Employment Effects of Healthcare Policy: Evidence from the 2007 FDA Black Box Warning on Antidepressants*

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April 22, 2020

ABSTRACT: Public policies aimed at improving health may have indirect effects on outcomes such as education and employment. We study the labor market effects of the US Food and Drug Administration's 2007 expanded black box warning on antidepressants. Our difference-in-differences estimates imply that the warning reduced employment by 6.1 percent among women aged 35-49 with a history of depression. We explore potential mechanisms and find that antidepressant and psychotherapy use among women aged 35-49 decreased after the warning. Our analysis suggests that the 2007 warning reduced US labor force participation by 0.23 percentage points, leading to $11.8 billion in lost wages.

KEYWORDS: Mental Health, Employment, Antidepressants, Black Box Warnings
JEL CLASSIFICATION: I18, D83, J22

*We thank Timothy Bersak, Sandra Black, Kasey Buckles, Michael Darden, Matthew Harris, Daniel Hungerman, Ethan Lieber, Rebecca Myerson, Vincent Pohl, Nicolas Ziebarth and seminar participants at Purdue University, the University of Georgia, the University of Notre Dame, the Conference of the American Society of Health Economists, the International Health Economics Association World Congress, and the Midwest Health Economics Conference for helpful comments. The data used in this article can be obtained from the websites of the National Survey on Drug Use and Health (https://nsduhweb.rti.org/respweb/homepage.cfm) and the Medical Expenditure Panel Survey (https://www.meps.ahrq.gov/mepsweb/). Additional replication materials will be provided in the Online Appendix. Cronin and Skira have nothing to disclose. Bütikofer received support from the Research Council of Norway through its Centres of Excellence Scheme, FAIR Project No. 262675 and from the Research Council of Norway FRIHUMSAM-Project No. 275800.

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1 Introduction

Since the year 2000, antidepressant use in the United States has risen 65 percent. Between 2011 and 2014, almost 13 percent of Americans aged 12 and over reported using an antidepressant in the past month (Pratt et al., 2017). Prescription antidepressants are the most common treatment for depression and anxiety disorders, the diagnostic rates of which have also grown steadily over the last few decades (see Figure 1).[1] Among the many personal and societal consequences of these disorders, Ettner et al. (1997), and more recently Cronin et al. (2020), show empirically that mental illness can have a substantial negative impact on the labor market outcomes of affected individuals.[2] For example, Ettner et al. (1997) estimate that individuals with a mental illness are roughly 13 percentage points less likely to work and that employed women with a mental illness earn 30 percent less annually than women without a mental illness.

The extent to which antidepressants protect the employment and productivity of those with depression and anxiety is an open question. Furthermore, it is unclear the extent to which government policy could or should impact labor market outcomes by promoting mental health treatment.[3] We provide insight on these questions by analyzing the labor market effects of the US Food and Drug Administration's (FDA) 2007 expanded black box warning on antidepressants. A black box warning appears on a prescription drug's label (or package insert) and is meant to call attention to serious adverse or life-threatening side effects. It is the strongest warning required by the FDA. In October 2004, the FDA required that drug manufacturers of 36 antidepressants include a black box warning of increased risk of suicidal thinking and behavior (suicidality) for children and adolescents. The warning was expanded on May 2, 2007 to incorporate the following three messages: (i) in addition to children and adolescents, antidepressants increase the risk of suicidality in young adults *under the age of 24* with major depressive disorder and other psychiatric disorders; (ii) individuals 65 and older experience a *reduced* risk of suicidality while taking the drug; and (iii) patients of *all ages* who are started on antidepressant therapy should be monitored appropriately and observed closely for clinical worsening, suicidality, or unusual changes in behavior.

While a number of studies in the economics literature have examined the impact of the 2004 warning on antidepressant use, this study is the first to estimate the impacts of the 2007 expanded warning on

[1] Depression and anxiety are often discussed as a single mental illness because they share common symptoms and treatments. In this paper, we do not distinguish between the two, but recognize there are important and nuanced clinical differences.

[2] These findings are consistent with the long-held view that health is a form of human capital (Grossman, 1972). Currie and Madrian (1999) summarize a large body of empirical research indicating that both physical and mental health have important effects on educational attainment, labor supply, and earnings.

[3] In recent years, policy makers have made numerous attempts to curb the growth of mental illness in the U.S., mostly by lowering the cost of mental health treatment. Examples include state-level mental health parity laws passed throughout the 1990s and early 2000s; the (federal) Mental Health Parity Act of 1996 and Mental Health Parity and Addiction Equity Act of 2008; and the Patient Protection and Affordable Care Act of 2010, which made mental health one of 10 essential health benefits all individual and small-group insurance plans must cover.

prescription antidepressant utilization and the employment of affected individuals. If antidepressant use declined in response to the expanded warning, the labor market outcomes of those suffering from depression may have been affected. There are several reasons to expect, *a priori*, that the expanded warning had important implications for antidepressant use among the prime working-age population. First, the 2007 expanded warning recommended that new patients of *all ages* receive enhanced monitoring. Second, while the warning of suicidality risk in 2004 explicitly targeted children and adolescents, the warning of suicidality risk in 2007 targeted young adults aged 18-24, a group that is more likely to be in the workforce. Last, several studies have found that adult antidepressant utilization fell in response to the 2004 warning (Olfson et al., 2008; Libby et al., 2009; Parkinson et al., 2014) even though that warning had no stated relevance for them. If adults older than 24 view drug-associated risks for young adults as more salient than risks for children and adolescents, it may be even more likely that prime-working age adults responded to the 2007 expanded warning.

We use cross-sectional data from the nationally representative National Survey on Drug Use and Health (NSDUH) to estimate the reduced-form effects of the FDA's 2007 expanded black box warning on the employment of men and women aged 18-64. We use a difference-in-differences strategy that compares the employment of ever-depressed individuals, before and after the warning, to the employment of never-depressed individuals. We find that employment among ever-depressed women aged 35-49 decreased by 6.1 percent (4.4 percentage points) in response to the expanded warning. The warning did not have a significant effect on employment for ever-depressed men or for ever-depressed women outside the ages of 35-49. These results are robust to numerous alternative specifications.

To further understand these findings, we explore several mechanisms through which the 2007 expanded black box warning may have affected employment. We first study the most obvious mechanism, a decrease in antidepressant use, using the Medical Expenditure Panel Survey (MEPS).[4] Consistent with the employment effects reported above, we find that depressed women aged 35-49 were 19 percent (7.6 percentage points) less likely to use antidepressants in the eight months following the warning than they were prior to the warning, relative to similarly aged non-depressed women. Furthermore, we find no evidence that antidepressant use among depressed men aged 18-64 and among women outside the ages of 35-49 responded to the warning. In line with the warning's language regarding new antidepressant users, the decrease in use was stronger among new users than continuing ones. We then explore additional mechanisms, including changes in the use of other mental health treatments, such as psychotherapy and benzodiazepines (drugs with sedative properties typically prescribed for anxiety), and

[4]The MEPS contains individual-level employment information that would, presumably, allow us to study both employment and antidepressant effects using one dataset. Unfortunately, the MEPS sample is substantially smaller than that of the NSDUH, making it highly unlikely that the (indirect) employment effect of the warning would be statistically detectable. In Section 5.3, we conduct a formal power test to make this point.

non-medical antidepressant substitutes, such as alcohol and marijuana. We find evidence of a decrease in psychotherapy use among depressed women aged 35-49 after the warning, suggesting complementarity between antidepressants and psychotherapy. Such complementarity is also implied by the structural model estimates in Cronin et al. (2020). We find weak evidence that the expanded warning increased benzodiazepine use, and it had no effect on alcohol consumption or marijuana use. Given the range of potential mechanisms underlying the employment response to the expanded warning, several of which we lack the data to explore (e.g., drug adherence), we focus on the reduced-form effects of the warning on employment, rather than exploit the warning as an instrument for antidepressant utilization.

Our estimates imply that the 2007 expanded black box warning had no impact on the targeted age group of 18-24 year olds. Instead, the warning led to a decline in antidepressant use and employment among women aged 35-49. Though the warning also applied to *all new* antidepressant users, we recognize that these findings are somewhat unexpected.[5] In Section 6, we discuss a number of explanations, and highlight the main ones here. First, numerous studies, including this one, document that females experience higher rates of depression than males, and that antidepressant use among middle-aged women is relatively high compared to men and younger females (Pratt and Brody, 2014; Blanchflower and Oswald, 2016; Pratt et al., 2017); thus, the 35-49 year old female subgroup likely contains a large fraction of marginal antidepressant users.[6] Second, Avery et al. (2012) provides evidence that antidepressant advertising, which must divulge the black box warning, is largely targeted towards middle-aged women, meaning this subsample may have a greater awareness of the warning than men or younger cohorts of women. Third, we find that the impact of the warning on both antidepressant use and employment is strongest for married women, suggesting spousal health insurance and income may enable middle-aged women to respond more strongly to the warning than younger women. Finally, both Brodie et al. (2003) and Collins and Schmeiser (2010) document examples of young adults not following health-related news, which may partly explain the lack of response by 18-24 year olds.

Our results underscore that public health policies can have significant and potentially unintended consequences beyond health and clinical considerations. Regarding the FDA's 2007 expanded black box warning in particular, employment effects seem to be limited to depressed women in their mid-30s to late-40s. Given that these women were in their prime-working years, the overall economic impact is not trivial. In Section 6, we argue that, among other consequences, the warning decreased overall labor force

[5]Other studies of FDA advisories and warnings have documented responses by non-targeted groups (Dusetzina et al., 2012). For example, Dorsey et al. (2010) find that the FDA's 2005 black box warning on antipsychotic medication, which targeted elderly individuals with dementia, led to statistically significant declines in atypical antipsychotic drug use among non-elderly individuals without dementia.

[6]While 50-64 year old women also experience depression and use antidepressants at a relatively high rate, the warning may have been more difficult for this group to interpret given the negative antidepressant-suicidality relationship that was emphasized for those 65 and older.

participation by 0.23 percentage points and led to roughly $11.8 billion (in 2006 dollars) in lost wages in the following year. Given existing research showing that the 2004 black box warning actually *increased* suicide rates (Gibbons et al., 2007; Busch et al., 2014) and worsened academic and behavioral outcomes for adolescents (Busch et al., 2014), our findings echo the concerns of other researchers regarding the efficacy and unintended consequences of the FDA's black box warnings on antidepressants.

Our paper contributes to the literature that studies the labor market effects of medical treatments and innovation (e.g., Thirumurthy et al., 2008; Papageorge, 2016; Cronin et al., 2020; Jeon and Pohl, 2019; Harris et al., forthcoming). One strand of this literature exploits treatment-related policy changes and information shocks to examine the relationship between medical treatments and employment. For example, Daysal and Orsini (2014) study the employment effects of hormone replacement therapy (HRT) on middle-aged women by exploiting a negative information shock similar to the black box warning studied in this paper. Both Garthwaite (2012) and Bütikofer and Skira (2018) study the labor market effects of pain medication by exploiting the removal of Vioxx, a type of Cox-2 inhibitor, from the worldwide market in 2004 in response to information about adverse cardiac side effects. All three papers document substantial worsening of labor market outcomes following negative information shocks. Our focus on an antidepressant-related regulatory change and information shock is particularly important given the popularity of the drug class, as well as existing evidence that antidepressant users are responsive to information shocks. Namely, Shapiro (2018a) finds greater exposure to direct-to-consumer advertising of antidepressants significantly decreases missed days of work. Our research advances this literature by exploring a range of mechanisms through which the black box warning may have affected employment, such as the use of various mental health treatments and non-medical substitutes. Prior studies have either focused exclusively on labor market effects or, if they consider mechanisms, only consider changes in the use of the medical treatment most directly impacted by the regulatory change or information shock.

Like several of the papers mentioned above, our paper contributes to a broader literature on the economics of information, particularly that which focuses on responses to negative product information. In the pharmaceutical domain, evidence shows consumers and physicians respond to information provided via direct-to-consumer advertising, clinical studies, drug recalls, and FDA announcements and labeling changes (e.g., Azoulay, 2002; Cawley and Rizzo, 2008; Chintagunta et al., 2009; Dusetzina et al., 2012; Collins et al., 2013; Shapiro, 2018b). For example, Cawley and Rizzo (2008) and Collins et al. (2013) show prescription drug withdrawals lead to reduced utilization of remaining drugs within the same therapeutic class. Dusetzina et al. (2012) review the literature on the impact of FDA drug risk communications and find drug-specific warnings are associated with large decreases in utilization. Among this literature are several papers that study responses to the FDA's 2004 black box warning on

antidepressants (e.g., Busch et al., 2010; Parkinson et al., 2014).[7] Our paper advances this literature by focusing on the 2007 expanded warning and estimating the indirect employment effects of the warning. In an important paper, Busch et al. (2014) study indirect effects of the 2004 warning, also using annual cross-sectional data from the NSDUH. The authors estimate the impact of the warning on academic and behavioral outcomes of adolescents aged 12-17 with probable depression using a difference-in-differences design. They find that adolescents with recent probable depression experienced a drop of 0.14 points in grade point average after the 2004 warning relative to those without probable depression. They also find increases in substance use and delinquency. Consistent with our findings, the indirect behavioral responses estimated by Busch et al. (2014) are driven entirely by girls.

The remainder of the paper is organized as follows: Section 2 details the history of the FDA's black box warnings on antidepressants. In Section 3, we describe the data and our empirical strategy. Section 4 contains our estimates of the impact of the 2007 expanded black box warning on employment, as well as robustness checks. In Section 5, we explore mechanisms through which the warning may have altered employment. Finally, in Section 6, we discuss the implications of our findings.

2 Background

Modern pharmaceutical antidepressants were first introduced in the 1950s and are currently one of the three most commonly used drug classes in the U.S. (Pratt et al., 2017). The most popular antidepressants today are selective serotonin reuptake inhibitors (SSRIs), the first of which, fluoxetine (marketed as Prozac), was introduced in 1987.[8] SSRIs grew in popularity, in part, because they have fewer side effects and are less toxic in overdose compared to earlier antidepressants, such as tricyclic antidepressants (TCAs). Recent research has proven both SSRIs and TCAs to be more effective at reducing depressive symptoms, on average, than a placebo.[9] In addition to depression, SSRIs and other antidepressants are now commonly prescribed for a multitude of ailments, including generalized anxiety, panic disorder, obsessive compulsive disorder, post-traumatic stress disorder, eating and sleep disorders, pain, and migraines (Wong et al., 2017).

The introduction of SSRIs produced an abundance of clinical research. By the late 1990s and early 2000s, a growing body of evidence indicated that some younger patients, particularly those under age

[7]The collective literature on the impact of the 2004 warning on pediatric and adolescent antidepressant utilization suggests declines in use of 20 percentage points or more (Gibbons et al., 2007; Nemeroff et al., 2007; Olfson et al., 2008; Libby et al., 2009; Busch et al., 2010, 2011; Parkinson et al., 2014), while estimated effects for adults are negative with varying magnitudes (Olfson et al., 2008; Libby et al., 2009; Parkinson et al., 2014).

