time since 1^{st} + HIV test	0.16	.
Observations	263	273

Normalized differences between the salient group and HIV+ high CD4 count women (Column 1) and HIV− women (Column 2) are presented.

Table A11: Propensity Score Results

	Pre-HAART		Post-HAART	
	Linear	Quadratic	Linear	Quadratic
Panel A: Salient vs High CD4 HIV+				
Domestic Violence	0.0088	0.0018	-0.0332***	-0.0344***
	(0.0173)	(0.0189)	(0.0123)	(0.0126)
	1328	1299	1679	1661
Heroin Use	0.0079	0.0184	-0.0179***	-0.0139**
	(0.0112)	(0.0140)	(0.0053)	(0.0056)
	1436	1296	5188	4689
Stimulant Use	0.0162	0.0061	0.0016	-0.0049
	(0.0151)	(0.0159)	(0.0085)	(0.0083)
	1351	1347	4671	4714
Panel B: Salient vs HIV−				
Domestic Violence	-0.0011	0.0077	-0.0027	-0.0017
	(0.0173)	(0.0184)	(0.0121)	(0.0131)
	1363	1344	1725	1723
Heroin Use	-0.0097	-0.0157	-0.0224***	-0.0290***
	(0.0144)	(0.0139)	(0.0071)	(0.0061)
	890	866	3398	3354
Stimulant Use	0.0188	0.0140	-0.0257***	-0.0243***
	(0.0160)	(0.0164)	(0.0093)	(0.0094)
	1403	1394	5037	5024

Average treatment effects from propensity score matching are presented, both a linear and quadratic specification. Controls following the algorithm proposed by Imbens (2015) are included. For each outcome, we show the estimated coefficient, standard error in parenthesis, and number of observations.

Table A12: Joint Estimation: Domestic Violence and Stimulant Use, Salient Group vs HIV+ High CD4 Count Women

	[1]	[2]	[3]	[4]
Panel A: Full Sample				
Domestic Violence				
HAART available	-.440***	-.375***	-.248***	-.248***
	(.058)	(.075)	(.085)	(.089)
Salient Group	-.201**	-.072	-.030	.005
	(.090)	(.115)	(.116)	(.102)
Salient × HAART	.	-.191	-.205*	-.238*
		(.117)	(.121)	(.126)
Experienced V pre-HAART	.	.	.	.825***
				(.090)
Obs.	6629	6629	6629	6629
Stimulant Use				
HAART available	-.198***	-.150**	-.184***	-.158*
	(.048)	(.061)	(.068)	(.081)
Salient Group	-.073	.023	.050	.081
	(.111)	(.126)	(.126)	(.119)
Salient × HAART	.	-.128	-.127	-.138
		(.099)	(.101)	(.121)
Stimulant use pre-HAART	.	.	.	1.591***
				(.096)
Obs.	6629	6629	6629	6629
Rho	0.331***	0.330***	0.322***	0.294***
Panel B: African American Women				
Domestic Violence				
HAART available	-.510***	-.417***	-.329***	-.356***
	(.072)	(.092)	(.098)	(.104)
Salient Group	-.193*	-.014	.034	.077
	(.108)	(.140)	(.141)	(.124)
Salient × HAART	.	-.270*	-.288*	-.327**
		(.145)	(.148)	(.157)
Experienced V pre-HAART	.	.	.	.892***
				(.107)
Obs.	4250	4250	4250	4250
Stimulant Use				
HAART available	-.207***	-.144*	-.204**	-.159
	(.059)	(.076)	(.084)	(.097)
Salient Group	.064	.182	.216	.260*
	(.134)	(.156)	(.159)	(.148)
Salient × HAART	.	-.157	-.146	-.160
		(.119)	(.122)	(.144)
Stimulant use pre-HAART	.	.	.	1.575***
				(.122)
Obs.	4250	4250	4250	4250
Rho	0.323***	0.321***	0.320***	0.288***
Basic Controls	N	N	Y	Y

Difference-in-differences estimates are presented where the outcome variables are domestic violence and stimulant use and the control group consists of relatively healthy HIV+ women. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual.

