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Revisiting Offsets of Psychotherapy Coverage

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Abstract

Mental illness is a leading cause of disability worldwide with vast costs to society. Yet, insurance coverage for effective treatments remains limited. This paper revisits the Offset Hypothesis, which claims insurance coverage for psychotherapy is self-financing through reductions in the use of other health care services and improved labor market outcomes. I study a 2008 reform of the Danish public health care system that introduced 60 percent coverage of the cost of psychotherapy for depression and anxiety patients below age 38. Using Regression Discontinuity and Difference-in-Difference designs, I show that psychotherapy coverage reduces the use of other mental health services, physical health care and suicide attempts, but does not impact employment, sick leave or disability pension receipt. Still, the reduction in health care costs is sufficiently large to finance the policy. This suggests mental health coverage is both welfare improving and cost reducing.

JEL Codes: I13, I18, I38, H51, H55

Key words: Mental Health, Health Insurance, Health Care, Offset, Labor Market

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1 Introduction

Depression and anxiety disorders each affect around 300 million individuals globally (WHO, 2017). These conditions are associated with a wide range of adverse outcomes, including poor physical health, impaired productivity, welfare dependence and suicide. In the US alone, the annual societal cost of depression is 211 billion dollars (Greenberg et al., 2015).

Less than half of the individuals suffering from depression or anxiety receive treatment (Kohn et al., 2004). While health insurance policies typically cover treatment at psychiatric hospitals, coverage is limited for services for mild to moderate mental illness (Hewlett and Moran, 2014). This is particularly true for psychotherapy, which is the recommended treatment for depression and anxiety. Hence, while clinical guidelines suggest anxiety and depression patients should always receive therapy and only receive drugs as a supplement, most are only treated with drugs (Cuddy and Currie, 2020a). In the UK, this have been termed "the clearest breach of any of the NICE Guidelines for any illness affecting large numbers of people" (Layard et al., 2007).

A continuing policy agenda argues that increasing health insurance coverage for psychotherapy can close the treatment gap, increase compliance with clinical guidelines and pay for itself by reducing the economic and social costs of mental illness. This claim, often termed the Offset Hypothesis, predicts that each dollar spent on psychotherapy coverage saves up to 4 dollars through (*i*) reductions in other mental health services, (*ii*) reductions in physical health services and (*iii*) improvements in labor market outcomes (Layard, 2016; Chisholm et al., 2016). Based on these arguments, increased mental health coverage has entered policy recommendations by the WHO and the OECD as well as actual health care policy, for example, the *Mental Health Parity and Addiction Equity Act* in the US and *Improving Access to Psychological Therapies* in the UK. However, the claims of the Offset Hypothesis are based on studies fraught with methodological issues and there is no causal evidence from actual health care policies.

In this paper, I provide causal evidence of the effect of psychotherapy coverage on health care use, mental health and labor market outcomes. Based on this, I revisit the Offset Hypothesis and assess whether psychotherapy coverage is self-financing within an actual health care system.

I study a nationwide reform of the Danish public health insurance system in 2008. The reform introduced 60 percent coverage of the cost of psychotherapy for depression and anxiety patients delivered by private practice psychologists in an outpatient setting. It was largely modelled after *Improving Access to Psychological Therapies* in the UK and resembles similar polices in Norway and Australia as well as policy recommendations by the OECD (Hewlett and Moran, 2014). In contrast to other policies, however, the Danish government restricted eligibility to individuals within a certain age range to meet a fixed budget limit. The lower age threshold was set to age 18. The upper age threshold was determined by extending the age range, starting from age 18 and moving up, until the expected costs met the budget ceiling. This happened at age 37, which became the upper age limit. This arbitrary age cutoff and large-scale natural experiment provides unique opportunities to study the causal effect of psychotherapy coverage.

I exploit the quasi-experimental variation generated by the reform in two separate empirical strategies: (i) a Regression Discontinuity Design, comparing individuals just above and below the upper age threshold at 37, and (ii) a Difference-in-Difference strategy, comparing treated individuals aged 18-37 to untreated individuals aged 38-50, before and after the introduction of the policy. I implement both of these strategies using the full population. This is appropriate when studying mental health outcomes where compliers of the reform – psychotherapy users – account for a large share of the variation. However, compliers account for a small share of the variation in population-wide measures of physical health and labor market outcomes, making effects of the policy near impossible to detect. Instead, for these outcomes, I use an alternative Regression Discontinuity analysis comparing individuals experiencing a mental health shock just before or after turning 38 years old. As treatment is conditional on having a mental health shock, the share of compliers is much larger in this subsample than in the overall population.

To provide a uniquely comprehensive view of costs and benefits of psychotherapy coverage, I link high-frequency administrative data on health care use with a broad array of socioeconomic characteristics and labor market outcomes. Using data on the full population of Denmark during 2000-2016, I provide five sets of results.

First, I show that the reform provides psychological therapy for one percent of the population each year. This is a large effect considering that less than six percent of the population consume any mental health care within a year.

Second, I show that the introduction of psychotherapy coverage reduces psychiatric hospital contacts with depression or anxiety diagnoses by seven percent. Both outpatient ambulatory and emergency room visits decrease, but there is no change in hospitalizations, which are rare for these diagnoses. Psychotherapy coverage increases the use of mental health services provided by primary care physicians, representing a general shift from secondary to primary care. The use of antidepressants increases as well, implying that antidepressants and psychotherapy, in line with clinical guidelines, are used as complements in the treatment of depression and anxiety. This also implies that the disproportionally high use of psychiatric drugs seen in most countries cannot be explained by substitution towards drugs when access to psychotherapy is limited. Since surveys of patient preferences reveal a clear preference for psychotherapy over psychiatric drugs (Layard et al., 2007), this suggests that the disproportionately high use of psychiatric drugs is caused by supply-side factors and thus best addressed through supply-side policies (Cuddy and Currie, 2020a).

Third, I find that insurance coverage for psychotherapy has important positive effects on mental health and that the policy reduces the incidence of suicide attempts by twenty percent. This could be consistent with rational individuals trading off health care expenses and mental health. However, given that psychotherapy is a middle-cost treatment and suicide attempts are an extreme outcome, it seems reasonable to conclude that psychotherapy use was inoptimally low prior to the reform and that some of the increase in psychotherapy represents behavioral

hazard rather than moral hazard (Baicker et al., 2015). These results also suggest part of the reduction in psychiatric hospital contacts occurs because access to cheap psychotherapy prevents a worsening of mental health, as is often claimed in the debate on offsets.

Fourth, I find that psychotherapy coverage reduces the use of physical health care, including prescription drugs for physical ailments associated with mental illness, e.g., ulcer medications, and somatic hospital contacts. However, I find no evidence that psychotherapy coverage affects labor market outcomes and I can reject increases in employment of more than 3.6 months, reductions in sick leave of more than 2 months and reductions in disability pension receipt of more than 3 months within the first five years after treatment. These results have broad implications beyond psychotherapy coverage. This is one of the first papers to study the effect of health insurance on labor market outcomes in a country without employer-based insurance or means-tested public health insurance, both of which create work (dis)incentive effects (Currie and Madrian, 1999).[1] In addition, recent research documents how non-cognitive skills, including mental health, are crucial for children's future outcomes (Heckman et al., 2006) and are an increasingly important determinant of labor market success (Edin et al., 2017). However, my results suggest policies that improve mental health of adults have no effect on labor market outcomes.

Lastly, I estimate the effect on health insurance expenditure and show that reductions in mental health care offset 60 percent of the cost of psychotherapy coverage, while reductions in physical health care offset 150 percent of the cost. These results confirm the main prediction of the Offset Hypothesis: Insurance coverage for psychotherapy is self-financing. Theoretically, this is a sufficient condition for the policy to be welfare improving (Glazer and McGuire, 2012). Hence, the results suggest mental health coverage is both welfare improving and cost reducing. This confirms the economic rationale behind recent policies and continued efforts to close the gap in insurance coverage for mental health care.

[1] Employer-based insurance provides additional incentives for work (Garthwaite et al., 2014). Means-tested public health insurance provides disincentives for work (Baicker et al., 2014).

The rest of the paper is structured as follows. Section 2 reviews the existing literature on offsets of psychotherapy coverage. Section 3 describes the data and the institutional setting. Section 4 lays out a simple model of offsets and discusses welfare implications. Section 5 describes the estimates on mental health services and mental health, including empirical methods and robustness checks. Section 6 presents estimates on physical health care and labor market outcomes. Section 7 estimates the aggregate cost offset of psychotherapy coverage. Section 8 concludes.

2 Related Literature

The Offset Hypothesis dates back to Follette and Cummings (1967), who claimed psychotherapy coverage reduces the use of physical health care among worried-well patients. It has since been extended to include savings in mental health care and labor market outcomes (Layard, 2016). The Offset Hypothesis is based on the following chain of causal claims: (1) insurance coverage for psychotherapy would lead more individuals to use psychotherapy, correcting potential underuse, (2) the increase in treatment would improve mental health, (3) the improvement in mental health would (*i*) reduce the use of other mental health services, (*ii*) reduce the use of physical health services and (*iii*) improve labor market outcomes.[2,3] What can existing research tell us about these claims?

(1) The RAND Health Insurance Experiment (HIE), which randomized insurance eligibility to 5,809 individuals in the 1970s, and a wealth of recent contributions, document that health insurance coverage increases health care use (Manning et al., 1987; Card et al., 2008; Anderson et al., 2012; Finkelstein et al., 2012). A few papers study psychotherapy in particular and find suggestive evidence of larger responses for these services (Manning et al., 1987; Ellis et al., 2017). Hence, we can expect insurance coverage to increase the use of psychotherapy.

[2]Note that offsets may also arise more directly from price substitution between health care services.

[3]Another potential benefit of psychotherapy coverage is improved treatment of maternal depression, which could increase parental investments in children (Baranov et al., 2020).

(2) The effects of health insurance on health are much more debated and the results are mixed (Manning et al., 1987; Card et al., 2009; Goldin et al., 2021). Hence, marginal increases in psychotherapy do not necessarily improve mental health even though RCTs show that psychotherapy is effective on average (Layard, 2016). Baicker et al. (2013) study the Oregon Health Insurance Experiment, which randomized Medicaid eligibility, and find that health insurance coverage reduces depressive symptoms. However, the study cannot distinguish between effects arising from increased mental health care, physical health care or income effects from public health insurance.[4] A related literature finds that parity laws, which require insurance companies to provide the same level of coverage for mental health and physical health services, only lead to small increases in mental health care (CHBRP, 2010; Ettner et al., 2016). Nonetheless, Lang (2013) estimate a 5 percent reduction in suicides from state-level parity laws in the US. Hence, existing literature suggests mental health coverage may improve mental health.

(3i) Regarding offsets in other mental health services, the best available evidence comes from studies of physical health care. The RAND HIE estimated the effect of insurance coverage for outpatient care on inpatient hospital contacts and rejected economically significant offsets (Manning et al., 1987).[5] In a more recent contribution, Chandra et al. (2010) find that increased cost sharing for physician visits and prescription drugs reduces the use of these services, but increases inpatient hospitalizations, offsetting 20 percent of the savings on physician visits and prescription drugs. Whether these results generalize to mental health services and the case of psychotherapy coverage is, however, unclear.

(3ii) The effect of psychotherapy on physical health services has been extensively studied in medicine and psychology since the 1960s (Follette and Cummings, 1967; Jones and Vischi, 1979; Mumford et al., 1984; Eells, 1999). These studies find sizable reductions in physical health care, in particular, inpatient hospital contacts. However, most estimates are based on simple

[4]There is also a potential for income effects when studying psychotherapy coverage, but they are arguably much smaller than in studies of public health insurance coverage in general.

[5]The RAND HIE also tested the Offset Hypothesis, but lacked statistical power to confirm or reject it.

comparisons before and after treatment without appropriate control groups. Hence, it remains unclear whether psychotherapy coverage reduces the use of physical health care (Layard et al., 2007).

(3iii) The effect of psychotherapy coverage on labor market outcomes is largely unknown and there is no causal evidence from actual health care policies. The best available evidence comes from RCTs, which find suggestive evidence of increased employment (Wells et al., 2000) and reduced sickness absence (Nieuwenhuijsen et al., 2014).[6]

Overall, we know little about the effects of psychotherapy coverage and what we do know is scattered across studies in different settings. Assessing the case for health insurance coverage for psychotherapy requires a comprehensive view of the costs and benefits. This paper contributes new evidence to each of the strands of literature described above and, most importantly, provides estimates of the complete range of costs and benefits of psychotherapy coverage.

3 Institutional Setting and Data

The empirical analysis is based on Danish administrative data covering all citizens in Denmark during the period 2000-2016. I link yearly registers on socioeconomic characteristics with monthly labor market outcomes and health records. Labor market outcomes include employment, sick leave and disability pension receipt.[7]

Hospital contacts are recorded in the National Patient Register ('Landspatientregistret') with information on all inpatient, outpatient and emergency room (ER) visits at psychiatric and somatic hospitals. Primary care is recorded in the National Public Health Insurance Reg-

[6] In theory, public health insurance may actually reduce labor supply through negative income effects. Baicker et al. (2014) and Garthwaite et al. (2014) find zero and negative effects on employment from eligibility in public health insurance in the US. However, compared with these papers studying the effect of health insurance more broadly, income effects are arguably small in the case of psychotherapy coverage. Furthermore, the US employer-based health insurance system and means-tested public health insurance (Medicaid) makes negative labor supply effects much more probable than in countries with universal public health insurance.

[7] Labor market outcomes are recorded in the DREAM register. Employment is defined as having more than 80 hours of work within a month (full employment is 160). Employment information is only available from 2008. In Denmark, workers are entitled to sickness benefits, which reimburse employers for lost work hours due to sickness, for up to 5 months. Individuals who are not able to return to work thereafter may apply for disability pension and receive sickness benefits until this is granted or rejected. Mental illness is one of the main reasons individuals are granted a disability pension.

ister ('Sygesikringsregistret'), with information on services provided by primary care physicians (PCPs) and private practice specialists, including psychiatrists and psychologists.

The Danish public health insurance covers all registered citizens. Primary care physicians act as gatekeepers and access to specialized health care requires a referral. The majority of hospitals are public, while PCPs and specialists operate in small private practices. The policy is financed through income taxes and most health care services are provided free of charge. Patients pay for physical therapy, dental services, prescription drugs and psychological treatment.

Mental health care is organized in a stepped-care system. Depending on the severity of the illness, patients receive treatment through four different providers: (1) primary care physicians, (2) private practice psychologists, (3) private practice psychiatrists and (4) psychiatric hospitals. Primary care physicians are the first point of contact for most mental health patients. PCPs determine the diagnosis and appropriate treatment by discussing symptoms and administering psychometric tests in mental health consultations.[8] PCPs either prescribe drugs or refer patients to specialized care. According to clinical guidelines, PCPs should refer mild cases to psychotherapy, typically by private practice psychologists, while moderate cases should be treated with a combination of psychotherapy and drugs, prescribed either by a PCP or by a psychiatrist. Private practice psychiatrists treat moderate to severely ill patients, primarily by prescribing drugs.[9] For the most severe cases, PCPs are instructed to refer patients to a psychiatric hospital. Within psychiatric hospitals, patients are treated with psychiatric drugs and different kinds of counselling, including psychotherapy and social services. Most patients are treated on an outpatient basis while inpatient services are mostly used for patients with schizophrenia. Psychiatric hospitals also offer emergency services, which do not require a referral.

[8] A psychometric test is a survey of symptoms of depression and anxiety.

[9] There is a shortage of psychiatrists, meaning they rarely have time to provide therapy. Some of the patients seeing a psychiatrist are former and now stable psychiatric hospital patients.

The public health insurance scheme provides full coverage for all mental health services except therapy by private practice psychologists. However, since 1992, the public health insurance has covered 60 percent of the cost of up to 12 sessions with a psychologist for individuals experiencing specific traumatic events.[10] In 2007, this included nine different patient groups;

(1) victims of violence, (2) traffic accident victims, (3) next of kin to severe mental health patients, (4) patients with serious somatic diseases, (5) next of kin to patients with serious somatic diseases, (6) bereaved individuals, (7) patients who tried to commit suicide, (8) women who undergo an induced abortion after week 12 of the pregnancy,[11] and (9) victims of incest below age 18.[12]

The price of a 45-minute session with a psychologist is 860 DKK (137 USD) of which 516 DKK (82 USD) is paid by the public health insurance and 344 DKK (55 USD) by the patient.[13] While the nine criteria cover a broad group of traumatic events, the policy does not provide coverage for general depression or anxiety and these patients have to pay the full cost of psychological treatment themselves. This changed on April 1st 2008 with the introduction of a tenth criterion; (10) patients with mild to moderate depression aged 18 to 37 years, and on May 1st 2011 with the addition of an eleventh criterion; (11) patients with mild to moderate anxiety aged 18 to 28.[14]

The empirical analysis exploits the 2008-reform, which introduced the depression criterion and the upper age threshold at 37, to estimate the causal effect of psychotherapy coverage. In the Appendix, I show that PCPs use the depression criterion to refer both depression and anxiety patients to psychological treatment. Hence, in effect, the 2008-reform provides psychotherapy

[10]These individuals are eligible for up to a year after the event.

[11]In Denmark, induced abortion after week 12 of the pregnancy is illegal unless there are complications with the pregnancy, e.g., chromosomal abnormalities.

[12]Source: https://www.retsinformation.dk/Forms/R0710.aspx?id=10810

[13]This is 2020 prices. Source: http://okportalen.dk/VisDokument.aspx?FilID=5390 Page 108. The exchange rate is approximately 6.3 DKK/USD.

[14]Furthermore, these patients are eligible for re-referral and, in total, up to 24 sessions with a psychologist.

coverage for both depression and anxiety patients and the introduction of the anxiety criterion in 2011 had little effect on treatment rates.[15]

In July 2012, the upper age limit of the depression criterion was removed.[16] As the age-37 threshold is central to the identification strategy, the main analysis focuses on the period 2000-2011. To obtain a sharp distinction between pre and post-reform years, I define years as running from April to March, as the depression criterion is introduced in April 2008.[17]

Data Limitations

The dataset includes all health care covered by the public health insurance scheme, but there is no data on private expenditure. Therefore, I cannot study crowding out of private health care expenditure (Cutler and Gruber, 1996). Nonetheless, to estimate the cost offset, all I need is a measure of the costs of psychotherapy coverage – public psychotherapy costs – and potential benefits in terms of reduced use of other health care services and improved labor market outcomes. Because the private market for other health care services is negligible in Denmark, the lack of data on private health care expenditure is not a limitation for the analysis.

Mental Health Care Before the Introduction of Psychotherapy Coverage

Figure 1A displays the use of mental health services by age during the pre-reform period 2000-2007. For individuals using more than one type of service within a year, I plot the most care-intensive of the received treatments, ranging from PCP mental health consultations to inpatient contacts at psychiatric hospitals.

As shown in Figure 1A, the share of the population receiving some mental health care increases throughout life. Around one percent of children, five percent of young adults and six percent of the middle-aged receive some mental health care within a year. Two percent of the

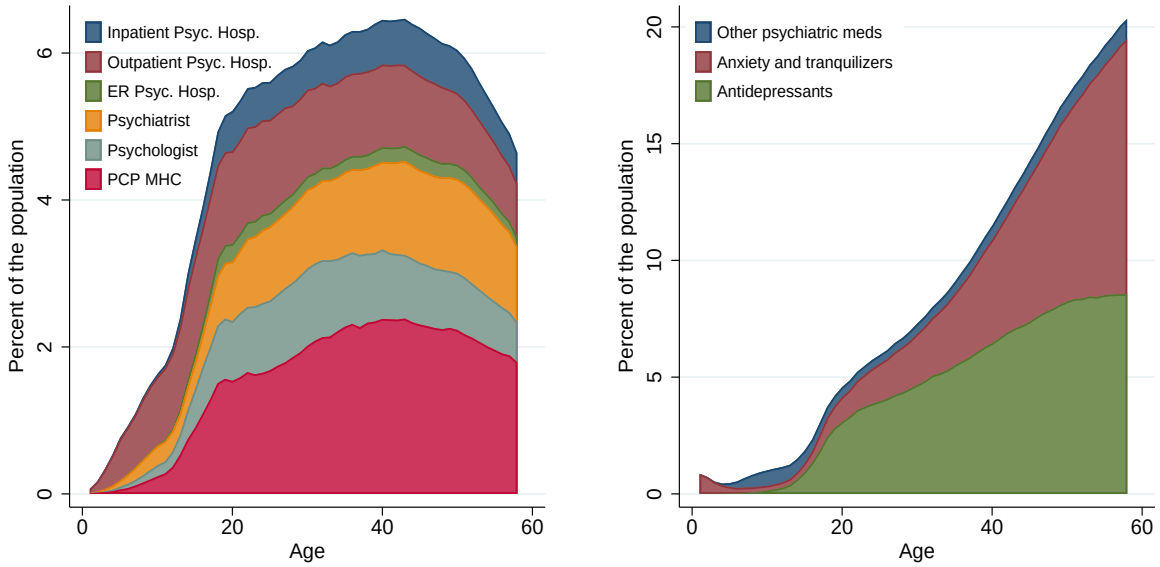
[15] This unintended use of the depression criterion has also been documented in an evaluation of the policy by Fjeldsted and Christensen (2011), who find that 68 percent of the patients in psychological treatment through the depression criterion do not suffer from mild to moderate depression – 29 percent suffer from severe depression while 39 percent are not depressed at all.

