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ORIGINAL ARTICLE

Effects of the Affordable Care Act on Health Behaviors After 3 Years

Charles Courtemanche[1,2,3] · James Marton[4] · Benjamin Ukert[5] · Aaron Yelowitz[1] · Daniela Zapata[6]

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Abstract This paper examines the impacts of the affordable care act (ACA)—which substantially increased insurance coverage through regulations, mandates, subsidies, and Medicaid expansions—on behaviors related to future health risks after 3 years. Using data from the Behavioral Risk Factor Surveillance System and

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✉ James Marton
marton@gsu.edu

Charles Courtemanche
courtemanche@uky.edu

Benjamin Ukert
bukert@wharton.upenn.edu

Aaron Yelowitz
aaron@uky.edu

Daniela Zapata
dzapata@impaqint.com

[1] Department of Economics, Gatton College of Business and Economics, University of Kentucky, Lexington, KY 40506-0034, USA

[2] National Bureau of Economic Research, Cambridge, MA, USA

[3] Institute of Labor Economics (IZA), Bonn, Germany

[4] Department of Economics, Andrew Young School of Policy Studies, Georgia State University, Atlanta, GA 30302-3992, USA

[5] Leonard Davis Institute of Health Economics, University of Pennsylvania, 3641 Locust Walk, Philadelphia, PA 19104-6218, USA

[6] IMPAQ International, 1325 G Street, NW, Suite 900, Washington, DC 20005, USA

an identification strategy that leverages variation in pre-ACA uninsured rates and state Medicaid expansion decisions, we show that the ACA increased preventive care utilization along several dimensions, but increased risky drinking. These results are driven by the private portions of the law, as opposed to the Medicaid expansion. We also conduct subsample analyses by income and age.

Keywords Affordable care act · Health insurance · Medicaid · Health behavior · Preventive care

JEL Classification I12 · I13 · I18

Introduction

Emerging literatures in health economics and health policy seek to evaluate the impacts of the primary components of the affordable care act (ACA), including the individual mandate, subsidized Marketplace coverage, and state Medicaid expansions that were implemented in 2014 (Sommers et al. 2014; Courtemanche et al. 2016; Obama 2016). While the stated goals of the ACA include improving access to health care in order to improve health outcomes, economists have long understood that expansions of insurance coverage could plausibly influence investments in health capital in either direction (for example Cawley and Ruhm 2011; Barbaresco et al. 2015). The purpose of this paper is to estimate the impacts of the ACA on behaviors related to future health risks. These include both behaviors that reduce future risks (such as utilization of preventive medical services) and those that increase risks (such as smoking and drinking). Our primary innovation is to use data from the 2011–2016 Behavioral Risk Factor Surveillance System (BRFSS), which gives us a longer post-treatment period than prior studies and therefore a greater ability to detect effects.

The net effects of health insurance coverage on both preventive care utilization and risky health behaviors depend on the relative roles of out-of-pocket prices, ex ante moral hazard, and income effects. By lowering the portion of medical costs borne by the patient, health insurance reduces the price of preventive care as well as medications and counseling services related to risky behaviors. The direct price effect should therefore work in the direction of healthier lifestyles along both dimensions. However, expansions in insurance coverage could also lead to less healthy lifestyles through ex ante moral hazard, the phenomenon in which the reduction in financial risk associated with unhealthy behavior incentivizes such behavior. While ex ante moral hazard has most often been examined in the context of risky health behaviors, the same logic could also apply to a failure to adhere to screening and vaccination guidelines (Barbaresco et al. 2015; Simon et al. 2017). In addition, income effects from gaining free or subsidized coverage could influence behaviors in potentially conflicting ways. Consumers may choose to spend money they had budgeted for the direct purchase of medical care on alcohol, cigarettes, and junk food or, conversely, on healthy food and gym memberships (Simon et al. 2017).

Following Courtemanche et al. (2017, 2018a), we estimate difference-in-difference-in-differences (DDD) models to evaluate the impact of the ACA, where the differences come from time, state Medicaid expansion status, and local area pre-treatment uninsured rate. Most of the previous ACA literature tends to focus on the effects of the ACA Medicaid expansions using a simpler difference-in-differences (DD) model that compares changes over time in Medicaid expansion states to changes in non-expansion states. We seek to identify the impact of the other components of the ACA as well, such as the individual mandate and subsidized Marketplace coverage.[1] This is inherently more challenging because these components were implemented in every state simultaneously. Our third difference addresses this issue by exploiting an additional layer of plausibly exogenous variation arising from the fact that the national components of the ACA should provide the most intense "treatment" in local areas with the highest pre-reform uninsured rates.

The BRFSS is well suited for our study because it includes a number of questions related to health behaviors and other outcomes of interest. In addition, it is large enough to precisely estimate the effects of state policies, with over 300,000 observations per year. Our sample consists of non-elderly adults included in the 2011–2016 waves of the BRFSS.

Our results provide some evidence of both improved access to preventive services and the presence of ex ante moral hazard. For the full sample of non-elderly adults, the ACA increased several aspects of preventive care utilization (well-patient checkups, pap and HIV tests, and mammograms) but also risky drinking in non-Medicaid-expansion states, with the effects being statistically indistinguishable in Medicaid expansion states. No statistically significant results emerge for flu shots, body mass index (BMI), drinks per month, smoking, or exercising. Event study regressions provide support for our econometric approach while also revealing some evidence of additional ex ante moral hazard—greater smoking and less exercise—in the ACA's third year. Finally, we conduct subsample analyses by income and age. The gains in preventive care are largely concentrated among the lower half of the income distribution, while the results suggesting ex ante moral hazard are clearer among the upper half. The increases in pap and HIV tests are concentrated among those below the sample median age, while the rise in mammograms is driven by those above the median age.

These findings with 3 years of post-reform data build on analyses by Courtemanche et al. (2018a) and Simon et al. (2017) that also used the BRFSS but only through 2015. Moreover, Courtemanche et al. (2018a) only examine a single preventive care outcome (well-patient checkups), while Simon et al. (2017) only estimate causal effects of the ACA's Medicaid expansion.

[1] Our results could also partially reflect the ACA's employer mandate, which took effect in 2015 and became stronger in 2016. See https://obamacarefacts.com/obamacare-employer-mandate/.

Literature Review

The RAND Health Insurance Experiment of the 1970s–1980s provides some of the first causally interpretable evidence on the impacts of health insurance coverage on health behaviors. Randomized variation in the generosity of insurance coverage through the experiment did not lead to statistically significant changes in smoking behavior or weight (Brook et al. 1983). There is also a large literature focusing on Medicaid expansions prior to the ACA. In terms of risky health behaviors, Medicaid expansions for children and pregnant women in the 1980s and 1990s reduced low birthweight (Currie and Gruber 1996), but increased smoking among pregnant women (Dave et al. 2015).

Studies of the more recent randomized 2008 Oregon Medicaid lottery found that Medicaid coverage increased use of preventive services but did not have statistically significant effects on smoking or obesity (Finkelstein et al. 2012; Baicker et al. 2013). Kolstad and Kowalski (2012) found that the expansion of coverage resulting from the 2006 Massachusetts insurance reform increased utilization of some types of preventive care, while Courtemanche and Zapata (2014) found that it reduced BMI but did not significantly influence smoking. Among seniors, Dave and Kaestner (2009) documented slightly worsening smoking and drinking habits as a result of gaining Medicare coverage, while Card et al. (2008) found mixed results for preventive care.

In terms of the ACA, one strand of the literature examines the 2010 mandate for insurers to cover dependents up to 26 years old. Evidence suggests that this dependent coverage expansion did not impact the utilization of preventive services, but did reduce BMI (Barbaresco et al. 2015). Another strand of literature examines the major components of the ACA that were implemented in 2014. Simon et al. (2017) used the BRFSS and found that the ACA Medicaid expansion increased some aspects of preventive care use among low-income childless adults. However, they did not find any evidence of effects on risky health behaviors. Similarly, Courtemanche et al. (2018a) showed that the full ACA increased well-patient checkups, but found no evidence of effects on risky health behaviors. Cotti et al. (2018) use scanner, rather than survey, data and find little evidence that the ACA's Medicaid expansion influenced purchases of snack foods, soda, cigarettes, or alcohol.

Relative to the previous literature, we make two main contributions. First, to our knowledge, we provide the first causally interpretable evidence on the effects of the ACA on health behaviors after 3 years. Simon et al. (2017), Courtemanche et al. (2018a), and Cotti et al. (2018) only used 2 years of post-treatment data. Since none of these studies found effects on risky behaviors, the addition of the third post-treatment year will ultimately prove essential for documenting any ex ante moral hazard. The importance of the third year is not surprising. Enrollment in the Marketplaces has continued to rise each year since the ACA took effect, and the estimated gain in insurance coverage from the fully implemented ACA rose from 6.5 percentage points in 2014 to 9.7 percentage points in 2015 to 11.8 percentage points in 2016 (Courtemanche et al. 2018b). Moreover, a long literature on economic models of addiction suggests that health habits—particularly those related to addictive

substances—can take time to adjust in response to changing incentives (Cawley and Ruhm 2011).