[8]Seratonin is a neurotransmitter, a chemical that carries signals between brain cells. SSRIs block the brain's reabsorption of seratonin, making more available.

[9]Cipriani et al. (2018) conduct a meta-analysis of 522 randomized control trials of 21 different antidepressants, and find all 21 drugs to be statistically more effective than placebo. These results echo those of an earlier meta-analysis (Kirsch et al., 2008) focused on clinical trials submitted to the FDA, including both approved and non-approved antidepressants.

18, experienced an increase in the incidence of suicidal ideation, and potentially an increase in suicide attempts, after beginning treatment with an SSRI.[10] The most commonly cited theory as to why SSRIs, in particular, might increase suicidality, is that they tend to give new patients energy before altering their mood, potentially aiding a suicidal thought or attempt (Ludwig et al., 2009). The FDA's first public recognition of this association came on June 19, 2003, when it released a statement saying paroxetine (marketed as Paxil), an SSRI, should not be used to treat major depressive disorder for children under 18. After a series of public health advisories,[11] the FDA mandated on October 15, 2004 that a black box warning be added to all antidepressants describing increased risks of suicidality in children and adolescents with major depressive disorder and other psychiatric disorders. The specific wording of the warning can be seen in Appendix Figure A1.

Shortly after the FDA's 2004 decision, the agency's Division of Psychiatry Products was asked to expand their exploration of suicidality in antidepressant trials to the adult population. This was a major effort, involving 372 placebo-controlled antidepressant trials and almost 100,000 patients (Noel, 2015). On December 13, 2006, the FDA's Psychopharmacologic Drugs Advisory (PDA) Committee met to consider the results of these trials. The meeting convened with a vote of six-to-two in favor of altering the black box warning in three ways: (i) expand the warning that the drug increases the risk of suicidality to include young adults *under the age of 24* with major depressive disorder and other psychiatric disorders; (ii) notify individuals 65 and older of a *reduced* risk of suicidality while taking the drug; and (iii) state that patients of *all ages* who are started on antidepressant therapy should be monitored appropriately and observed closely for clinical worsening, suicidality, or unusual changes in behavior. The new warning was announced to the public on May 2, 2007. The exact wording of the expanded warning can be seen in Appendix Figure A2. Both the FDA's PDA committee meeting in December 2006 and the black box announcement in May 2007 generated significant media coverage.[12] Appendix Figure A3 contains a timeline of FDA announcements and actions on the association between antidepressants and suicidality.

[10]This body of evidence was systematically reviewed when the FDA sponsored a meta-anlaysis of over 20 pediatric randomized control trials and found SSRIs doubled the risk of suicidality versus receiving a placebo (4 percent versus 2 percent). None of the suicide attempts documented in the trials were fatal (Hammad et al., 2006). Antidepressants were first linked to an increase in the risk of suicide in the 1950s, when TCAs were introduced (Ludwig et al., 2009).

[11]On October 27, 2003, the FDA announced an advisory committee would examine the risk of suicidality associated with antidepressant use in pediatric and adolescent patients. This announcement was accompanied by a public health advisory, distributed via MedWatch, to all US physicians recommending close supervision of all high-risk patients. On March 22, 2004, the FDA issued a second public health advisory urging clinicians to "carefully monitor patients on antidepressants for possible worsening of depression or suicidality." Moreover, the FDA called on manufacturers of 10 antidepressants to add to their label a warning (though not a black box one) that all patients should be carefully monitored for suicidality.

[12]A LexisNexis search of "antidepressant warning (warning*s*)" for May 2007 reveals 807 (933) news articles, more than twice as many articles found in April or June of 2007. A search of those same terms for December 2006 reveals 672 (808) articles, also more than twice the articles found in November 2006 or January 2007. The December 2006 meeting and May 2007 announcement were covered by major news outlets and programs, such as ABC's Good Morning America, ABC's World News, CNN, National Public Radio, NBC News, the New York Times, PBS NewsHour, and the Washington Post.

3 Empirical Approach

3.1 Data

The data we use for our main analyses come from the National Survey on Drug Use and Health (NSDUH). The NSDUH is a nationally representative survey sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA) that provides information on demographics, substance use, mental health, other-health related issues, and labor market status. Every year the NSDUH surveys 67,500 individuals age 12 and older.[13]

In 2004, the NSDUH began classifying individuals as having had a major depressive episode (MDE) in their lifetime if for a period of two weeks or longer, they (i) experienced at least 5 out of 9 symptoms commonly associated with depression and (ii) one of the symptoms was a depressed mood or loss of interest or pleasure in daily activities. The other symptoms reflect changes in functioning, such as problems with sleep, eating, energy, concentration and decisiveness, self-image and worth, or recurrent thoughts of death or suicide. This definition of MDE matches, almost exactly, the clinical definition of depression outlined in the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV).[14] We define our treatment group as those who have ever had an MDE in their lifetime and our control group as those who have never experienced an MDE in their lifetime.[15] Importantly, assignment to the treatment and control groups using lifetime MDE is *not* based on a medical diagnosis or an individual's decision to seek treatment for depression. Assignment based on diagnosis and/or mental health treatment receipt could be problematic if the warning altered individual healthcare behaviors, potentially changing the composition of the treatment and control groups in a way that biases the difference-in-differences estimates.[16] We revisit this point in Section 4.2. Furthermore, given the NSDUH data is cross-sectional, the lifetime MDE information is key in allowing us to identify individuals with a history of depression, not just those currently suffering from depression.

Our main outcome of interest is an indicator for whether the individual was employed in the past week, which includes those working full-time, working part-time, and who report having a job or a business but did not work in the past week. All others are defined as not employed, which includes the

[13] See Appendix B for a discussion of why NSDUH is better suited for this analysis relative to other datasets.

[14] Unlike the definition in the DSM-IV, no exclusions were made for an MDE caused by medical illness, bereavement, or substance use disorders in NSDUH. The DSM-IV is published by the American Psychiatric Association and offers a common language and standard criteria for classifying mental disorders.

[15] In referencing the treatment group, we will often describe individuals as having experienced "a lifetime MDE."

[16] In comparison, the treatment group in Busch et al. (2014) consists of those with probable depression, defined as receiving any treatment or counseling services for emotional or behavioral problems from a range of sources over the past 12 months. They conduct specification tests to defend the identifying assumption that the composition of their treatment and control groups is stable; however, these tests cannot guarantee that unobserved characteristics of the groups do not change. They use the "probable depression" definition because the validated diagnostic instrument for MDE that we use was not asked until 2004.

unemployed, the disabled, homemakers, those in school or training, the retired, and those without a job for some other reason.

The NSDUH contains rich information on demographics, such as the individual's gender, race, ethnicity, marital status, educational attainment, and whether he/she lives in a large metro, small metro, or non-metro. For those aged 12-21, age is known in years. In the public-use data, an individual's precise age in years is not available if he/she is over the age of 21. Instead, the NSDUH bins the following ages together: 22-23, 24-25, 26-29, 30-34, 35-49, 50-64, 65 and older. Our sample consists of those aged 18-64; individuals in their prime-working years. We estimate our models on subsamples of coarse age groups, including those aged 18-25, 26-34, 35-49, and 50-64. We consider these groups because 18-25 year olds were directly targeted by the 2007 warning and 26-34 year olds were just outside the targeted age range. Studying those aged 35-49 allows us to examine whether the warning affected individuals well outside the targeted group. Moreover, the warning also applied to "patients of all ages who are started on antidepressant therapy," providing another reason to examine responses among older individuals. We also include individuals aged 50-64, but note that for this group, the warning's message may have been difficult to interpret as positive antidepressant-suicidality associations were highlighted for young adults and negative associations were highlighted for those aged 65 and over.

We use data from 2005 to 2008 inclusive. Our sample starts in 2005, which was the first full year the MDE-related questions were asked to all adult respondents. Beginning in 2005 is also advantageous because it allows us to avoid capturing responses to the 2004 black box warning and FDA advisories that preceded the initial warning.[17] We do not consider years beyond 2008 to avoid the worst of the Great Recession and its potential effects on employment and healthcare. NSDUH interviews are conducted quarterly. To improve statistical power, we consider 6-month periods (i.e., in a given calendar year, quarters 1 and 2 make up one period and quarters 3 and 4 make up another period).[18] We consider all eight 6-month periods from 2005 to 2008. Our sample consists of 65,109 male observations and 74,576 female observations.

In Tables 1 and 2 we present summary statistics for men and women, respectively, by whether or not they experienced a lifetime MDE and by coarse age groups from 2005-2008. We also show the pre- and post-warning employment means for each group. Women are almost two times more likely to have experienced a lifetime MDE than men. Moreover, we show in Section 5.1 using the MEPS data that, conditional on depression, women are much more likely than men to use antidepressants and antidepressant use is increasing in age for both sexes.[19] Men of all ages with a lifetime MDE are less likely

[17]To address concerns that the 2004 warning impacted antidepressant use trends, and subsequently employment, in 2005, we conduct robustness tests in Section 4.3 that drop the first and second half of 2005 from the sample.

[18]We have also estimated our models with time measured in quarters and results are qualitatively similar.

[19]The NSDUH includes some information that could be interpreted as antidepressant use. If a respondent reports (i) thoughts or plans of suicide in their lifetime, or (ii) experiencing at least 5 out of 9 MDE symptoms in the same 2-week period in their lifetime, then they are asked whether they are "currently taking prescription medications prescribed for mood." As we

to be employed. For women younger than 35, employment rates are similar for those with and without a lifetime MDE. However, women age 35 and over with a lifetime MDE are less likely to be employed than those without. On average, both men and women with a lifetime MDE are more highly educated, are less likely to be married, and are more likely to be white than those who have not experienced an MDE in their lifetime. We control for these characteristics in our regressions.

3.2 Empirical Strategy

We estimate the following difference-in-differences model using OLS:

$$Emp_{it} = \alpha_0 + \alpha_1 MDE_{it} + \alpha_2 MDE_{it} \times Post_t + \alpha_3 X_{it} + \tau_t + \varepsilon_{it} \quad (1)$$

where Emp_{it} is an indicator for whether person i is employed at time t (where time is measured in 6-month intervals). MDE_{it} is an indicator for whether person i has had an MDE in their lifetime. $Post_t$ is an indicator equal to 1 starting in 2007. We define the first half of 2007 as "treated" because the FDA advisory committee agreed that antidepressant labeling changes were needed during their meeting in mid-December 2006 and the expanded black box warning was announced by the FDA on May 2, 2007. Given the media coverage of the December meeting (see footnote 12), healthcare providers and patients may have responded to that meeting and the proposed labeling changes before the black box warning was formally announced. If providers and patients responded only to the May 2007 announcement, then including the first half of 2007 in the post-warning period will cause our estimates to be conservative.[20] X_{it} are individual controls, including age, education, race, marital status, and metro status, and τ_t are time fixed effects. In all our models, we use NSDUH sampling weights, which are representative of the US population and account for survey non-response, and we report heteroskedastic-robust standard errors.

The coefficient of interest is α_2, which represents the change in the probability of employment of individuals with a lifetime MDE following the expanded black box warning in 2007, compared to the change in the probability of employment of individuals without a lifetime MDE. Our identification strategy, like that of Busch et al. (2014), relies on two key assumptions: (i) the composition of the treatment and control groups did not change in response to the warning and (ii) employment trends for the treatment and control groups would have been the same in the absence of the warning (i.e., the parallel trends assumption). We provide evidence supporting these assumptions in Section 4.2.

observe in the MEPS, the usage rate for such medications is higher for women and increasing with age. That said, these data are less than ideal for our purposes, not just because of the MEPS advantages detailed later, but because the vast majority of those categorized as not having a lifetime MDE are never asked about "prescription medications prescribed for mood." Within the context of our empirical setting, the non-depressed control group has missing antidepressant use by design. Moreover, this measure of prescription use does not capture well antidepressant use for those with a history of mild or moderate depression.

[20] We examine the sensitivity of our results to the definition of $Post_t$ and the exclusion of the first half of 2007 in Section 4.3.

4 Results

4.1 Main Findings

The difference-in-differences estimates are displayed in Table 3. We present results separately by gender, for the full sample (i.e., those aged 18-64) and for our four coarse age groups (18-25, 26-34, 35-49, 50-64 year olds). We find no significant effect of the 2007 black box warning on the employment of men who have experienced a lifetime MDE. Women aged 35-49 with a lifetime MDE experienced a 4.4 percentage point decline (p=0.039) in employment in response to the expanded warning, a 6.1 percent decline relative to the pre-warning mean for this group. There was no statistically significant impact of the warning on the employment of women under the age of 35 or over the age of 49.

We then reestimate Equation 1 allowing the effects of the warning to vary over time. That is, we replace $MDE_{it} \times Post_t$ with separate interactions between MDE_{it} and indicators for each post-warning period. Results are shown in Table 4. Again, we find that the warning had a significant effect on the employment of 35-49 year old women, but no other subgroup. The negative employment effect for this group in the baseline difference-in-differences model is driven by an 8 percentage point decline in employment in the second half of 2007. The point estimates in the first half of 2007 as well as the first and second halves of 2008 are negative and smaller in magnitude (a 2.5-4 percentage point decline), but not precisely estimated. Moreover, we cannot reject the null hypothesis that the warning reduced employment equally in all post-warning periods (p=0.53), though we acknowledge the data may be under-powered for a test of joint equality of coefficients. As a result, our ability to determine whether the employment effect was acute and short-lived or sustained is limited. We cautiously interpret these results as suggestive evidence that the employment impact was largest shortly after the black box warning announcement in May 2007 and diminished thereafter.[21]

These results imply that the 2007 expanded black box warning did not affect the employment of the targeted age group of 18-24 year olds. Instead, the warning led to a decline in employment among women aged 35-49. Though the warning also applied to *all new users*, we recognize that these findings are somewhat unexpected; thus, we proceed as follows: First, the next several subsections provide support for our identifying assumptions as well as a litany of robustness tests, all of which support our key findings. Then in Section 5, we estimate the impact of the warning on antidepressant use and find strikingly similar patterns of behavior. Finally, in Section 6, we provide a detailed discussion of our collective findings. Here, we point to pre-warning mental health and treatment patterns across demographic groups as well as responses to the preceding 2004 black box warning, and we argue that our results are consistent with

[21] Main and time-varying effects without the inclusion of individual controls, X_{it}, are virtually identical to those with controls. Results are available upon request.

a large body of related evidence on how risk preferences, awareness of new health information, and direct-to-consumer-advertising vary across demographic groups.

4.2 Support for Identifying Assumptions

We next provide support for the two main identifying assumptions underlying the difference-in-differences model. First, we address concerns related to changes in the composition of our treatment group. As previously stated, because the individuals comprising our treatment group have experienced an MDE in their lifetime, we think these concerns are muted relative to strategies that define the treated group based on diagnosis or the receipt of mental healthcare. Nevertheless, one might worry about individuals who never experienced a lifetime MDE prior to the warning and develop depressive symptoms after the warning. If in the absence of the warning some of these individuals would seek out treatment (that prevents their symptoms from intensifying), but do not do so in the presence of the warning and subsequently experience a major depressive episode, then this may introduce a different set of depressed individuals into the treatment group.[22] To address these concerns, in Figure 2, we plot the share of men and women who ever experienced an MDE in their lifetime throughout our sample period. There are no abrupt or sharp changes in the proportion of individuals (overall or by age group) with a lifetime MDE after the warning.[23] The one exception is men aged 50-64, who see some fluctuations in lifetime MDE status in the post-warning period.