[16] At the same time, the upper age limit of the anxiety criterion was increased to 38.

[17] Hence, the pre-reform 2000-2007 runs from April 2000 to March 2008, while the post-reform period 2008-2011 runs from April 2008 to March 2012.

population see their PCP for mental health consultations. Around one percent see a psychologist, another one percent see a psychiatrist and two percent are treated at psychiatric hospitals. Within psychiatric hospitals, around half of the patients suffer from anxiety or depression and more than half of these patients are mild to moderate cases, see Appendix Figure A.3.

Figure 1: Age Profiles of Mental Health Care



A Use of Mental Health Services

B Psychiatric Drug use

Note: Panel A shows the percent of the population using different mental health services by age. If a person uses more than one type of mental health treatment in a year, I plot the most care-intensive treatment based on the following ranking; (1) inpatient contacts at psychiatric hospitals, (2) outpatient contacts at psychiatric hospitals, (3) emergency room visits at psychiatric hospitals, (4) private practice psychiatrists, (5) private practice psychologists and (6) PCP mental health consultations. Panel B plots the share of the population on psychiatric drugs, split into antidepressants (ATC N06 excl. N06AB), anxiety and tranquillizers (ATC N05B and N05C) and other psychiatric drugs (ATC N05-6, excl. the other drugs). For individuals using more than one type of drug, I plot only one based on the following priority 1) antidepressants, 2) anxiety medications, 3) other.

Figure 1B plots the share of the population using psychiatric drugs. Around five percent of 20-year-olds, twelve percent of 40-year-olds and twenty percent of 60-year-olds use psychiatric drugs, making it the most common type of mental health treatment. There are equally many 20-year-olds, twice as many 40-year-olds and five times as many 60-year-olds using psychiatric drugs as there are using any mental health service. Hence, many patients only receive psychiatric

drugs.[18] While this violates clinical guidelines, it is consistent with treatment patterns in other countries (Layard et al., 2007; Cuddy and Currie, 2020a).

Expected Effects of Psychotherapy Coverage

How should we expect the introduction of psychotherapy coverage to affect the treatment of mental illness? As discussed, many mild to moderate patients were treated in psychiatric hospitals before the reform. Based on this, we might expect psychotherapy coverage to reduce psychiatric hospital contacts, as these patients could be treated by psychologists instead. If these patients also need drugs, a shift away from psychiatric hospitals could increase PCP or psychiatrist visits, as psychologists cannot prescribe drugs. Furthermore, the reform may induce more individuals to seek any treatment – including drugs. Therefore, it is not clear whether private practice psychiatrists or psychiatric drugs are substitutes or complements to psychotherapy.

4 Offset Theory

To evaluate the welfare implications of offsets, I consider a simple model of health insurance inspired by Glazer and McGuire (2012) and McGuire (2011).

Individuals are sick with probability p and healthy with probability $1-p$. Healthy individuals derive utility from non-health consumption, y^h, while sick individuals derive utility from non-health goods, y^s, and health care services, x_1 and x_2. We can think of x_1 as psychological treatment and x_2 as psychiatric hospital treatment. Expected utility is:

$$EU = pU^s(x_1, x_2, y^s) + (1-p)U^h(y^h) \tag{1}$$

Individuals spend all their income, I, on non-health consumption and health care services:

$$y^h = I - \pi, \qquad y^s = I - \pi - (1-c_1)x_1 - (1-c_2)x_2 \tag{2}$$

The price of health care is normalized to 1 and c is the share of costs paid by the insurance. The insurance policy is actuarial fair with premiums $\pi = p[c_1x_1 + c_2x_2]$. The effect of a marginal

[18] Part of this pattern may be explained by patients mostly using mental health services around the onset of the disease, while many stay on psychiatric drugs for the rest of their life.

change in psychotherapy coverage (c_1) on expected utility is (derivation in Appendix):

$$\frac{\frac{dEU}{dc_1}}{\bar{U}_y} = \underbrace{\frac{U_y^s - \bar{U}_y}{\bar{U}_y} x_1}_{\text{Marginal Insurance Value}} - \underbrace{c_1 \frac{dx_1}{dc_1}}_{\text{Moral Hazard}} - \underbrace{c_2 \frac{dx_2}{dc_1}}_{\text{Offset}} \tag{3}$$

where U_y^s is the marginal utility of non-health consumption in the sick state and $\bar{U}_y = pU_y^s + (1-p)U_y^h$ is the expected marginal utility of non-health consumption.

The first term shows the marginal insurance value and the consumption smoothing gain from a marginal increase in the generosity of psychotherapy coverage. The second term captures the moral hazard effect, which reduces welfare because a lower out-of-pocket price induces individuals who value psychotherapy below its full cost to start treatment. Hence, the first two terms represent the classic trade-off between risk protection and efficiency. The third term is the offset. The sign of the offset depends on whether x_1 and x_2 – psychotherapy and psychiatric hospital treatment – are substitutes or complements. If they are substitutes, the offset is positive because the lower out-of-pocket price of psychotherapy reduces psychiatric hospital use and creates a positive fiscal externality.[19] Conversely, if they are complements, the offset is negative.

The marginal insurance value is always positive but depends on unobserved preferences. Therefore, without offsets, it is not possible to say if an increase in insurance coverage is optimal.[20,21] However, if offsets are positive and larger than the increase in moral hazard, $-\frac{c_2 \frac{dx_2}{dc_1}}{c_1 \frac{dx_1}{dc_1}} > 1$, this is a sufficient condition for the policy change to be welfare improving.[22]

The policy change is self-financing if offsets are larger than the cost of the policy. Specifically, $-\frac{c_2 \frac{dx_2}{dc_1}}{c_1 \frac{dx_1^p}{dc_1}} > 1$, where $c_1 \frac{dx_1^p}{dc_1}$ is public psychotherapy costs. This condition is sufficient, but not necessary for welfare improvements, because substitution from private to public psychotherapy

[19] If patients are fully rational, it follows from the Envelope theorem that substitution from psychiatric hospital treatment to psychotherapy does not affect their welfare.

[20] The marginal insurance value is positive if individuals are risk averse and coverage is not full initially, $c_1 < 1$.

[21] If there is moral hazard, $\frac{dx_2}{dc_1} > 0$, it is optimal with some but not full coverage, $0 < c_1 < 1$.

[22] As the marginal insurance value is always positive, this is a sufficient, but not necessary condition for welfare improvements.

does not increase moral hazard ($\frac{dx_1^p}{dc_1} \geq \frac{dx_1}{dc_1}$). Therefore, any self-financing policy is also welfare improving and we can use this as a sufficient statistic.[23]

Based on the above model, I calculate the aggregate cost offset (CO) as the change in public health insurance costs across other health care services divided by public psychotherapy costs:

$$CO = -\frac{\sum_{j=2} c_j \frac{dx_j}{dc_1}}{c_1 \frac{dx_1^p}{dc_1}} \tag{4}$$

Labor market improvements are not included in the model, but the same logic applies: Changes in labor market outcomes affect welfare if they are associated with fiscal externalities. Hence, government spending on disability pension, sick leave, unemployment benefits and tax revenue from increased earnings should all be included, but increases in net-of-tax earnings accruing only to the individual should not.[24]

5 Impact on Mental Health Services and Mental Health

This section estimates the effect of the introduction of the depression criterion in 2008 on the use of mental health services and mental health.

Methods

The depression criterion creates a discontinuity in the out-of-pocket price of psychological treatment at age 37. As the age-37 threshold is arbitrary and does not determine eligibility in other public policies, I can use this to identify the effect of psychotherapy coverage in a Regression Discontinuity design (RD). The estimation model is:

$$Y_{it} = \alpha_0 + f(a) + \alpha_1 Treat_{it} + \mu_{it} \tag{5}$$

where Y_{it} is the outcome of interest, $Treat_{it}$ is an indicator equal to one for individuals below age 38, $f(a)$ is a continuous age profile and μ_{it} is the individual error. The discontinuity at

[23] This is based on a rationality assumption. If individuals underuse psychotherapy, e.g., because of stigma, or if treatment is associated with non-pecuniary externalities, e.g., health effects, cost-increasing policies may also be welfare improving.

[24] Intuitively, any benefit of treatment accruing to the individual is already part of the decision to seek treatment, while costs and benefits to others are not, and policy makers may force individuals to internalize these using subsidies and taxes.

the cutoff and the causal effect of psychotherapy coverage is captured by α_1. I estimate the age profile $f(a)$ using local linear regression with a triangular kernel and a bandwidth of 7.5 years. In addition, I allow for different age profiles on each side of the cutoff. The identifying assumption is that the relationship between outcomes and the running variable (age) would have been continuous if not for the depression criterion.[25]

The RD method identifies short-run treatment effects on 37-year-olds.[26] To study heterogeneity in treatment effects by age, I complement the analysis with a Difference-in-Difference design (DID), comparing the change in outcomes before and after the introduction of psychotherapy coverage between a treatment group of individuals aged 18-37 years and a control group of individuals aged 38-50 years. The DID method identifies treatment effects on the entire eligible population from age 18 to 37 and captures medium-term effects of psychotherapy coverage. However, it relies on stronger identifying assumptions than the RD method. The estimation model of the DID method is as follows:

$$Y_{it} = \beta_0 + \beta_1 Treat_{it} + \beta_2 Post_t + \beta_3 Post_t \times Treat_{it} + \epsilon_{it} \tag{6}$$

where $Treat_{it}$ is a treatment indicator equal to one for ages 18-37, $Post_t$ is an indicator for the post-reform period 2008-2011 and ϵ_{it} is the individual error. The β_3 coefficient captures the causal effect of psychotherapy coverage. The identifying assumption, also called the parallel trends assumption, is that the difference in outcomes between the treatment and control groups would have remained constant had it not been for the reform.

Mental Health Services

Figure 2A shows the share of the population starting psychological treatment through the public health insurance system by age during the post-reform period 2008-2011. I follow previous

[25]Note that this is different from a standard RD in that treatment is not locally randomized. Instead, identification relies on a continuity argument. Examples of papers using this strategy: Card et al. (2008); Anderson et al. (2012); Shigeoka (2014).

[26]In addition to the upper age threshold at 37, the depression criterion has a lower age limit at age 18. However, unlike the age-37 threshold, the age-18 threshold is not arbitrary and age 18 is used as a cutoff in many other settings. In Appendix Table A.1, I show that Difference-in-Discontinuity (RD-DID) estimates, using the age-18 cutoff, are similar to DID estimates on the youngest treated individuals.

literature and consider treatment initiations, here defined as the first treatment in at least a year (Cuddy and Currie, 2020b). I do this because insurance coverage is more likely to change treatment trajectories of new patients and because the age limit of the depression criterion only applies to new referrals. Hence, individuals who started treatment before age 38 can continue to receive psychotherapy. The focus on treatment initiations also enables me to directly compare RD coefficients estimated on monthly data with DID coefficients estimated on yearly data because I can convert RD coefficients to yearly rates by multiplying by 12.[27]

Each year around two percent of the population below age 38 starts psychological treatment. This share drops discontinuously to around one percent after age 37 – the upper age limit of the depression criterion – after which only patients experiencing traumatic events have psychotherapy coverage.[28] The RD estimate is 0.71, implying that 0.7 percentage points more 37-year-olds start psychological treatment because of the depression criterion. This is a substantial effect considering that about six percent of 40-year-olds use any mental health care in a given year. While these numbers do not include private health care expenditure on psychotherapy, they do show that the reform caused a lot more individuals to receive psychotherapy through the public health insurance. The question is now whether this led to reductions in other mental health services.

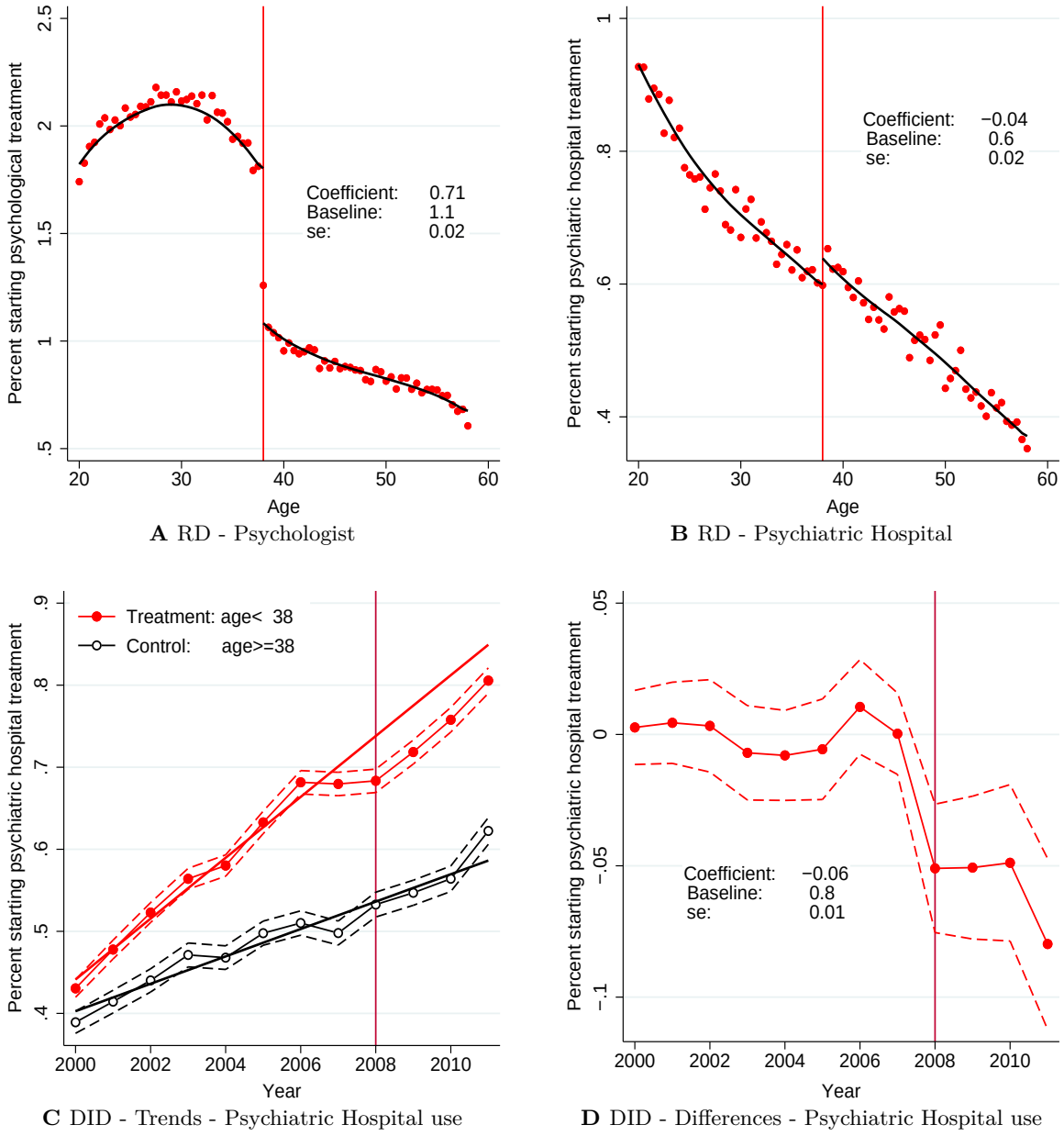
As shown in Figure 2B, the probability of starting treatment at a psychiatric hospital with a depression or anxiety diagnosis decreases with age, but increases discontinuously after age 37. This suggests that more individuals below age 38 would have visited a psychiatric hospital if not for the depression criterion. The RD estimate is -0.04 percentage points – a 7 percent reduction.[29]

[27] This works for treatment initiations because, by definition, it is not possible to start treatment more than once in a given year.

[28] One could worry that knowledge of the age threshold could lead to intertemporal substitution with patients seeking care just before turning 38 to secure eligibility. However, as shown in Figure 2A, there is no evidence of "bunching" below the age threshold.

[29] In Appendix Figure A.7, I show that there are no consistent effects on psychiatric hospital contacts with other diagnoses.

Figure 2: Effect on Mental Health Services



A RD - Psychologist

B RD - Psychiatric Hospital

C DID - Trends - Psychiatric Hospital use

D DID - Differences - Psychiatric Hospital use

Note: Panels A and B display RD estimates on 37-year-olds and the percentage of the population starting treatment by age during the post-reform period 2008-2011. Panel A plots the use of psychologists while Panel B plots psychiatric hospital contacts with a depression or anxiety diagnosis. The coefficients are estimated using monthly data, but plotted by age measured at a half-yearly level. The smooth age profiles are estimated using local linear regression with a bandwidth of 7.5 years. I exclude the month that individuals turn 38, as they are both eligible and ineligible for psychotherapy coverage in that month. Standard errors are clustered at the individual level. Panels C and D illustrate the DID-method using estimates on psychiatric hospital contacts. Panel C plots the share of the population starting treatment in the treatment and control groups over time, along with separate linear pre-trends estimated using the years 2000-2007. Panel D plots the difference in the deviation from these pre-trends between the treatment and control groups over time. All outcomes are defined as probabilities of starting treatment, defined as the first treatment in at least twelve months. Standard errors are bootstrapped using 500 repetitions and clustered sampling at the individual level.

Table 1 presents the full results on various mental health services. In addition to RD estimates on 37-year-olds, I report DID estimates on all individuals aged 18 to 37 and for each 5-year age range: 18-22, 23-27, 28-32, and 33-37. Before estimating the DID models, I first take out separate linear pre-trends for the treatment and control groups to account for age-specific trends. Figure 2, panels C and D, show the results on psychiatric hospital contacts to illustrate the method. Psychiatric hospital contacts increase at a faster pace in the treatment group than in the control group during the pre-reform period 2000-2007, suggesting the parallel trends assumption is not valid. However, the two groups share the same deviations from their respective pre-trends and, as shown in Figure 2D, the difference in deviations is stable around zero until 2008. This suggests the DID method is valid once pre-trends are accounted for.[30] In 2008, when the depression criterion is introduced, the difference in deviations drops dramatically as psychiatric hospital contacts fall below trend in the treatment group but stays on trend in the control group. Hence, psychotherapy coverage reduces psychiatric hospital contacts. The DID estimate is -0.06 %-points (7.5 percent).[31]

The first row of Table 1 reports the results for psychotherapy use. The estimates range from 0.71 to 0.98 percentage points across age groups and methods. The estimates are largest for individuals in the middle of the eligible age range around age 30 and smallest for the youngest individuals around age 18 and the oldest individuals around age 37. This pattern might reflect that the incidence of new episodes of mental illness is decreasing in age, but that the USD 50 co-payment on psychotherapy still deters some of the youngest age groups from seeking treatment.

The second row shows treatment effects on psychiatric hospital contacts. The DID estimates range from -0.043 percentage points for 33-37-year-olds to -0.086 percentage points for 18-22-year-olds. Hence, the offset in psychiatric hospital contacts is much larger for the young. The

[30] The augmented identifying assumption is that the difference in deviations from pre-trends would have stayed constant if not for the reform.