Second, we also conduct, to our knowledge, the first investigation of the effects of the fully implemented ACA (including the provisions related to private coverage) on a broad spectrum of preventive care measures. Simon et al. (2017) examined several preventive care outcomes but only offered causally interpretable results for the ACA's Medicaid expansion. Courtemanche et al. (2018a) estimated the impacts of both the private and Medicaid expansion components of the ACA, but only considered one preventive care measure (well-patient checkups).

Data

We use data from the BRFSS, an annual telephone survey conducted by the US Centers for Disease Control and Prevention (CDC) in conjunction with state health departments. The BRFSS collects information on various types of health behaviors for all 50 states and the District of Columbia. Having a large sample size (more than 300,000 adults per year) is critical because the ACA affected insurance coverage for only a fraction of the population, thus limiting plausible effect sizes.

Our sample consists of BRFSS respondents 19–64 years old who were interviewed between 2011 and 2016. Older individuals were excluded because the ACA was not intended to affect their health-care coverage. We start our sample with calendar year 2011 because this is the first year in which the BRFSS included cell phones in its sampling frame. Thus our 2011–2016 sample period gives us a total of 3 years of pre-reform data and 3 years of post-reform data.

We examine ten dependent variables related to preventive care or risky behaviors. Our preventive care outcomes are indicators for a recent well-patient checkup (that is physical), flu shot, pap test, and mammogram in the past year, and whether the person was ever tested for HIV.[2] Our risky health behavior outcomes are a binary indicator for whether one smokes, a count of alcoholic drinks consumed in the past month, an indicator for whether one was a risky drinker in the last month,[3] a continuous variable measuring the respondents' body weight in the form of BMI,[4] and a

[2] The BRFSS survey questions we use to build the preventive care outcomes are: "About how long has it been since you last visited a doctor for a routine checkup?" A routine checkup is a general physical exam, not an exam for a specific injury, illness, or condition; during the past 12 months, "have you had either a flu shot or a flu vaccine that was sprayed in your nose?"; "how long has it been since you had your last Pap test?"; "how long has it been since you had your last mammogram?"; and "not counting tests you may have had as part of blood donation, have you ever been tested for HIV? Include testing fluid from your mouth".

[3] According to the CDC (https://www.cdc.gov/alcohol/fact-sheets/alcohol-use.htm), risky drinking is defined as consuming 60 or more (32 or more) drinks in the last month for men (women), or having any episodes of binge drinking in the last month. Binge drinking is defined as having five or more drinks in one occasion for men and four or more drinks in one occasion for women. We also considered using binge drinking as an outcome; the results were very similar to those for risky drinking.

[4] BMI is defined as weight in kilograms divided by height in squared meters. We also considered a binary outcome for obesity (BMI $\geq$ 30) and the results were qualitatively similar to those for BMI. The BRFSS computes BMI based on respondents' reported height and weight. Self-reported height and

binary variable for any exercise in the last month.[5] Smoking, drinking, and obesity-related behaviors were selected because they represent three of the leading causes of preventable death in the USA, costing 467,000, 64,000, and 216,000 lives, respectively, per year as of 2005 (Danaei et al. 2009; Cawley and Ruhm 2011).

Our analysis includes controls for demographic characteristics, household characteristics, economic characteristics, and measures that capture state differences in the implementation of the ACA. Specifically, we use BRFSS information to construct dummy variables for age groups, gender, race/ethnicity, marital status, education, household income, number of children in the household, whether the respondent reports their primary occupation to be a student, and whether the respondent is unemployed. Additionally, we use data from the Bureau of Labor Statistics to control for seasonally adjusted monthly state unemployment rate. Finally, following Courtemanche et al. (2017, 2018a), we include dummy variables for whether states set up their own insurance exchanges and whether these exchanges experienced glitches (KFF 2014; Kowalski 2014).

One of our treatment variables, measuring the "dose" of the ACA's impact, is the uninsured rate in the respondent's "local area" in the pre-reform year of 2013, computed within our BRFSS sample. Defining local areas is not straightforward since the BRFSS does not contain narrow geographic identifiers such as county. Beyond state of residence, the only geographic information available in the BRFSS is an "area type" variable indicating whether the respondent resides in the center city of an MSA, outside the center city of an MSA but inside the county containing the center city, inside a suburban county of the MSA, or not in an MSA. Moreover, the "area type" variable is missing for cell phone respondents. Following Courtemanche et al. (2018a), we define four "local areas" within each state—those living within a central city, suburbs, non-MSA, and location unavailable (that is, cell phone sample)—and calculate the pretreatment average uninsured rates accordingly. This approach produces a total of 194 "areas" (some states do not have all four area types) with 2013 uninsured rates that are computed from between 219 and 5804 respondents each, with the average being 1475 respondents and the median being 1205 respondents.[6]

Footnote 4 (continued)
weight are widely known to suffer from measurement error, but attempting to correct for this error rarely has a meaningful effect on regression estimates (Courtemanche et al. 2015).

[5] For the risky health behaviors we used the following questions and pre-calculated variables in the BFRSS; "do you now smoke cigarettes every day, some days, or not at all?"; the calculated total number of alcoholic beverages consumed per month, the calculated BMI based on questions regarding height and weight, "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?". We created the risky drinker variable ourselves based on the government definition in footnote 2, the calculated alcohol consumption variable mentioned above, and a binge drinking question that states, "Considering all types of alcoholic beverages, how many times during the past 30 days did you have X [$X=5$ for men, $X=4$ for women] or more drinks on an occasion?".

[6] The lack of county identifiers precludes other possible measures of the "dose" of the ACA's impact, such as county-level variation in physician density, that would have to be computed outside the BRFSS.

Table 1 Means and standard deviations of dependent variables by state Medicaid expansion status and pretreatment uninsured rate

	Full sample	Medicaid expansion; ≥ median baseline uninsured	Medicaid expansion; < median baseline uninsured	Non-expansion; ≥ median baseline uninsured	Non-expansion; < median baseline uninsured
Checkup	0.626 (0.483)	0.600 (0.490)	0.689 (0.462)	0.593 (0.491)	0.679 (0.467)
Flu shot	0.324 (0.467)	0.324 (0.469)	0.402 (0.490)	0.292 (0.455)	0.358 (0.479)
Pap test	0.559 (0.496)	0.522 (0.500)	0.562 (0.496)	0.556 (0.497)	0.564 (0.496)
Mammogram	0.363 (0.481)	0.332 (0.471)	0.484 (0.500)	0.285 (0.451)	0.447 (0.497)
HIV	0.443 (0.497)	0.439 (0.496)	0.395 (0.489)	0.490 (0.500)	0.419 (0.493)
BMI	27.864 (6.282)	27.944 (6.386)	27.906 (6.225)	28.059 (6.446)	28.252 (6.379)
Smoker	0.216 (0.412)	0.246 (0.430)	0.185 (0.388)	0.241 (0.428)	0.202 (0.401)
Alcoholic drinks per month	14.292 (36.019)	13.833 (35.114)	13.526 (31.460)	14.783 (39.790)	12.692 (31.912)
Risky drinking	0.217 (0.412)	0.212 (0.409)	0.190 (0.392)	0.217 (0.413)	0.179 (0.383)
Any exercise	0.768 (0.422)	0.760 (0.427)	0.787 (0.410)	0.739 (0.439)	0.762 (0.426)

SD in parentheses. BRFSS sampling weights are used

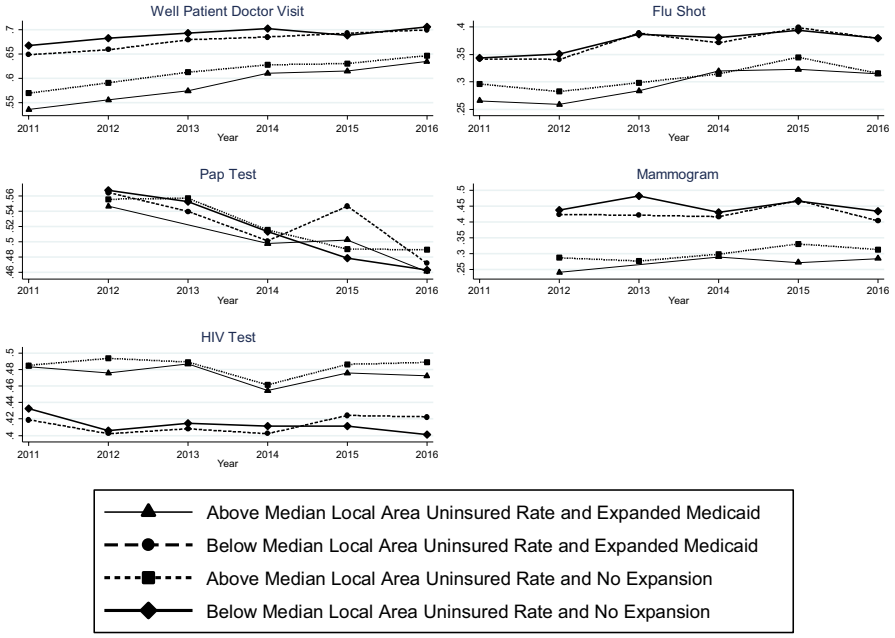

Fig. 1 Changes in preventive care variables over time by state Medicaid expansion status and local area pretreatment uninsured rate

Our Medicaid expansion variable is constructed based on information collected by the Kaiser Family Foundation (KFF). According to the KFF, 32 states expanded Medicaid by 2016. Most states expanded Medicaid in January 2014, with a handful of exceptions. Michigan's expansion (April) and New Hampshire's expansion (August) both took place during 2014. In addition, Pennsylvania, Indiana and Alaska expanded Medicaid in January, February, and September of 2015, respectively. Finally, Montana and Louisiana expanded Medicaid in January and July of 2016, respectively. We classify states as part of the Medicaid expansion treatment group beginning the month of their expansions.