In the spirit of Busch et al. (2014), we also estimate versions of Equation 1, where we use each covariate in X_{it} (i.e., age, education, race, marital status, and metro status) as the outcome variable and test whether the coefficient on $MDE_{it} \times Post_t$ is significant. While all tested characteristics are included as controls in the main difference-in-differences model (i.e., where employment is the outcome of interest), evidence of significant changes in these characteristics would raise concerns regarding *unobserved* compositional changes, which would threaten the validity of our identification strategy. For men aged 18-25, 4 out of 17 coefficients were significant at the 5 percent level, and for men aged 26-34, 2 out of 17 coefficients were significant at the 5 percent level. For both men and women aged 50-64, 1 out of 17 coef-

[22] Similarly, one might worry about those who never experienced an MDE prior to the warning because they took antidepressants to keep mild or moderate depression under control. The warning could lead some of these individuals to stop taking antidepressants, triggering an MDE.

[23] It has been suggested that the group who has experienced an MDE in their lifetime may be largely comprised of those with a history of depression, meaning this depression measure may not change much over time and may mask small changes in the proportion of individuals who recently experienced an MDE. In Appendix Figure A4, we plot the share of individuals who experienced an MDE in the past year. Generally, these proportions are quite stable. We prefer using MDE in one's lifetime rather than in the past year to define the treatment group because it allows us to include more individuals who may be affected by the warning (i.e., individuals who may use or consider using antidepressant therapy), such as those with a history of depression (not just recent depression) as well as those who currently suffer from mild or moderate depression that was more severe in the past. According to Pratt et al. (2017), roughly 45 percent of all antidepressant users in the U.S. have been taking antidepressants for over 5 years. If antidepressants effectively prevent MDEs, a large share of antidepressant users could in fact not have experienced an MDE in some time.

ficients were significant at the 5 percent level. There were no coefficients significant at the 5 percent level for women in the other three age groups we consider or for men aged 35-49. Thus, out of 136 coefficients, only 5.9 percent were significant at the 5 percent level. Half of the significant coefficients relate to small changes in racial or ethnic groups that make up less than 1 percent of the sample (e.g., Hawaiian/Pacific Islander), which we suspect are unlikely to impact our estimates.[24] Thus, we interpret the results of this exercise as evidence that compositional changes in the treatment group are not a large concern, particularly for women aged 35-49, the group for whom we find declines in employment due to the warning.

Our second identifying assumption is that pre-warning employment trends for the ever- and never-depressed groups are parallel. We test this assumption using an event-study design. Specifically, we estimate a model of the form:

$$Emp_{it} = \alpha_0 + \alpha_1 MDE_{it} + \sum_{\ell=2005Q1/2}^{2008Q3/4} \pi_\ell \mathbb{1}(t = \ell) \times MDE_{it} + \alpha_3 X_{it} + \tau_t + \varepsilon_{it}. \quad (2)$$

The indicator for the second half of 2006 is omitted; thus, the π_ℓ coefficients describe the evolution of employment before and after the black box warning relative to 2006Q3/Q4. This specification provides both a visual and statistical summary of the differences in pre-warning employment trends for the treatment and control groups across subsamples. Figures 3 and 4 show plots of the π_ℓ coefficients from Equation 2 along with 95 percent confidence intervals for men and women, respectively. The figures show no differences in the pre-warning employment trends of the treatment and control groups. In fact, relative to the base period, we find no statistically significant employment differences between treatment and control groups in any of the pre-warning periods for any of the subsamples analyzed.

4.3 Robustness Checks

We perform a number of robustness exercises. First, we estimate our model under alternative timing assumptions and specifications. Second, we address concerns related to the Great Recession. Third, we estimate our model using two alternative definitions of depression. Last, we consider the effect of the warning on weekly work hours. For brevity, for most of these robustness checks, we show results only for women aged 35-49, the group for which we find significant employment effects, and we briefly discuss the results for the other subgroups. Parameter estimates for the other groups are available by request.[25]

[24] Results from this exercise are available upon request.

[25] Our results are also robust to not using the NSDUH sampling weights. See column 8 of Appendix Table A1.

4.3.1 Alternative Timing Assumptions and Specifications

In our baseline specification, we classify the first half of 2007 as part of the post-warning period because the FDA advisory meeting where labeling changes were discussed took place in December 2006 and the black box warning was announced in May 2007 (see Appendix Figure A3). If individuals did not respond to the FDA meeting but only to the black box announcement, then the first half of 2007 is only partially treated. We reestimate Equation 1 dropping the first half of 2007 from the sample. Results are presented in column 1 of Appendix Table A1. Relative to our baseline estimates, the decline in employment for women aged 35-49 increases in magnitude to 5.1 percentage points (p=0.028), which is consistent with the first half of 2007 being an intermediate, partially-treated period that makes our baseline estimates conservative. We then reestimate Equation 1 including the first half of 2007 but defining $Post_t$ to be equal to 1 starting in the second half of 2007, such that only 6-month periods that are fully treated after the black box warning announcement are considered to be in the post-warning period. Results are presented in column 2 of Appendix Table A1. We find that women aged 35-49 experienced a 4.6 percentage point decline (p=0.040) in employment. For both these specification checks, we find no significant impact of the warning for men or for women outside the ages of 35-49. Thus, our results are not sensitive to alternative timing assumptions regarding the warning.

Our baseline specification includes the first and second halves of 2005 in the pre-warning period. Including these periods could be problematic if the 2004 warning continued to have an effect on antidepressant use trends in 2005. Specifically, the 2004 warning could cause a declining employment trend for the (lifetime MDE) treatment group that is not mimicked by the control group, leading to a violation of the parallel trends assumption and an overstatement of the true treatment effects. The event study results do not indicate that this is a concern; nevertheless, we reestimate our model, first excluding the first half of 2005 from the sample, then excluding the second half of 2005 as well. The results are presented in columns 3 and 4 of Appendix Table A1. When we drop the first half of 2005, we find a 5.9 percentage point decline (p=0.011) in employment for women aged 35-49. When we drop all of 2005, we find a 6.9 percentage point decline (p=0.010) in employment for these women. We find no significant effects for the other subgroups. These estimates are similar to our main findings; moreover, our treatment effects are larger when 2005 is removed, which runs counter to the narrative above. Existing literature on the antidepressant response to the 2004 black box warning further supports including data from 2005 in our analysis, as most studies find that the primary antidepressant response took place after the various FDA hearings and advisories in late 2003 and early 2004 that eventually led to the black box announcement in October (Nemeroff et al., 2007; Olfson et al., 2008; Busch et al., 2014). In fact, in their examination of the indirect effects of the 2004 warning on adolescents, Busch et al. (2014) treat the first quarter of 2004

as the first treated period, despite the fact that the warning was not announced until October of that year.[26]

In addition to the evidence already provided, we perform one more robustness exercise to address any lingering concerns about differential employment trends among the never- and ever-depressed. We reestimate Equation 1 including an ever-depressed-specific time trend, (i.e., $MDE_{it} \times t$). The results are presented in column 5 of Appendix Table A1. We estimate a positive depression-specific trend, but it is not statistically significant, and the effect of the warning on 35-49 year old women subsequently grows to an 8.9 percentage point decline (p=0.045) in employment. We continue to find no significant effects of the warning for men or for women outside of the ages 35-49 when we include the ever-depressed-specific trend.

4.3.2 The Great Recession

Another potential concern is that our sample period, particularly the post-warning period, overlaps with the Great Recession (which started in December 2007 and ended in June 2009 according to the National Bureau of Economic Research), which may impact our estimates. In particular, if the recession had a greater employment impact on depressed individuals than non-depressed individuals, then our estimates would confound the effects of the black box warning and the recession. We think this is unlikely for two reasons. First, the time-varying effects of the warning suggest the employment response by women occurred in the second half of 2007 and eroded in magnitude after. If the Great Recession influenced our results, we would expect to find larger effects towards the end of the sample period when the recession worsened. Second, we find significant effects of the warning for women and no significant effects for men, while the literature suggests men experienced more employment declines and unemployment increases than women during the Great Recession (Hoynes et al., 2012).

Nevertheless, it is possible that those in poor health were impacted earlier and more significantly by the recession, perhaps because they were less likely to be hired and/or more likely to be laid off. If this is the case, we would also expect to find declines in employment for individuals with chronic health conditions, such as asthma, diabetes, or high blood pressure. Moreover, given that body weight is (i) correlated with diabetes and high blood pressure and (ii) more easily observable to employers than mental health problems, we might expect an even stronger employment effect for individuals suffering from those conditions, were the above narrative correct. To test this idea, we reestimate Equation 1 but define the treatment group as individuals who have ever been diagnosed with asthma, diabetes, or high blood pressure. Results for all groups are presented in Appendix Tables A2 and A3. We generally find no significant effect of the warning (i.e., post-2007) on individuals with these conditions, giving us

[26] We do not study the impact of the 2004 warning on employment mainly because the lifetime MDE measure used to define the treatment group is not available in the NSDUH prior to 2004. In addition, the timing of the "treatment" is ambiguous as there were several FDA advisories, announcements, and meetings leading up to the October 2004 black box warning announcement that contributed to a decline in antidepressant use.

confidence that the employment declines we find for women are not driven by the recession impacting those with poor physical or mental health. Furthermore, we view this exercise as a more general placebo check that our estimated effect of the warning on women does not simply reflect some other change (perhaps in healthcare policy) that impacted individuals with poor health during this time.[27]

4.3.3 Alternative Depression Definitions

As explained in Section 4.2, our preference is to define the treatment and control groups using lifetime MDE status because the warning is unlikely to alter the composition of these groups. That said, one concern is that the NSDUH definition of MDE is almost the exact diagnostic indicator for major depressive disorder outlined by the DSM-IV (see footnote 14), meaning some individuals suffering from minor forms of depression could be in our control group. In this section, we reestimate Equation 1 using two alternative definitions of depression to categorize individuals into treatment and control groups. First, we define the treatment group as those who have ever been told by a doctor or medical professional they have depression or anxiety. While this definition allows for individuals with more minor forms of depression to be categorized as depressed, entry into the treatment group depends on a diagnosis (i.e., seeking out treatment); therefore, the warning is more likely to lead to compositional changes in the treatment and control groups than our preferred definition. Given that our objective is to expand the original treatment group to include individuals with minor depression, our second new definition categorizes as depressed anyone with a lifetime MDE *or* who has ever been told by a doctor they have depression or anxiety.

The results using these alternative depression definitions can be found in columns 6 and 7 of Appendix Table A1. For women aged 35-49, the warning reduced employment by 3.9 percentage points when we use the first definition and by 3.6 percentage points when we use the second definition. Both estimates are significant at the 5 percent level. We again find no significant effects for males or for women outside the ages of 35-49.

[27] As another robustness check, we use the NSDUH to examine whether reasons individuals did not work in the past week changed in response to the warning. We estimate our baseline difference-in-differences model and consider as outcomes separate indicators for being unemployed or laid off (and looking for work), disabled, a homemaker, in school or training, retired, and without a job for some other reason. Values of zero for these indicators include all other activities, including working in the past week. We find the probability of reporting not working due to being disabled significantly increased by 2.7 percentage points (p=0.035) among women aged 35-49 with lifetime MDE. Notably, we find no significant effects for this group (with very small point estimates) on the probability of engaging in productive activities, such as schooling or training, or being unemployed, which should further alleviate concerns about the Great Recession impacting our estimates. This exercise further corroborates our baseline employment findings and underscores that women aged 35-49 with a history of depression saw their work capacity deteriorate after the warning. Results from this analysis are available upon request.

4.3.4 Effect on Work Hours

We next analyze whether work hours were impacted by the 2007 warning. We consider the hours a NSDUH respondent reports working in the past week and assign zero hours to those who were not employed. If our employment results are robust, we should see a decrease in works hours among the sample of 35-49 year old women. We reestimate Equations 1 and 2 with weekly hours as the outcome and present the results for women aged 35-49 in columns 1 and 2 of Appendix Table A4. The difference-in-differences estimates imply that work hours fell by 2.8 hours (p <0.01) following the warning, and the time-varying warning effects suggest the decline started in the first half of 2007 and grew stronger in the second half of 2007. The pattern of effects is consistent with our baseline employment results, as it is reasonable to believe that women may have first reduced their work hours before leaving employment.

It is possible the warning also impacted the work hours of ever-depressed women who continued working, though we are limited in our ability to explore such intensive margin adjustments. We can condition the sample on those who were employed last week, but given the robust decline in extensive margin employment, there may be concerns about sample selection. We present estimates of the impact of the warning on work hours conditional on being employed, which we interpret as merely suggestive in light of the potential selection effects. The results in columns 3 and 4 of Appendix Table A4 show that weekly hours conditional on working declined by 1.6 (p=0.048), with effects concentrated in the first half of 2007 and second half of 2008. These results are again consistent with the notion that women may have first decreased their work hours in response to deteriorating mental health and then exited employment. We find no significant effect of the warning on unconditional or conditional work hours of the other subgroups.

5 Mechanisms

The above results suggest that employment fell for women aged 35-49 in response to the 2007 expanded black box warning on antidepressants. The most likely reason for this effect is that the warning led to a decline in antidepressant use, worsening mental health, leading to lower rates of employment. In this section, we first provide evidence that antidepressant use did in fact decline for women aged 35-49. We then explore a number of other potential mechanisms.

5.1 Impact of 2007 Expanded Warning on Antidepressant Use

The NSDUH data is not well-suited to study antidepressant utilization in our context. Instead, we use the Medical Expenditure Panel Survey (MEPS) data and a difference-in-differences strategy similar to what was described above to study the impact of the 2007 black box warning on antidepressant use.

The MEPS, which is collected by the Agency for Healthcare Research and Quality (AHRQ), has been administered continuously since 1996. It contains detailed health, illness, medical expenditure, health insurance, and demographic information for a nationally representative sample of households in the U.S. New participants are added to the MEPS annually, drawn randomly from the previous year's National Health Interview Survey sample. Each cohort is interviewed five times over the two years that follow January 1st of the cohort year.