[31] Appendix Figures A.5 and A.4 replicate Figures 2B and 2D for all outcomes studied in this section.

Table 1: Effects on Mental Health Services

Method			DID			RD
Age range	18-37	18-22	23-27	28-32	33-37	37
Psychologist	0.924***	0.826***	0.979***	0.974***	0.917***	0.713***
	[1.051]	[0.969]	[1.023]	[1.126]	[1.055]	[1.108]
	(0.015)	(0.025)	(0.023)	(0.023)	(0.022)	(0.025)
Psychiatric hospital	-0.058***	-0.086***	-0.072***	-0.061***	-0.043***	-0.043***
	[0.799]	[0.982]	[0.848]	[0.762]	[0.682]	[0.652]
	(0.011)	(0.022)	(0.017)	(0.017)	(0.016)	(0.016)
Psyc. hosp. outpat	-0.039***	-0.040***	-0.057***	-0.040***	-0.030**	-0.031**
	[0.444]	[0.511]	[0.474]	[0.435]	[0.386]	[0.365]
	(0.008)	(0.016)	(0.012)	(0.013)	(0.012)	(0.012)
Psyc. hosp. ER	-0.022***	-0.056***	-0.025**	-0.020*	-0.013	-0.010
	[0.328]	[0.450]	[0.357]	[0.297]	[0.259]	[0.244]
	(0.007)	(0.014)	(0.012)	(0.011)	(0.010)	(0.010)
Psyc. hosp. inpat	-0.008	-0.005	-0.006	-0.013*	-0.009	0.002
	[0.161]	[0.177]	[0.159]	[0.158]	[0.156]	[0.150]
	(0.006)	(0.009)	(0.008)	(0.007)	(0.007)	(0.008)
PCP MHC	0.175***	0.225***	0.201***	0.188***	0.160***	0.055
	[3.090]	[2.700]	[2.927]	[3.204]	[3.354]	[3.429]
	(0.024)	(0.038)	(0.037)	(0.036)	(0.037)	(0.037)
PCP psych. test	0.848***	0.991***	0.953***	0.875***	0.654***	0.214***
	[2.491]	[2.307]	[2.554]	[2.524]	[2.523]	[2.782]
	(0.020)	(0.033)	(0.030)	(0.030)	(0.028)	(0.034)
Psychiatrist	0.020	0.077***	0.011	0.002	0.001	0.001
	[0.695]	[0.683]	[0.711]	[0.702]	[0.687]	[0.691]
	(0.012)	(0.021)	(0.019)	(0.019)	(0.017)	(0.017)

Note: The table presents effects of the introduction of psychotherapy coverage in 2008 on the percentage of the population using various mental health services. Columns 1-5 present DID estimates for the following age groups: 18-37 (all treated individuals), 18-22, 23-27, 28-32 and 33-37. In these regressions, I first estimate and take out separate linear pre-trends for the treatment and control groups using the pre-reform period 2000-2007. Standard errors are bootstrapped using 500 repetitions and clustered sampling at the individual level. Column 6 presents RD estimates on 37-year-olds, using the age-37 threshold of the depression criterion and monthly data. Because individuals are both eligible and ineligible for psychotherapy coverage the month they turn 38 years, I exclude this month. All outcomes are defined as probabilities of starting treatment, meaning the first treatment in at least twelve months. For the psychiatric hospital outcomes in rows 2-5, I focus on anxiety and depression diagnoses. The brackets report the counterfactual probability of the outcomes in the treatment group. For the DID results, this is equal to the projected post-reform outcome of the treatment group as based on the pre-trend plus the post-reform deviation from the pre-trend in the control group. For the RD results, this is equal to the level of the outcome just above the age cutoff. Standard errors clustered at the individual level are reported in parenthesis. *** $p<0.001$ ** $p<0.05$, * $p<0.1$.

RD estimate on 37-year-olds is identical to the DID estimate on 33-37-year-olds, suggesting the methods are internally consistent.

The results on psychiatric hospital treatments are driven by reductions in outpatient contacts and ER visits, while the estimates on inpatient contacts are small and insignificant. Inpatient contacts with depression or anxiety diagnoses are rare, with baseline probabilities, shown in brackets, of 0.16 percent.

Psychotherapy coverage increases the use of PCP mental health consultations with an overall DID estimate of 0.18 percentage points (6 percent). This may reflect that PCPs often discuss symptoms and psychometric tests with patients before referring them to psychological treatment. Indeed, the use of psychometric tests increases almost as much as the use of psychotherapy with an overall DID estimate of 0.85 percentage points. Nonetheless, these results may also reflect that more patients are treated by PCPs in collaboration with psychologists, implying a general shift from secondary to primary care.

Surprisingly, psychotherapy coverage does not affect the use of private practice psychiatrists. All estimates except the DID estimate on 18-22-year-olds are close to zero and insignificant. The estimate on 18-22-year-olds is positive and significant, but the increase appears in 2011 – three years after the depression criterion is introduced. The Danish Health Authority tightened guidelines on antidepressant treatment in 2011 after years of rapid growth. They recommended that children and young adults always see a psychiatrist before receiving antidepressants, which is a likely explanation for the observed increase in the use of psychiatrists among the young.[32]

Psychiatric Drugs

Table 2 presents results on the use of antidepressants and anxiety medications. At the same as the tightening of clinical guidelines on depression treatment for children and young adults in 2011, the Danish Health Authority questioned benefits of antidepressants and put focus on their side effects to reduce perceived overuse. This led to massive reductions in antidepressant use

[32] https://www.sst.dk/da/nyheder/2013/faerre-bruger-antidepressiv-medicin

Table 2: Effects on Psychiatric Drugs

Method			DID			RD
Age range	18-37	18-22	23-27	28-32	33-37	37
Antidepressants	0.051***	0.017	0.036	0.086***	0.032	0.048**
	[1.485]	[1.724]	[1.500]	[1.392]	[1.413]	[1.317]
	(0.016)	(0.030)	(0.024)	(0.023)	(0.023)	(0.024)
Anxiety & tranquilizers	0.035**	0.039*	0.036	0.049**	0.030	-0.033
	[0.755]	[0.581]	[0.681]	[0.771]	[0.911]	[1.045]
	(0.017)	(0.022)	(0.022)	(0.023)	(0.024)	(0.021)

Note: The table presents effects of the introduction of psychotherapy coverage in 2008 on the percentage of the population using psychiatric drugs. Columns 1-5 present DID estimates for the following age groups: 18-37 (all treated individuals), 18-22, 23-27, 28-32 and 33-37. In these regressions, I first estimate and take out separate linear pre-trends for the treatment and control groups using the pre-reform period 2000-2007 and I limit the post-reform period to the years 2008-2010. Standard errors are bootstrapped using 500 repetitions and clustered sampling at the individual level. Column 6 presents RD estimates on 37-year-olds, using the age-37 threshold of the depression criterion and monthly data. Because individuals are both eligible and ineligible for psychotherapy coverage the month they turn 38 years, I exclude this month. All outcomes are defined as probabilities of starting treatment, here specified as the first treatment in at least five years. The brackets report the counterfactual probability of the outcomes in the treatment group. For the DID results, this is equal to the projected post-reform outcome of the treatment group as based on the pre-trend plus the post-reform deviation from the pre-trend in the control group. For the RD results, this is equal to the level of the outcome just above the age cutoff. Standard errors clustered at the individual level are reported in parenthesis. *** $p<0.001$ ** $p<0.05$, * $p<0.1$.

from 2011, see Appendix Figure A.6. To avoid this coinciding policy change, I restrict the post-reform period to 2008-2010 when estimating the DID results on psychiatric drugs. Furthermore, I define treatment initiations as the first time in five years - the furthest back the data allows for - rather than one year.[33] I do this because psychiatric drugs are particularly noisy and patients move in and out of treatment with gaps of several years. I discuss the sensitivity of the results to the definition of treatment initiations in the robustness section.

Psychotherapy coverage increases antidepressant use. The overall DID estimate on 18-37-year-olds is 0.05 percentage points (3.4 percent). The effects are largest for 28-32-year-olds with an increase of 0.09 percentage points while the DID estimates for the remaining age groups are positive but insignificant. The RD estimate on 37-year-olds is 0.048 percentage points and significant. Overall, these results suggest antidepressants are used as complements to psychotherapy, in line with clinical guidelines. A possible explanation is that psychotherapy coverage induces more individuals to seek mental health care and that some of these patients need antidepressants.

[33]The data on psychiatric drugs go back to 1995 and the pre-reform period starts in 2000.

In Appendix Table A.2, I show that the increase in antidepressants is driven by prescriptions from PCPs, while antidepressant prescriptions from psychiatrists and hospital doctors are unchanged.

The use of anxiety medications and tranquilizers increases slightly with an overall DID estimate on 18-37-year-olds of 0.035 percentage points. However, the coefficients are only borderline significant and the RD estimate on 37-year-olds is negative, suggesting these results should be interpreted with caution.

Mental Health

Table 3 reports the effect on suicide attempts. Suicide attempts include unsuccessful attempts leading to an acute hospital contact and successful attempts leading to death. This is an extreme measure of poor mental health. However, among young adults in particular, suicide attempts are relatively common. As shown in brackets in Table 3, around 0.2 percent of 18-year-olds try to commit suicide each year. Less than 2 percent of these attempts result in death, see Appendix Figure A.8. Hence, most suicide attempts are cries for help rather than actual attempts to end life. Whether a given hospitalization is recorded as a suicide attempt is a judgement made by nurses and doctors, who are instructed to record a suicide attempt if a person engages in self-harm or, in the absence of intervention, would have engaged in self-harm even if the motive is not to end life. Hence, the definition is broad and encompasses more mild cases as well.

Taking an overdose of painkillers, usually over-the-counter drugs, is the most common type of suicide attempt. The recording of poisoning from painkillers is less contingent on the judgement of individual nurses and doctors than the recording of suicide attempts. Therefore, I also report results for this outcome.

The introduction of the depression criterion causes a decline in suicide attempts. The overall DID estimates on 18-37-year-olds is -0.027 percentage points – a twenty percent reduction. The effect is much larger among the young. The DID estimates range from -0.058 percentage points for 18-22-year-olds to -0.011 percentage points for 33-37-year-olds. The RD estimate on 37-

Table 3: Effects on Mental Health

Method			DID			RD
Age range	18-37	18-22	23-27	28-32	33-37	37
Suicide attempts	-0.027***	-0.058***	-0.040***	-0.021***	-0.011***	-0.001
	[0.133]	[0.236]	[0.149]	[0.100]	[0.085]	[0.069]
	(0.003)	(0.006)	(0.004)	(0.004)	(0.004)	(0.005)
Poisoning from painkillers	-0.012***	-0.037***	-0.018***	-0.007**	-0.006**	-0.005
	[0.104]	[0.219]	[0.112]	[0.068]	[0.060]	[0.052]
	(0.002)	(0.005)	(0.004)	(0.003)	(0.003)	(0.005)

Note: The table presents effects of the introduction of psychotherapy coverage in 2008 on the percentage of the population experiencing suicide attempts and poisoning from painkillers. Columns 1-5 present DID estimates for the following age groups: 18-37 (all treated individuals), 18-22, 23-27, 28-32 and 33-37. In these regressions, I first estimate and take out separate linear pre-trends for the treatment and control groups using the pre-reform period 2000-2007. Standard errors are bootstrapped using 500 repetitions and clustered sampling at the individual level. Column 6 presents RD estimates on 37-year-olds, using the age-37 threshold of the depression criterion and monthly data. Because individuals are both eligible and ineligible for psychotherapy coverage the month they turn 38 years, I exclude this month. All outcomes are defined as probabilities of starting treatment, meaning the first treatment in at least twelve months. The brackets report the counterfactual probability of the outcomes in the treatment group. For the DID results, this is equal to the projected post-reform outcome of the treatment group as based on the pre-trend plus the post-reform deviation from the pre-trend in the control group. For the RD results, this is equal to the level of the outcome just above the age cutoff. Standard errors clustered at the individual level are reported in parenthesis. *** $p<0.001$ ** $p<0.05$, * $p<0.1$.

year-olds is zero. The lack of a decline in suicide attempts among the oldest treated individuals does not necessarily mean mental health does not improve in this group. As shown in Appendix Figure A.8, the share of suicide attempts resulting in death increases with age from around 2 percent among 18-year-olds to 12 percent among 37-year-olds. Hence, a suicide attempt is a more extreme outcome in these ages.

The results on poisoning from painkillers mimic the results on suicide attempts, but with smaller coefficients. The overall DID estimate is -0.012 percentage points on a basis of 0.1 percent. Overall, these results suggest psychotherapy coverage substantially improves mental health.

Heterogeneity

Appendix Tables A.3 and A.4 split the results by income and gender, respectively. Overall, the lowest income tertile accounts for most of the offset in mental health services and mental health. Moreover, the increase in psychotherapy and the offsets in mental health services is much larger

for women, who have markedly higher baseline probabilities of anxiety and depression (Pedersen et al., 2014).

Robustness

This section describes a number of robustness checks, which are provided in the Appendix, of the empirical results on mental health services and mental health. I focus on the following outcomes: Psychiatric hospital contacts, antidepressants and suicide attempts.

In Appendix Figure A.9, I show that the RD estimates are not sensitive to the choice of bandwidth in the estimation of local linear age profiles. Appendix Figure A.10 displays RD estimates using a wide range of placebo age cutoffs. These show that the significant RD estimates on 37-year-olds are clear outliers and, therefore, unlikely to be spurious age discontinuities.

For the Difference-in-Difference results, the main concern is that the control group, consisting of individuals aged 38 to 50 years, is very different from the treatment group aged 18 to 37 years. In Appendix Figure A.11, I show that the results do not change if I reduce the maximum age of the control group from 50 to 40 years to make the two groups more comparable. Furthermore, in Appendix Table A.1, I show that estimating a Difference-in-Discontinuity model around the lower age-18 cutoff of the depression criterion yields similar results to the DID estimates on 18-22-year-olds – the age group furthest from the control group in age.[34]

I estimate the DID results as deviations from linear pre-trends, predicted using the pre-reform period 2000-2007. By accounting for pre-trends, I implicitly condition on the outcome variable in the pre-reform period. This might cause a mechanical deviation from trend in 2008 – the first year of the post-reform period – when I no longer condition on the outcome variable. In Appendix Figure A.13, I show that the DID results do not meaningfully change if I instead estimate the pre-trends using the years 2000-2004, 2000-2005 or 2000-2006.

Both the DID and RD methods compare treated individuals on one side of the age cutoff with control individuals on the other side. The underlying assumption is that the control group

[34]The lower age limit at age 18 is not arbitrary and is used in many other public policies. However, the Difference-in-Discontinuity model accounts for any pre-existing discontinuities at age 18.

is unaffected by the reform, such that differences between treated and control individuals can be interpreted as treatment effects. However, one might worry that the arbitrary and unfair nature of age cutoffs lead PCPs to treat control individuals differently than otherwise to compensate them. To show that this is not the case, Appendix Figure A.12 plots the post-reform deviation from pre-trends for each two-year age group between 18 and 50 years. For both psychiatric hospital contacts and suicide attempts, the deviation from trend is zero above age 38, while they are all negative below. This suggests the observed treatment effects arise through reductions in the treatment group rather than increases in the control group. For antidepressants, the deviations from pre-trend are also close to zero in the control group, but positive in the treated age range, implying that the observed effect arises through increases in antidepressant use among the treated rather than reductions among control individuals.

Increased use of psychotherapy in the treatment group might increase waiting lists and reduce access to treatment for the control group. However, as shown in Appendix Figure A.2, the use of psychotherapy in the control group remains stable after the introduction of the depression criterion, suggesting the reform did not reduce access to treatment for ineligible patients.

Lastly, in Appendix Figure A.14, I evaluate the robustness of the results to the definition of and focus on treatment initiations. I run the main regressions using, as the outcome, a dummy equal to one if the patient receives treatment for the first time in x months, for each x between 0 and 60. The focus on treatment initiations is particularly important for the RD estimates as they require sharp changes in outcomes across age cutoffs. Because of path dependence, the variation in treatment rates over time is largely determined by idiosyncratic variation among existing patients, making it difficult to detect treatment effects on first time patients. The DID estimates do not rely on sharp effects by age and are, therefore, less sensitive to the definition of the outcome. Likewise, the results on suicide attempts and psychiatric hospital contacts are less sensitive to this issue than the results on antidepressants – the most path-dependent of the outcomes.

6 Physical Health and Labor Market Outcomes

The results in the previous section demonstrate that psychotherapy coverage has a significant impact on how mental health patients are treated and on their mental health. In this section I ask whether this leads to improvements in physical health and labor market outcomes. Estimating these effects is difficult because compliers of the policy make up less than one percent of the population. Under these circumstances, detecting an effect on mean outcomes of the full population is only possible for outcomes for which a large part of the variance is plausibly driven by compliers, for example, psychiatric hospital contacts. For physical health and labor market outcomes, the methods used up until now are not informative about the effects of psychotherapy coverage.

Instead, I consider a subsample of the population with a mental health shock, defined as the first time the individual receives a psychometric test from their PCP.[35] Psychometric tests are used to diagnose mental illness, in particular depression and anxiety. Therefore, psychotherapy is common among these patients and many are compliers of the policy. This allows me to detect even small treatment effects on this subsample.

To identify the effect of psychotherapy coverage, I again use a Regression Discontinuity design, now comparing individuals who experience a mental health shock just before and after turning 38. Because I condition on having a psychometric test, this specification is subject to concerns about manipulation of the running variable. If psychotherapy coverage increases the probability of getting a psychometric test, individuals below the cutoff might differ from those above, thus invalidating the identifying assumptions of the RD method. However, within this framework, I can follow individuals before and after they receive the psychometric test. Therefore, I can evaluate and account for pre-existing differences between individuals on either side of the cutoff.

[35] This is defined as the first time in 12 months. I allow for multiple events per individual.

While this method allows me to study physical health and labor market outcomes, the results are specific to 37-year-olds. One could compare individuals who experience a mental health shock between ages 18-37 (treatment group) and 38-50 (control group) in a Difference-in-Difference design. However, labor market outcomes of young adults who have not yet entered the labor market are not comparable to those of adults above age 37.

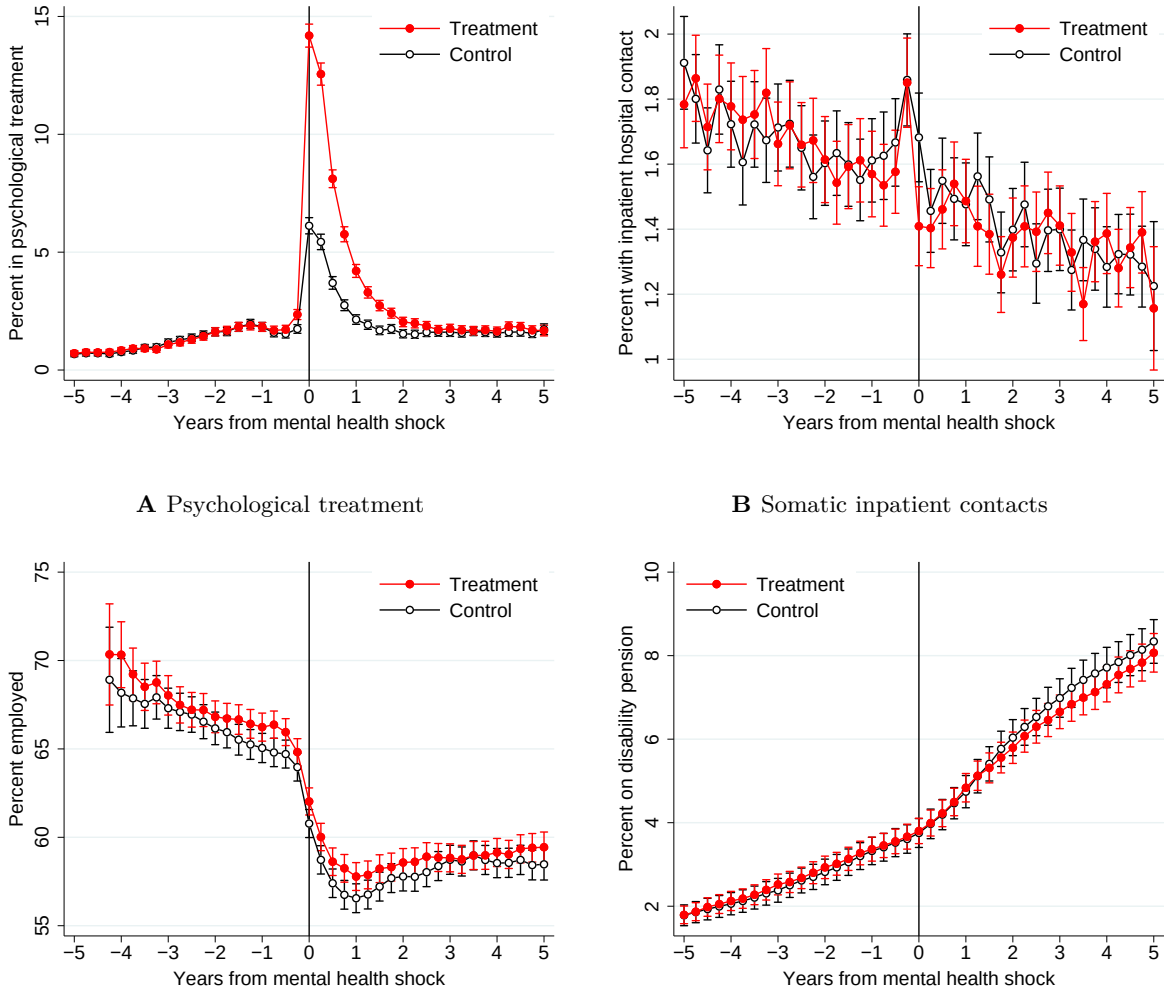
Figure 3A illustrates the method using estimates on psychological treatment. Each dot in the figure is an RD estimate of the share of the sample seeing a psychologist in each quarter from five years before to five years after experiencing a mental health shock. For both groups, the shock happens during the post-reform period 2008-2011. However, the treatment group experiences the shock just before turning 38, while the control group experiences it just after turning 38.