Table 1 provides pretreatment means and standard deviations for our preventive care and risky health behavior-dependent variables, stratified into four groups based on whether the respondent's state expanded Medicaid and whether her local area's pretreatment uninsured rate was above or below the median within the sample.[7] Table A1 in Online Appendix does the same for our control variables. According to Table 1, 63 percent of respondents had a well-patient checkup in the past year,

[7] We were able to compare the mean baseline BRFSS values of the majority of our health behavior measures of interest with publically reported values from the CDC (NCHS 2017) as a check on their validity. Our measures were generally consistent with those compiled by the CDC which gives us confident that our results are not being driven by data collection idiosyncrasies associated with the BRFSS.

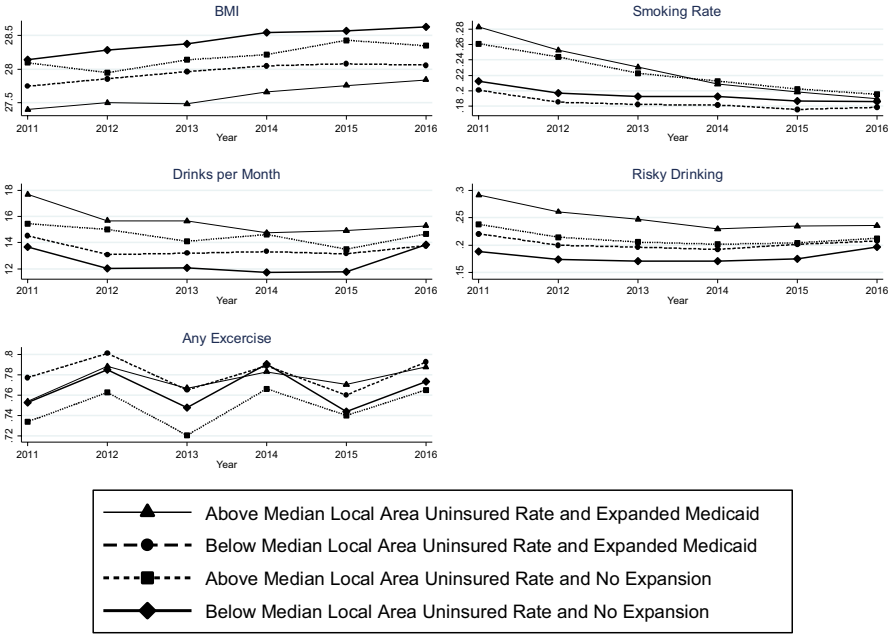

Fig. 2 Changes in risky health behavior variables over time by state Medicaid expansion status and local area pretreatment uninsured rate

32 percent had a flu shot, 56 percent had a pap test, 36 percent had a mammogram, and 44 percent have ever had an HIV test. All preventive care outcomes, with the exception of having a HIV test, had higher pretreatment rates in Medicaid expansions states, especially in states with below the median baseline uninsured rate. Our econometric strategy will account for these baseline differences.

In terms of risky health behaviors, the average BMI of the sample in the pretreatment period was 27.9, 22 percent were smokers, the sample average was almost 15 alcoholic drinks per month, and about 21 percent of the sample was engaged in risky drinking. Pretreatment smoking and binge drinking rates and the number of drinks per month were higher in states with baseline uninsured rates above the median, while BMI was higher among non-expansion states.

Figure 1 shows how the average values of the preventive care outcome variables change across the sample period for four groups stratified by state Medicaid expansion status and local area pretreatment uninsured rate (above or below the median). Well-patient doctor visits and flu shots were trending upward before the ACA's 2014 implementation, while Pap tests were declining and mammograms and HIV tests were relatively flat. Importantly, for all these outcomes the pretreatment trends appear relatively similar across the four groups, providing preliminary support for an identification strategy based on pretreatment uninsured rates and Medicaid expansion decisions. After the ACA took effect, we see some evidence of increases in some of these measures—most notably pap and HIV

Table 2 Effects of ACA on preventive care outcomes. (Pretreatment uninsured rate = 0.206)

	Checkup	Flu shot	Pap test	Mammogram	HIV test
Coefficient estimates of interest					
Post * pretreatment uninsured	0.136***	0.083	0.288*	0.095**	0.113***
	(0.039)	(0.079)	(0.118)	(0.030)	(0.034)
Medicaid expansion * post * pretreatment uninsured	0.051	0.008	−0.080	−0.022	−0.011
	(0.053)	(0.068)	(0.106)	(0.056)	(0.035)
Implied effects of ACA at mean pretreatment uninsured rate					
ACA without Medicaid expansion	0.028***	0.017	0.059*	0.020**	0.023**
	(0.008)	(0.016)	(0.024)	(0.006)	(0.007)
Medicaid expansion	0.011	0.002	−0.017	−0.005	−0.002
	(0.108)	(0.014)	(0.022)	(0.011)	(0.007)
Full ACA (with Medicaid expansion)	0.038***	0.019	0.043*	0.015	0.021*
	(0.011)	(0.013)	(0.019)	(0.011)	(0.008)
Pretreatment mean and standard deviation of outcome	0.639	0.335	0.515	0.350	0.447
	(0.483)	(0.472)	(0.499)	(0.477)	(0.497)
Sample size	1,577,507	1,497,214	441.224	443,970	1,446,305

SE, heteroscedasticity-robust and clustered by state, are in parentheses

*** Indicates statistically significant at 0.1% level; ** 1% level; * 5% level. BRFSS sampling weights are used. All regressions include state*location type and year*location type fixed effects as well as the controls

tests in 2015—but an econometric evaluation is necessary to determine whether these are causal effects of the law.

Figure 2 presents similar graphs for the risky behavior outcomes. Prior to the ACA's implementation, BMI was trending upward while smoking and drinking were trending downward and exercise did not exhibit a clear pattern. Again, pretreatment trends are broadly similar across the four groups. After the ACA, BMI and smoking appear to largely continue their pre-existing trends, while the downward trend in drinking disappears and actually turns positive for some groups.

Methods

We seek to estimate the effects of both the fully implemented ACA (including the Medicaid expansion) and the ACA without the Medicaid expansion for each outcome. The major challenge associated with this objective is in disentangling the impacts of the nationwide components of the ACA from underlying annual fluctuations in our outcomes of interest that would have occurred even in the absence of the ACA. In this paper we adopt the DDD strategy Courtemanche et al. (2017) use to identify the impact of the ACA on health insurance coverage after 1 year and that Courtemanche et al. (2018a) use to estimate the effect on access, risky health behaviors, and self-assessed health after 2 years. Such an approach exploits sub-state geographic variation in the intensity of treatment arising from differential pre-reform uninsured rates. Adding this layer of sub-state variation allows us to include time

period fixed effects while still identifying the effects of the national components of the ACA.

Assuming that a geographic area's treatment intensity is proportional to its baseline (2013) uninsured rate, our DDD model is given by Eq. (1):

$$y_{iast} = \gamma_0 + \gamma_1\left(UNINSURED_{as} * POST_t\right) + \gamma_2(MEDICAID_{st} * POST_t) + \gamma_3\left(UNINSURED_{as} * MEDICAID_{st} * POST_t\right) + \gamma_4 \boldsymbol{X_{iast}} + \theta_{at} + \alpha_{as} + \varepsilon_{iast} \quad (1)$$

where y_{iast} is a generic health behavior outcome described in Table 1 for individual i in area type a in state s in time period t, $POST_t$ is an indicator for whether period t is in the post-reform period of January 2014 or later, X_{iast} is a vector of control variables previously described in Table 2, $MEDICAID_{st}$ is an indicator for whether state s participated in the ACA's Medicaid expansion as of time (month/year) t, and $UNINSURED_{as}$ is the 2013 (pre-reform) uninsured rate in area type (central city, rest of MSA, non-MSA, cell phone) a within state s. Further, θ_{at} denotes time fixed effects for each month or year * area type combination; these control for time as flexibly as possible and also allow time trends to evolve differentially across individuals living in the four different constructed area types. Finally, α_{as} denotes fixed effects for each geographic area (for example, central city in Georgia), and ε_{iast} is a standard error term. Note that $POST_t$ is not separately included in Eq. (1) since it is absorbed by the time fixed effects (θ_{at}), while the terms $UNINSURED_{as} * MEDICAID_s$ are not separately included in Eq. (1) since they are absorbed by the area fixed effects (α_{as}).