The MEPS data have several characteristics that make them well-suited for this analysis. First, survey participants report all prescription drugs that they take by name, allowing us to determine whether an individual is taking an antidepressant known to carry a black box warning.[28] Second, depression and anxiety, which can be reported in each interview period as diagnosed or inferred from interview responses, are coded using ICD9-CM codes.[29] Measuring depression and anxiety via ICD9-CM codes has advantages over the MDE measure from the NSDUH and other measures like the Kessler-6 (K6) scale,[30] as it is easier to interpret, includes both those with major and minor depressive disorders, and is less likely (than the K6 score) to be influenced by the use of antidepressants. That said, self-reporting is likely influenced by prior diagnosis, which is less likely to be true of the MDE and K6 measures. Third, the panel nature of the data allows us to examine prescription drug behavior for the same individuals, before and after the warning. As such, with the MEPS, we can ensure that the ever-depressed and never-depressed groups are fixed over time. Fourth, the MEPS allows us to measure an individual's exact age, rather than coarse age bins. Not only does this allow us to control for age in years in our econometric specifications, but more importantly, allows us to stratify our analysis by customized age bins that better correspond to notable mental health transitions in the population. For example, for all MEPS analysis, we pay special attention to the subgroup of women between the ages of 35 and 44, a range typically considered pre-perimenopausal. According to Clayton and Ninan (2010), the mean age of perimenopause onset, the 4-8 year menopause transitional

[28]The recorded name of the drug is important because not all drugs taken for depression and anxiety were affected by the 2007 black box warning on antidepressants. For example, among the drugs taken for depression and anxiety by the 2006 MEPS cohort, as indicated by the recorded ICD9-CM code, 17 percent were benzodiazepines (e.g., Xanax, Valium), which do not carry the antidepressant black box warning.

[29]In addition to reporting medical care consumption in each interview, individuals are asked to report all "health problems (experienced during the current interview period) including physical conditions, accidents, or injuries that affect any part of the body as well as mental or emotional health conditions, such as feeling sad, blue, or anxious about something." Participants are told explicitly to include ailments even if they did not seek professional medical care. An individual's description of the illness is recorded as verbatim text, which is later coded to 5-digit ICD9-CM codes by professional coders.

[30]The K6 is a commonly used mental health scale that is calculated from responses to six questions of the form: "During the past 30 days, how often did you feel . . . [nervous, hopeless, restless or fidgety, so depressed that nothing could cheer you up, that everything was an effort, worthless]?" For each question, a value of 0, 1, 2, 3, or 4 is assigned to the answers "none of the time," "a little of the time," "some of the time," "most of the time," or "all of the time," respectively. The K6 is calculated by summing the scores from each of the six questions, generating a 0-24 scale, with higher scores indicating a greater tendency towards mental illness. A cutoff of 4 has been identified as optimal in identifying respondents with mental health treatment needs (Prochaska et al., 2012).

phase, is 47.5. A large body of research associates perimenopause with an increased risk of depression, particularly for those with a history of depression (Noble, 2005; Deecher et al., 2008; Vivian-Taylor and Hickey, 2014). However, depression diagnosis can be particularly challenging for women experiencing the physical changes associated with perimenopause, which can overshadow the emotional and cognitive changes (Clayton and Ninan, 2010). As such, perimenopausal women may be less responsive to the warning, either because they are never diagnosed or because those that are diagnosed experience more severe bouts of depression that make them relatively more heavily dependent on antidepressants.

We use the 2006 MEPS cohort, which is comprised of individuals who complete their first interview in the first half of 2006 and their last interview in December of 2007, so they are observed before and after the warning. Summary statistics for this cohort by sex and age group (18-25, 26-34, 35-49, 35-44, and 50-64 year olds) are presented in Tables 5 and 6. Individuals are categorized as depressed if over the two years that they are interviewed, they ever report an illness with any of the following ICD9-CM codes: 296, Episodic mood disorders (affective psychoses); 300, Anxiety, dissociative and somatoform disorders (neurotic disorders); 309, Adjustment disorder with depressed mood; or 311, Depressive disorder (not classified elsewhere). The relationship between depression and observables is similar to that seen in the NSDUH. The relationship between depression and antidepressant use has several notable features. First, conditional on having ever reported depression, women are much more likely than men to use antidepressants and antidepressant use is increasing in age for both sexes. Second, never-depressed individuals are very unlikely to take antidepressants.[31] Third, for most individuals, the 2007 black box warning is announced early in the fourth interview round, so rounds 4 and 5 typically represent the post-warning period.[32] For men and women 35 and older, where our sample size is largest, there is a clear positive trend in antidepressant use in the first three rounds. Because this pattern is not mimicked by the non-depressed group, it will be important to account for this trend in our empirical specification.

Our empirical model is as follows:

$$\begin{aligned} AD_{it} = \alpha_0 + \alpha_1 Dep_i + \alpha_2 Post_t + \alpha_3 Dep_i \times Post_t \\ + \alpha_4 t + \alpha_5 Dep_i \times t + \alpha_6 Post_t \times (t - t_{i,BB}) + \alpha_7 X_{it} + \varepsilon_{it} \end{aligned} \tag{3}$$

where AD_{it} indicates that individual i uses any antidepressants in interview round t; Dep_i indicates that individual i ever reports an ICD9-CM code associated with depression or anxiety; $Post_t$ indicates that round t ended after May 1, 2007; X_{it} are individual controls (age, sex, race, Census region, living in an

[31] As mentioned above, antidepressants are used in the treatment of illnesses besides depression and anxiety, including pain, insomnia, and migraines (Wong et al., 2017). While a non-trivial fraction of antidepressant users may not suffer from depression or anxiety, the table suggests they represent a very small fraction of the total non-depressed population.

[32] May 1, 2007 occurs in the fourth interview period for 87 percent of the sample and in the third interview period for the remainder.

MSA, marital status, family size, interview period length); and ε_{it} is the econometric error. Finally, $t_{i,BB}$ marks the interview round containing May 1, 2007 for individual i (i.e., the *transition* round), meaning $(t - t_{i,BB})$ is 0 in the transition round, 1 in the following round, etc. This specification allows the time trend in antidepressant use to differ after the warning and by depression status. We estimate the model via OLS, cluster standard errors at the individual level, and use the MEPS longitudinal sample weights.

We treat an individual-interview round as the unit of observation because the MEPS data records the round in which prescriptions are filled, but not the exact fill date or whether/when drugs are taken. As such, each individual has one transition round that contains May 1, 2007 and we do not know whether prescriptions filled in this round occurred before or after the warning. Our baseline specification puts the transition round in the post-warning period, which is the most conservative approach, as some (re)fills early in this period occur before May 1, making it more difficult to find a significant decline in antidepressant drug use. We later show that our results are robust to dropping the transition round entirely.

The estimates corresponding to Equation 3 are presented in Table 7.[33] The key parameter of interest is α_3. Consistent with the employment effects reported in Section 4, we find that antidepressant use among women aged 35-49 decreased by 7.6 percentage points (a 19 percent decline relative to the pre-warning mean for this group) and that this decrease is significantly different from zero at the 5 percent level. When we further restrict this group to those aged 35-44, women who are less likely to have entered perimenopause, we find an even larger and significant 12.6 percentage point decrease in antidepressant use (a 33 percent decline relative to the pre-warning mean for this group). Thus, it appears 35-44 year old women were particularly responsive to the warning.[34] The fact that α_5 is positive and significant for both groups of women highlights the importance of the group-specific trends. This parameter captures the fact that antidepressant use increases among the depressed groups prior to the 2007 expanded warning, allowing α_3 to be identified by a break in this trend. In Section 5.1.1, we perform placebo analyses to test for alternative explanations for this break in trend.[35]

[33]In Section 4.3.1, we discussed a robustness exercise where we included a depression-specific trend in the baseline employment regression. Using NSDUH data, we also reestimated Equation 1 without time fixed effects, instead including t, $MDE_{it} \times t$, and $Post_t \times t$ to be more consistent with our MEPS specification. We find employment among women aged 35-49 with a lifetime MDE declined by 8.9 percentage points ($p < 0.05$) following the warning and no significant effects for any other group. Given the longer sample period when we use the NSDUH, we prefer the specification with time fixed effects because it allows for more flexible effects of time on employment, which may be especially important during the Great Recession.

[34]Estimates are virtually identical when we exclude the individual controls, X_{it}. Results are available upon request. Estimates without differential trends are presented in Appendix Table A5 and suggest none of the subgroups responded to the 2007 expanded warning with a decrease in their antidepressant use. In fact, antidepressant use *increases* among women aged 26-34 and 35-49. This finding is unsurprising, given the positive trend in antidepressant use leading up to the warning observed in Tables 5 and 6, and underscores the importance of the differential trends.

[35]For a more thorough understanding of how our econometric specification connects to the data, see Appendix Figure A5. The figure shows mean residuals, by depression status and interview round, from a regression of antidepressant use on controls, X_{it}, for 35-44 year old women with a round 4 transition period (i.e., roughly 85 percent of the 35-44 year old subgroup). The figure visually depicts the variation in the data that identifies constant $(\alpha_0,\ \alpha_1)$, trend $(\alpha_4,\ \alpha_5,\ \alpha_6)$, and

Also consistent with our employment effects, the 2007 expanded warning did not significantly impact the antidepressant use of women outside the ages of 35-49 or most subgroups of men. We, however, lack statistical power in the younger subsamples, particularly 18-25 year olds. We find weakly significant *positive* effects for 26-34 year old men; however, this subsample contains only 66 depressed men and fails every robustness test examined below (i.e., point estimates vary substantially and effects are no longer significant), including the removal of the transition round, inclusion of individual-specific fixed effects, use of an alternative definition of depression, and not using MEPS sampling weights.[36]

Our findings are consistent with previously estimated effects of the 2004 black box warning on adult antidepressant use. Libby et al. (2009) found that SSRI use within 30 days of a new depression diagnosis fell 15 percent for adults aged 25-89 after the 2004 warning. Using MEPS data, Parkinson et al. (2014) found that new antidepressant use fell 16 percent for adults aged 25-64 after the 2004 warning. We attempt a similar analysis below, separating new and continuing antidepressant use.[37] By classifying antidepressant use in this way, we consider an even more infrequent outcome than in our primary analysis, as only about 25 percent of antidepressant use is classified as new. Given the rare outcome as well as the small sample sizes, unsurprisingly our estimates are seldom statistically different from zero. We, therefore, interpret these results as suggestive.

In the first column of Table 8, we show estimates from Equation 3 where (i) AD_{it} equals 1 if individual i fills a new antidepressant prescription in round t and zero otherwise and (ii) the sample includes all individuals aged 25-64. The probability an ever-depressed individual is a new antidepressant user declines by 2.9 percentage points (a 30 percent decline) after the 2007 warning. That the 2007 warning yields a larger response among adults than the 2004 warning is expected, given that the 2007 warning (i) targeted older antidepressant users and (ii) added language that applied to new antidepressant users of all ages. Though neither Libby et al. (2009) nor Parkinson et al. (2014) show how the 2004 adult new-user effect differs by gender, we show in columns 2 and 3 of Table 8 that the decline in new antidepressant use in 2007 is primarily driven by women. In columns 4-7, we show the impact of the 2007 warning on new and continuing antidepressant use for 35-49 and 35-44 year old ever-depressed women. For both groups of women, we find declines in the probability of being a new antidepressant user that are nearly statistically significant at conventional levels – both p-values are under 0.15. Moreover, the estimated impact on continuing

trend break ($\alpha_2,\ \alpha_3$) parameters. Apparent is the break in the antidepressant use trend following the black box warning for ever-depressed women in this subgroup, net of the much smaller break in trend for the never-depressed.

[36]The data are not well-suited for allowing time-varying warning effects. Technically, three post-warning period effects can be estimated; however, the first post-warning period for every individual is the transition round and the third post-warning period is only identified by individuals for whom May 1 occurs in the third interview round, which is only 13 percent of the sample.

[37]For each drug taken during a MEPS survey period, the data contain the date that particular drug (e.g., Prozac) was first prescribed to the individual, even if the first prescription occurred prior to the first MEPS interview. We cannot, however, observe when an individual was first prescribed a particular *class* of drugs (e.g., SSRIs) because first prescription use is not recorded for drugs that are never taken during the MEPS survey.

users is smaller, with larger standard errors, than new users.[38] This result is compelling because, among 35-49 year old women, the 2007 warning provided relevant information primarily for new users; thus, it is sensible that the overall decline in antidepressant use among 35-49 year olds is driven by new users.

5.1.1 Robustness Checks

The findings presented in Table 7 are robust to a variety of alternative model specifications and assumptions.[39] We present the results of these robustness checks for women aged 35-49 and 35-44 in Appendix Table A6. Columns 1 and 2 contain estimates of Equation 3 where the transition round is dropped for each individual. Recall, the 2007 expanded black box warning was announced during the transition round, so that round contains both pre- and post-warning antidepressant use, likely leading our estimates to be biased towards zero. As expected, the estimated effect of the warning grows for women aged 35-49 and 35-44 when the transition round is dropped. The true impact of the warning on these women likely lies somewhere between our baseline estimates and these. Columns 3 and 4 contain estimates of Equation 3 where individual-level fixed effects are included. The fixed effects purge the model of individual time-invariant unobservables, which may be correlated with observables of interest, causing bias. In our setting, the key observable of interest, $Dep_i \times Post_t$, cannot be correlated with permanent unobservables as (i) its permanent component, Dep_i, is controlled for explicitly and (ii) all included individuals are observed before and after the warning. As such, individual fixed effects can only impact estimation of the treatment effect through their correlation with other covariates. In light of this, it is unsurprising that point estimates for both subsamples are similar to our baseline results; that said, in the fixed effects specification there is substantial degrees of freedom loss. Columns 5 and 6 contain estimates where individuals are categorized as depressed if they ever register a K6 score greater than 4 during the survey (see footnote 30). Finally, columns 7 and 8 show results without the use of MEPS sampling weights. Again, both sets of estimates are quantitatively similar to our preferred estimates.[40]

[38] While the decreases in antidepressant use among continuing users are not statistically significant, such declines may be important. Doctors typically advise patients wishing to discontinue their antidepressant use to gradually reduce their dose over several weeks to avoid withdrawal, also called antidepressant discontinuation syndrome (ADS) (Warner et al., 2006). ADS can be accompanied by numerous adverse (and work-incompatible) symptoms, such as headaches, dizziness, lethargy, flu-like symptoms, and nausea, as well as the return of depressive symptoms. Discontinuation syndrome can happen immediately after suddenly quitting an antidepressant and can be quite acute, which could also contribute to the negative employment effects we find.

[39] In addition to the robustness checks presented in this subsection, we examined numerous adaptations of the trend-break model, for which results are available upon request. First, we estimated an alternative, slightly more flexible model that replaces both the linear time trend, t, and post-warning trend, $Post \times (t - t_{i,BB})$, with interview round fixed effects. Second, we restricted the model so that it does not allow for the linear trend to vary post-warning (i.e., $\alpha_6 = 0$). Third, rather than measuring the time trend, t, using interview rounds (i.e., 1-5), we estimated models measuring t in calendar months (i.e., 1-24) and days (i.e., 1-730), with months or days assigned based on the middle or end of the interview round. For each of these specifications, results are very similar to our main findings.

[40] Results for other subsamples are available upon request. Across all alternative specifications, we find no significant effects of the warning on antidepressant use for men or for women aged 26-34 and 50-64. In the main specification, we found

We also address our reliance on differential linear trends for identification in our main specification. This assumption may be undesirable for two reasons. First, if the growth in antidepressant use over time is truly quadratic, for example, as opposed to linear, then the negative results we estimate for 35-49 and 35-44 year old women could be driven by model misspecification. Second, with time, survey participants may learn that their interview will last longer if they report medical care consumption. As such, the decrease in antidepressant use that we observe post-warning could simply result from under-reporting by survey participants in later rounds of the survey. Both of these concerns suggest that a negative treatment effect would be observed independent of the black box warning.