In each group, around 2 percent see a psychologist before the mental health shock and there are no pre-existing differences in psychotherapy use. When the shock happens, the share of individuals seeing a psychologist increases to 15 percent in the treatment group and 6 percent in the control group.[36] Hence, because of the depression criterion, the treatment group is 9 percentage points more likely to see a psychologist at the time of the mental health shock. The gap in psychological treatment between the treatment and control group diminishes over time and disappears after three years.

Panel B shows the effect on somatic hospitalizations. Between one and two percent of the sample is hospitalized with equal rates in the treatment and control groups in all quarters except for the first quarter immediately after the shock. At this point, the share hospitalized is significantly smaller in the treatment group.

[36]The increase in psychological treatment in the control group reflects that some mental health shocks in the sample are triggered by traumatic events that are covered by the nine traumatic event criteria of the public health insurance already in place before the depression criterion was introduced.

Figure 3: Effects on Physical Health and Labor Market Outcomes



A Psychological treatment

B Somatic inpatient contacts

C Employment

D Disability pension

Note: The figure plots RD estimates of the average outcomes of individuals experiencing a mental health shock just before (treatment group) and after (control group) turning 38 years, from five years before the shock to five years after. Mental health shocks are defined as the first time in at least twelve months a person receives a psychometric test from their PCP. The coefficients are estimated using monthly data, but averaged within quarters. I use a bandwidth of 7.5 years to estimate local linear age profiles. 95% confidence intervals are based on standard errors clustered at the individual level. Employment information is only available from 2008. Therefore, for employment, estimates for -5 years are not available and pre-shock estimates are based on patients experiencing mental health shocks late in the post-reform period 2008-2011.

Panel C shows the effect on employment. Five years before the mental health shock around 70 percent of the treatment and control group is employed. This share decreases to 65 percent leading up to the shock and then drops to 57 percent immediately after – a pattern consistent with substantial earnings penalties of mental health shocks (Biasi et al., 2018). During the following five years, the employment rate recovers slightly and stabilizes at 60 percent. While

employment is negatively affected by mental health shocks, psychotherapy coverage does not mitigate the drop. The treatment and control groups are equally slow to recover.

Panel D shows the effect on disability pension receipt. The share of the sample on a disability pension increases throughout the period from 2 percent five years before to 8 percent five years after the mental health shock. The treatment and control groups follow each other closely until around two years after the shock when more individuals in the control group start receiving disability pension. The difference is, however, not statistically significant and the gap starts to narrow around four years after the shock.

Table 4 presents the full results on physical health services and labor market outcomes in the short term (within two years) and longer term (within five years). Appendix Figure A.15 displays the change in RD estimates over time for the remaining outcomes in Table 4. To account for potential pre-existing differences between individuals above and below the age cutoff, I estimate treatment effects using a person-fixed effect RD model (FE-RD):

$$Y_{it} = \omega_0 + f(a) \times Post_t + \omega_1 Post_t + \omega_2 Treat_i \times Post_t + \pi_i + \rho_{it} \tag{7}$$

where $f(a)$ is a flexible polynomial in age at the time of the mental health shock estimated using local linear regression, $Treat_i$ is a treatment indicator equal to one for individuals below age 38 at the time of the mental health shock, $Post_t$ is a dummy equal to one in the post-shock period, π_i are individual fixed effects, and ρ_{it} is an error term.[37] ω_2 captures the causal effect of psychotherapy coverage and the change in the difference in outcomes before and after the mental health shock between individuals experiencing a mental health shock just before and after turning 38 years. Appendix Figure A.16 shows the points underlying the person-fixed effect RD estimates and the fit of the local linear age profiles used to estimate the discontinuities.

The first row of Table 4 shows the first stage result, here stated as the cumulative share of the sample that starts seeing a psychologist during the analysis period. The treatment group is around 12 percentage points more likely than the control group to start seeing a psychologist.

[37] For persons with multiple shocks, I create an individual fixed effect per event.

Hence, the share of compliers in this subsample is markedly larger than in the general population, where only one percent are compliers in a given year.

Rows 2-7 report results on a range of physical health care services. For these outcomes, I report the number of services consumed during the post-shock period. I do this by multiplying the average monthly treatment effects, ω_2 from equation (6), by the number of months in the post-shock period – either 24 or 60.

Overall, PCP visits increase slightly, while specialist visits, somatic drug use and hospital contacts decrease. The average number of somatic drug purchases, which covers prescription drugs for physical ailments related to mental illness such as ulcer medications, decreases by 0.07 within the first two years and by 0.14 within five years.[38] The IV estimates suggest that, on average, each psychotherapy user has 0.6 and 1.1 fewer somatic drug purchases within two and five years, respectively.

Hospital contacts decrease in response to psychotherapy coverage. Each psychotherapy user has 0.22 fewer inpatient contacts, 0.38 fewer outpatient contacts and 0.1 fewer emergency room visits within two years. The estimates on hospital contacts within five years are of similar size, suggesting these are short-term effects. In summary, psychotherapy coverage reduces physical health care use, but mostly in the short term.

The remaining rows of Table 4 show results on labor market outcomes; sick leave, disability pension receipt and employment. Again, I multiply coefficients by the number of months in the post-shock period such that coefficients reflect changes in the number of months spent in employment, on sick leave etc. Overall, none of the estimates is statistically significant and there is little evidence to suggest psychotherapy coverage improves labor market outcomes. Sick leave drops by 0.18 months for each treated patient in the short term. However, the reduction is insignificant and vanishes in the longer term. Given the standard errors reported in

[38]Specifically, somatic drugs include antacid/ulcer drugs (ATC code: A02), functional gastrointestinal drugs (ATC code: A03), constipation (ATC code: A06), minerals (ATC code: A12), muscle relaxants (M03). These were selected because they have the highest odds ratio of consumption, outside psychiatric drugs, of mental health patients compared to the overall population.

Table 4: Effects on Physical Health and Labor Market Outcomes

Time period	Within two years		Within five years	
Method	Reduced form	IV	Reduced form	IV
Psychologist	12.33***		12.13***	
	[21.94]		[25.20]	
	(0.43)		(0.45)	
Physical health outcomes				
PCP visit	0.03	0.21	0.12	1.00
	[11.70]	(0.70)	[25.66]	(1.51)
	(0.09)		(0.18)	
Specialist visit	-0.02	-0.18	-0.05	-0.45
	[2.39]	(0.38)	[5.95]	(0.81)
	(0.05)		(0.10)	
Somatic drugs	-0.07**	-0.58**	-0.14*	-1.13*
	[0.93]	(0.24)	[2.58]	(0.67)
	(0.03)		(0.08)	
Inpatient visit	-0.03*	-0.22*	-0.04	-0.29
	[0.45]	(0.12)	[1.07]	(0.27)
	(0.02)		(0.03)	
Outpatient visit	-0.05*	-0.38*	-0.05	-0.37
	[1.37]	(0.20)	[3.34]	(0.42)
	(0.02)		(0.05)	
ER visit	-0.01	-0.10	-0.00	-0.02
	[0.67]	(0.12)	[1.64]	(0.25)
	(0.01)		(0.03)	
Labor market outcomes				
Sick leave	-0.02	-0.18	0.01	0.11
	[3.69]	(0.55)	[6.46]	(1.02)
	(0.07)		(0.12)	
Disability pension	-0.02	-0.15	-0.16	-1.29
	[1.21]	(0.28)	[3.92]	(0.92)
	(0.03)		(0.11)	
Employment	0.05	0.39	-0.03	-0.27
	[13.70]	(0.72)	[34.49]	(1.96)
	(0.09)		(0.24)	

Note: The table reports FE-RD estimates comparing individuals experiencing a mental health shock just before (treated) and after (control) turning 38 years, before and after the mental health shock. Mental health shocks are defined as the first time in at least twelve months a person receives a psychometric test from their PCP. The coefficients are estimated on a monthly level using data five years before and after the shock. I use a bandwidth of 7.5 years to estimate local linear age profiles. The first two columns show effects within two years, while the last two columns show results within five years after the shock. Columns 1 and 3 report reduced form estimates. Columns 2 and 4 report 2SLS IV estimates, using the effects on psychotherapy, reported in row 1, as the first stage. Physical health outcomes are reported as cumulative number of services and labor market outcomes are reported as cumulative months. I obtain these coefficients by multiplying the monthly-level estimates (ω_2 from equation 6) by the number of months in the post-shock period. Brackets report the counterfactual probability of the outcomes. This is equal to the level of the outcome in the control group. Standard errors clustered at the individual level are reported in parenthesis. *** p<0.001 ** p<0.05, * p<0.1.

parenthesis, I can reject reductions in sick leave of more than 2 months per psychotherapy user during the first five years after the mental health shock. As shown in Figure 3D, psychotherapy coverage reduces disability pension receipt after two years, but the effect disappears over time. The average reduction during the first five years is 1.29 months per psychotherapy user and is not statistically significant. Given the standard errors, I can reject reductions in disability pension receipt of more than 3 months per psychotherapy user within five years. The results for employment are ambiguous. In the short term, employment increases, but this effect vanishes and becomes negative in the longer term. Given the standard errors, I can reject an increase in employment of more than 3.6 months per treated individual during the first five years after the mental health shock.

Robustness

The main concern for the above analysis is manipulation of the running variable – age at the mental health shock. As shown in the mental health results, psychotherapy coverage increases the use of psychometric tests – my measure of a mental health shock. Hence, there is manipulation of the running variable, whether caused by patients or PCPs. This might mean individuals just above and below the age cutoff are not similar, in which case control individuals do not provide a meaningful counterfactual. However, the FE-DID model accounts for pre-existing discontinuities in the outcomes, meaning that any time-invariant differences in outcomes between individuals on either side of the cutoff have no effect on the estimates. Second, during the pre-shock period there is, for most of the outcomes studied and for additional characteristics shown in Appendix Table A.5, no difference between individuals receiving a psychometric test before or after turning 38 years. Third, in Appendix Figure A.6, I show that using first time PCP mental health consultations as an alternative measure of mental health shocks provides similar results. There is no discontinuity in this outcome around the age-37 cutoff and, therefore, no manipulation of the running variable. However, the standard errors on IV-estimates are larger because the share of compliers is lower in this subsample.

Another concern is representativeness of the subsample of individuals receiving psychometric tests. About 30 percent of psychotherapy users receive a psychometric test. Appendix Table A.7 shows characteristics of psychotherapy users in the full population and in the mental health shock subsample. Patients receiving psychometric tests are more likely to be male and have higher income, earnings and wealth. They are also markedly less likely to have had a previous mental health episode. Hence, either these patients are on average less ill or they are more likely to be new cases of mental illness. Logically, as psychometric tests are used to diagnose patients with anxiety and depression, previously diagnosed patients are less likely to receive these.

To address this concern, I perform a Regression Kink Design (RKD) analysis using the full population, exploiting that the number of months of psychotherapy coverage a person enjoys during the post-reform period is a linearly decreasing function of their age at the reform with a kink at age 38. For instance, a person aged 34 in 2008 has 48 months of psychotherapy coverage during the post-reform period, a person aged 36 in 2008 has 24 months of coverage, and persons aged 38 or more in 2008 has zero months of coverage.[39] These results, discussed in the Appendix, largely confirm the results in Table 4.

7 Aggregate Cost Offsets

The previous sections show that psychotherapy coverage leads to reductions in psychiatric hospital contacts and suicide attempts, but increased antidepressant use. Furthermore, I find evidence of reductions in somatic drug use and somatic hospital contacts but no improvements in labor market outcomes. In this section, I evaluate the size of the cost offset of psychotherapy coverage based on these findings. Hence, I focus on mental health and physical health services and estimate the financial implications of the observed effects on these outcomes.[40]

[39]The advantage of this method over the DID and RD methods on population data is that the RKD model estimates cumulative probabilities. The cumulative share of the population who are compliers of the policy during the post-reform period is around 3 percent, making it easier to detect treatment effects on mean outcomes of the entire population.

[40]Note that psychotherapy coverage is cheap compared to the potential savings from even small improvements in labor market outcomes. Hence, even though I can reject large improvements in labor market outcomes, it is practically impossible to statistically reject that improvements in labor market outcomes can finance psychotherapy coverage.

To evaluate cost offsets on different health care services, I need information on prices. The price of health care provided by private practice PCPs, psychiatrists and psychologists is negotiated in collective agreements and recorded in the data. For hospitals, I use official DRG (Diagnoses Related Group) prices, which determine part of the reimbursement for hospitals.[41]

Table 5 presents the results. The first seven rows report the financial implications of effects on mental health services and mental health. When calculating these, I sum all services used within a year after the first treatment. For example, for a woman starting psychological treatment in June 2008, I attribute to that observation, all public health insurance expenditure caused by her use of psychotherapy during June 2008 - June 2009. To ease comparisons with results on physical health care, I focus on the RD estimates on 37-year-olds.

Columns 1 and 2 report the effect on the number of services used and the costs. I estimate these coefficients using 2SLS IV, where the RD estimate on psychological treatment is the first stage. Hence, coefficients reflect service use and costs per additional psychotherapy user.

As shown in Table 5, compliers on average receive 9 sessions of therapy within twelve months at a total cost of 5,000 DKK (800 USD) per person. Increases in PCP mental health consultations, psychometric tests and antidepressants add an additional 151 DKK to the per person cost of psychotherapy coverage, while savings in psychiatric hospital contacts amount to 3,148 DKK. Summing up, row 7 reports the mental health offset. The RD estimate is -0.59, implying that for each DKK spent on psychotherapy coverage, the public health insurance saves 0.6 DKK on other mental health services. Hence, in isolation, the savings on other mental health services can cover 60 percent of the costs of psychotherapy coverage. I reach a similar conclusion and a mental health offset of 44 percent when considering Difference-in-Difference results on 18-37-year-olds, see Appendix Table A.9.

[41] DRG prices assign an expected cost to each diagnosis group. To deal with inconsistent recording of DRG prices over time, I use average within-diagnosis group DRG prices. I calculate the average DRG price within two-digit ICD-10 diagnosis codes, for example hypertension 2-digit ICD-10: I1. I do this by type of patient; ER, outpatient or inpatient to allow for different costs of these services. Psychiatric hospitals are not reimbursed based on DRG prices, but the Danish Department of Health Care Data ('Sundhedsdatastyrelsen') still publishes recommended DRG prices for these services. Source: https://sundhedsdatastyrelsen.dk/da/afregning-og-finansiering/takster-drg/takster-2018

Table 5: Aggregate Effects on Public Health Insurance Expenditure

Outcome	Number of services (per treated)	Costs (per treated)
Psychotherapy	9.26***	5,009***
	(0.20)	(104)
Mental health		
PCP MHC	0.03	9
	(0.16)	(66)
Psychometric test	0.48***	105***
	(0.11)	(23)
Antidepressants	0.29	37*
	(0.19)	(21)
Psychiatric Hospital	-1.04	-3,148
	(0.75)	(2,360)
Suicide attempts	-0.00	63
	(0.01)	(179)
Mental Health Offset		-0.59
		(0.47)
Physical health		
PCP visits	0.21	32
	(0.70)	(103)
Specialist visits	-0.18	59
	(0.38)	(119)
Somatic drugs	-0.58**	-89*
	(0.24)	(53)
Inpatient visits	-0.22*	-7,309*
	(0.12)	(3,886)
Outpatient visits	-0.38*	-2,199*
	(0.20)	(1,222)
ER visits	-0.10	-89
	(0.12)	(116)
Physical Health Offset		-1.52**
		(0.73)

Note: This table presents Regression Discontinuity estimates on 37-year-olds of the effect of psychotherapy coverage on the number of services used and associated costs for different mental health outcomes (rows 1-7) and physical health services (rows 8-14). For mental health outcomes, the table reports population-wide estimates based on the results presented in section 5. I sum services used and costs within a year after the first treatment. For physical health services, the table reports FE-RD estimates using a subsample of individuals receiving a psychometric test, based on the short-term results (within two years) presented in section 6. Both sets of results are measured per treated individual, estimated using 2SLS IV regressions where the baseline results on number of individuals using psychotherapy is the first stage. All variables are winzorized at the 99th percentile of positive values to avoid outliers. The mental health and physical health offsets are estimated by 2SLS IV, using as the outcome the sum of costs on either mental health services or physical health services and, as the first stage, the effect on psychotherapy costs. This is equivalent to the cost offset described in equation 4 in the theory section. Standard errors are clustered at the individual level. *** $p<0.001$ ** $p<0.05$, * $p<0.1$.

The remaining rows of Table 5 report the results for physical health services. Because these are estimated on a different sample than the mental health results, I report a separate physical health offset. Furthermore, to ease comparisons with the effects on mental health services, I focus on the short-term results – within two years after the mental health shock.

While somatic drug use decreases substantially in response to psychotherapy coverage, the savings for the public health insurance only amount to 89 DKK as these drugs are fairly cheap.[42] Conversely, the savings from reductions in hospital contacts are substantial. The reductions in inpatient contacts, outpatient contacts and emergency visits are associated with cost savings of 7,300 DKK, 2,200 DKK and 90 DKK, respectively. In total, the physical health offset is -1.52, suggesting the public health insurance saves 1.5 DKK on physical health services for each DKK spent on psychotherapy coverage. In other words, the savings on physical health services are sufficiently large to finance the policy. However, the cost estimates are measured with substantial noise and I cannot reject that the physical health offset is smaller than one.

If we assume the results on physical health services, estimated on the mental health shock sample, generalize to the overall population, savings in mental health and physical health services more than fully offset the cost of the policy. As mentioned in the theory section, this is a sufficient condition for the policy to be welfare improving. Hence, psychotherapy coverage is both welfare improving and cost reducing.

8 Conclusion

The Offset Hypothesis claims health insurance coverage for psychotherapy is self-financing through reductions in the use of other mental health services, physical health services and improvements in labor market outcomes. These arguments date back to the 1960s and have played a central role in successful and continuing efforts to increase insurance coverage for mental health care. Still, we know little about the validity of the causal claims of the Offset Hypothesis.

[42] In addition, prescription drugs are only partially covered by the public health insurance scheme.