The effect of the ACA on health behaviors without the Medicaid expansion is given by $\gamma_1 * UNINSURED_{as}$, which means it is assumed to be zero in a (hypothetical) area with a 0 percent uninsured rate at baseline and increases linearly as the pre-reform uninsured rate rises. The identifying assumption is that, in the absence of the ACA, any changes in health behaviors that would have occurred in 2014–2016 would not have varied differentially by area uninsured rates, conditional on the controls. We do *not* need to assume that there would have been no changes at all in health behaviors in the absence of the ACA (conditional on the controls), as would be the case in a pre–post-comparison that did not employ variation in pre-reform (2013) uninsured rates.

The effect of the Medicaid expansion alone on health behaviors is given by $\gamma_3 * UNINSURED_{as} * MEDICAID_s$. As with the other pieces of the ACA, this approach assumes that the impact of the Medicaid expansion varies linearly with the state's pre-reform (2013) uninsured rate. Following Miller (Miller 2012) and Courtemanche et al. (2017, 2018a), we consider γ_2 to represent unobserved confounders rather than capturing part of the expansion's causal effect, since the Medicaid expansion should not causally affect coverage in an area with a 0 percent baseline uninsured rate. The identifying assumption for the impact of the Medicaid expansion is therefore that, in the absence of the ACA, differential changes in health behaviors in 2014–2016 between Medicaid expansion and non-expansion states would not have been correlated with pre-reform uninsured rates. This is of course a weaker assumption than would be required by a DD model examining the impact of the Medicaid expansion on health behaviors.

Table 3 Effects of ACA on risky health behaviors. (Pretreatment uninsured rate = 0.206)

	BMI	Drinks per month	Risky drinking	Smoker	Any exercise
Coefficient estimates of interest					
Post * pretreatment uninsured	−0.236	1.766	0.076	−0.007	−0.003
	(0.393)	(2.378)	(0.028)	(0.042)	(0.050)
Medicaid expansion * post * pretreatment uninsured	0.011	1.463	0.006	0.033	0.038
	(0.494)	(2.153)	(0.003)	(0.032)	(0.051)
Implied effects of ACA at mean pretreatment uninsured rate					
ACA without Medicaid expansion	−0.049	0.363	0.016*	0.002	−0.001
	(0.081)	(0.489)	(0.006)	(0.009)	(0.010)
Medicaid expansion	0.002	0.301	0.001	0.007	0.008
	(0.101)	(0.442)	(0.007)	(0.007)	(0.011)
Full ACA (with Medicaid expansion)	−0.046	0.664	0.017*	0.008	0.007
	(0.086)	(0.496)	(0.007)	(0.007)	(0.006)
Pretreatment mean and standard deviation of outcome	27.977	14.203	0.215	0.205	0.772
	(6.384)	(36.379)	(0.410)	(0.404)	(0.419)
Sample size	1,503,710	1,510,877	1,502,567	1,547,824	1,532,577

See notes from Table 2

We also estimate several variants of Eq. (1) as robustness checks. First, since some control variables (for example income, education, marital status) could be endogenous to the ACA, we re-estimate our main regression including only the demographic controls age, gender, and race/ethnicity. The second and third checks involve two alternate ways to compute pretreatment uninsured rates: (1) pooling all three pretreatment years rather than just using 2013, and (2) simply using state-level estimates rather than defining sub-state areas based on the "area type" variable. For the fourth check, we drop respondents interviewed on cell phones since we do not know whether they live in a central city, suburban area, or rural area. Recall that we originally included them as a distinct sub-state group. Next, we drop 19–25 year olds since they were already partially treated by the ACA-dependent coverage expansion that took effect in 2010. In another check, we drop the five "early expansion" states that Kaestner et al. (2017) classify as having comprehensive Medicaid expansions under the ACA before 2014. Lastly, we drop the seven states who took up the Medicaid expansion after January 2014 (Courtemanche et al. 2017).

Results

Tables 2 and 3 report the results from the baseline DDD regression for the preventive care and risky health behavior outcomes, respectively. The results from the robustness checks are generally quite similar; they are available in Tables A2–A11 of Online Appendix. The top panel of each table presents the coefficient estimates and standard errors for the variables of interest, while the bottom panel gives the implied effects of the ACA with and without the Medicaid expansion at the average pretreatment uninsured rate of 0.206. Indicators of statistical significance are given at the 0.1 percent, 1 percent, and 5 percent level. Table A12 of Online Appendix reports all of the regression coefficients from our baseline regressions for each outcome.

The results from Table 2 show that the fully implemented ACA increased utilization of all the preventive care outcomes in non-Medicaid-expansion states, with the effects on checkups, pap tests, and HIV tests being statistically significant at the 5 percent level or better. The magnitudes of the increases are 3.8, 1.9, 4.3, 1.5, and 2.1 percentage points for checkups, flu shots, pap tests, mammograms, and HIV tests, respectively. To provide a benchmark, Courtemanche et al. (2018b) estimated that the full ACA increased health insurance coverage by 9.5 percentage points using the same BRFSS data and econometric model. If we assume that the ACA only affected preventive care via the extensive margin of health insurance coverage, the results therefore imply that between 17 and 50 percent of newly insured individuals increased their preventive care usage, depending on the outcome. Moreover, the estimated effects represent between 5 and 11 percent of the outcomes' sample means. For these reasons, we consider the magnitude of the increase in preventive care utilization to be economically meaningful. Interestingly, all the gains appear to be attributable to the private expansion component of the ACA (the package of reforms that took effect nationally), as opposed to the Medicaid expansion. The effects of the Medicaid expansion are statistically insignificant and relatively small for all outcomes. Moreover, the increase in mammograms actually becomes significant without the Medicaid expansion.

Turning to the risky health behavior outcomes in Table 3, we observe only one statistically significant effect of the full ACA: a 1.6 percentage point increase in the probability of being a risky drinker. This represents a sizeable 7.4 percent increase relative to the sample mean. Again, the effect is nearly completely driven by the private portion of the ACA rather than the Medicaid expansion. The point estimates for drinks per month, smoking, and exercise also point in the direction of worse health behaviors, while the reverse is true for BMI. However, the effects for these outcomes are all insignificant and much smaller in magnitude relative to the sample mean.

Event Study Model

We next estimate an event study model to trace out the ACA's impact by year. This serves two purposes. First, such an approach provides indirect tests of the identifying assumptions of our DDD model, as any "effects" of the ACA that emerge during the pretreatment period likely reflect placebo test failures. Second, the event study model also allows us to distinguish between the ACA's effects in each of the three post-treatment years, thereby specifically illustrating the importance of our addition of 2016 to the sample period. The event study model is given by the following equation, with 2013 being the base year:

$$\begin{aligned} y_{iast} = {} & \theta_0 + \theta_1\left(UNINSURED_{as} * Y2011_t\right) + \theta_2\left(UNINSURED_{as} * Y2012_t\right) \\ & + \theta_3\left(UNINSURED_{as} * Y2014_t\right) + \theta_4\left(UNINSURED_{as} * Y2015_t\right) \\ & + \theta_5\left(UNINSURED_{as} * Y2016_t\right) + \theta_6(MEDICAID_s * Y2011_t) \\ & + \theta_7(MEDICAID_s * Y2012_t) + \theta_8(MEDICAID_s * Y2014_t) \\ & + \theta_9(MEDICAID_s * Y2015_t) + \theta_{10}(MEDICAID_s * Y2016_t) \\ & + \theta_{11}\left(UNINSURED_{as} * MEDICAID_s * Y2011_t\right) \\ & + \theta_{12}\left(UNINSURED_{as} * MEDICAID_s * Y2012_t\right) \\ & + \theta_{13}\left(UNINSURED_{as} * MEDICAID_s * Y2014_t\right) \\ & + \theta_{14}\left(UNINSURED_{as} * MEDICAID_s * Y2015_t\right) \\ & + \theta_{15}\left(UNINSURED_{as} * MEDICAID_s * Y2016_t\right) \\ & + \boldsymbol{\theta}_{16}\boldsymbol{X}_{\boldsymbol{iast}} + \alpha_{as} + \varepsilon_{iast} \end{aligned} \tag{2}$$

where $Y2011_t$, $Y2012_t$, $Y2014_t$, $Y2015_t$, and $Y2016_t$ are indicators for each year and the other variables are defined as in Eq. (1). The tests for differential pretreatment trends (that is, falsification tests) are provided by evaluating whether the coefficients on the "treatment" variables in the pretreatment years (θ_1, θ_2, θ_{11}, θ_{12}) are equal to 0.[8]

[8] Recall that the coefficient on the $MEDICAID_s * POST_t$ variable in our main regression was assumed to capture unobserved confounders rather than part of the causal effect of the Medicaid expansion. We therefore do not consider θ_6 and θ_7 to provide additional falsification tests and do not show the estimates for these coefficients in the tables.