To address these concerns, we conduct a series of placebo tests, where we assume that a policy (or fake warning) occurred on May 1, every year between 2003 and 2009. For each placebo warning occurring in year y, the MEPS cohort from year $y-1$ is used, as in our main analysis. If the claims discussed above are valid, we should consistently find a negative "May 1" effect across years. Results from this placebo analysis for women aged 35-49 and 35-44 can be seen in Appendix Table A7. First, independent of statistical significance, the results are not overwhelmingly negative – excluding 2007, only one in six effects is negative. Second, significant treatment effects are not estimated in any of the placebo years for women aged 35-49. Though not shown, results for the other subsamples are similar. Of the 72 placebo treatment effects estimated (6 years and 12 total subsamples), 35 are negative and just 4 are significantly different from zero at the 10 percent level. With a purely random treatment, one would expect 36 negative parameters and 7.2 significant effects.

5.1.2 Alternative Control Groups

When studying the employment effects of the 2007 black box warning, never-depressed individuals form a natural control group, as they should not respond to the warning and they have employment rates and trends that are similar to ever-depressed individuals. However, when studying antidepressant use, Tables 5 and 6 reveal that non-depressed individuals are very unlikely to use antidepressants and the pre-warning trend in antidepressant use among the non-depressed does not match that of the depressed.[41] Other researchers have dealt with similar issues when studying the impact of treatment-related policy on both treatment utilization and some indirect outcome. For example, Garthwaite (2012) analyzes the

the warning had a *positive*, though insignificant, effect on antidepressant use for women aged 18-25, which is unexpected. This positive insignificant effect persists when the transition round is dropped and when sampling weights are removed; however, the effect becomes marginally significant when fixed effects are added (p=0.10) and when the alternative depression measure is used (p=0.052). Note that this group contains just 64 depressed women.

[41] Despite the difference in trend, it is still important to control for antidepressant use by the non-depressed, as this group captures other changes that could have occurred in the overall drug market *at the same time* as the warning. In other words, our specification measures a break in the antidepressant use trend among depressed individuals, accounting for other market-level changes that may have occurred at the same time as the warning.

impact of the 2004 market removal of Vioxx on the use of Cox-2 inhibitors (and ultimately employment) among those with joint conditions. Similar to our strategy, in his preferred specifications, those *without* a joint condition serve as the control group. Busch et al. (2014) present figures showing a decrease in antidepressant use among adolescents with probable depression after the 2004 antidepressant black box warning. They do not estimate a corresponding difference-in-differences model (i.e., their antidepressant use analysis is performed without a control group, while those without probable depression serve as the control group in their academic and behavioral outcomes analysis).

We address remaining concerns about using non-ill, light prescription drug users as a control group by considering several alternative control groups. Each of these alternatives reduces the size of the estimation sample, sometimes substantially, making statistical inference difficult. Nonetheless, the findings support our main conclusion that the 2007 expanded warning reduced antidepressant use for 35-49 year old depressed women. The alternative control group results for women aged 35-49 are presented in Appendix Table A8. Results for other subgroups generally mirror our preferred estimates and are available upon request.

We first estimate Equation 3 using depressed individuals only (i.e., no control group). In columns 1 and 2, the parameter on $Post$ measures the break in the antidepressant use trend following the 2007 warning for ever-depressed women. The estimates are slightly larger than our preferred results, which suggests using never-depressed individuals as a control group is a more conservative approach. Next, we consider a control group of never-depressed individuals who are likely to take antidepressants, but unlikely to be affected by the warning given the suicidality risk applied to those with "major depressive disorder and other psychiatric disorders." According to Wong et al. (2017), the most common physical ailments for which antidepressants are prescribed are pain, migraines, and sleep disorders. We, therefore, construct a control group of never-depressed individuals who ever report experiencing migraines (ICD9-CM 346) or sleep disorders (ICD9-CM 327 or 780).[42] Results are presented in columns 3 and 4. The estimates are quantitatively similar to our preferred estimates. Finally, we construct a control group of individuals who never report depression, but report any of the following common chronic illnesses: diabetes (ICD9-CM 250), hypertension (ICD9-CM 401), and hypercholesterolemia (ICD9-CM 272). We then estimate a model that compares illness-specific prescription drug use for depressed and non-depressed chronically-ill individuals, before and after the 2007 black box warning on antidepressants.[43] Results are presented in columns 5 and 6. The effects are slightly larger in magnitude than our baseline estimates, and again reveal that depressed women in their late 30s and 40s experienced a significant decline in antidepressant use.

[42] In the 2006 MEPS cohort, roughly 12 (8) percent of non-depressed women (men) experience migraines and/or a sleep disorder. About 8 (4) percent of these women (men) use antidepressants in any given survey round, meaning antidepressant use is 3-4 times more common among this control group than our original control group (i.e., all never-depressed individuals).

[43] In the 2006 MEPS cohort, roughly 25 percent of non-depressed men and women report at least one of the three chronic illnesses and 70 percent of these individuals consume prescription treatment for those illnesses in any given survey round.

5.2 Alternative Mechanisms

The most obvious channel underlying the employment decline generated by the FDA's 2007 black box warning is a reduction in antidepressant use. That said, other plausible mechanisms exist. In this section, we first explore the possibility that the warning affected mental health treatments that may be complements to or substitutes for antidepressants; namely, psychotherapy and benzodiazepine prescriptions. Both the 2004 and 2007 warnings were added to all antidepressant drugs on the market; however, the warning did not apply to benzodiazepines, such as Alprazolam (marketed as Xanax) and Diazepam (marketed as Valium), which are more targeted toward the treatment of anxiety. Antidepressants and benzodiazepines are commonly prescribed for both depression and anxiety disorders. In the 2006 MEPS cohort, among prescription drug users who report depression (i.e., ICD9 codes 296 or 311) as the primary condition a prescription drug treats, 73 percent take an antidepressant and 7 percent take a benzodiazepine. Among those reporting anxiety (i.e., ICD9 code 300) as the primary condition, 47 percent take an antidepressant and 36 percent take a benzodiazepine. It is not clear how employment would respond if individuals substituted from antidepressants to benzodiazepines. On one hand, substituting from antidepressants to another FDA approved prescription drug seems likely to protect against declining mental health more than taking nothing at all. On the other hand, benzodiazepines, which are sedatives, carry significant side effects that are likely to hinder employment, including reduced energy levels and muscle function as well as dizziness. Moreover, benzodiazepines are commonly abused. According to the Substance Abuse and Mental Health Services Administration (2011), drug treatment program admissions for benzodiazepine abuse tripled from 1998 to 2008.

To explore these alternative mechanisms, we use the MEPS data to reestimate Equation 3, considering two new outcomes: (i) an indicator for whether the individual went to psychotherapy during an interview round and (ii) an indicator for whether the individual filled a benzodiazepine prescription during an interview round. In Table 9, we present estimates for women aged 35-49 and 35-44. The results in column 1 show a weakly significant 4.7 percentage point decline (p=0.070) in the probability of therapy use after the warning, a 41 percent decrease from the pre-warning mean among depressed women aged 35-49. These results imply that therapy and antidepressants are complements, consistent with the structural model estimates in Cronin et al. (2020).[44] One explanation for this complementarity could be the sequence of events that typically results in the use of mental health treatment. Depressive symptoms are often first revealed to a patient's general practitioner, who may prescribe antidepressants or refer the patient to a psychiatrist or psychologist who helps the patient determine whether they would like to use psychotherapy and makes recommendations about medication. As such, a patient considering the dynamic implications

[44] Among this subgroup, conditional on using psychotherapy in an interview round, antidepressants are also used almost 75 percent of the time.

of their choices may respond to the black box warning by withholding depressive symptoms from their general practitioner, for fear of being prescribed antidepressants. A reduction in therapy use could then naturally result. Above, we reported that the decline in antidepressant use following the 2007 warning was driven by new users, which further supports this narrative. The results in columns 3 and 4 provide weak evidence that antidepressants and benzodiazepines are substitutes, as the point estimates imply benzodiazepine use increased in response to the warning. However, these effects are not precisely estimated for women aged 35-49 and are marginally significant for those aged 35-44 (p=0.098).[45]

In addition to medical substitutes, we use the NSDUH to examine whether individuals responded to the 2007 warning by using non-medical antidepressant substitutes, including alcohol and marijuana. In particular, we consider as outcomes indicators for: (i) any marijuana use in the past month; (ii) using marijuana 20 or more days in the past month; (iii) using alcohol (in any amount) 20 or more days in the past month; (iv) binging alcohol in the past month (defined as consuming 5 or more drinks on the same occasion at least once in the past 30 days); and (v) heavy alcohol use (defined as consuming 5 or more drinks on the same occasion 5 or more days in the past 30 days). For brevity, we present the results only for women aged 35-49 in Appendix Table A9, with the results for the other groups available by request. Generally, we find no effect of the warning on these substitutes for males or females, and notably no effects for women aged 35-49. Thus, it does not appear that women aged 35-49 substituted toward risky behaviors such as alcohol or marijuana consumption. These findings are consistent with Darden and Papageorge (2018), who provide evidence that antidepressants and alcohol are substitutes for men, but not women.

5.3 Summary: Explaining the Decline in Employment

We have provided evidence that both antidepressant and psychotherapy use declined for ever-depressed women aged 35-49 following the 2007 black box warning on antidepressants. These responses likely led to a decline in mental health, followed by separation from the labor market. Our results from the MEPS suggest within the 35-49 year old age range, 35-44 year old women responded most strongly to the warning as they experienced the largest decrease in antidepressant use. We find weak evidence that benzodiazepine use increased, and no evidence that alcohol or marijuana use responded to the warning. It is worth noting that an alternative explanation for the decline in antidepressant and therapy use is that women lose their health insurance when they stop working, and thus, the relative cost of medication and therapy increases. In results available by request, we find no significant change in health insurance coverage of depressed women aged 35-49 after the warning. There are, however, additional mechanisms

[45] Both the therapy and benzodiazepine results are generally robust to including individual fixed effects and dropping the transition round, though the magnitudes of coefficients and standard errors differ slightly. Effects of the warning on therapy and benzodiazepine use among all other subsamples are not significantly different from zero. Results for other specifications and subsamples are available upon request.

through which the black box warning may have affected employment that we are unable to examine using our data. For example, the warning may have affected drug adherence, which is not observed in the MEPS data. That is, we observe prescription fills, but not actual consumption of such fills, which means our extensive margin antidepressant use estimates are likely understated. Also, the warning called for new antidepressant users to be "observed closely," which could have had direct labor market implications.

Alternative mechanisms aside, we can use our estimates to compute an effect of mental health treatment on the employment of ever-depressed women aged 35-49, assuming that the *only* channels through which the 2007 black box warning affected employment are antidepressant fills and psychotherapy use. To do this, we define an indicator variable called "any mental health treatment" that is equal to 1 if an individual fills an antidepressant prescription or receives psychotherapy in a MEPS survey round.[46] In columns 5 and 6 of Table 9, we have again estimated Equation 3, but now with any mental health treatment as the dependent variable. We find that the warning significantly reduced any mental health treatment by 9.4 percentage points and 14.5 percentage points for depressed women aged 35-49 and 35-44, respectively. Dividing the "reduced-form" NSDUH employment effects from Section 4 for 35-49 year olds by the appropriate "first-stage" effects suggests that the decrease in mental health treatment utilization induced by the warning reduced the employment of depressed women by 47 percentage points. This calculation suggests a large effect of untreated depression on employment, but we urge caution when interpreting this result.[47] As mentioned above, there are several other mechanisms through which the warning may have affected employment that we cannot empirically explore or lack the statistical power to explore. Furthermore, as discussed in Section 5.1, our "first-stage" estimates are likely understated because the transition round is only partially treated, inflating the effect of treatment on employment. Finally, depression definitions and period lengths differ across the models used to estimate the reduced-form and first-stage effects. These latter technical issues could potentially be overcome by estimating employment effects using the MEPS data, but small sample sizes prevent such analysis.[48]

[46]Despite some evidence that benzodiazepine use increased after the warning, we exclude their use from the definition of "any mental health treatment," as the direction of their effect on employment is ambiguous. If common benzodiazepine side effects (e.g., dizziness, reduced muscle function and energy, etc.) reduce employment, including benzodiazepine use in our treatment definition would lead us to overstate the impact of mental health treatment on employment.

[47]These types of two-stage least squares estimates tend to be large in this strand of literature. For example, Busch et al. (2014) find among depressed adolescent girls, the decrease in antidepressant use induced by the 2004 warning decreased grades by a full point (e.g., from a B to a C), increased smoking and illicit drug use by 20 to 25 percentage points, and increased the probability of stealing or fighting by 30 to 35 percentage points. Garthwaite (2012) finds the decline in use of Cox-2 inhibitors induced by the withdrawal of Vioxx led to a 22 percentage point decline in employment among those with joint pain. Estimates from Daysal and Orsini (2014) imply that hormone replacement therapy increases employment of middle-aged women by 33 percentage points.

[48]We find significant antidepressant and therapy effects for 35-49 year old women, our largest subgroup. We can approximate the warning-induced decline in employment needed to find a significant difference in pre- versus post-warning employment for this group at the 5 percent level in the MEPS using the following inequality: $(\%\ \text{EMP}_{pre} - \%\ \text{EMP}_{post})/\sqrt{(2 \times \sigma^2 \times 1/N)} > 1.96$, where N is the number of depressed women aged 35-49 (364)

An additional explanation for why women aged 35-49 responded strongly to the warning, while other subgroups did not, is that they could more afford to do so. Tables 2 and 6 show that 35-49 year old women are much more likely to be married than younger cohorts. Having a working spouse (i.e., being part of a two-earner household, with access to health insurance through one's spouse), may lessen the burden associated with not taking antidepressants and separating from the labor market. To explore this idea, we reestimate Equations 1 and 3 separately for married and single women aged 35-49. Using the NSDUH data, we find ever-depressed married women saw a 5.2 percentage point decline (p=0.065) in employment in response to the warning, while single women experienced a statistically insignificant decline of 2.9 percentage points. Using the MEPS data, we find ever-depressed married women aged 35-49 experienced an 8.8 percentage point decrease (p=0.068) in antidepressant use following the warning, while single women saw an insignificant 5.5 percentage point decline. Thus, it seems married women largely drive the antidepressant and employment response to the 2007 warning, providing support for the idea that having a secondary source of income and health insurance may have enabled these women to adjust their mental health treatment and labor market behavior.[49] Results from this exercise are available by request.

6 Discussion

We study the employment effects of the 2007 expanded black box warning on antidepressants. Our estimates suggest that the warning led to a significant decline in the employment of depressed women aged 35-49, but had no impact on the employment of depressed men or on depressed women outside the ages of 35-49. These findings survive a number of robustness tests. We explore several mechanisms through which the warning may have affected employment, ultimately finding two channels. For depressed women aged 35-49, the same age group experiencing a decline in employment, we find (i) a significant decline in antidepressant drug use, driven especially by new users, which is consistent with language used in the warning, and (ii) a reduction in psychotherapy use. Each of these responses likely contributed to the observed decline in employment.