Using a recent reform of the Danish public health insurance scheme that introduced 60 percent coverage of psychological treatment for depression and anxiety, I revisit and test the predictions of the Offset Hypothesis. Exploiting arbitrary age limits in eligibility for the policy, I show that access to cheap psychotherapy reduces suicide attempts, the use of mental health services meant for severely ill patients (psychiatric hospitals) and the use of physical health services. The savings in mental health care offset 60 percent of the cost of the policy, while the reductions in physical health care offset 150 percent of the cost. However, I do not find improvements in labor market outcomes, such as reduced sick leave and disability pension receipt, or increased employment. Hence, although the empirical results do not support one of the main pillars of the Offset Hypothesis – that access to psychotherapy improves labor market outcomes – my results confirm its main prediction: Psychotherapy coverage is self-financing.

These results confirm the economic rationale behind recent expansions of mental health coverage and show that proposed policies to further scale-up mental health care (Hewlett and Moran, 2014) may lead to substantial savings and more allocatively efficient health care systems.

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A Appendix

Derivation of Theoretical Welfare Effects

Model Assumptions:

Expected Utility: $$EU = pU^s(x_1, x_2, y^s) + (1-p)U^h(y^h) \tag{8}$$

Budget constraints: $$y^s = I - \pi - (1-c_1)x_1 - (1-c_2)x_2 \tag{9}$$

$$y^h = I - \pi \tag{10}$$

Insurance premium: $$\pi = p[c_1x_1 + c_2x_2] \tag{11}$$

Combine:

$$EU = pU^s(x_1, x_2, I - p[c_1x_1 + c_2x_2] - (1-c_1)x_1 - (1-c_2)x_2) + (1-p)U^h(I - p[c_1x_1 + c_2x_2])$$

Derive patients' health care consumption when sick, taking the insurance premium as given:

$$U^s = U^s(x_1, x_2, I - \pi - (1-c_1)x_1 - (1-c_2)x_2)$$

$$\frac{dU^s}{dx_1} = U_1^s - (1-c_1)U_y^s = 0 \Leftrightarrow U_1^s = (1-c_1)U_y^s \tag{12}$$

$$\frac{dU^s}{dx_2} = U_2^s - (1-c_2)U_y^s = 0 \Leftrightarrow U_2^s = (1-c_2)U_y^s \tag{13}$$

Derive optimal insurance generosity taking into account patient behavior by differentiating expected utility with respect to psychotherapy coverage c_1:

$$\frac{dEU}{dc_1} = pU_1^s\frac{dx_1}{dc_1} + pU_2^s\frac{dx_2}{dc_1} + pU_y^s\left(-px_1 - pc_1\frac{dx_1}{dc_1} - pc_2\frac{dx_2}{dc_1} - (1-c_1)\frac{dx_1}{dc_1} + x_1 - (1-c_2)\frac{dx_2}{dc_1}\right)$$
$$+(1-p)U_y^h\left(-px_1 - pc_1\frac{dx_1}{dc_1} - pc_2\frac{dx_2}{dc_1}\right)$$

Substitute in first order conditions from equations (12) and (13):

$$\begin{aligned}
\frac{dEU}{dc_1} =& p(1-c_1)U_y^s\frac{dx_1}{dc_1} + p(1-c_2)U_y^s\frac{dx_2}{dc_1} \\
&+ pU_y^s\left(-px_1 - pc_1\frac{dx_1}{dc_1} - pc_2\frac{dx_2}{dc_1} - (1-c_1)\frac{dx_1}{dc_1} + x_1 - (1-c_2)\frac{dx_2}{dc_1}\right) \\
&+ (1-p)U_y^h\left(-px_1 - pc_1\frac{dx_1}{dc_1} - pc_2\frac{dx_2}{dc_1}\right) \\
\Leftrightarrow \frac{dEU}{dc_1} =& pU_y^s\left(-px_1 - pc_1\frac{dx_1}{dc_1} - pc_2\frac{dx_2}{dc_1} + x_1\right) \\
&+ (1-p)U_y^h\left(-px_1 - pc_1\frac{dx_1}{dc_1} - pc_2\frac{dx_2}{dc_1}\right) \\
\Leftrightarrow \frac{dEU}{dc_1} =& U_y^s x_1 + \left(pU_y^s + (1-p)U_y^h\right)\left(-x_1 - c_1\frac{dx_1}{dc_1} - c_2\frac{dx_2}{dc_1}\right)
\end{aligned}$$

Define expected marginal utility of income: $\bar{U}_y \equiv pU_y^s + (1-p)U_y^h$:

$$\frac{dEU}{dc_1} = (U_y^s - \bar{U}_y)x_1 + \bar{U}_y\left(-c_1\frac{dx_1}{dc_1} - c_2\frac{dx_2}{dc_1}\right)$$

Lastly, write in monetary terms by dividing by expected marginal utility of income:

$$\frac{\frac{dEU}{dc_1}}{\bar{U}_y} = \underbrace{\frac{U_y^s - \bar{U}_y}{\bar{U}_y}x_1}_{\text{Marginal Insurance Value}} - \underbrace{c_1\frac{dx_1}{dc_1}}_{\text{Moral Hazard}} - \underbrace{c_2\frac{dx_2}{dc_1}}_{\text{Offset}}$$

Which is equation 3 in the main text.

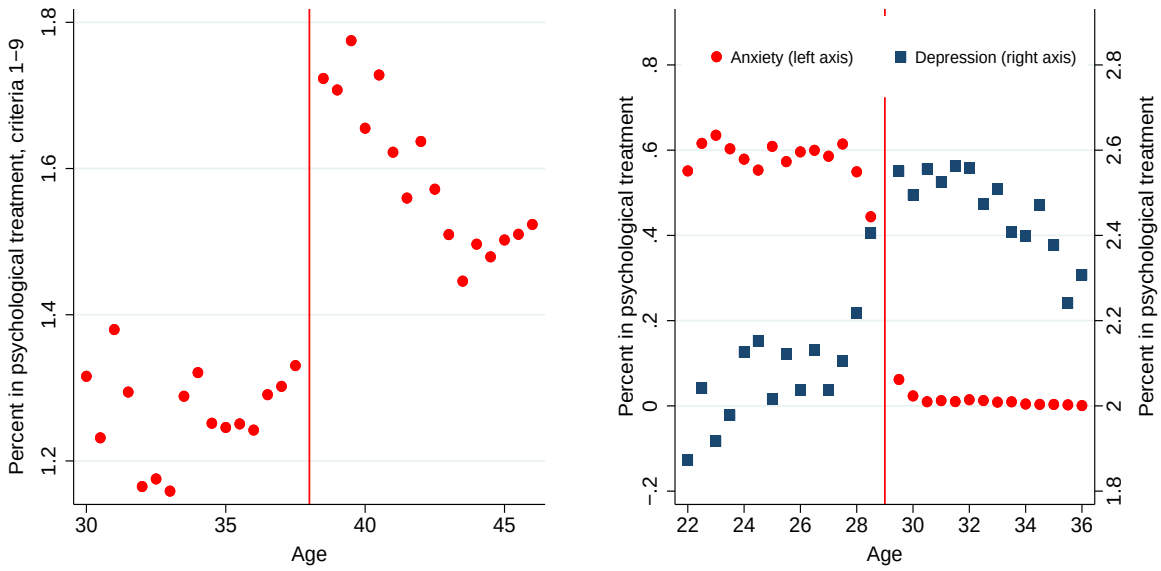
Substitution Between Referral Criteria

The intention of the depression policy was to provide psychotherapy coverage for individuals with mild to moderate depression. In this section, I argue that while the policy specified that only depression patients were eligible, anxiety patients indirectly gained coverage as well.

Patients need a referral from a PCP to be eligible for psychotherapy coverage, and it is up to PCPs to determine whether patients with mental health problems suffer from depression, anxiety or other mental illnesses. As psychotherapy coverage depends on the diagnosis, there is a large incentive for PCPs and patients to misrepresent a certain condition in order gain eligibility.

Figure A.1 shows two examples of substitution between referral criteria. Because information on the referral criterion used for a particular patient is only recorded from July 2011 and onward, Figure A.1 plots data for the period July 2011 - June 2012.

Figure A.1: Substitution Between Referral Criteria



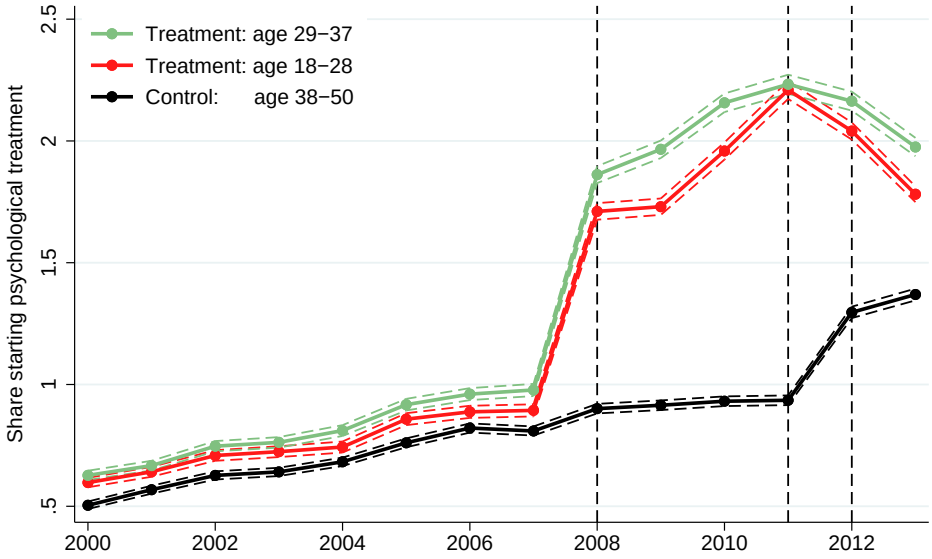
A Depression (10) to Criteria 1-9 at age 38 threshold **B** Anxiety (11) to Depression (10) at age 29 threshold

Panel A shows the share of the population in psychological treatment through one of the nine traumatic event criteria of the public health insurance scheme. Anyone experiencing one of the nine traumatic events described in the Institutional Settings and Data section, are eligible

for psychotherapy and there is no age threshold for these criteria. Nonetheless, the share of the population that receives psychological treatment through such referrals increases discontinuously at age 38. This discontinuity happens because some of the patients who age out of the depression policy at age 37 use one of the nine traumatic event criteria instead. Hence, PCPs and patients substitute between the depression criterion and the nine traumatic event criteria.

Panel B shows the share of the population receiving psychological treatment through the anxiety criterion and the depression criterion. At age 29 – the upper age threshold of the anxiety criterion – the share of the population in psychological treatment through the anxiety criterion drops to zero. However, the drop in anxiety referrals at age 29 is almost completely canceled out by an equivalent increase in depression referrals. Hence, patients who age out of the anxiety policy are instead referred to psychotherapy through the depression criterion. Consequently, the anxiety criterion has no discernible effect on the share of the population receiving psychotherapy.

Figure A.2: Effect of Anxiety Criterion



This is also shown in Figure A.2A, which plots the share of the population starting psychological treatment over time across three different age groups; 18-28, 29-37 and 38-50. The 18-28 and 29-37 age groups are eligible for the depression criterion introduced in 2008. However, only the 18-28 age group is eligible for the anxiety criterion introduced in 2011, and I can, therefore,

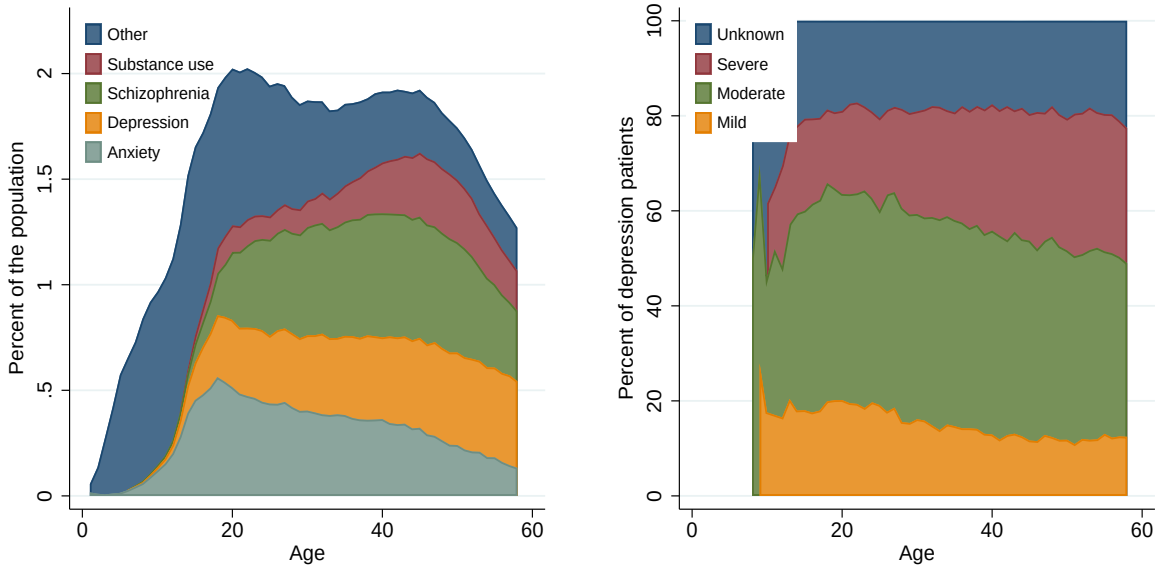
isolate the effect of this reform by comparing the change in psychotherapy use in this treated group with the two untreated age groups.

The use of psychotherapy increases dramatically in 2008 for the both the 18-28 age group and the 29-37 age group, showing that the depression criterion increased treatment rates. The effect of the introduction of the anxiety criterion is much less clear. In 2011, the share of individuals aged 18-28 years that start psychological treatment increases relative to the other groups, but the effect is less than one-sixth of the effect of the introduction of the depression criterion.

In conclusion, these results show that the introduction of the depression criterion in 2008 provided psychotherapy coverage for both depression and anxiety patients.

Additional Summary Statistics

Figure A.3: Age Profiles of Mental Health Care



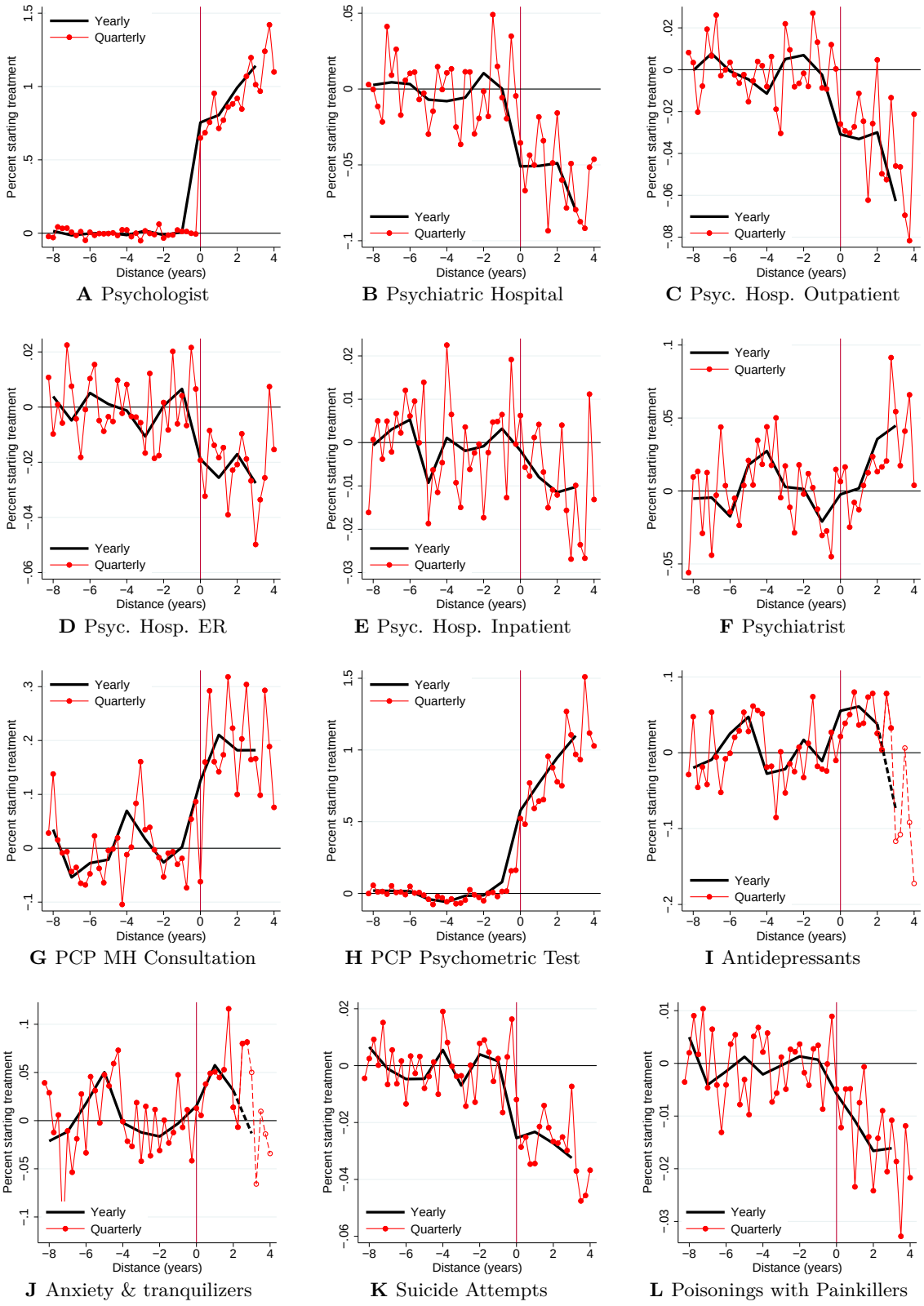
A Diagnoses in Psychiatric Hospitals

B Depression Severity of Psychiatric Hospital Patients

Note: Panel A plots the percentage of the population in psychiatric hospital treatment by age and diagnosis group. The diagnosis groups are based on the first number in the ICD-10 codes for mental disorders – category F – see http://apps.who.int/classifications/icd10/browse/2016/en. For individuals with more than one diagnosis within a year, I plot only one diagnosis, based on the following priority 1) neurotic, 2) mood, 3) schizophrenia, 4) substance use, 5) other. Panel B plots the share of patients with depressive episodes (ICD-10: F32,F33) in psychiatric hospitals with mild (ICD-10: F32.0,F33.0), moderate (ICD-10: F32.1,F33.1), severe (ICD-10: F32.2,F32.3,F33.2,F33.3) or unknown severity of depression.