Table 4 Event study regressions for preventive care outcomes

	Checkup	Flu shot	Pap test	Mammogram	HIV test
Coefficient estimates of interest					
2011 * pretreatment uninsured	−0.297** (0.089)	0.128 (0.066)	−0.063 (0.076)	0.103 (0.059)	−0.055 (0.050)
2012 * pretreatment uninsured	−0.178** (0.065)	0.055 (0.046)	–	–	0.050 (0.039)
2014 * pretreatment uninsured	−0.029 (0.050)	0.029 (0.094)	0.192* (0.087)	0.067 (0.040)	0.056 (0.077)
2015 * pretreatment uninsured	−0.041 (0.092)	0.209 (0.163)	–	–	0.176* (0.069)
2016 * pretreatment uninsured	0.092 (0.083)	0.177 (0.089)	0.237 (0.181)	0.055 (0.053)	0.154 (0.075)
Medicaid expansion * 2011 * pretreatment uninsured	0.105 (0.080)	−0.039 (0.052)	0.011 (0.117)	0.037 (0.077)	−0.110 (0.056)
Medicaid expansion * 2012 * pretreatment uninsured	0.036 (0.052)	0.076 (0.063)	–	–	−0.159* (0.058)
Medicaid expansion * 2014 * pretreatment Uninsured	0.061 (0.58)	0.156 (0.63)	0.111 (0.116)	0.053 (0.068)	−0.084 (0.077)
Medicaid expansion * 2015 * pretreatment uninsured	0.091 (0.080)	−0.037 (0126)	–	–	−0.117 (0.084)
Medicaid expansion * 2016 * pretreatment uninsured	0.033 (0.086)	−0.042 (0.090)	−0.084 (0.154)	0.029 (0.063)	−0.156** (0.053)
Implied effects of ACA at mean pretreatment uninsured rate					
ACA without Medicaid expansion in 2014	−0.006 (0.010)	0.006 (0.019)	0.040* (0.018)	0.014 (0.008)	0.012 (0.016)
ACA without Medicaid expansion in 2015	0.008 (0.019)	0.043 (0.034)	–	–	0.036* (0.014)
ACA without Medicaid expansion in 2016	0.019 (0.017)	0.036 (0.018)	0.049 (0.037)	0.011 (0.011)	0.032* (0.015)
Full ACA (with Medicaid expansion) in 2014	0.007 (0.011)	0.038* (0.016)	0.062*** (0.017)	0.025* (0.012)	−0.006 (0.014)
Full ACA (with Medicaid expansion) in 2015	0.010 (0.012)	0.036 (0.022)	N/A	N/A	0.012 (0.012)
Full ACA (with Medicaid expansion) in 2016	0.026 (0.016)	0.028 (0.023)	0.031 (0.025)	0.018 (0.010)	−0.001 (0.011)

See notes from Table 2

Table 4 presents the event study results for the preventive care outcomes, and Table 5 does the same for the risky health behavior outcomes. Note that the pap test and mammogram variables are not available in 2013 and 2015, so 2012 is the base year for those outcomes while no effect is reported in 2015. There are a total of 36 falsification tests (four pretreatment interaction terms for each of the eight outcomes with no missing years plus two for each of the two remaining outcomes). We obtain four falsification test failures, or eleven percent, which is reasonably close to the five percent that would expected due to chance, albeit somewhat larger. Two of the four failures are for the checkup variable, meaning that for the other outcomes

Table 5 Event study regressions for risky health behaviors

	BMI	Drinks per month	Risky drinking	Smoker	Any exercise
Coefficient estimates of interest					
2011 * pretreatment uninsured	0.933	−6.064	−0.045	0.074	0.091
	(0.704)	(3.222)	(0.042)	(0.037)	(0.053)
2012 * pretreatment uninsured	−0.869	−0.220	−0.121**	0.044	−0.034
	(0.651)	(4.892)	(0.038)	(0.047)	(0.101)
2014 * pretreatment uninsured	−0.703	7.779	0.017	0.013	0.001
	(0.714)	(3.921)	(0.034)	(0.052)	(0.051)
2015 * pretreatment uninsured	−0.556	−3.183	0.060	0.064	0.064
	(0.637)	(2.885)	(0.050)	(0.034)	(0.045)
2016 * pretreatment uninsured	−0.358	−6.438	−0.031	0.087*	−0.032
	(0.569)	(3.748)	(0.037)	(0.039)	(0.107)
Medicaid expansion * 2011 * pretreatment uninsured	−0.049	2.131	−0.005	−0.083	−0.084
	(0.814)	(5.242)	(0.057)	(0.042)	(0.065)
Medicaid expansion * 2012 * pretreatment uninsured	1.880*	−6.846	0.015	−0.097	−0.093
	(0.793)	(6.174)	(0.046)	(0.054)	(0.109)
Medicaid expansion * 2014 * pretreatment uninsured	0.856	−7.236	0.016	0.019	0.012
	(0.887)	(4.284)	(0.039)	(0.049)	(0.049)
Medicaid expansion * 2015 * pretreatment uninsured	1.252	3.307	−0.040	−0.052	−0.003
	(0.730)	(4.064)	(0.050)	(0.037)	(0.057)
Medicaid expansion * 2016 * pretreatment uninsured	1.234	5.796	0.056	−0.071	−0.098
	(0.906)	(3.968)	(0.052	(0.044)	(0.082)
Implied effects of ACA at mean pretreatment uninsured rate					
ACA without Medicaid expansion in 2014	−0.145	1.600	0.003	0.003	0.001
	(0.015)	(0.806)	(0.007)	(0.010)	(0.012)
ACA without Medicaid expansion in 2015	−0.114	−0.655	0.013	0.013	0.013
	(0.131)	(0.594)	(0.010)	(0.007)	(0.009)
ACA without Medicaid expansion in 2016	−0.074	−1.324	−0.006	0.018*	−0.006
	(0.117)	(0.771)	(0.008)	(0.008)	(0.022)

Table 5 (continued)

	BMI	Drinks per month	Risky drinking	Smoker	Any exercise
Full ACA (with Medicaid expansion) in 2014	0.032 (0.123)	−0.112 (0.809)	0.007 (0.010)	0.007 (0.010)	0.003 (0.010)
Full ACA (with Medicaid expansion) in 2015	0.143 (0.173)	0.026 (1.026)	0.005 (0.010)	0.003 (0.007)	0.013 (0.010)
Full ACA (with Medicaid expansion) in 2016	0.180 (0.137)	−0.132 (0.661)	0.005 (0.013)	0.003 (0.009)	−0.027* (0.011)

See notes from Table 2

Table 6 Income below median subsample. (Pretreatment uninsured rate = 0.320)

Preventive care outcomes:	Checkup	Flu shot	Pap test	Mammogram	HIV test
ACA w/o Medicaid	0.045**	0.021	0.073	0.043***	0.038***
	(0.017)	(0.019)	(0.050)	(0.011)	(0.011)
Medicaid expansion	−0.001	9.006	−0.036	−0.001	−0.022
	(0.018)	(0.020)	(0.039)	(0.018)	(0.015)
Full ACA (w/Medicaid)	0.045**	0.027	0.037	0.042*	0.016
	(0.016)	(0.017)	(0.035)	(0.017)	(0.015)
Pretreatment mean and SD	0.581	0.282	0.523	0.290	0.475
	(0.493)	(0.450)	(0.499)	(0.454)	(0.499)
Sample size	796,268	748,471	230,937	232,567	722,738
Risky health behavior outcomes:	BMI	Drinks per month	Risky drinking	Smoker	Any exercise
ACA w/o Medicaid	−0.080	0.894	0.021	−0.007	−0.003
	(0.118)	(0.795)	(0.011)	(0.014)	(0.014)
Medicaid expansion	0.006	−0.900	−0.012	0.012	0.020
	(0.175)	(0.682)	(0.012)	(0.012)	(0.017)
Full ACA (w/Medicaid)	−0.074	−0.007	0.008	0.005	0.017
	(0.138)	(0.760)	(0.011)	(0.008)	(0.012)
Pretreatment mean and SD	28.344	12.507	0.196	0.276	0.709
	(6.766)	(37.676)	(0.397)	(0.447)	(0.454)
Sample size	752,253	756,077	750,961	779,208	769,377

See notes from Table 2

the falsification tests only fail six percent of the time. One way to interpret these results is therefore that the estimated increase in well-patient checkups should be treated with caution, but that the DDD model performs quite well for the other outcomes.