The 2007 black box warning on antidepressants targeted 18-24 year olds; however, we find no response among 18-25 year old men or women with a history of depression. Moreover, we find a significant

and % EMP$_{pre}$ is the percentage of those women ever employed in the pre-warning period (46 percent). Assuming σ^2 is 0.23, which is the observed variance in employment among this group, roughly 27 women would need to stop working, or not start working, for us to find a significant employment effect for this subsample. Among the 364 depressed women aged 35-49, 214 take antidepressants or visit a therapist at some point in the pre-warning period. Our estimates suggest the warning reduced treatment use by 9.4 percentage points (i.e., 34 fewer people used mental health treatment). Thus, to find significant employment effects, nearly 80 percent of those resisting mental health treatment would have worked with treatment, which is implausible.

[49]Consistent with this narrative, we noted above that women aged 35-49 saw no significant change in health insurance coverage after the warning.

response by 35-49 women, but not men. Though unexpected, these findings are quite sensible. Regarding 35-49 year old women, note first that the warning contained language that applied to *all new* antidepressant users, and our estimated effects are concentrated among new users. Second, females experience higher rates of depression than males, and antidepressant use among middle-aged women is relatively high compared to men and younger females (Pratt and Brody, 2014; Blanchflower and Oswald, 2016; Pratt et al., 2017); thus, the 35-49 year old female subgroup may contain a large set of marginal antidepressant users. Third, there is some evidence that females are more responsive to antidepressants than men (Kornstein et al., 2000; Young et al., 2009; Sramek et al., 2016). Fourth, middle-aged women may have had more exposure to the black box warning via direct-to-consumer advertising (DTCA). Avery et al. (2012) document that from 1995 to 2007, almost 60 percent of antidepressant magazine ads were in outlets targeted at women (e.g., *Women's Day*, *Good Housekeeping*, *Glamour*, *Cosmopolitan*, *Vogue*), and the majority of antidepressant television ads appeared in programs primarily targeted at women (e.g., soap operas, talk shows, dramas). Such magazines and programs are presumably consumed more by middle-aged women than younger groups. Importantly, when a drug has a black box warning, the risks must be highlighted and made clear in ads. Thus, women in their late 30s and 40s likely had relatively more exposure to the warning through DTCA. Fifth, we find that the employment and antidepressant declines among 35-49 year old women are driven by those who are married, and likely have another source of income and health insurance through their spouse. As middle-aged women are more likely to be married compared to younger females, they may have faced fewer constraints in adjusting their antidepressant and employment behavior.

Regarding 18-25 year olds, among those in our NSDUH estimation sample, about half were targeted directly by the *2004* black box warning (i.e., they were younger than 18 at the time of the 2004 warning). A large literature documents substantial declines in antidepressant use after the 2004 warning for the pediatric and adolescent population (Busch et al., 2010; Parkinson et al., 2014). As most individuals under age 18 still live with their parents, we speculate that parental influence played a large role in this decline. The remaining half of the 18-25 year old NSDUH sample was not *directly* targeted by the 2004 warning. In an unpublished working paper, Collins and Schmeiser (2010) use a lab experiment to show that the 2004 warning did not significantly reduce the intent of college students (i.e., roughly 18-25 year olds) to fill an antidepressant prescription, and attribute their findings to potential demographic variation in risk perception. An alternative explanation is offered by Brodie et al. (2003), who document that individuals aged 18-34 are less likely to report that they follow health news closely relative to older counterparts. Thus, a plausible explanation for our null findings for 18-25 year olds is that roughly half of this group (i.e., those under 18 in 2004) may have already adjusted their mental healthcare behavior in response to the initial warning. The other half (i.e., those over 18 in 2004 and, thus, aged 21-25 in 2007) were not directly targeted by the 2004 warning, but due to a combination of risk preferences and lack of awareness (possibly

due to a lack of DTCA aimed at their demographic) were similarly unlikely to respond to the 2007 warning.

It is important to note several limitations of our analysis. We find no evidence of a change in antidepressant use following the warning for 18-25 year olds, but a lack of statistical power in the MEPS prevents us from drawing firm conclusions about this group's response. In addition, our analysis of dynamic treatment effects using the NSDUH suggests that the post-warning employment decrease among depressed women aged 35-49 is driven by a strong decline in the second half of 2007, the first fully treated period after the black box warning announcement. However, we cannot reject that the post-warning time-varying treatment effects are equal to each other, making it difficult to determine whether the employment effects were concentrated shortly after the warning or more sustained. Furthermore, the implied two-stage least squares estimate we calculate should be interpreted with caution as there are likely additional mechanisms through which the warning impacted employment beyond those we explored, such as drug adherence. Finally, we provide some rationale and speculation for why women aged 35-49 responded to the warning and why 18-25 years old did not, but a deeper empirical examination of the differential responses by age is a promising area for future work.

Even in light of these limitations, our findings provide an important example of how health policy can impact human capital development and the economy at large, which may not be considered by policy architects. In the case of the 2007 expanded black box warning on antidepressants, our estimates suggest that the economic impact was significant. According to the Bureau of Labor Statistics, women aged 35-49 comprised approximately 16.4 percent of the labor force in the U.S. in 2006. Data from the 2005 MEPS cohort suggest that 23.3 percent of women ever working over the 2-year interview period also experienced some form of depression or anxiety in that time frame. Thus, prior to the announcement of the expanded black box warning, depressed women aged 35-49 comprised about 3.8 percent of the US labor force. Our estimates imply that employment among this group fell in response to the warning by 6.1 percent, representing a 0.23 percentage point reduction in the size of the US labor force, or 352,042 fewer individuals. Again from the 2005 MEPS cohort, average annual income from wages for this demographic (i.e., ever-depressed employed women aged 35-49) was $33,594 in 2006 dollars. As such, the warning led to roughly $11.8 billion in lost wages.[50]

Reduced wages only capture a fraction of the total impact of the warning. The expansion of the black box warning and ensuing reduction in mental health treatment presumably increased pain and suffering

[50] Annual earnings for this subgroup are calculated as (weighted) average reported hours (i.e., 37.41) times (weighted) average reported hourly wage (i.e., $17.96) times fifty weeks. Our calculation assumes that (i) those maintaining and leaving employment worked similar hours with similar wages, and (ii) the warning-induced employment reduction results in a full year out of the labor force. The first assumption may be unrealistic if part-time workers or low-wage workers are more likely to leave employment post-warning. As such, we use a similar method to calculate annualized earnings among ever-depressed employed women aged 35-49 who ever experience an unemployment spell over the two-year sample period. Average annualized earnings for this group are $24,906 (33.23 hours at $14.99 dollars per hour), which implies roughly $8.8 billion in lost wages.

for patients who were affected. There were also implications for suppliers of antidepressants. Maybe most importantly, a complete analysis of the costs and benefits of the warning would consider the impact on suicide rates, which speaks to the original objective of the warning. Recall, the 2004 and 2007 antidepressant black box warnings were the result of an extensive research effort by the FDA, which included meta-analyses of nearly 400 randomized control trials (RCTs) and over 100,000 patients. In short, these studies suggested that antidepressant use among children, adolescents, and young adults increased their risk of suicidality; the black box warning was added, and then expanded, to lower the incidence of suicide.

Several studies have shown that suicide rates among children and adolescents *increased* after the 2004 black box warning was added (Gibbons et al., 2007; Busch et al., 2014); the *opposite* of the intended effect. Ludwig et al. (2009) provide a thorough rationalization of this unexpected outcome. The authors describe three problems with the RCTs supporting the decision to add the warnings: (i) they were not externally valid, as the most severely depressed patients were almost always excluded from the trials; (ii) they were severely under-powered;[51] and (iii) much of the data on suicidal thoughts and attempts suffers from ascertainment bias (i.e., side effects are more common with any active drug than with placebo; thus, those receiving antidepressants complete more doctor visits, meaning more opportunities to report suicidal thoughts and attempts). Ludwig et al. (2009) go on to estimate the effect of SSRI sales on suicide across 26 countries by exploiting institutional differences in how all drugs are priced, regulated, and distributed. They find that one SSRI pill per capita *reduces* suicide by 5 percent.

In addition to the research discussed above, which suggests the 2004 warning may have actually increased suicide rates, Busch et al. (2014) find that the 2004 warning generated perverse indirect effects as well. Using a similar empirical strategy to the one employed in this paper, Busch et al. (2014) find that the warning lowered GPAs, increased delinquency, and increased tobacco and illicit drug use among depressed adolescent girls. In this paper, we show yet another unintended consequence of the black box warnings on antidepressants – a reduction in employment among depressed women. The sum of these findings underscores the complexity associated with calculating the costs and benefits of these black box warnings, and FDA regulatory actions more generally.

[51] As the authors explain, at typical suicide rates, to find a 20 percent effect of SSRIs on suicide, one would need 1.9 million subjects. Finding a 5 percent effect would require 30 million patients, which is about twice the number of Americans who suffer from major depressive disorder in any given year. As a result, the researchers conducting these RCTs examine the impact of antidepressants not on suicides, but on suicidal thoughts and attempts. The decision to examine these outcomes leads to the third problem, which is that considering and/or attempting suicide is very different from death via suicide. A small fraction of those who consider suicide attempt it and few attempted suicides are fatal (Cutler et al., 2001; Baldessarini et al., 2006).

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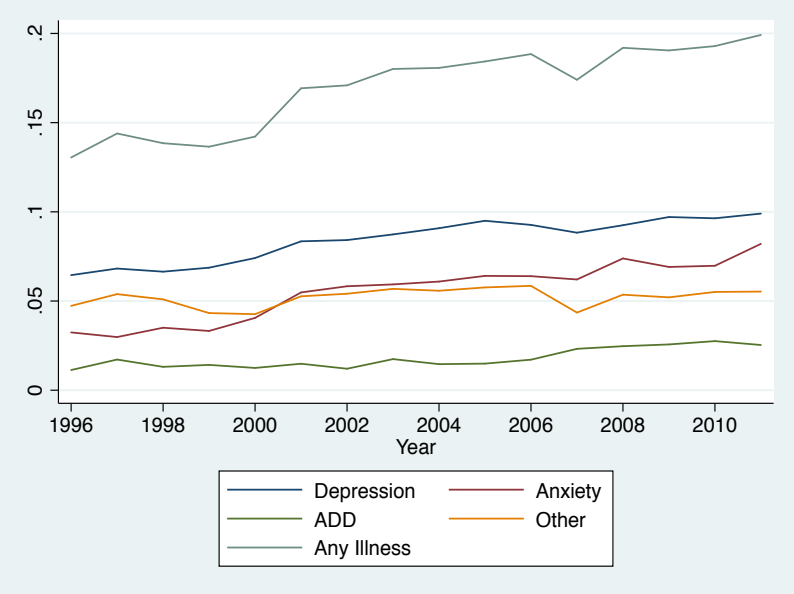
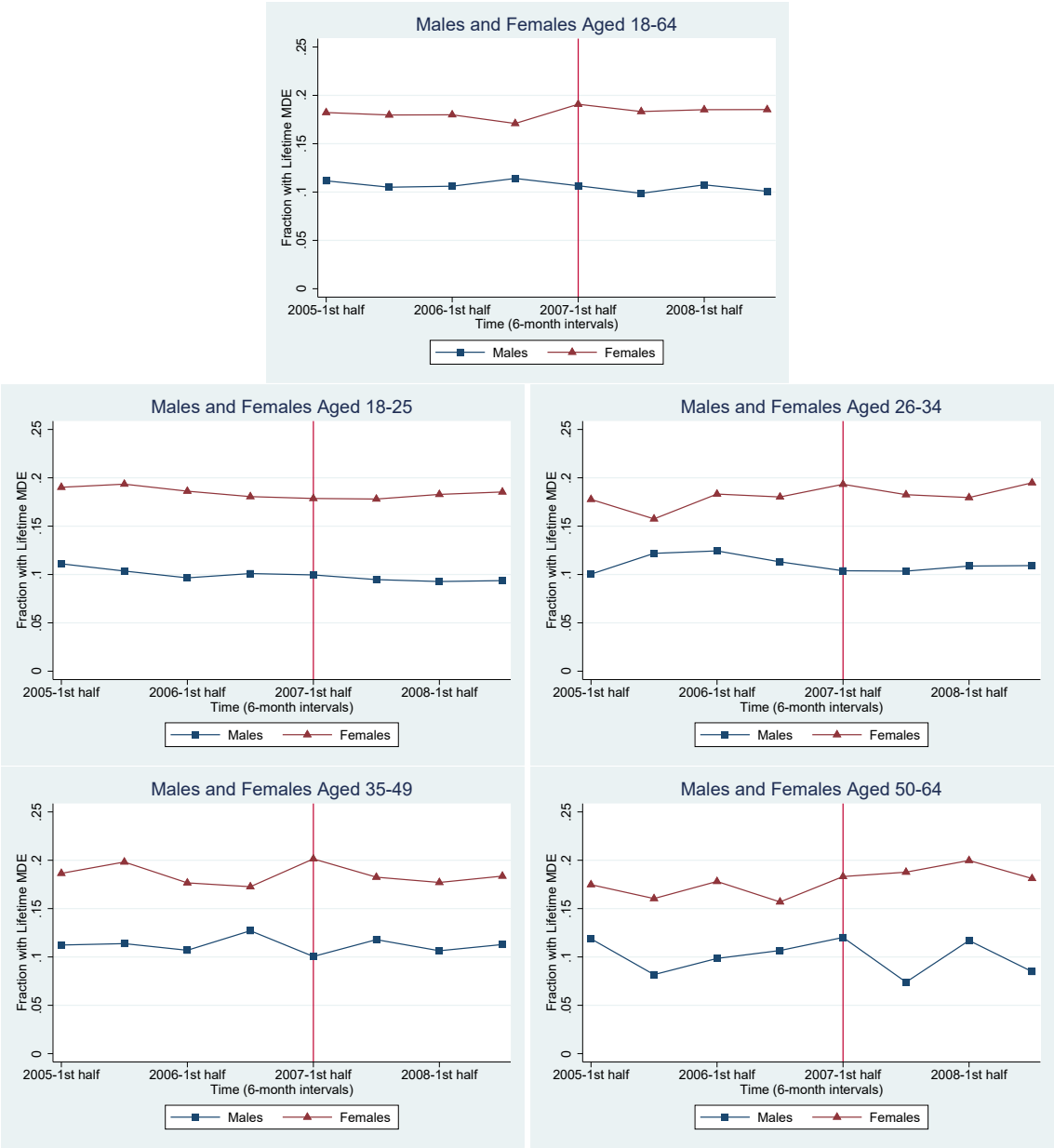
Figures and Tables

Figure 1: Proportion of Individuals with Mental Health Conditions Over Time (1996-2011 MEPS Cohorts)