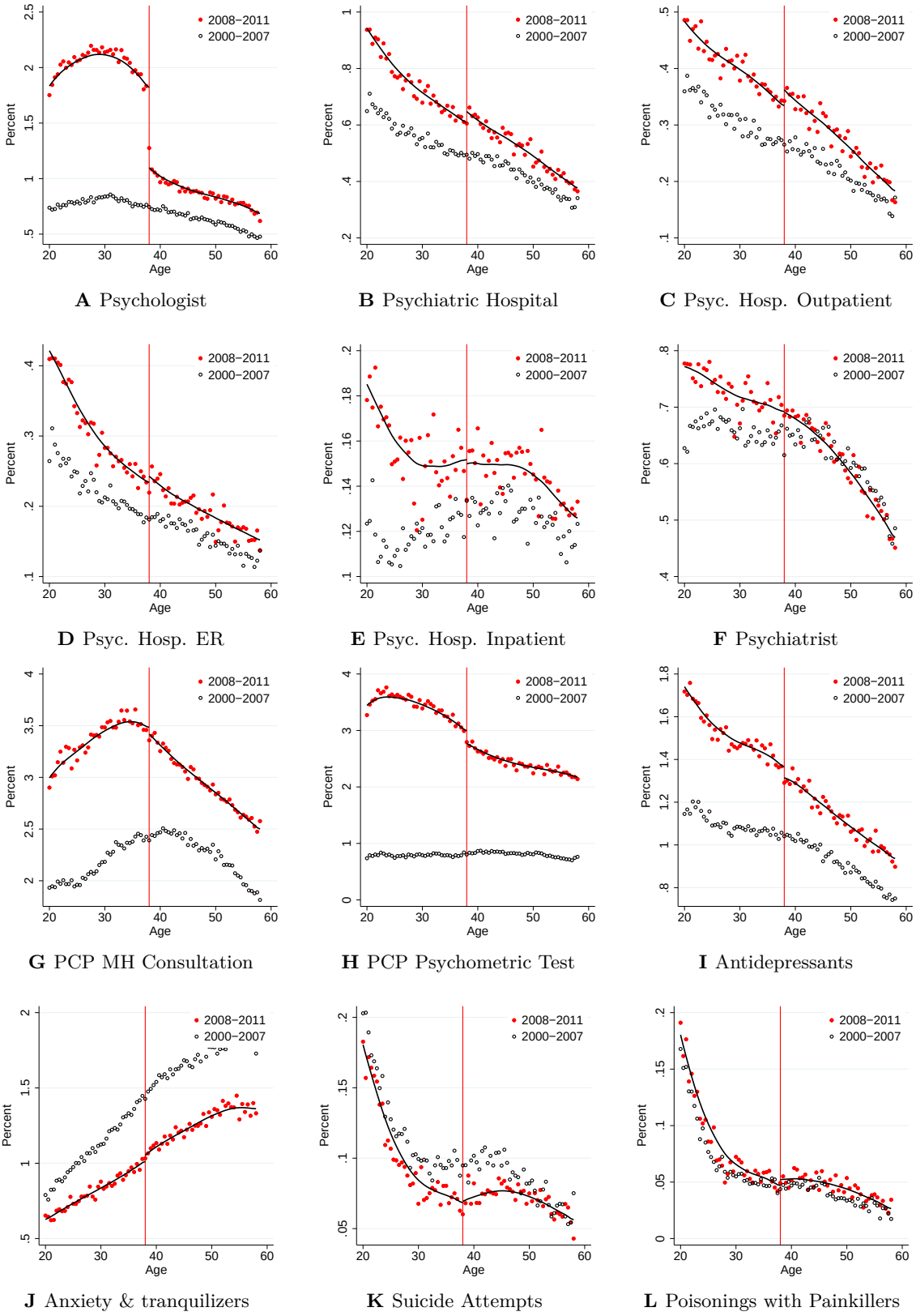
Mental Health Results: Appendix Graphs and Tables

Figure A.4: DID Estimates on 18-37-Year-Olds Over Time



Note: The figure plots the differences in deviations from pre-trends (estimated using the years 2000-2007) between the treatment group (ages 18-37) and the control group (ages 38-50). The figure reports estimates on a quarterly and yearly level, centered around the introduction of the depression criterion in the second quarter of 2008.

Figure A.5: RD Estimates on 37-Year-Olds



A Psychologist **B** Psychiatric Hospital **C** Psyc. Hosp. Outpatient

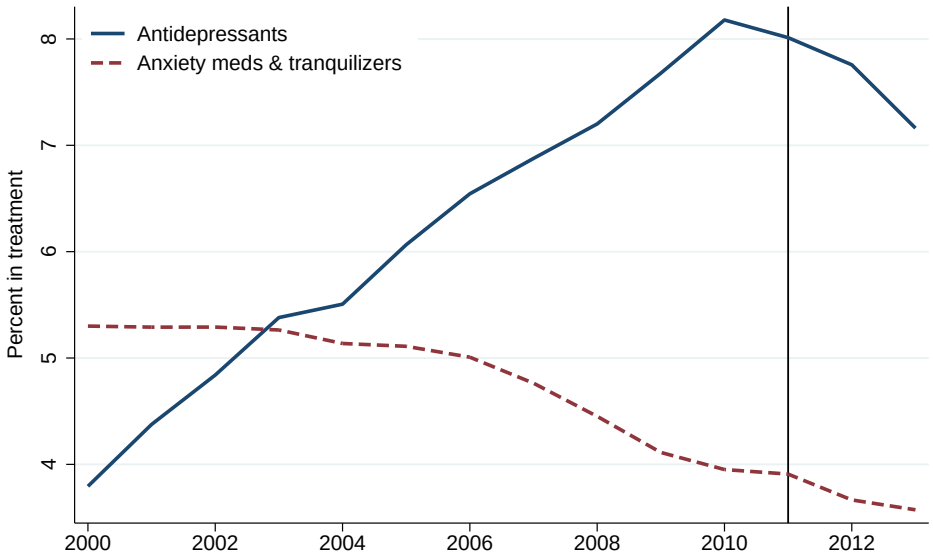
D Psyc. Hosp. ER **E** Psyc. Hosp. Inpatient **F** Psychiatrist

G PCP MH Consultation **H** PCP Psychometric Test **I** Antidepressants

J Anxiety & tranquilizers **K** Suicide Attempts **L** Poisonings with Painkillers

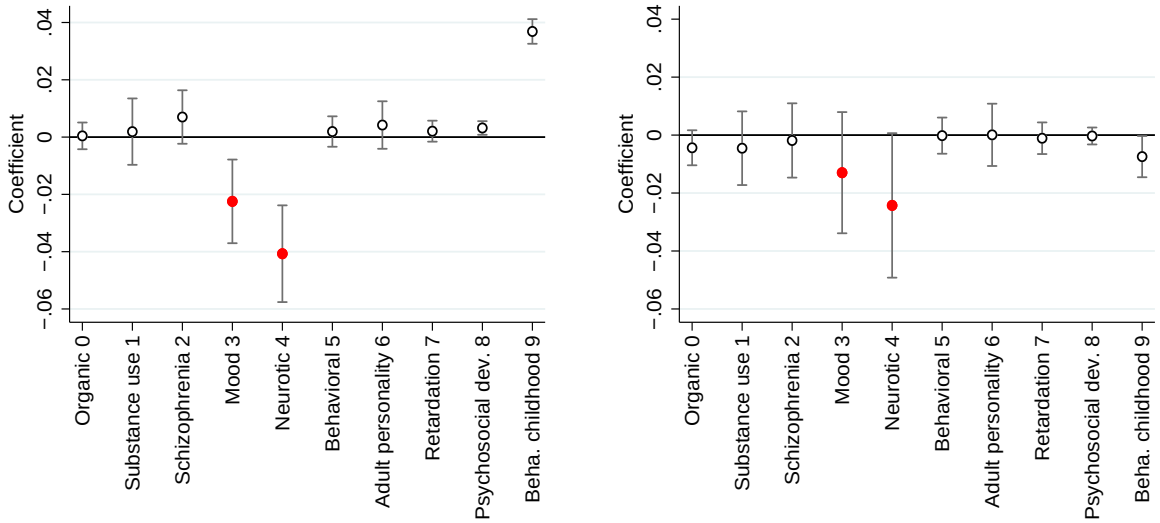
Note: The figure plots RD estimates on 37-year-olds before (2000-2007) and after (2008-2011) the introduction of the depression criterion. The coefficients are estimated using monthly data, but plotted by age measured at a half-yearly level. The red vertical line represents the upper age threshold at age 37 of the depression criterion. The smooth age profiles are estimated using local linear regression with a bandwidth of 7.5 years. I exclude the month individuals turn 38, because the person is both eligible and ineligible for psychotherapy coverage.

Figure A.6: Trends in Psychiatric Drug use Ages 18-50



Note: The figure plots the percentage of the population aged 18-50 years using different psychiatric drugs. The black vertical line marks a change in clinical guidelines on depression treatment for young adults in 2011 that required these patients to see a psychiatrist before being prescribed antidepressants.

Figure A.7: Effects on Psychiatric Hospital Contacts by Diagnosis



A Differences-in-Differences

B Regression Discontinuity

Note: The figure plots DID estimates on 18-37-year-olds (panel A) and RD estimates on 37-year-olds (panel B) on the percentage probability of starting psychiatric hospital treatment across ten different diagnosis groups, defined using the first number of the ICD-10 codes for mental disorders. In the DID regressions, I first estimate and take out separate linear pre-trends, based on the pre-reform period 2000-2007, for the treatment and control group. The RD results are estimated using local linear regression with a bandwidth of 7.5 years. I exclude the month individuals turn 38, because the person is both eligible and ineligible for psychotherapy coverage. Standard errors are clustered at the individual level. For the DID estimates, standard errors are bootstrapped using 500 repetitions to account for the estimation of pre-trends.

Table A.1: RD-DID Estimates on 18-year-olds

Method	DID	RD-DID
Age range	18-22	18
Psychologist	0.826***	0.729***
	[0.969]	[0.898]
	(0.025)	(0.049)
Psychiatric hospital	-0.086***	-0.057
	[0.982]	[0.780]
	(0.022)	(0.041)
Psyc. hosp. Outpat	-0.040***	-0.047
	[0.511]	[0.481]
	(0.016)	(0.032)
Psyc. hosp. ER	-0.056***	-0.034
	[0.450]	[0.303]
	(0.014)	(0.025)
Psyc. hosp. Inpat	-0.005	0.025
	[0.177]	[0.096]
	(0.009)	(0.016)
Psychiatrist	0.077***	0.063*
	[0.683]	[0.598]
	(0.021)	(0.036)
PCP MHC	0.225***	0.017
	[2.700]	[2.421]
	(0.038)	(0.070)
PCP Psych. test	0.991***	0.469***
	[2.307]	[2.194]
	(0.033)	(0.063)
Antidepressants	0.017	0.049
	[1.724]	[1.392]
	(0.030)	(0.054)
Anxiety meds	0.039*	-0.072**
	[0.581]	[0.436]
	(0.022)	(0.035)
Suicide Attempts	-0.058***	-0.051**
	[0.236]	[0.202]
	(0.010)	(0.022)
Poisoning with painkillers	-0.037***	-0.025
	[0.219]	[0.223]
	(0.010)	(0.023)

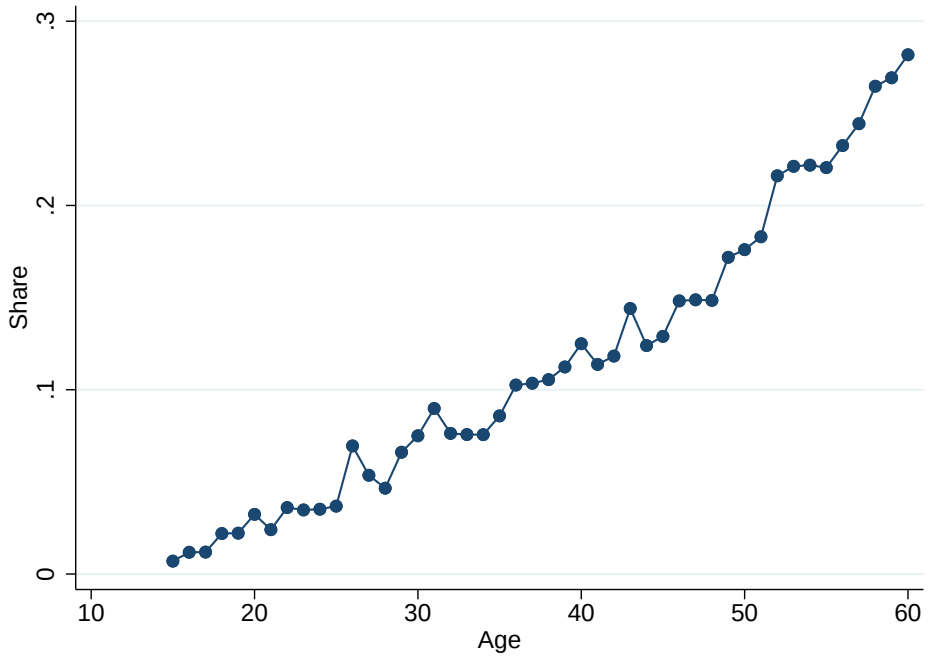
Note: The table presents estimates of the effect of psychotherapy coverage on mental health services and mental health. Column 1 presents DID estimates for individuals aged 18-22. In these regressions, I first estimate and take out separate linear pre-trends for the treatment and control groups using the pre-reform period 2000-2007. Standard errors are bootstrapped using 500 repetitions and clustered sampling at the individual level. Column 2 presents Difference-in-Discontinuity (RD-DID) estimates on 18-year-olds, using the lower age threshold at age 18 of the depression criterion. I estimate the following Difference-in-Discontinuity model: $Y_{it} = \gamma_0 + f(a) + f(a) \times Post_t + \gamma_1 Treat_{it} + \gamma_2 Post_t + \gamma_3 Post_t \times Treat_{it} + \eta_{it}$, which is similar to the RD model in equation (5), but includes full interactions with post-period dummies. γ_3 captures the causal effect of psychotherapy coverage. I use a bandwidth of 2.5 years because age profiles of mental health care use are steeply increasing in young ages. Estimates are based on monthly data and I exclude the month individuals turn 18. The outcomes are defined as probabilities of starting treatment. The brackets report the counterfactual probability of the outcomes in the treatment group. For the DID results, this is equal to the projected post-reform outcome of the treatment group as based on the pre-trend plus the post-reform deviation from the pre-trend in the control group. For the RD-DID results, this is equal to the level of the outcome just below the age cutoff. Standard errors clustered at the individual level are reported in parenthesis. *** p<0.001 ** p<0.05, * p<0.1.

Table A.2: Effects on Psychiatric Drugs By Prescriber Type

Method			DID			RD
Age range	18-37	18-22	23-27	28-32	33-37	37
Antidepressants						
Total	0.051***	0.017	0.036	0.086***	0.032	0.048**
	[1.485]	[1.724]	[1.500]	[1.392]	[1.413]	[1.317]
	(0.010)	(0.028)	(0.026)	(0.024)	(0.022)	(0.024)
PCP Prescriber	0.049***	0.038	0.027	0.076***	0.031	0.043*
	[1.282]	[1.462]	[1.307]	[1.208]	[1.221]	[1.130]
	(0.010)	(0.026)	(0.024)	(0.022)	(0.020)	(0.022)
Psychiatrist Prescriber	-0.007***	-0.011*	-0.011**	-0.003	-0.007	-0.004
	[0.053]	[0.077]	[0.057]	[0.044]	[0.043]	[0.037]
	(0.002)	(0.007)	(0.005)	(0.005)	(0.004)	(0.004)
Hospital Prescriber	0.009**	-0.010	0.020**	0.013	0.007	0.009
	[0.151]	[0.185]	[0.137]	[0.140]	[0.150]	[0.149]
	(0.004)	(0.010)	(0.008)	(0.008)	(0.007)	(0.008)
Anxiety & tranquilizers						
Total	0.035***	0.039	0.036	0.049**	0.030	-0.033
	[0.755]	[0.581]	[0.681]	[0.771]	[0.912]	[1.045]
	(0.010)	(0.024)	(0.024)	(0.023)	(0.023)	(0.021)
PCP Prescriber	0.048***	0.054**	0.046**	0.062***	0.041*	-0.026
	[0.632]	[0.475]	[0.570]	[0.636]	[0.779]	[0.910]
	(0.009)	(0.023)	(0.022)	(0.021)	(0.021)	(0.019)
Psychiatrist Prescriber	0.001	0.001	0.004*	0.001	-0.001	-0.001
	[0.006]	[0.007]	[0.004]	[0.005]	[0.007]	[0.006]
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Hospital Prescriber	-0.014***	-0.016**	-0.014**	-0.013*	-0.011	-0.007
	[0.117]	[0.098]	[0.107]	[0.130]	[0.126]	[0.129]
	(0.003)	(0.008)	(0.007)	(0.008)	(0.007)	(0.007)

Note: The table presents estimates of the effect of the introduction of psychotherapy coverage in 2008 on the use of antidepressants and anxiety medications prescribed by PCPs, psychiatrists or hospital doctors. Columns 1-5 present DID estimates for the following age groups: 18-37 (all treated individuals), 18-22, 23-27, 28-32 and 33-37. In these regressions, I first estimate and take out separate linear pre-trends for the treatment and control group using the pre-reform period 2000-2007 and I limit the post-reform period to years 2008-2010. Standard errors are bootstrapped using 500 repetitions and clustered sampling at the individual level. Column 6 presents RD estimates on 37-year-olds, using the age-37 threshold of the depression criterion and monthly data. Because individuals are both eligible and ineligible for psychotherapy coverage the month they turn 38 years, I exclude this month. The outcomes are defined as probabilities of starting treatment, here specified as the first treatment in at least five years. The brackets report the counterfactual probability of the outcomes in the treatment group. For the DID results, this is equal to the projected post-reform outcome of the treatment group as based on the pre-trend plus the post-reform deviation from the pre-trend in the control group. For the RD results, this is equal to the level of the outcome just above the age cutoff. Standard errors clustered at the individual level are reported in parenthesis. *** $p<0.001$ ** $p<0.05$, * $p<0.1$.

Figure A.8: Share of Suicide Attempts Resulting in Death



Note: The figure plots the share of suicide attempts (hospital contacts plus mortality cases) that results in death by age.

Table A.3: Heterogeneity in Response to Psychotherapy Coverage by Income

Method	DID						RD		
Age group	18-27			28-37			37		
Income tertile	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Psychologist	0.844***	1.033***	1.109***	1.038***	1.035***	0.822***	0.743***	0.760***	0.636***
	[1.185]	[1.091]	[0.951]	[1.233]	[1.191]	[0.895]	[1.221]	[1.177]	[0.937]
	(0.033)	(0.033)	(0.033)	(0.030)	(0.035)	(0.029)	(0.045)	(0.045)	(0.040)
Psychiatric hospital	-0.143***	-0.023	-0.053**	-0.077***	-0.041*	-0.026	-0.067*	-0.051**	-0.019
	[1.260]	[0.878]	[0.672]	[1.152]	[0.651]	[0.358]	[1.162]	[0.520]	[0.279]
	(0.031)	(0.025)	(0.022)	(0.030)	(0.021)	(0.016)	(0.037)	(0.025)	(0.019)
Antidepressants	0.065	0.099***	0.064*	0.088**	0.072**	0.017	0.061	0.029	0.056*
	[2.038]	[1.597]	[1.238]	[1.761]	[1.500]	[0.971]	[1.758]	[1.326]	[0.832]
	(0.041)	(0.037)	(0.033)	(0.038)	(0.036)	(0.028)	(0.048)	(0.042)	(0.033)
Suicide Attempts	-0.064***	-0.054***	-0.017**	-0.020	-0.014*	-0.010*	0.001	-0.006	0.003
	[0.286]	[0.184]	[0.095]	[0.168]	[0.073]	[0.035]	[0.148]	[0.043]	[0.017]
	(0.015)	(0.011)	(0.009)	(0.014)	(0.008)	(0.005)	(0.014)	(0.007)	(0.005)

Note: This table presents estimates of the effect of the introduction of psychotherapy coverage in 2008 on psychotherapy use, psychiatric hospital treatment, antidepressant use and suicide attempts by income tertiles. Columns 1-6 present Difference-in-Differences (DID) estimates for 18-27-year-olds and 28-37-year-olds. In these regressions, I first estimate and take out separate linear pre-trends, based on the pre-reform period 2000-2007, for the treatment and control groups. Standard errors are bootstrapped using 500 repetitions and clustered sampling at the individual level. Columns 7-9 present Regression Discontinuity estimates on 37-year-olds, based on the age-37 eligibility threshold of the depression criterion. These are estimated on monthly data and I exclude the month individuals turn 38, because the person is both eligible and ineligible for psychotherapy coverage. Income tertiles are based on year, gender and age-specific income ranks. For individuals below age 28, I use parental income instead of own income. To avoid using post-retirement income of the parents, I use parents' household income ten years prior. For individuals aged 28 or more, I use their own income from the year before. The outcomes are defined as probabilities of starting treatment. For psychological treatment, psychiatric hospital treatment and suicide attempts, this is defined as the first treatment in at least a year. For antidepressants, this is defined as the first treatment in at least five years. The brackets report the counterfactual probability of the outcomes in the treatment group. For the DID results, this is equal to the average predicted outcome in the post-reform period as based on the estimated pre-trend in the treatment group plus the post-reform deviation from the pre-trend in the control group. For the RD results, this is equal to the level of the outcome just above the age 37 threshold. Standard errors are clustered at the individual level. *** $p<0.001$ ** $p<0.05$, * $p<0.1$.