The coefficient estimates on the treatment variables in the post-reform years provide a few new insights. First, new evidence of ex ante moral hazard emerges in the third post-treatment year: a statistically significant increase in smoking (1.8 percentage points) among those in non-expansion states in 2016 and a statistically significant decrease in exercise (2.7 percentage points) in Medicaid expansion states. These findings were masked in the aggregate post-reform results reported in Table 3 and were also not found by either of the prior studies that used only two post-treatment years. Second, we observe some evidence that the gains in preventive care diminish over time. The full ACA increased flu shots, pap tests, and mammograms by 3.8, 6.2, and 2.5 percentage points, respectively, in the first year after the ACA took effect, and all of these effects are statistically significant. In contrast, by 2016 these magnitudes had fallen to 2.8, 3.1, and 1.8 percentage points, none of which are statistically significant. If taken at face value, these results are consistent with pent-up demand driving some of the increase in 2014. However, the estimates from 2014 and 2016 are not statistically different, so we are reluctant to emphasize such an interpretation. Moreover, the results for HIV

Table 7 Income above median subsample. (Pretreatment uninsured rate = 0.064)

Preventive care outcomes:	Checkup	Flu shot	Pap test	Mammogram	HIV test
ACA w/o Medicaid	0.007 (0.007)	0.015 (0.012)	0.020* (0.008)	−0.001 (0.012)	0.010 (0.009)
Medicaid expansion	0.010 (0.012)	0.001 (0.011)	0.019 (0.012)	−0.014 (0.012)	−0.010 (0.007)
Full ACA (w/Medicaid)	0.016 (0.010)	0.017 (0.009)	0.038** (0.013)	−0.014 (0.010)	−0.001 (0.009)
Pretreatment mean and SD	0.684 (0.465)	0.378 (0.484)	0.610 (0.487)	0.464 (0.499)	0.41 (0.491)
Sample size	781,239	748,743	210,287	211,403	723,567
Risky health behavior outcomes:	BMI	Drinks per month	Risky drinking	Smoker	Any exercise
ACA w/o Medicaid	−0.026 (0.070)	−0.275 (0.447)	0.006 (0.006)	0.007 (0.004)	0.001 (0.011)
Medicaid expansion	0.066 (0.096)	0.822 (0.412)	0.010 (0.007)	0.010* (0.005)	−0.001 (0.010)
Full ACA (w/Medicaid)	0.040 (0.099)	0.547 (0.470)	0.016 (0.008)	0.017** (0.006)	−0.001 (0.005)
Pretreatment mean and SD	27.289 (5.580)	16,474 (33.297)	0.244 (0.423)	0.141 (0.348)	0.842 (0.365)
Sample size	751,457	754,800	751,606	768,616	763,200

See notes from Table 2

tests do not fit this pattern, as the effects (at least in non-expansion states) are stronger in 2016 and 2015 than in 2014.

Subsample Analyses

We next conduct subsample analyses that stratify the sample by income and age. We expect the ACA's impacts to be most pronounced among young adults and individuals of low socioeconomic status, as these groups experienced the largest insurance coverage gains from the ACA (Courtemanche et al. 2018c). Specifically, we re-estimate Eq. (1) for four subsamples: those with household incomes above and below the sample median, and those with age above and below the sample median. For each subsample, we re-compute the relevant pretreatment uninsured rate based on only the respondents in that particular subsample. The need to retain a sufficient number of individuals in each local area in each subsample to compute reliable pretreatment uninsured rates is why we only stratify into two broad categories along each dimension.

Table 6 reports the results for the low-income subsample, while Table 7 does the same for the high income subsample. For the preventive care outcomes, the effects appear largely concentrated among those with incomes below the median. The impacts of the private portion of the ACA on checkups, mammograms, and

Table 8 Age below median (19–48) subsample. (Pretreatment uninsured rate = 0.236)

Preventive care outcomes:	Checkup	Flu shot	Pap test	Mammogram	HIV test
ACA w/o Medicaid	0.020*	0.006	0.064**	0.011	0.021**
	(0.010)	(0.018)	(0.023)	(0.012)	(0.006)
Medicaid expansion	0.021	0.011	−0.015	0.004	0.018
	(0.012)	(0.020)	(0.029)	(0.016)	(0.009)
Full ACA (w/Medicaid)	0.041***	0.017	0.049*	0.015	0.038***
	(0.011)	(0.014)	(0.024)	(0.013)	(0.009)
Pretreatment mean and SD	0.577	0.281	0.596	0.221	0.515
	(0.494)	(0.449)	(0.491)	(0.415)	(0.500)
Sample size	779,427	732,916	212,543	213,531	710,785
Risky health behavior outcomes:	BMI	Drinks per month	Risky drinking	Smoker	Any exercise
ACA w/o Medicaid	−0.070	0.599	0.017*	0.002	0.008
	(0.108)	(0.734)	(0.008)	(0.011)	(0.012)
Medicaid expansion	−0.013	−0.218	0.002	0.012	0.001
	(0.152)	(0.696)	(0.009)	(0.011)	(0.014)
Full ACA (w/Medicaid)	−0.083	0.381	0.018	0.015	0.008
	(0.127)	(0.747)	(0.009)	(0.008)	(0.008)
Pretreatment mean and SD	27.489	15.194	0.256	0.225	0.787
	(6.273)	(37.965)	(0.436)	(0.417)	(0.409)
Sample size	736,688	742,330	737,948	763,051	753,292

See notes from Table 2

HIV tests are statistically significant for the low-income subsample, and the magnitudes are larger than those from the full sample reported in Table 2. In contrast, we observe statistically insignificant and relatively small effects on these outcomes among those above the median income, and the signs are mixed. The only exception to this pattern is that the magnitude of the effect of the full ACA on pap tests is almost identical in the two subsamples, and is only significant among those with higher incomes since the standard error is much smaller for that group. Turning to the risky behavior outcomes, ex ante moral hazard appears more prevalent among the high income subsample. As shown in the bottom panel of Table 7, for this subsample the estimated effects of the full ACA are in the direction of less healthy behaviors for all outcomes. The only result that is statistically significant at the 5 percent level or better is the estimated increase in smoking, while the rise in risky drinking is significant at the 10 percent level. Though statistically insignificant, the estimated increase in drinks per month is economically meaningful at 3.3 percent of the sample mean. Among the low-income subsample, the pattern of signs is more mixed, with the full ACA leading to healthier behaviors for three outcomes and less healthy behaviors for two, and none of these estimates are statistically significant or especially large.[9]

[9] The BRFSS only reports income in ranges (for example $15,000 to $19,999), so we assign each respondent a value of income equal to the midpoint of the associated category when doing the stratification. Since this leads to measurement error, we also tried assessing heterogeneity in impacts by soci-

Table 9 Age above median (49–64) subsample. (Pretreatment uninsured rate = 0.155)

Preventive care outcomes:	Checkup	Flu shot	Pap test	Mammogram	HIV test
ACA w/o Medicaid	0.042*** (0.012)	0.037* (0.015)	0.045 (0.026)	0.038* (0.015)	0.026* (0.010)
Medicaid expansion	−0.001 (0.016)	−0.020 (0.013)	−0.025 (0.026)	−0.001 (0.017)	−0.026* (0.011)
Full ACA (w/Medicaid)	0.041*** 0.010)	0.017 (0.012)	0.020 (0.023)	0.037** (0.012)	0.001 (0.011)
Pretreatment mean and SD	0.717 (0.451)	0.406 (0.491)	0.497 (0.500)	0.612 (0.487)	0.315 (0.464)
Sample size	798,080	764,298	228,681	230,439	735,520
Risky health behavior outcomes:	BMI	Drinks per month	Risky drinking	Smoker	Any exercise
ACA w/o Medicaid	−0.118 (0.109)	0.267 (0.582)	0.007 (0.004)	−0.005 (0.005)	−0.015 (0.009)
Medicaid expansion	0.166 (0.151)	1.144 (0.711)	0.007 (0.007)	−0.005 (0.006)	0.011 (0.012)
Full ACA (w/Medicaid)	0.048 (0.117)	1.412* (0.586)	0.014 (0.008)	−0.010 (0.006)	−0.004 (0.009)
Pretreatment mean and SD	28.635 (6.235)	12.640 (31.553)	0.149 (0.356)	0.201 (0.400)	0.733 (442)
Sample size	767,022	768,547	764,619	784,773	779,285

See notes from Table 2

Tables 8 and 9 report the results for the age subsamples. For preventive care, we see that the estimated effects of the full ACA are consistently positive across all outcomes in both subsamples. While the impact on checkups is an identical 4.1 percentage points for both groups, the increases in pap and HIV tests are only statistically significant in the younger subsample, and they are much larger than the corresponding increases in the older subsample (4.9 and 3.8 percentage points compared to 2.0 and 0.1 percentage points). In contrast, the gain in mammograms is concentrated among the older subsample, consistent with them being more commonly recommended for that age group. For risky behaviors, the patterns are mixed, and the only estimates significant at the 5 percent level are an increase in drinks per month from the fully implemented ACA for the older subsample and an increase in risky drinking from the private portion of the ACA for the younger subsample.

Footnote 9 (continued)
oeconomic status by stratifying by education level. These results are available upon request. Because the differences across subsamples were less clear stratifying by education than income, we decided to report the income subsamples only in the body of this paper. In other words, our results suggest that BRFSS income, despite its measurement error, is a better proxy for actual income that education. In part, this could be because for younger adults—who were disproportionately affected by the ACA's insurance gains—current education is not the same as completed education.