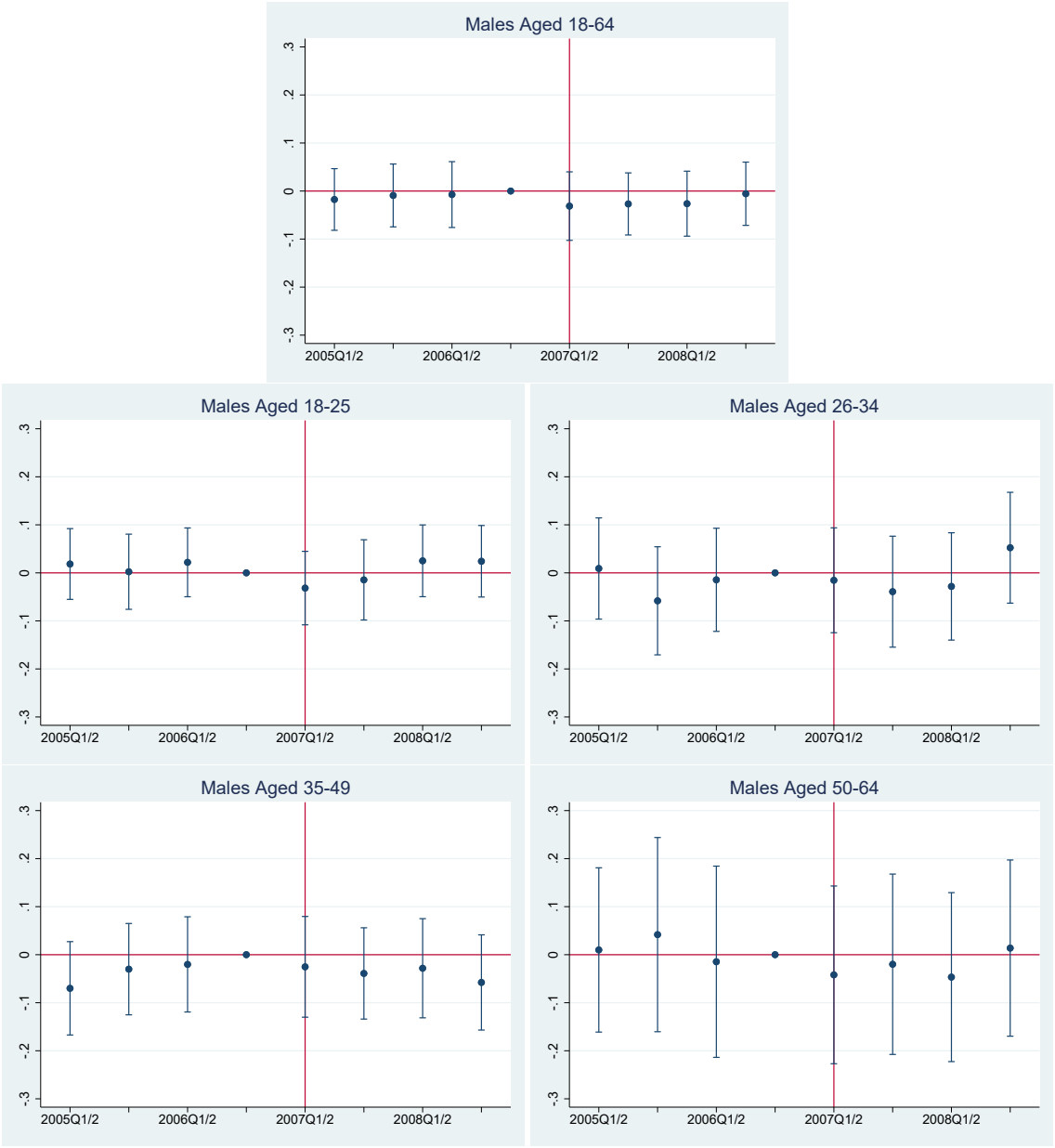
Notes: Proportions are calculated using population weighted Medical Expenditure Panel Survey (MEPS) data in the Medical Condition Files. Individuals are grouped by cohort (i.e., year entering the MEPS sample) and categorized according to whether they report the illness (as indicated by ICD9 code) over the two-year interview period. Individuals of all ages are included. Any (mental) illness corresponds to ICD9 codes 290-319.

Figure 2: Proportion of Males and Females with a Lifetime MDE Over Time (NSDUH)



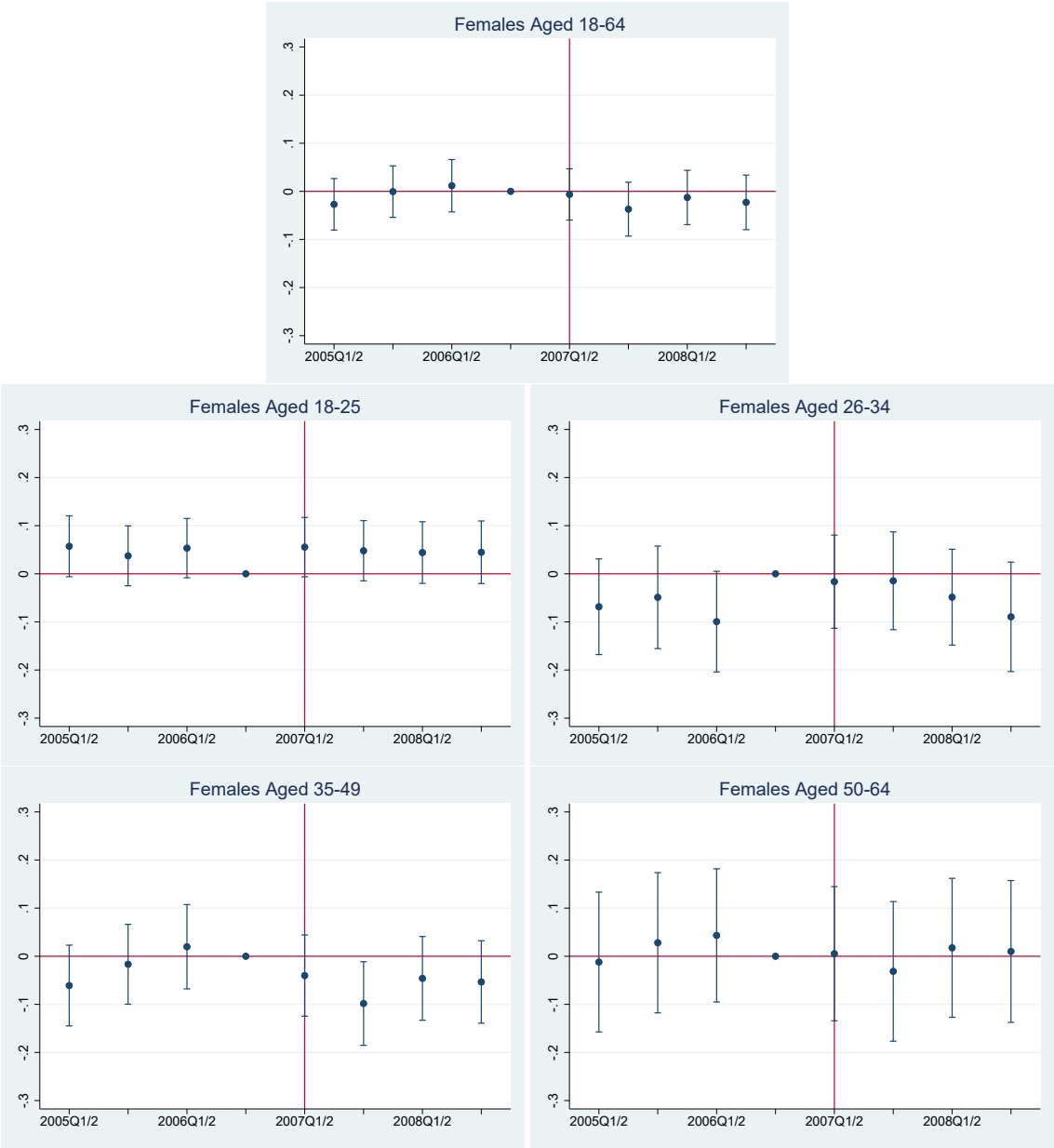
Notes: Proportions are calculated using the NSDUH sampling weights and include all observations in our sample from 2005-2008.

Figure 3: Event Study Estimates of the Effect of the Warning on Male Employment (NSDUH)



Notes: Each panel contains plots of the estimates of π_ℓ from Equation 2 with 95 percent confidence interval bars. The dependent variable is an indicator for whether the individual was employed in the past week. The reference category is 2006Q3/Q4. Each specification includes indicator variables for having a lifetime MDE, age (when possible), education, marital status, race and ethnicity, metro type, and time (measured in 6-month periods). All models are estimated by OLS with heteroskedasticty-robust standard errors and NSDUH sampling weights.

Figure 4: Event Study Estimates of the Effect of the Warning on Female Employment (NSDUH)



Notes: Each panel contains plots of the estimates of π_ℓ from Equation 2 with 95 percent confidence interval bars. The dependent variable is an indicator for whether the individual was employed in the past week. The reference category is 2006Q3/Q4. Each specification includes indicator variables for having a lifetime MDE, age (when possible), education, marital status, race and ethnicity, metro type, and time (measured in 6-month periods). All models are estimated by OLS with heteroskedasticty-robust standard errors and NSDUH sampling weights.

Table 1: Descriptive Statistics for Males by Age Group and Depression Status (NSDUH)

	All		18-25		26-34		35-49		50-64	
	No MDE	MDE	No MDE	MDE	No MDE	MDE	No MDE	MDE	No MDE	MDE
Employed										
Pre-warning	84.78	75.52	77.11	75.37	91.13	81.50	91.95	79.40	76.31	65.21
Post-warning	84.04	73.05	74.45	71.98	90.18	81.36	90.73	76.92	77.95	62.48
Education										
Less than high school	16.19	12.84	22.28	17.78	16.28	12.58	14.86	12.54	13.84	10.33
High school	30.74	30.32	35.95	34.84	28.81	27.77	31.01	29.68	28.38	30.28
Some college	24.81	28.10	30.23	35.66	24.78	29.94	23.09	26.24	23.44	24.49
College graduate	28.26	28.74	11.54	11.73	30.14	29.71	31.04	31.54	34.34	34.91
Marital Status										
Married	56.42	43.94	9.63	8.72	50.46	37.25	69.62	52.30	74.38	59.73
Previously married	11.60	20.44	1.06	2.26	7.10	13.54	14.54	25.48	17.84	30.18
Never married	31.98	35.62	89.31	89.03	42.44	49.21	15.84	22.22	7.79	10.09
Race/Ethnicity										
White	66.40	77.15	61.58	68.13	57.67	68.71	66.66	79.15	75.13	86.51
Black	11.41	7.93	13.22	9.42	11.75	11.16	11.25	7.39	10.22	5.27
Native American	0.47	0.41	0.53	0.62	0.44	0.23	0.48	0.41	0.46	0.43
Hawaiian/Pacific Islander	0.37	0.33	0.48	0.50	0.42	0.26	0.41	0.28	0.23	0.36
Asian	4.60	2.54	4.45	4.12	5.84	3.23	4.78	2.98	3.63	0.40
Multiple	0.94	1.23	1.10	1.17	0.97	1.28	0.80	1.47	1.01	0.91
Hispanic	15.79	10.40	18.64	16.04	22.91	15.12	15.62	8.33	9.32	6.11
Metro Status										
Large metro	54.84	53.68	53.42	53.31	56.94	56.98	56.60	55.50	52.15	48.88
Small metro	29.23	30.07	30.93	31.14	29.21	26.50	27.71	29.84	30.02	32.43
Non-metro	15.93	16.24	15.65	15.55	13.85	16.52	15.68	14.66	17.83	18.70
N	58,253	6,856	31,146	3,406	9,107	1,195	12,562	1,632	5,438	623
Share	89.37%	10.63%	90.09%	9.91%	88.94%	11.06%	88.77%	11.23%	89.96%	10.04%

Notes: All means and proportions are calculated using the NSDUH sampling weights and include all observations in our sample from 2005-2008. We report the raw number of individuals in each subsample; however, depression shares are weighted.

Table 2: Descriptive Statistics for Females by Age Group and Depression Status (NSDUH)

	All		18-25		26-34		35-49		50-64	
	No MDE	MDE	No MDE	MDE	No MDE	MDE	No MDE	MDE	No MDE	MDE
Employed										
Pre-warning	71.98	69.41	69.25	70.32	72.29	71.93	77.06	72.70	67.08	62.43
Post-warning	72.10	68.31	69.43	71.23	73.28	74.22	77.86	69.34	66.02	61.62
Education										
Less than high school	13.31	11.15	16.72	14.32	12.93	10.86	11.81	11.42	13.37	9.02
High school	30.63	27.39	33.35	33.14	25.34	23.67	29.82	26.19	33.48	27.82
Some college	27.50	32.13	34.79	37.18	27.16	32.15	26.88	32.11	24.11	28.99
College graduate	28.55	29.32	15.15	15.37	34.56	33.32	31.50	30.27	29.04	34.17
Marital Status										
Married	57.13	47.07	17.31	14.62	58.47	47.73	68.70	57.16	65.98	54.02
Previously married	16.70	25.07	2.45	4.09	10.26	16.33	18.44	29.26	27.35	38.70
Never married	26.17	27.86	80.24	81.30	31.27	35.94	12.86	13.58	6.66	7.28
Race/Ethnicity										
White	64.68	77.01	60.04	68.49	57.67	71.96	63.98	79.10	72.90	83.06
Black	13.78	8.74	15.38	11.78	14.39	9.71	14.09	8.55	12.05	6.41
Native American	0.57	0.53	0.62	0.65	0.61	0.81	0.50	0.47	0.60	0.36
Hawaiian/Pacific Islander	0.41	0.34	0.34	0.53	0.50	0.22	0.48	0.19	0.31	0.51
Asian	5.10	2.04	4.89	3.46	6.36	2.49	5.67	1.62	3.72	1.37
Multiple	1.02	1.54	1.11	1.90	1.01	2.07	0.71	1.17	1.36	1.44
Hispanic	14.44	9.79	17.63	13.18	19.47	12.74	14.58	8.90	9.07	6.83
Metro Status										
Large metro	55.46	49.23	53.50	52.46	57.43	49.14	57.50	49.50	52.86	46.94
Small metro	28.69	32.48	31.37	32.05	28.86	34.52	27.04	31.37	29.00	32.81
Non-metro	15.84	18.29	15.14	15.49	13.70	16.34	15.46	19.13	18.14	20.25
N	60,491	14,085	31,150	7,122	9,542	2,311	13,967	3,376	5,832	1,276
Share	81.78%	18.22%	81.56%	18.44%	81.87%	18.13%	81.50%	18.50%	82.19%	17.81%

Notes: All means and proportions are calculated using the NSDUH sampling weights and include all observations in our sample from 2005-2008. We report the raw number of individuals in each subsample; however, depression shares are weighted.