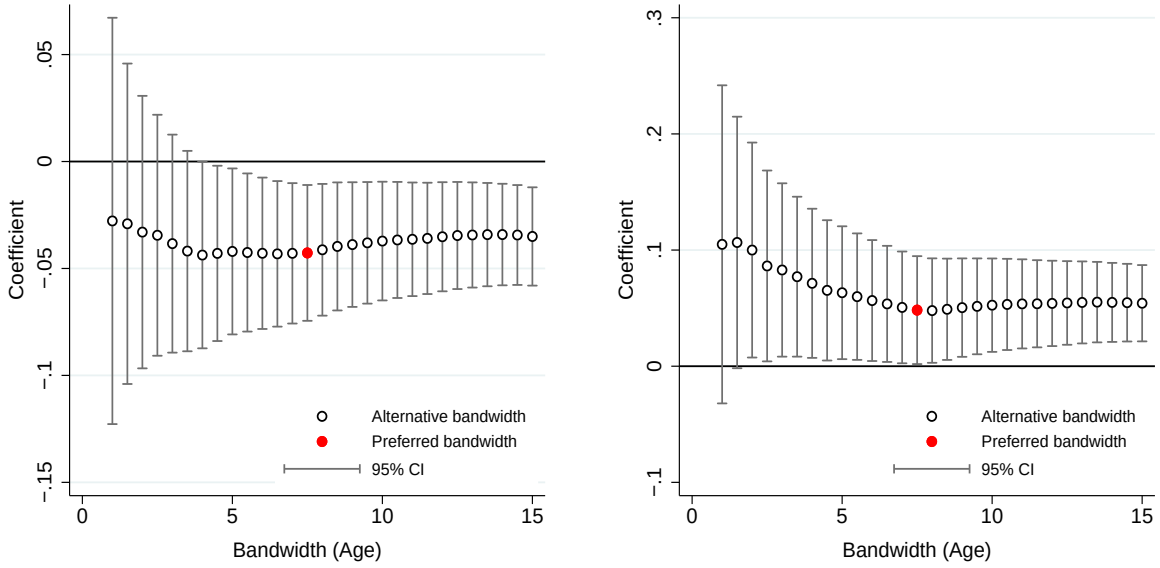
Table A.4: Heterogeneity in Response to Psychotherapy Coverage by Gender

Method	DID						RD		
Age group	18-27			28-37			37		
Gender	Women	Men	Difference	Women	Men	Difference	Women	Men	Difference
Psychologist	1.336***	0.518***	0.818***	1.295***	0.574***	0.721***	0.970***	0.454***	0.516***
	[1.515]	[0.518]	[0.997]	[1.607]	[0.568]	[1.039]	[1.632]	[0.592]	[1.039]
	(0.031)	(0.019)	(0.036)	(0.031)	(0.017)	(0.035)	(0.042)	(0.026)	(0.050)
Psychiatric hospital	-0.120***	-0.031*	-0.088***	-0.077***	-0.024	-0.053*	-0.018	-0.068***	0.049
	[1.183]	[0.622]	[0.561]	[0.883]	[0.540]	[0.343]	[0.747]	[0.557]	[0.190]
	(0.022)	(0.017)	(0.029)	(0.021)	(0.017)	(0.028)	(0.025)	(0.021)	(0.032)
Antidepressants	0.119***	-0.019	0.138***	0.092***	0.005	0.087**	0.072**	0.023	0.050
	[1.979]	[1.179]	[0.800]	[1.688]	[1.125]	[0.562]	[1.563]	[1.073]	[0.490]
	(0.031)	(0.024)	(0.040)	(0.028)	(0.025)	(0.037)	(0.037)	(0.030)	(0.047)
Suicide Attempts	-0.045***	-0.045***	-0.001	-0.013*	-0.017**	0.003	0.004	-0.006	0.010
	[0.220]	[0.144]	[0.076]	[0.092]	[0.089]	[0.004]	[0.069]	[0.069]	[-0.001]
	(0.010)	(0.009)	(0.013)	(0.007)	(0.007)	(0.010)	(0.008)	(0.008)	(0.011)

Note: This table presents estimates of the effect of the introduction of psychotherapy coverage in 2008 on psychotherapy use, psychiatric hospital treatment and suicide attempts by gender. Columns 1-6 present Difference-in-Differences (DID) estimates for 18 to 27-year-olds and 28 to 37-year-olds. In these regressions, I first estimate and take out separate linear pre-trends, based on the pre-reform period 2000-2007, for the treatment and control group. Standard errors are bootstrapped using 500 repetitions and clustered sampling at the individual level. Columns 7-9 present Regression Discontinuity estimates on 37-year-olds, based on the age 37 eligibility threshold of the depression criterion. These are estimated on monthly data and I exclude the month individuals turn 38, because the person is both eligible and ineligible for psychotherapy coverage. The outcomes are defined as probabilities of starting treatment. For psychological treatment, psychiatric hospital treatment and suicide attempts, this is defined as the first treatment in a least a year. For antidepressants, this is defined as the first treatment in a least five years. The brackets report the counterfactual probability of the outcomes in the treatment group. For the DID results, this is equal to the average predicted outcome in the post-reform period as based on the estimated pre-trend in the treatment group plus the post-reform deviation from the pre-trend in the control group. For the RD results, this is equal to the level of the outcome just above the age 37 threshold. Standard errors are clustered at the individual level. *** $p<0.001$ ** $p<0.05$, * $p<0.1$.

Mental Health Results: Robustness Checks

Figure A.9: Sensitivity of RD estimates on 37-Year-Olds to Choice of Bandwidth

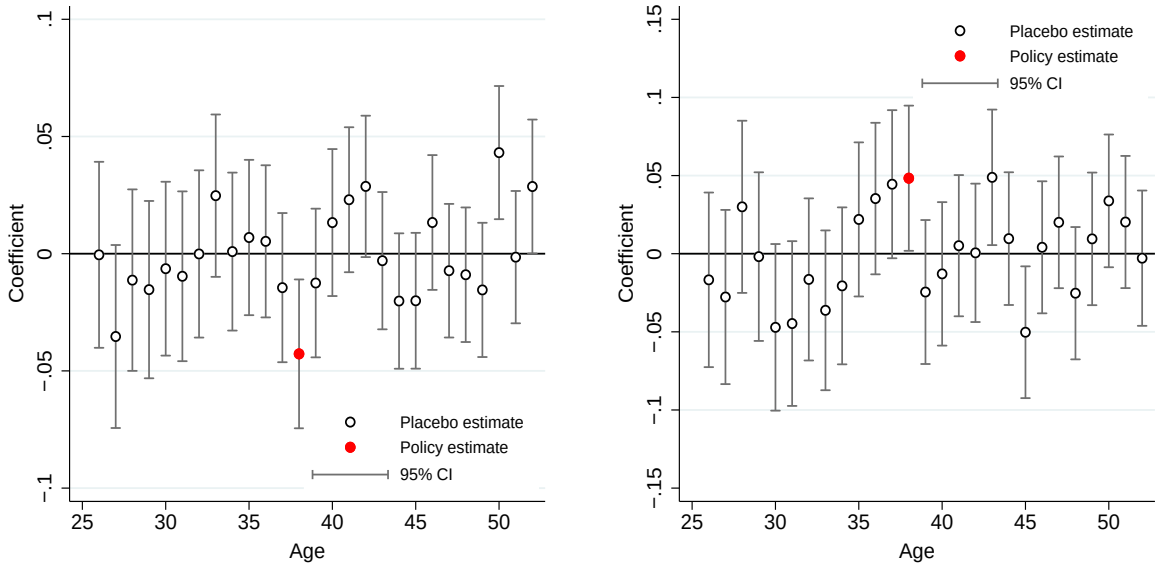


A Psychiatric Hospital Treatment

B Antidepressants

Note: The figure plots RD estimates on 37-year-olds using different bandwidths to estimate local linear age profiles. Standard errors are clustered at the individual level. The baseline preferred bandwidth is 7.5 years.

Figure A.10: Placebo Discontinuities for RD estimates

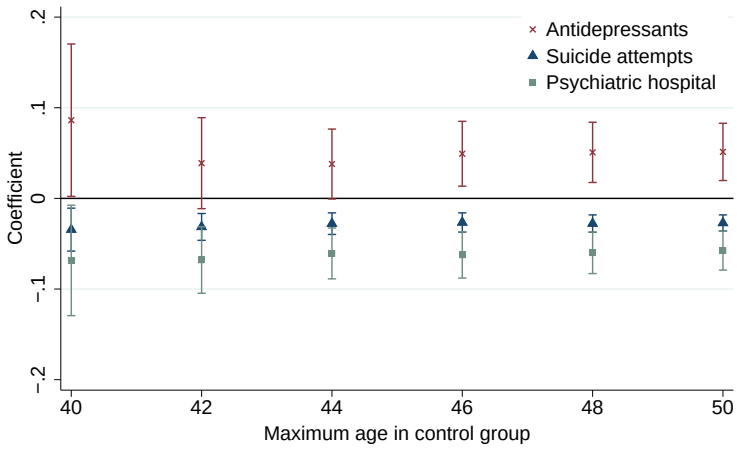


A Psychiatric Hospital Treatment

B Antidepressants

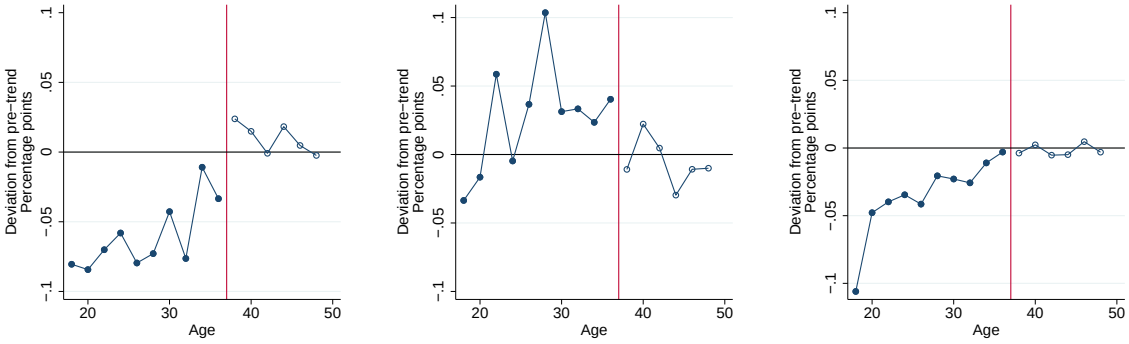
Note: The figure plots placebo RD estimates for each age between 26 and 52 years. I use the age range 26-52 years because I need 7.5 years, the bandwidth used throughout, on either side of the placebo cutoff to estimate local linear age profiles. Standard errors are clustered at the individual level.

Figure A.11: Sensitivity of DID Estimates to Changing the Age Range in the Control Group



Note: The figure shows how the DID estimates on 18-37-year-olds change when the upper age limit of the control group is lowered. Standard errors are bootstrapped with 500 repetitions and individual-level clustrered sampling.

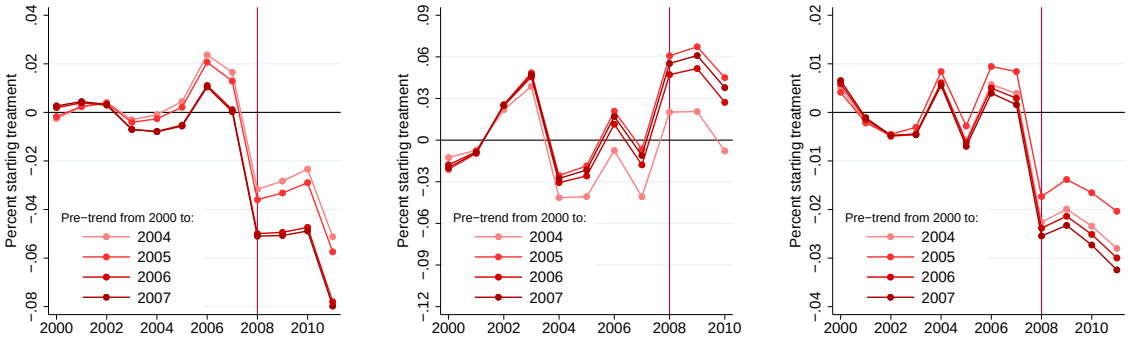
Figure A.12: Deviations From Pre-Trends by Age



A Psychiatric Hospital **B** Antidepressants **C** Suicide Attempts

Note: The figure shows deviations from pre-trends, estimated using the period 2000-2007, in the post-reform period 2008-2011 by two-year age groups. The vertical line marks the upper age limit of the depression criterion.

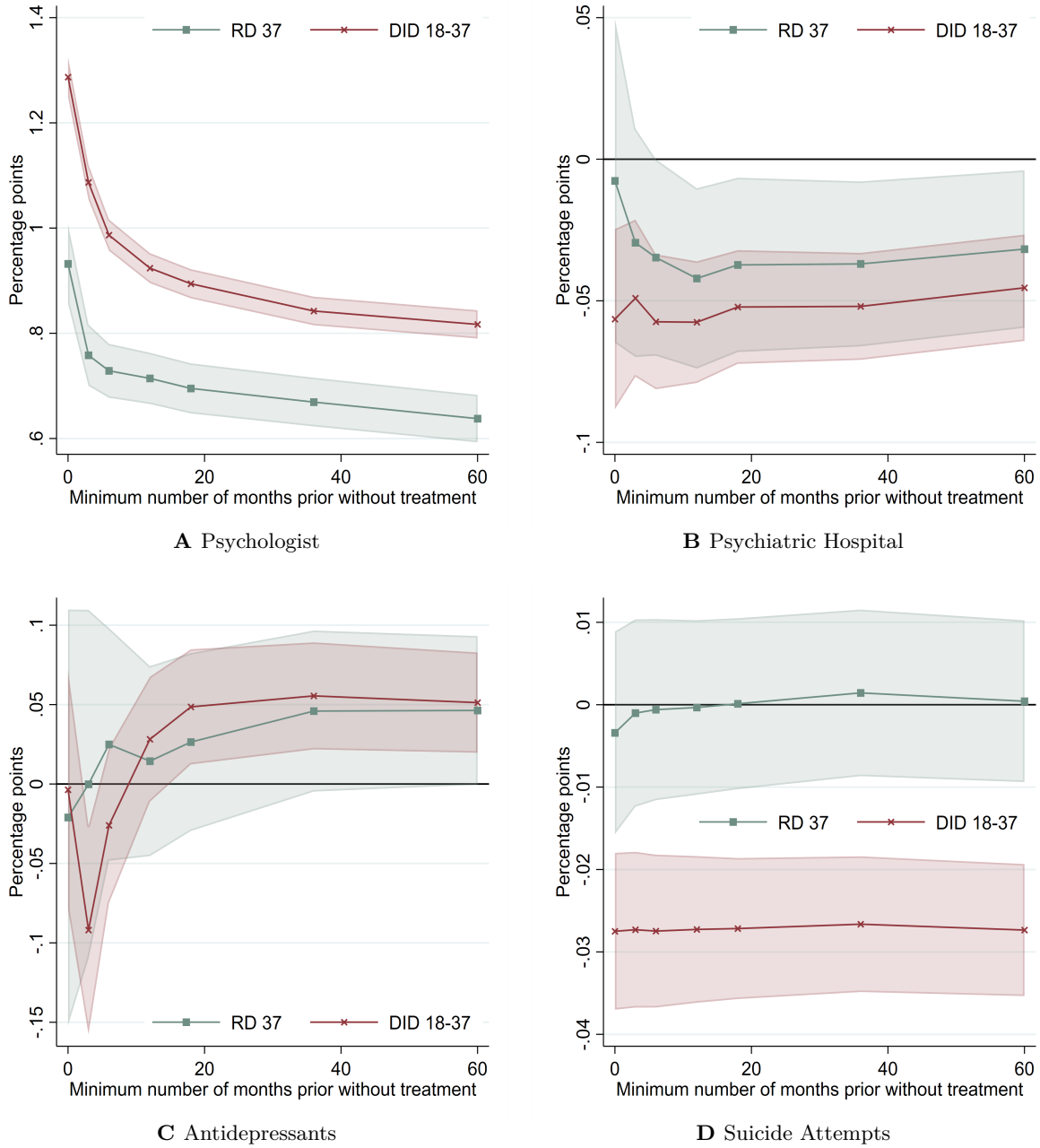
Figure A.13: Sensitivity of Difference-in-Differences Results to Years in Pre-Trends



A Psychiatric Hospital **B** Antidepressants **C** Suicide Attempts

Note: The figure shows how the DID estimates on 18-37-year-olds change if I estimate the pre-trends using the years 2000-2004, 2000-2005, and 2000-2006 instead of all pre-reform years 2000-2007 used in the baseline regressions.

Figure A.14: Sensitivity to Definition of Treatment Initiations



A Psychologist

B Psychiatric Hospital

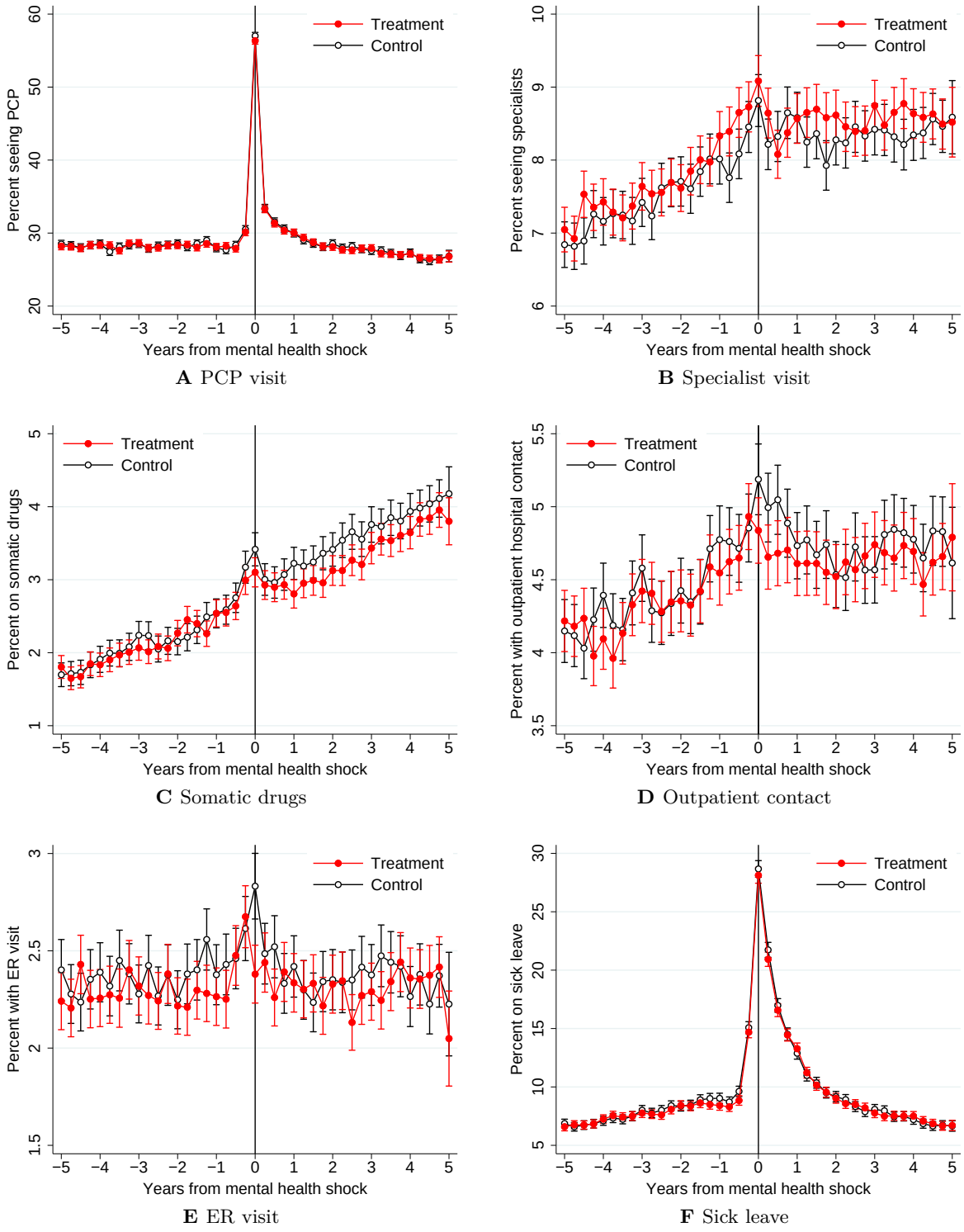
C Antidepressants

D Suicide Attempts

Note: The figure shows how DID estimates on 18-37-year-olds and RD estimates on 37-year-olds change if I define treatment initiations based on a different number of preceeding months without treatment. 95% confidence intervals for DID estimates are based on standard errors bootstrapped with 500 repetitions and individual-level clustrered sampling. 95% confidence intervals for RD estimates are based on standard errors clustered at the individual level.