Table 10 Age 65 and older

Preventive care outcomes:	Checkup	Flu shot	Pap test	Mammogram	HIV test
ACA w/o Medicaid	0.003 (0.004)	0.004 (0.010)	0.006 (0.012)	0.003 (0.009)	0.008* (0.004)
Medicaid expansion	0.004 (0.004)	0.001 (0.010)	−0.002 (0.010)	0.004 (0.013)	−0.020** (0.007)
Full ACA (w/MEDICAID)	0.007* (0.003)	0.005 (0.007)	0.004 (0.007)	0.007 (0.013)	−0.012* (0.006)
Pretreatment mean and SD	0.858 (0.349)	0.605 (0.489)	0.270 (0.444)	0.626 (0.484)	0.123 (0.329)
Sample size	731,224	700,828	219,203	255,172	655,332
Risky health behavior outcomes:	BMI	Drinks per month	Risky drinking	Smoker	Any exercise
ACA w/o Medicaid	0.096 (0.083)	−0.345 (0.322)	−0.004 (0.004)	−0.005 (0.003)	0.009 (0.006)
Medicaid expansion	−0.038 (0.074)	−0.103 (0.281)	−0.001 (0.004)	0.005 (0.004)	−0.006 (0.007)
Full ACA (w/Medicaid)	0.058 (0.031)	−0.448 (0.395)	−0.004 (0.002)	−0.001 (0.003)	0.003 (0.004)
Pretreatment mean and SD	27.546 (5.394)	9.647 (27.100)	0.069 (0.253)	0.091 (0.288)	0.685 (0.465)
Sample size	711,120	704,029	701,088	718,118	714,310

See notes from Table 2. Also, since the pretreatment uninsured rate for those 65 and older is very small because of Medicare, we evaluate the effects at the non-elderly pretreatment uninsured rate of 0.206

Table 11 Difference-in-difference results for childless adults below poverty line

Preventive care outcomes:	Checkup	Flu shot	Pap test	Mammogram	HIV test
Medicaid expansion	0.035 (0.026)	−0.006 (0.018)	−0.012 (0.030)	0.013 (0.018)	−0.011 (0.016)
Pretreatment mean and SD	0.625 (0.484)	0.323 (0.467)	0.347 (0.479)	0.357 (0.479)	0.387 (0.487)
Sample size	110,021	103,093	32,765	33,432	98,196
Risky health behavior outcomes:	BMI	Drinks per month	Risky drinking	Smoker	Any exercise
Medicaid expansion	0.213 (0.182)	−1.980 (1.754)	−0.008 (0.015)	−0.008 (0.013)	0.024 (0.019)
Pretreatment mean and SD	28.163 (7.303)	11.445 (41.510)	0.160 (0.367)	0.304 (0.460)	0.641 (0.480)
Sample size	104,908	103,886	103,097	107,512	106,199

See notes for Table 2

In an additional set of regressions, we also examined the impacts of the ACA on those aged 65 and above as a falsification test. This is because those aged 65 and above should not have been directly impacted by the ACA, as they were already

covered by Medicare. The results, reported in Table 10, were generally both statistically and economically insignificant, as expected.

Difference-in-Difference Analysis for Medicaid Expansion

In the above DDD analyses, we repeatedly find little to no evidence of effects of the Medicaid expansion on the various outcomes. While this could indicate genuine null effects, it is also possible that the DDD model is poorly suited to identify plausibly sized effects of the Medicaid expansion. The DDD estimator for the triple interaction term is inherently less efficient than the simpler DD estimator used by most evaluations of the ACA's Medicaid expansion. Additionally, as discussed in the previous section, it is impractical to estimate our DDD model with narrowly defined subsamples because of the need to retain a sufficient number of individuals to compute pretreatment uninsured rates in each local area for each subsample. As such, it may be difficult to identify the effects of a narrowly targeted intervention such as the Medicaid expansion, which primarily focused on low-income childless adults.

For these reasons, we close our empirical analysis by estimating a DD model with the sample restricted to adults with household income below 100 percent of the Federal Poverty Level (FPL) and no children in the home. The first restriction prevents confounding from the ACA's expansion of private coverage, since those with incomes below 100 percent of the FPL were prohibited from purchasing subsidized insurance on the Marketplace. The second restriction minimizes the share of the sample that was eligible for Medicaid prior to the ACA, since eligibility criteria were more generous for adults with children in most states. By estimating a DD model with BRFSS data and a low-income subsample, our approach mirrors that of Simon et al. (2017), with the key difference being our inclusion of the third post-treatment year. Specifically, the DD model is identical to Eq. (1) but drops the $UNINSURED_{as} * MEDICAID_s * POST_t$ term. Results from regressions that further drop the $UNINSURED_{as} * POST_t$ term are virtually identical and are available upon request.

Table 11 reports the results. Even in the less rigorous DD model with a sample narrowly restricted to the individuals most likely to benefit from the Medicaid expansion, we find no statistically significant effects on any of the ten outcomes in either direction. The magnitudes are all relatively small, at least compared to the 9.8 percentage point increase in insurance coverage estimated using the same sample and DD method. Additionally, the signs are mixed, with six pointing in a favorable direction (greater preventive care use, healthier lifestyle habits) and four in an unfavorable direction.[10] Therefore, the null results for the Medicaid expansion observed

[10] In a paper released after ours, Cawley et al. (2018) found similar results to the ones described in Table 11 using the same DD approach, dataset, population, and slightly longer pre-treatment period of analysis (their period of analysis covers 2010–2016). Cawley et al. (2018) find that among low-income childless adults the Medicaid expansion had small and not statistically significant effects on 9 out of the 10 outcomes examined in Table 11, the only exception being probability of ever having an HIV test. For this outcome, Cawley et al. (2018) find that the Medicaid expansion increased the probability of ever

throughout the paper do not appear to simply be due to limitations of the DDD design.

Discussion

This paper estimates the effects of the ACA on the health behaviors of non-elderly adults after 3 years. We consider two distinct types of outcomes: positive health investments in the form of preventive services and disinvestments in the form of risky behaviors. Both types of behaviors could theoretically be influenced by both the reduction in effective prices of medical services after obtaining insurance coverage and ex ante moral hazard from the expectation of lower out-of-pocket costs in the future if a preventable illness occurs. Using data from the BRFSS and an identification strategy that leverages variation in pre-ACA uninsured rates and state Medicaid expansion decisions, we find some evidence to support both of these hypotheses. The ACA increased preventive care along several dimensions, including well-patient checkups, pap tests, mammograms, and HIV tests. This is consistent with the direct price effect dominating ex ante moral hazard for preventive services, which makes sense since these services are purchased directly in the medical sector. In contrast, while certain medical treatments can help individuals make healthier lifestyle choices, the prices of food, gym memberships, alcohol, and cigarettes are not directly influenced by health insurance. Perhaps for this reason, we find that ex ante moral hazard dominates for at least some risky behaviors, while other behaviors do not seem to be influenced by insurance in either direction.

An interesting aspect of our results is that we consistently find that any observed effects are attributable to the "private portion" of the ACA—the package of national reforms including regulations in the non-group insurance market, mandates, and subsidized health insurance exchanges—as opposed to the Medicaid expansion. This echoes the findings of Courtemanche et al. (2018a, b) that improvements in access to care and self-assessed health from the ACA are driven mostly by the private expansion. One possible explanation is that Medicaid historically pays providers much less than private insurers, which can lead to difficulty finding a primary care doctor or specialist.[11] Since the medical services under consideration in this paper—screenings, vaccines, counseling services, and prescriptions for weight loss or smoking cessation drugs—are generally administered in office-based settings, this could potentially help explain Medicaid's null effects.

However, other factors argue against this explanation. Medicaid increased its payment rates to match those of Medicare in 2013 and 2014, with only a few states

Footnote 10 (continued)
having an HIV test by 2.5 percentage points (whereas we find an insignificant reduction of 1.1 percentage points).

[11] See, for instance, https://health.usnews.com/health-news/health-insurance/articles/2015/05/26/youve-got-medicaid-why-cant-you-see-the-doctor.

maintaining the full fee bump thereafter.[12] Polsky et al. (2015) show that the Medicaid fee bump improved availability of primary care appointments for enrollees. This implies that, if provider payment rates are the issue, we should have found a positive of effect of Medicaid expansion on preventive care in 2014 followed by a reduction in 2015, rather than null effects across all years. Moreover, results from the randomized Oregon Medicaid experiment indicate that Medicaid increased use of preventive services, even without the fee bump (Finkelstein et al. 2012; Baicker et al. 2013). In sum, it is difficult to say more at this stage beyond simply that Medicaid's effects may vary by context, which could include both demand-side factors such as the demographic characteristics of newly covered individuals or supply-side factors such as supply of health-care providers. Additionally, a Medicaid expansion could conceivably be less effective when it occurs alongside an expansion of private coverage (such as Marketplace coverage), as the expansion of private coverage places additional strain on provider capacity.[13]

Another noteworthy result is that, while the majority of our results for risky behaviors are statistically insignificant, we find relatively robust evidence that the ACA increased risky drinking. It is possible that a single result could emerge by chance given the large number of hypotheses tested in our paper,[14] but it is also possible that ex ante moral hazard could be especially pronounced in the case of risky drinking. One argument for why ex ante moral hazard has not been found more frequently in the literature is that diseases from many risky behaviors, such as cancer or heart disease from smoking or obesity, often occur far into the future. Individuals may assume that even if they are currently uninsured, they will be insured (perhaps by Medicare or a future job) by time those illnesses occur (Barbaresco et al. 2015). In contrast, excessive drinking can lead to the need for expensive medical care immediately, such as an ambulance ride and hospitalization due to acute alcohol poisoning.

Our work is subject to several limitations, including general concerns about the extent to which the self-reported outcomes we examine accurately measure the behavior of BRFSS respondents. That being said, subjective self-reported health

[12] See https://www.advisory.com/daily-briefing/2015/04/23/states-to-continue-medicaid-pay-bump.