Table A13: Joint Estimation: Domestic Violence and Stimulant Use, Salient Group vs HIV− Women

	[1]	[2]	[3]	[4]
Panel A: Full Sample				
Domestic Violence				
HAART available	-.553***	-.545***	-.489***	-.457***
	(.057)	(.073)	(.081)	(.085)
Salient Group	-.147*	-.130	-.131	-.035
	(.086)	(.113)	(.115)	(.101)
Salient × HAART	.	-.021	-.022	-.096
		(.116)	(.119)	(.129)
Experienced V pre-HAART	.	.	.	.981***
				(.085)
Obs.	6514	6514	6514	6512
Stimulant Use				
HAART available	-.188***	-.136**	-.259***	-.188**
	(.050)	(.065)	(.074)	(.091)
Salient Group	-.154	-.048	-.094	.032
	(.112)	(.128)	(.132)	(.118)
Salient × HAART	.	-.143	-.129	-.188
		(.101)	(.109)	(.126)
Stimulant use pre-HAART	.	.	.	1.473***
				(.110)
Obs.	6514	6514	6514	6512
Rho	0.376***	0.376***	0.377***	0.316***
Panel B: African American Women				
Domestic Violence				
HAART available	-.554***	-.479***	-.392***	-.363***
	(.072)	(.093)	(.101)	(.105)
Salient Group	-.078	.059	.072	.167
	(.101)	(.138)	(.143)	(.128)
Salient × HAART	.	-.206	-.244*	-.317**
		(.145)	(.149)	(.159)
Experienced V pre-HAART	.	.	.	.895***
				(.097)
Obs.	4353	4353	4353	4351
Stimulant Use				
HAART available	-.201***	-.142*	-.290***	-.209**
	(.059)	(.077)	(.089)	(.105)
Salient Group	-.116	.004	-.014	.189
	(.135)	(.156)	(.163)	(.144)
Salient × HAART	.	-.159	-.185	-.263*
		(.119)	(.131)	(.149)
Stimulant use pre-HAART	.	.	.	1.478***
				(.135)
Obs.	4353	4353	4353	4351
Rho	.392***	0.391***	0.395***	0.326***
Basic Controls	N	N	Y	Y

Difference-in-differences estimates are presented where the outcome variables are domestic violence and stimulant use and the control group consists of HIV− women. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual.

Table A14: Joint Estimation: Domestic Violence and Heroin Use, Salient Group vs HIV+ High CD4 Count Women

	[1]	[2]	[3]	[4]
Panel A: Full Sample				
Domestic Violence				
HAART available	-.435***	-.366***	-.234***	-.238***
	(.059)	(.075)	(.085)	(.090)
Salient Group	-.203**	-.067	-.028	.009
	(.091)	(.115)	(.116)	(.102)
Salient × HAART	.	-.202*	-.214*	-.240*
		(.117)	(.121)	(.127)
Experienced V pre-HAART	.	.	.	.845***
				(.090)
Obs.	6629	6629	6629	6629
Heroin Use				
HAART available	-.173***	-.053	-.123	.010
	(.059)	(.069)	(.080)	(.102)
Salient Group	-.098	.132	.150	.133
	(.127)	(.144)	(.145)	(.151)
Salient × HAART	.	-.317**	-.305**	-.396**
		(.127)	(.131)	(.176)
Heroin use pre-HAART	.	.	.	1.854***
				(.149)
Obs.	6629	6629	6629	6629
Rho	0.229***	0.226***	0.254***	0.306***
Panel B: African American Women				
Domestic Violence				
HAART available	-.505***	-.408***	-.318***	-.348***
	(.072)	(.092)	(.099)	(.105)
Salient Group	-.198*	-.013	.030	.081
	(.109)	(.140)	(.141)	(.125)
Salient × HAART	.	-.280*	-.298**	-.327**
		(.145)	(.148)	(.158)
Experienced V pre-HAART	.	.	.	.911***
				(.108)
Obs.	4250	4250	4250	4250
Heroin Use				
HAART available	-.197***	-.081	-.225***	-.072
	(.072)	(.081)	(.080)	(.117)
Salient Group	-.060	.158	.166	.203
	(.159)	(.178)	(.177)	(.188)
Salient × HAART	.	-.300*	-.255	-.386*
		(.155)	(.158)	(.221)
Heroin use pre-HAART	.	.	.	1.836***
				(.177)
Obs.	4250	4250	4250	4250
Rho	0.274***	0.271***	0.287***	0.281***
Basic Controls	N	N	Y	Y

Difference-in-differences estimates are presented where the outcome variables are domestic violence and heroin use and the control group consists of relatively healthy HIV+ women. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual.