Physical Health & Labor Market Results: Appendix Figures and Tables

Figure A.15: Physical Health and Labor Market Outcomes Around Mental Health Shocks



A PCP visit

B Specialist visit

C Somatic drugs

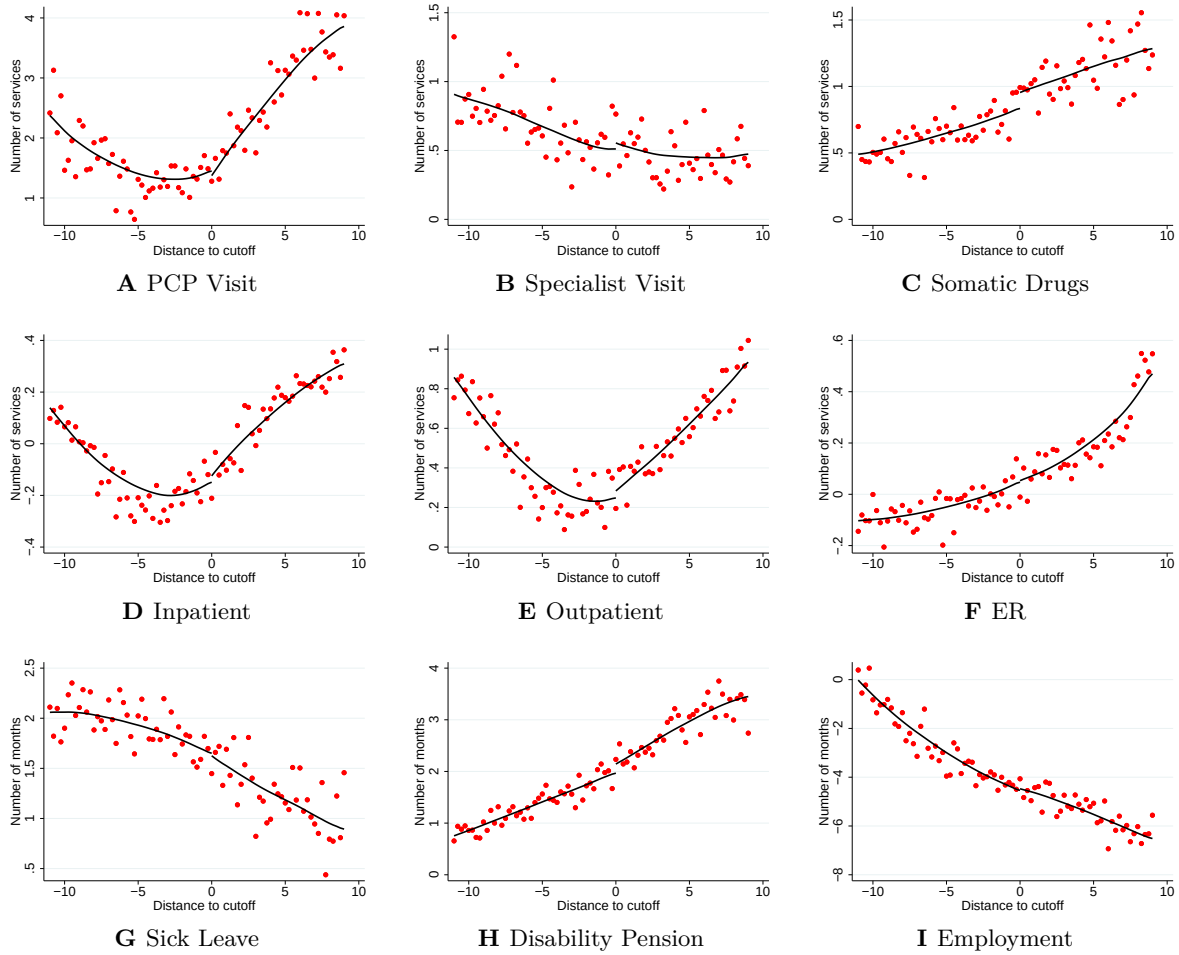
D Outpatient contact

E ER visit

F Sick leave

Note: The figure plots RD estimates of the average outcomes of individuals experiencing a mental health shock just before (treatment group) and after (control group) turning 38 years, from five years before the shock to five years after. Mental health shocks are defined as the first time in at least twelve months a person receives a psychometric test by their PCP. The coefficients are estimated using monthly data, but averaged within quarters. I use a bandwidth of 7.5 years to estimate local linear age profiles. 95% confidence intervals are based on standard errors clustered at the individual level.

Figure A.16: RD-FE Estimates on Physical Health and Labor Market Outcomes



Note: The figure illustrates person fixed effects estimates of the average change in outcomes from five years before to five years after a mental health shock by age at the mental health shock. The coefficients are estimated using monthly data. The smooth black lines are estimated using local linear regression with a bandwidth of 7.5 years. I multiply all coefficients by 60 – the number of months in the 5-year post-shock period – such that they reflect the cumulative number of services used for physical health services and the number of months spent on sick leave etc. for labor market outcomes.

Physical Health & Labor Market Results: Robustness Checks

Table A.5: Difference in Characteristics Between Individuals Above and Below Cutoff

	Coefficient
Percent male	-0.38
	[36.04]
	(0.55)
Avg. Income	2,373
	[280,337]
	(1,491)
Avg. earnings	1,713
	[211,664]
	(1,712)
Avg. wealth	367
	[8,133]
	(9,043)
Share previous mental health problems:	
Psychologist	0.36
	[11.95]
	(0.38)
PCP MH consulation	-0.64
	[29.03]
	(0.53)
Psychiatrist	-0.05
	[7.32]
	(0.30)
Psychiatric hospital	-0.21
	[8.85]
	(0.33)
Antidepressants	-1.41***
	[32.96]
	(0.54)
Anxiety & tranquilizers	-0.84*
	[20.10]
	(0.46)
Suicide attempts	-0.06
	[0.54]
	(0.08)
Poisoning from painkillers	-0.04
	[0.48]
	(0.08)

Note: The table reports RD estimates of average differences in characteristics of individuals receiving a psychometric test just before and after turning 38 years. All characteristics are measured from five to one years before the individual receives the psychometric test. For socioeconomic variables, I use the average during this period. For mental health services, I consider whether individuals at any point during the period used mental health services. Baseline characteristics of individuals receiving a psychometric test just after turning 38 are reported in brackets. Standard errors clustered at the individual level are reported in parenthesis.

Table A.6: Effects on Physical Health and Labor Market Outcomes - Alternative Definition of Mental Health Shock

Time period	Within two years		Within five years	
Method	Reduced form	IV	Reduced form	IV
Psychologist	7.16***		7.12***	
	[19.93]		[23.12]	
	(0.37)		(0.39)	
Physical health outcomes				
PCP visit	-0.12	-1.69	-0.18	-2.60
	[10.86]	(1.14)	[24.86]	(2.49)
	(0.08)		(0.18)	
Specialist visit	0.04	0.53	0.07	0.98
	[2.49]	(0.62)	[6.25]	(1.33)
	(0.04)		(0.09)	
Somatic drugs	-0.02	-0.31	-0.02	-0.34
	[0.90]	(0.39)	[2.45]	(1.04)
	(0.03)		(0.07)	
Inpatient visit	-0.02	-0.29	-0.04	-0.56
	[0.46]	(0.21)	[1.09]	(0.45)
	(0.01)		(0.03)	
Outpatient visit	-0.04*	-0.57*	-0.09*	-1.25*
	[1.34]	(0.32)	[3.31]	(0.66)
	(0.02)		(0.05)	
ER visit	-0.01	-0.17	-0.03	-0.46
	[0.67]	(0.19)	[1.66]	(0.39)
	(0.01)		(0.03)	
Labor market outcomes				
Sick leave	0.03	0.37	0.10	1.41
	[3.49]	(0.87)	[6.12]	(1.59)
	(0.06)		(0.11)	
Disability pension	-0.05	-0.71	-0.21*	-2.89*
	[1.41]	(0.48)	[4.39]	(1.50)
	(0.03)		(0.11)	
Employment	0.04	0.51	0.01	0.10
	[14.19]	(1.16)	[35.59]	(3.07)
	(0.08)		(0.22)	

Note: The table reports FE-RD estimates comparing individuals experiencing a mental health shock just before (treated) and after (control) turning 38 years, before and after the mental health shock. Mental health shocks are defined as the first time in at least twelve months a person has a mental health consultation with their PCP. The coefficients are estimated on a monthly level using data five years before and after the shock. I use a bandwidth of 7.5 years to estimate local linear age profiles. The first two columns show effects within two years while the last two columns show results within five years after the shock. Columns 1 and 3 report reduced form estimates. Columns 2 and 4 report 2SLS IV estimates, using the effects on psychotherapy, reported in row 1, as the first stage. Physical health outcomes are reported in cumulative number of services and labor market outcomes are reported in months. I obtain these coefficients by multplying the monthly-level estimates (ω_2 from equation 6) by the number of months in the post-shock period. Brackets report the counterfactual probability of the outcomes. This is equal to the level of the outcome in the control group (e.g., average number of months employed in the first five years after the shock). Standard errors clustered at the individual level are reported in parenthesis. *** p<0.001 ** p<0.05, * p<0.1.

Table A.7: Representativenes of Subsample of Patients Receiving Psychometric Tests

	Full sample	Subsample	Difference
Percent male	28.62	30.62	2.00*
	(0.33)	(0.70)	(1.14)
Avg. Income	278,918	282,311	3,393***
	(846)	(1,728)	(570)
Avg. earnings	217,728	225,265	7,538***
	(963)	(1,917)	(602)
Avg. wealth	7,020	10,490	3,470***
	(4,087)	(9,041)	(1,294)
Share previous mental health problems:			
Psychologist	13.33	10.53	-2.80***
	(0.25)	(0.47)	(0.95)
PCP MH consulation	25.82	22.37	-3.45***
	(0.32)	(0.63)	(1.10)
Psychiatrist	6.48	5.04	-1.44*
	(0.18)	(0.33)	(0.80)
Psychiatric hospital	6.68	4.68	-2.00**
	(0.18)	(0.32)	(0.79)
Antidepressants	25.64	20.41	-5.23***
	(0.32)	(0.61)	(1.08)
Anxiety & tranquilizers	15.86	12.58	-3.28***
	(0.27)	(0.50)	(0.98)
Suicide attempts	0.42	0.18	-0.23
	(0.05)	(0.07)	(0.37)
Poisoning with painkillers	0.35	0.23	-0.12
	(0.04)	(0.07)	(0.38)

Note: Column 1 reports average characteristics of individuals starting psychological treatment at the age of 36-38 during the post-reform period 2008-2011. Column 2 reports characteristics of a subsample of these individuals who also receive a psychometric test by their PCP. Column 3 report differences between these groups. All characteristics are measured from five to one years before the individual starts psychological treatment. For income, earnings and wealth variables I use the average value during this period. For mental health care services I consider whether individuals at any point during the period have used mental health services. Columns 1 and 2 report standard deviations in parentheses, while column 3 reports standard errors in parentheses. *** $p<0.001$ ** $p<0.05$, * $p<0.1$.

Regression Kink Design Analysis

This section presents Regression Kink Design (RKD) estimates of the effect of psychotherapy coverage on physical health and labor market outcomes. I exploit that the number of months of psychotherapy coverage a person enjoys during the post-reform period April 2008 - June 2012 is a linearly decreasing function of their age at the time of the introduction of psychotherapy coverage with two kinks – at age 33.83 and age 38. Persons aged 33.83 or less at the time of the reform have 52 months of psychotherapy coverage during the post-reform period, while persons aged 38 or more have zero months of coverage. Between age 33.83 and 38, the number of months of psychotherapy coverage drops by one for each additional month of age. Hence, the slope of the relationship between months of psychotherapy coverage and age changes discontinuously from zero for ages below 33.83 years to minus one between 33.83 and 38 years and again to zero after age 38. The RKD method exploits these discontinuities in the slope (kinks) to estimate the causal effect of psychotherapy coverage.

Figure A.17: Regression Kink Design: First Stage

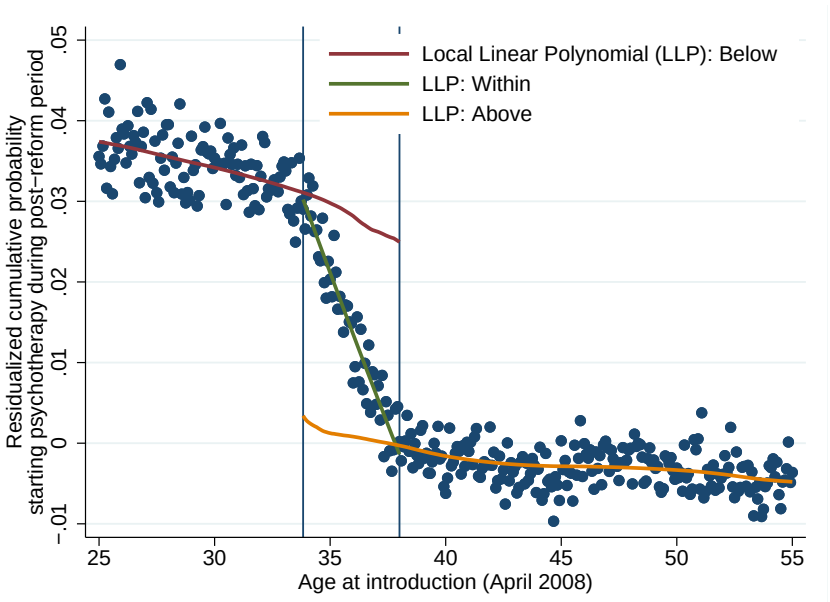


Figure A.17 illustrates the Regression Kink method using the cumulative share of the population starting psychological treatment during post-reform period. To account for pre-existing

age profiles in these numbers, I first estimate and take-out age-specific pre-trends during the pre-reform period January 2000- March 2008. I then plot the sum of deviations from these pre-trends during the post-reform. As Figure A.17 clearly shows, there are only small deviations from pre-trends among individuals aged 38 or more as of April 2008, as these individuals are never eligible for psychotherapy coverage during the period. Among individuals below age 33.83 in 2008, who are eligible for psychotherapy coverage throughout the post-reform period, the sum of deviations is around 3.5 percentage points, implying that around 3.5 percent of these individuals start using psychotherapy during the post-reform period. Within the age range 33.83 - 38 the use of psychotherapy drops linearly because each additional month of age means one less month of psychotherapy coverage during the period.

I estimate the following regression:

$$Y_i = \omega_0 + \omega_1 AgeReform_i + \omega_2 Within_i + \omega_3 AgeReform_i \times Within_i + \pi_i \tag{14}$$

where $AgeReform$ is age at the time of the reform and $Within_i$ is an indicator for whether the individual was between 33.83 and 38 years old – the age range where months of coverage is decreasing in age. I estimate this regression on two separate samples; (1) ages 20 - 38 and (2) ages 33.83 - 55. This yields two separate estimates for the kink at age 33.83 and age 38. As those just above age 33.83 lose coverage just before the end of the post-reform period, the estimates from the first regression represent short run estimates. Conversely, the difference in coverage between individuals just above and below age 38 at the time of the reform only exists in the start of the post-reform period after which both groups are ineligible. Hence, these effects represent more long-term outcomes.

I run the regressions with triangular weights around the kinks such that equation (14) is a local linear regression. I use a bandwidth of 7.5 years on each side of the two kinks. The parameter of interest is ω_3, which captures the change in the slope of the relationship between age and the outcome around the kinks.

The advantage of this method over the DID and RD methods on population data is that the RKD model estimates cumulative probabilities. As shown in the first row of Table A.8, which reports the Regression Kink estimates, the cumulative share of compliers is more than three times larger than in the baseline DID and RD estimates. This provides much better conditions for detecting treatment effects on mean outcomes of the entire population. This also allows me to assess whether treatment effects on the full population are different from the estimates based on the subsample of individuals receiving psychometric tests used in the main results described in Section 6.

Overall, the results presented in Table A.8 are qualitatively similar to the RD-FE estimates presented in Table 4 in Section 6. Psychotherapy coverage reduces somatic drug use and in- and outpatient hospital contacts, but there are no significant effects on labor market outcomes. Surprisingly, the coefficient on PCP visits is large, negative and significant. However, this is due to a spurious jump in deviations from pre-trends among 38-44-year-olds.

Table A.8: RKD Results on Physical Health and Labor Market Outcomes

Time period	Lower kink (short run)		Upper kink (long run)	
Method	Reduced form	IV	Reduced form	IV
Psychologist	2.81***		2.80***	
	[7.19]		[3.64]	
	(0.16)		(0.14)	
Physical Health Outcomes				
PCP visit	-0.38***	-13.38***	-0.75***	-26.94***
	[13.32]	(2.98)	[13.16]	(3.23)
	(0.08)		(0.08)	
Specialist visit	0.07*	2.52*	0.02	0.87
	[3.68]	(1.38)	[3.80]	(1.38)
	(0.04)		(0.04)	
Somatic drugs	-0.02	-0.88	-0.10***	-3.46***
	[0.74]	(0.70)	[0.95]	(0.78)
	(0.02)		(0.02)	
Inpatient visit	0.01	0.29	-0.03***	-1.17***
	[0.64]	(0.29)	[0.53]	(0.29)
	(0.01)		(0.01)	
Outpatient visit	-0.01	-0.24	-0.09***	-3.23***
	[1.89]	(0.63)	[1.79]	(0.66)
	(0.02)		(0.02)	
ER visit	0.01	0.41	-0.02***	-0.88**
	[0.94]	(0.34)	[0.92]	(0.34)
	(0.01)		(0.01)	
Labor Market Outcomes				
Sick leave	0.11***	3.80***	-0.03	-1.02
	[2.24]	(1.25)	[2.26]	(1.29)
	(0.04)		(0.04)	
Disability pension	0.05	1.63	-0.10	-3.74
	[1.64]	(2.18)	[2.36]	(2.37)
	(0.06)		(0.07)	
Employment	0.06	2.18	0.11	3.93
	[37.46]	(4.44)	[37.75]	(4.49)
	(0.12)		(0.13)	

Note: Robust standard errors are reported in parenthesis. For computational reasons, standard errors do not account for the pre-estimation of pre-trends. *** p<0.001 ** p<0.05, * p<0.1.

Additional Appendix Figures and Tables

Table A.9: Difference-in-Differences Estimates of the Mental Health Offset

Outcome	Number of services (per treated)	Costs (per treated)
Psychotherapy	9.20***	4,975***
	(0.08)	(45)
Mental health		
PCP MHC	0.44***	199***
	(0.08)	(35)
Psychometric test	1.53***	337***
	(0.05)	(12)
Antidepressants	0.03	-19
	(0.11)	(23)
Psychiatric Hospital	-1.09**	-2,471
	(0.49)	(1,562)
Suicide attempts	-0.04***	-218**
	(0.01)	(108)
Mental Health Offset		-0.44
		(0.32)

Note: This table presents Difference-in-Differences estimates on 18-37-year-olds of the effect of psychotherapy coverage on the number of services used and associated costs for different mental health outcomes. When calculating the number of services and costs associated with a given episode of mental health care, I sum all services used within a year after the first treatment. All results are measured per treated individual and estimated using 2SLS IV regressions where the baseline results on number of individuals using psychotherapy is the first stage. The mental health offset is estimated by 2SLS IV using, as the outcome, the sum of costs of mental health services and, as the first stage, the effect on psychotherapy costs. This is equivalent to the cost offset described in the theory section and equation 4. In all regressions, I first estimate and take out separate linear pre-trends for the treatment and control groups using the pre-reform period 2000-2007. Standard errors are bootstrapped using 500 repetitions and clustered sampling at the individual level. *** $p<0.001$ ** $p<0.05$, * $p<0.1$.