Table 3: Difference-in-Differences Estimates of the Effect of the Warning on Employment (NSDUH)

	All	18-25	26-34	35-49	50-64
			Panel A: Males		
MDE	-0.093***	-0.032**	-0.091***	-0.116***	-0.108***
	(0.012)	(0.014)	(0.020)	(0.018)	(0.035)
MDE × Post	-0.014	-0.011	0.010	-0.009	-0.034
	(0.018)	(0.020)	(0.029)	(0.026)	(0.050)
R^2	0.093	0.078	0.042	0.082	0.064
N	65109	34552	10302	14194	6061
			Panel B: Females		
MDE	-0.043***	-0.010	-0.025	-0.053***	-0.061**
	(0.010)	(0.011)	(0.019)	(0.015)	(0.026)
MDE × Post	-0.016	0.010	0.012	-0.044**	-0.015
	(0.014)	(0.015)	(0.027)	(0.021)	(0.037)
R^2	0.066	0.081	0.089	0.046	0.063
N	74576	38272	11853	17343	7108

Notes: All models are estimated by OLS with heteroskedasticty-robust standard errors (in parentheses) and NSDUH sampling weights. Each column within a panel represents a separate regression. The dependent variable is an indicator for whether the individual was employed in the past week. Unreported covariates include indicator variables for age (when possible), education, marital status, race and ethnicity, metro type, and time (measured in 6-month periods).

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Time-Varying Effects of the Warning on Employment (NSDUH)

	All	18-25	26-34	35-49	50-64
			Panel A: Males		
MDE	-0.093***	-0.032**	-0.091***	-0.116***	-0.108***
	(0.012)	(0.014)	(0.020)	(0.018)	(0.035)
MDE × 2007Q1/2	-0.023	-0.042	0.002	0.004	-0.050
	(0.031)	(0.032)	(0.044)	(0.044)	(0.079)
MDE × 2007Q3/4	-0.018	-0.025	-0.022	-0.010	-0.027
	(0.026)	(0.036)	(0.048)	(0.038)	(0.081)
MDE × 2008Q1/2	-0.018	0.014	-0.011	0.001	-0.054
	(0.028)	(0.031)	(0.046)	(0.043)	(0.074)
MDE × 2008Q3/4	0.003	0.013	0.069	-0.029	0.006
	(0.027)	(0.031)	(0.048)	(0.041)	(0.078)
R^2	0.093	0.078	0.043	0.082	0.064
N	65109	34552	10302	14194	6061
			Panel B: Females		
MDE	-0.043***	-0.010	-0.025	-0.053***	-0.062**
	(0.010)	(0.011)	(0.019)	(0.015)	(0.026)
MDE × 2007Q1/2	-0.002	0.018	0.038	-0.025	-0.010
	(0.021)	(0.023)	(0.038)	(0.033)	(0.056)
MDE × 2007Q3/4	-0.033	0.010	0.040	-0.083**	-0.047
	(0.023)	(0.024)	(0.041)	(0.035)	(0.060)
MDE × 2008Q1/2	-0.009	0.007	0.006	-0.031	0.002
	(0.023)	(0.025)	(0.040)	(0.035)	(0.059)
MDE × 2008Q3/4	-0.019	0.007	-0.035	-0.039	-0.006
	(0.023)	(0.026)	(0.049)	(0.034)	(0.061)
R^2	0.066	0.081	0.089	0.046	0.063
N	74576	38272	11853	17343	7108

Notes: All models are estimated by OLS with heteroskedasticty-robust standard errors (in parentheses) and NSDUH sampling weights. Each column within a panel represents a separate regression. The dependent variable is an indicator for whether the individual was employed in the past week. Unreported covariates include indicator variables for age (when possible), education, marital status, race and ethnicity, metro type, and time (measured in 6-month periods).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Descriptive Statistics for Males by Age Group and Depression Status (2006 MEPS Cohort)

	All		18-25		26-34		35-49		35-44		50-64	
	No Dep	Dep	No Dep	Dep	No Dep	Dep	No Dep	Dep	No Dep	Dep	No Dep	Dep
AD Use in Round												
1	0.009	0.342	0.001	0.326	0.002	0.235	0.007	0.289	0.012	0.200	0.018	0.440
2	0.008	0.358	0.000	0.266	0.003	0.271	0.006	0.311	0.005	0.210	0.019	0.459
3	0.009	0.363	0.001	0.172	0.000	0.257	0.011	0.374	0.016	0.317	0.018	0.460
4	0.011	0.395	0.000	0.299	0.003	0.260	0.010	0.369	0.011	0.277	0.025	0.511
5	0.012	0.335	0.003	0.175	0.003	0.183	0.005	0.307	0.005	0.187	0.032	0.473
Education												
Less than high school	0.146	0.132	0.289	0.190	0.149	0.065	0.126	0.153	0.144	0.161	0.101	0.135
High school	0.569	0.598	0.650	0.810	0.503	0.472	0.559	0.605	0.519	0.588	0.585	0.578
College graduate	0.280	0.269	0.055	0.000	0.345	0.463	0.310	0.239	0.333	0.245	0.310	0.287
Marital Staus												
Married	0.567	0.470	0.052	0.063	0.506	0.351	0.664	0.531	0.660	0.522	0.743	0.569
Previously married	0.125	0.244	0.022	0.033	0.102	0.154	0.157	0.243	0.139	0.240	0.161	0.323
Never married	0.308	0.286	0.926	0.904	0.392	0.496	0.179	0.226	0.201	0.238	0.096	0.108
Non-White	0.178	0.153	0.229	0.134	0.165	0.095	0.179	0.131	0.199	0.159	0.166	0.168
MSA	0.842	0.824	0.855	0.812	0.853	0.907	0.851	0.834	0.860	0.856	0.816	0.784
Employed	0.899	0.706	0.887	0.789	0.938	0.880	0.932	0.810	0.934	0.840	0.828	0.509
N	3780		491		601		1315		836		1132	
% Depressed	12.0		7.6		11.1		11.3		10.9		15.2	

Notes: All means and proportions are calculated using the MEPS longitudinal sampling weights and include all observations in our sample from the 2006 MEPS cohort. We report the raw number of individuals in each subsample; however, depression shares are weighted.

Table 6: Descriptive Statistics for Females by Age Group and Depression Status (2006 MEPS Cohort)

	All		18-25		26-34		35-49		35-44		50-64	
	No Dep	Dep	No Dep	Dep	No Dep	Dep	No Dep	Dep	No Dep	Dep	No Dep	Dep
AD Use in Round												
1	0.025	0.375	0.013	0.216	0.016	0.232	0.025	0.357	0.024	0.299	0.038	0.488
2	0.026	0.424	0.007	0.075	0.016	0.268	0.024	0.422	0.025	0.391	0.041	0.549
3	0.026	0.446	0.008	0.256	0.013	0.304	0.030	0.440	0.028	0.422	0.041	0.557
4	0.024	0.453	0.003	0.215	0.019	0.329	0.023	0.445	0.021	0.413	0.040	0.573
5	0.027	0.441	0.008	0.208	0.023	0.314	0.031	0.475	0.036	0.438	0.035	0.519
Education												
Less than high school	0.113	0.125	0.190	0.179	0.101	0.084	0.088	0.122	0.093	0.148	0.120	0.123
High school	0.569	0.618	0.670	0.744	0.537	0.634	0.550	0.575	0.526	0.533	0.564	0.631
College graduate	0.312	0.255	0.136	0.066	0.362	0.280	0.356	0.303	0.378	0.318	0.306	0.244
Marital Staus												
Married	0.577	0.529	0.147	0.201	0.564	0.429	0.679	0.591	0.679	0.496	0.651	0.581
Previously married	0.179	0.267	0.031	0.032	0.101	0.178	0.189	0.272	0.180	0.289	0.290	0.347
Never married	0.244	0.204	0.822	0.767	0.335	0.393	0.132	0.137	0.141	0.215	0.058	0.073
Non-White	0.223	0.151	0.256	0.209	0.222	0.230	0.226	0.145	0.245	0.185	0.201	0.095
MSA	0.853	0.824	0.867	0.855	0.887	0.828	0.848	0.825	0.842	0.806	0.818	0.811
Employed	0.792	0.652	0.853	0.837	0.785	0.795	0.812	0.695	0.796	0.681	0.734	0.516
N	4502		476		793		1638		1016		1315	
% Depressed	21.9		13.5		18.4		22.5		20.1		26.2	

Notes: All means and proportions are calculated using the MEPS longitudinal sampling weights and include all observations in our sample from the 2006 MEPS cohort. We report the raw number of individuals in each subsample; however, depression shares are weighted.

Table 7: Difference-in-Differences
Estimates of the Effect of the Warning on Antidepressant Use (2006 MEPS Cohort)

	All	18-25	26-34	35-49	35-44	50-64
			Panel A: Males			
Dep	0.363***	0.385***	0.351***	0.305***	0.216***	0.424***
	(0.031)	(0.100)	(0.091)	(0.048)	(0.055)	(0.055)
Post	0.004*	-0.004*	0.004	0.007	0.007	0.007
	(0.003)	(0.003)	(0.003)	(0.006)	(0.008)	(0.007)
Dep × Post	0.047	0.127	0.165*	0.016	-0.012	0.012
	(0.033)	(0.109)	(0.093)	(0.057)	(0.069)	(0.054)
t	-0.001	0.003	-0.004	-0.003	-0.003	0.002
	(0.002)	(0.003)	(0.004)	(0.004)	(0.005)	(0.004)
Dep × t	-0.013	-0.066*	-0.062*	0.005	0.009	0.005
	(0.012)	(0.035)	(0.032)	(0.019)	(0.023)	(0.022)
Post × (t-$t_{i,BB}$)	-0.013	-0.006	0.010	-0.001	-0.003	-0.003
	(0.012)	(0.011)	(0.011)	(0.009)	(0.012)	(0.011)
R^2	0.189	0.243	0.228	0.268	0.175	0.320
N	3760	491	601	1315	831	1125
			Panel B: Females			
Dep	0.329***	0.186**	0.232***	0.285***	0.223***	0.451***
	(0.025)	(0.079)	(0.077)	(0.037)	(0.047)	(0.039)
Post	0.002	0.014	0.004	-0.008	-0.013	0.010
	(0.005)	(0.009)	(0.010)	(0.008)	(0.011)	(0.011)
Dep × Post	-0.033	0.073	0.053	-0.076**	-0.126**	-0.027
	(0.027)	(0.105)	(0.082)	(0.039)	(0.055)	(0.041)
t	-0.001	-0.007	-0.006	0.004	0.007	-0.000
	(0.003)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)
Dep × t	0.026***	-0.010	0.005	0.047***	0.066***	0.017
	(0.010)	(0.036)	(0.031)	(0.014)	(0.018)	(0.015)
Post × (t-$t_{i,BB}$)	-0.001	-0.004	0.021	-0.002	-0.001	-0.005
	(0.002)	(0.013)	(0.017)	(0.011)	(0.015)	(0.013)
R^2	0.292	0.142	0.199	0.293	0.267	0.359
N	4484	476	793	1638	1012	1308

Notes: All models are estimated by OLS using the MEPS longitudinal sampling weights. Standard errors (in parentheses) are clustered at the individual level. Each column within a panel represents a separate regression. The dependent variable is an indicator for whether the individual filled an antidepressant prescription in the interview round. Unreported covariates include age, age squared, family size, interview period length, and indicators for male, nonwhite (race), highest educational degree, Census region, living in an MSA, and marital status.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Difference-in-Differences Estimates of the Effect of the Warning on New and Continuing Antidepressant Use (2006 MEPS Cohort)

	New AD Use					Continuing AD Use	
	Adults 25-64	Men 25-64	Women 25-64	Women 35-49	Women 35-44	Women 35-49	Women 35-44
Dep	0.068***	0.070***	0.067***	0.049**	0.040	0.237***	0.183***
	(0.011)	(0.018)	(0.015)	(0.022)	(0.028)	(0.036)	(0.045)
Post	0.002	0.003	0.000	-0.002	-0.007	-0.006	-0.006
	(0.002)	(0.002)	(0.004)	(0.009)	(0.009)	(0.007)	(0.010)
Dep × Post	-0.029*	-0.013	-0.036*	-0.053	-0.067	-0.022	-0.059
	(0.017)	(0.026)	(0.021)	(0.034)	(0.047)	(0.038)	(0.049)
t	-0.001	0.000	-0.001	-0.000	0.003	0.004	0.004
	(0.001)	(0.001)	(0.002)	(0.003)	(0.004)	(0.004)	(0.005)
Dep × t	0.009*	0.002	0.013*	0.024**	0.031**	0.023	0.035**
	(0.006)	(0.009)	(0.007)	(0.011)	(0.014)	(0.014)	(0.017)
Post × (t-$t_{i,BB}$)	0.001	-0.001	0.002	0.002	0.001	-0.004	-0.002
	(0.001)	(0.003)	(0.005)	(0.007)	(0.009)	(0.011)	(0.015)
R^2	0.056	0.046	0.058	0.067	0.076	0.218	0.187
N	7302	3284	4018	1631	1012	1638	1012
% Depressed	18.0	12.7	23.0	22.8	20.4	22.8	20.4

Notes: All models are estimated by OLS using the MEPS longitudinal sampling weights. Standard errors (in parentheses) are clustered at the individual level. Each column represents a separate regression. New antidepressant use is an indicator for whether the individual filled a prescription in the interview round for an antidepressant they have never taken before. Continuing antidepressant use is an indicator for whether the individual filled a prescription in the interview round for an antidepressant they have taken in the past. Unreported covariates include age, age squared, family size, interview period length, and indicators for male, nonwhite (race), highest educational degree, Census region, living in an MSA, and marital status.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Difference-in-Differences Estimates
of the Effect of the Warning on Alternative Medical Use of Females Aged 35-49 (2006 MEPS Cohort)

	(1)	(2)	(3)	(4)	(5)	(6)
	Therapy Use		Benzodiazepine Use		Any MH Treatment	
	35-49	35-44	35-49	35-44	35-49	35-44
Dep	0.091***	0.119***	0.103***	0.072***	0.325***	0.274***
	(0.022)	(0.034)	(0.025)	(0.028)	(0.037)	(0.048)
Post	0.001	-0.006	-0.005	-0.013	-0.003	-0.013
	(0.006)	(0.007)	(0.006)	(0.008)	(0.009)	(0.011)
Dep × Post	-0.047*	-0.053	0.046	0.069*	-0.094**	-0.145**
	(0.026)	(0.039)	(0.032)	(0.042)	(0.039)	(0.058)
t	-0.000	0.006	0.003	0.010**	0.001	0.007
	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.006)
Dep × t	0.009	0.000	-0.002	-0.006	0.044***	0.060***
	(0.009)	(0.014)	(0.011)	(0.012)	(0.014)	(0.019)
Post × (t-$t_{i,BB}$)	-0.001	-0.010	-0.005	-0.015*	0.004	-0.001
	(0.007)	(0.007)	(0.007)	(0.009)	(0.012)	(0.015)
R^2	0.089	0.096	0.080	0.056	0.307	0.287
N	1638	1012	1638	1012	1638	1012

Notes: All models are estimated by OLS using the MEPS longitudinal sampling weights. Standard errors (in parentheses) are clustered at the individual level. Each column represents a separate regression. In columns (1) and (2), the dependent variable is an indicator for whether the individual used psychotherapy in the interview round. In columns (3) and (4), the dependent variable is an indicator for whether the individual filled a benzodiazepine prescription in the interview round. In columns (5) and (6), the dependent variable is an indicator for whether the individual filled an antidepressant prescription or used psychotherapy in the interview round. Unreported covariates include age, age squared, family size, interview period length, and indicators for male, nonwhite (race), highest educational degree, Census region, living in an MSA, and marital status.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$