Table A15: Joint Estimation: Domestic Violence and Heroin Use, Salient Group vs HIV− Women

	[1]	[2]	[3]	[4]
Panel A: Full Sample				
Domestic Violence				
HAART available	-.557***	-.550***	-.491***	-.460***
	(.057)	(.073)	(.080)	(.085)
Salient Group	-.147*	-.134	-.145	-.042
	(.087)	(.113)	(.115)	(.101)
Salient × HAART	.	-.017	-.022	-.090
		(.116)	(.121)	(.130)
Experienced V pre-HAART	.	.	.	1.008***
				(.086)
Obs.	6514	6514	6514	6512
Heroin Use				
HAART available	-.257***	-.196**	-.286***	-.187
	(.068)	(.087)	(.099)	(.116)
Salient Group	-.163	-.039	-.041	-.105
	(.126)	(.145)	(.148)	(.138)
Salient × HAART	.	-.175	-.212	-.280
		(.137)	(.147)	(.181)
Heroin use pre-HAART	.	.	.	1.531***
				(.143)
Obs.	6514	6514	6514	6512
Rho	0.348***	0.347***	0.367***	0.320***
Panel B: African American Women				
Domestic Violence				
HAART available	-.558***	-.484***	-.394***	-.364***
	(.072)	(.093)	(.101)	(.106)
Salient Group	-.084	.049	.053	.158
	(.101)	(.138)	(.143)	(.129)
Salient × HAART	.	-.203	-.247	-.311*
		(.146)	(.151)	(.161)
Experienced V pre-HAART	.	.	.	.940***
				(.097)
Obs.	4353	4353	4353	4351
Heroin Use				
HAART available	-.276***	-.221*	-.398***	-.263*
	(.088)	(.116)	(.134)	(.151)
Salient Group	-.173	-.058	-.006	-.046
	(.151)	(.178)	(.180)	(.162)
Salient × HAART	.	-.160	-.224	-.326
		(.176)	(.194)	(.227)
Heroin use pre-HAART	.	.	.	1.339***
				(.177)
Obs.	4353	4353	4353	4351
Rho	0.374***	0.372***	0.380***	0.318***
Basic Controls	N	N	Y	Y

Difference-in-differences estimates are presented where the outcome variables are domestic violence and heroin use and the control group consists of HIV− women. Basic controls include age at visit, age squared, age cubed, race (Caucasian omitted), and site of visit (Chicago omitted). In all specifications, errors are clustered at the individual.

Table A16: Employment, Stimulant Use and Health

Current Stimulant Use		
Stimulants	-.103***	-.101***
CD4 count	.	.0002***
CD4 squared	.	-9.27e-08***
Age	-.001	.006
Age squared	.0003	.0001
Age cubed	-4.13e-06	-3.08e-06
Obs.	9952	9952
Stimulant Use Last Year		
Stimulant Use Last Year	-.075***	-.074***
CD4 count	.	.0002***
CD4 squared	.	-9.72e-08***
Age	-.0008	.007
Age squared	.0003	.0001
Age cubed	-4.06e-06	-3.00e-06
Obs.	9952	9952
Stimulant Use Two Years Ago		
Stimulant Use Two Years Ago	-.053***	-.055***
CD4 count	.	.0002***
CD4 squared	.	-9.89e-08***
Age	-.0005	.007
Age squared	.0003	.0001
Age cubed	-3.94e-06	-2.85e-06
Obs.	9952	9952

Results from OLS with individual level fixed effects are presented where the outcome is employment in the past six months. Each panel shows results from including current health and stimulant use from a different point in time: current, use last year, and use two years ago.

Table A17: Employment, Heroin Use and Health

Current Heroin Use		
Used heroin SLV	-.090***	-.091***
CD4 count	.	.0002***
CD4 squared	.	-9.67e-08***
Age	-.0001	.007
Age squared	.0003	.0001
Age cubed	-3.98e-06	-2.90e-06
Obs.	9949	9949
Heroin Use Last Year		
Heroin Use Last Year	-.078***	-.081***
CD4 count	.	.0002***
CD4 squared	.	-9.77e-08***
Age	-.0001	.008
Age squared	.0003	.0001
Age cubed	-3.98e-06	-2.89e-06
Obs.	9949	9949
Heroin Use Two Years Ago		
Heroin Use Two Years Ago	-.081***	-.087***
CD4 count	.	.0002***
CD4 squared	.	-9.96e-08***
Age	.0008	.009
Age squared	.0002	.00008
Age cubed	-3.84e-06	-2.73e-06
Obs.	9949	9949

Results from OLS with individual level fixed effects are presented where the outcome is employment in the past six months. Each panel shows results from including current health and heroin use from a different point in time: current, use last year, and use two years ago.