[13] Unpacking the impact of the various sub-components of the private portion of the ACA is challenging due to their simultaneous implementation. Hinde (2017) examines the effectiveness of the Marketplace tax credits and cost-sharing subsidies. Frean et al. (2017) found very little impact of the individual mandate's exemptions and penalties on coverage rates. This suggests that it is not the individual mandate, but rather regulated and subsidized marketplace coverage driving our results. The introduction of subsidized Marketplace plans led to gains in coverage and that, along with regulations requiring no cost sharing for preventive services, led to increases in preventive care utilization. Future work should employ other data sources to more closely examine the impact of the ACA on health care utilization in general.

[14] Following arguments made in other studies that looked at a similar number of outcomes, such as Barbaresco et al. (2015), we do not implement formal methods for multiple hypothesis testing because, while these control the Type I error rate, they do so at the expense of a large increase in the Type II error rate. While we cannot rule out the possibility of an occasional spurious result given the number of hypotheses tested, it is worth noting that we obtain many more statistically significant results than would be expected due to chance. For instance, in Tables 2 and 3, which contain our baseline results, we report twenty coefficient estimates. Five are significant at the 5 percent level, whereas only one would be expected to be significant by chance.

variables have been shown to be correlated with objective measures of health, such as mortality (Idler and Benyamini 1997; DeSalvo et al. 2006; Phillips et al. 2010). In our particular context, one may be additionally concerned that gains in coverage led to gains in knowledge about health status and behaviors through increased interaction with health-care providers and that this led to changes in reporting rather than actual changes in behavior.

In closing, while our research offers important new information about the effects of the ACA over a longer time frame than most prior studies, our results nonetheless provide only one piece of a much larger puzzle. Any comprehensive evaluation of the ACA would have to take into account effects on a wide range of other outcomes, including overall health, financial protection, health-care expenditures, fiscal costs, employment, and wages. We contribute to this broader debate by providing new evidence that the ACA increased utilization of preventive services but led to less healthy lifestyles along at least some dimensions.

References

Baicker, Katherine, Taubman Sarah, Allen Heidi, Bernstein Mira, Gruber Jonathan, Joseph P. Newhouse, Eric C. Schneider, Bill J. Wright, Alan M. Zaslavsky, Amy N. Finkelstein, and Oregon Health Study Group. 2013. The Oregon experiment: Effects of Medicaid on clinical outcomes. *New England Journal of Medicine* 368 (18): 1713–1722.

Barbaresco, Silvia, Charles Courtemanche, and Yanling Qi. 2015. Impacts of the Affordable Care Act dependent coverage provision on health-related outcomes of young adults. *Journal of Health Economics* 40: 54–68.

Brook, Robert H., John E. Ware Jr., Wiliam H. Rogers, Emmet B. Keeler, Allyson R. Davies, Cathy A. Donald, George A. Goldberg, Kathleen N. Lohr, Patricia C. Masthay, and Joseph P. Newhouse. 1983. Does free care improve adults' health? Results from a randomized controlled trial. *New England Journal of Medicine* 309 (23): 1426–1434.

Cawley, John, and Christopher Ruhm. 2011. The economics of risky health behaviors. In *Handbook of health economics 2*, ed. Thomas G. McGuire, Mark V. Pauly, and Pedro P. Barros, 95–199. New York: Elsevier.

Cawley, John, Soni Aparna, and Simon Kosali. 2018. Third year of survey data shows continuing benefits of Medicaid expansions for low-income childless adults in the U.S. *Journal of General Internal Medicine* 33 (9): 1495–1497.

Card, David, Carlos Dobkin, and Nicole Maestas. 2008. The impact of nearly universal insurance coverage on health care utilization: Evidence from medicare. *American Economic Review* 98 (5): 2242–2258.

Cotti, Chad D., Erik Nesson, and Nathan Tefft. 2018. Impacts of the ACA Medicaid expansion on health behaviors: Evidence from household panel data. Available at SSRN: https://ssrn.com/abstract=2989323.

Courtemanche, Charles, and Daniela Zapata. 2014. Does universal coverage improve health? The Massachusetts experience. *Journal of Policy Analysis and Management* 33 (1): 36–69.

Courtemanche, Charles, James Marton, and Aaron Yelowitz. 2016. Who gained insurance coverage in 2014, the first year of full ACA implementation? *Health Economics* 25: 778–784.

Courtemanche, Charles, James Marton, Benjamin Ukert, Aaron Yelowitz, and Daniela Zapata. 2017. Early impacts of the Affordable Care Act on health insurance coverage in Medicaid expansion and non-expansion states. *Journal of Policy Analysis and Management* 36 (1): 178–210.

Courtemanche, Charles, James Marton, Benjamin Ukert, Aaron Yelowitz, and Daniela Zapata. 2018a. Early effects of the Affordable Care Act on health care access, risky health behaviors, and self-assessed health. *Southern Economic Journal* 84 (3): 660–691.

Courtemanche, Charles, James Marton, Benjamin Ukert, Aaron Yelowitz, and Daniela Zapata. 2018. Effects of the Affordable Care Act on health care access and self-assessed health after three years. Working paper, Georgia State University.

Courtemanche, Charles, James Marton, Benjamin Ukert, Aaron Yelowitz, and Daniela Zapata. 2018. The three-year impact of the ACA on disparities in insurance coverage. Working paper, Georgia State University.

Courtemanche, Charles, Joshua Pinkston, and Jay Stewart. 2015. Adjusting body mass for measurement error with invalid validation data. *Economics and Human Biology* 19: 275–293.

Currie, Janet, and Jonathan Gruber. 1996. health insurance eligibility, utilization of medical care, and child health. *Quarterly Journal of Economics* 111: 431–466.

Danaei, Goodarz, Eric L. Ding, Dariush Mozaffarian, Ben Taylor, Jürgen Rehm, Christopher J.L. Murray, and Majid Ezzati. 2009. The preventable causes of death in the United States: Comparative risk assessment of dietary, lifestyle, and metabolic risk factors. *PLoS Medicine* 6 (4): e1000058.

Dave, Dhaval, and Robert Kaestner. 2009. Health insurance and Ex ante moral hazard: Evidence from medicare. *International Journal of Health Care Finance and Economics* 9 (4): 367–390.

Dave, Dhaval M., Robert Kaestner, and George L. Wehby. 2015. Does Medicaid Coverage for Pregnant Women Affect Prenatal Health Behaviors? NBER Working Paper 21049.

DeSalvo, Karen B., Nicole Bloser, Kristi Reynolds, Jiang He, and Paul Muntner. 2006. Mortality prediction with a single general self-rated health question. *Journal of General Internal Medicine* 21 (3): 267–275.

Finkelstein, Amy, Taubman Sarah, Wright Bill, Bernstein Mira, Gruber Jonathan, Joseph P. Newhouse, Baicker Katherine, and Oregon Health Study Group. 2012. The oregon health insurance experiment: Evidence from the first year. *Quarterly Journal of Economics* 127: 1057–1106.

Frean, Molly, Jonathan Gruber, and Benjamin D. Sommers. 2017. Premium subsidies, the mandate, and Medicaid expansion: Coverage effects of the Affordable Care Act. *Journal of Health Economics* 53: 72–86.

Hinde, Jesse M. 2017. Incentive(less)? The effectiveness of tax credits and cost-sharing subsidies in the Affordable Care Act. *American Journal of Health Economics* 3 (3): 346–369.

Idler, Ellen L., and Yael Benyamini. 1997. Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior* 38 (1): 21–37.

Kaestner, Robert, Bowen Garrett, Jiajia Chen, Anuj Gangopadhyaya, and Caitlyn Fleming. 2017. Effects of ACA Medicaid expansions on health insurance coverage and labor supply. *Journal of Policy Analysis and Management* 36 (3): 608–642.

Kaiser Family Foundation (KFF). 2014. State Decisions on Health Insurance Marketplaces and the Medicaid Expansion. http://kff.org/health-reform/state-indicator/state-decisions-for-creating-health-insurance-exchanges-and-expanding-medicaid/. Accessed 13 Sept 13 2018.

Kolstad, Jonathan, and Amanda Kowalski. 2012. The impact of health care reform on hospital and preventive care: Evidence from Massachusetts. *Journal of Public Economics* 96 (11): 909–929.

Kowalski, Amanda. 2014. The Early Impact of the Affordable Care Act State-by-state. NBER Working Paper 20597.

Miller, Sarah. 2012. The effect of insurance on emergency room visits: An analysis of the 2006 Massachusetts health reform. *Journal of Public Economics* 96: 893–908.

National Center for Health Statistics [NCHS]. 2017. Health, United States, 2016: With Chartbook on Long-term Trends in Health. Hyattsville, MD.

Obama, Barack. 2016. United States health reform: Progress to date and next steps. *Journal of the American Medical Association* 316 (5): 525–532.

Polsky, Daniel, Michael Richards, Simon Basseyn, Douglas Wissoker, Genevieve M. Kenney, Stephen Zuckerman, and Karin V. Rhodes. 2015. Appointment availability after increases in Medicaid payments for primary care. *New England Journal of Medicine* 372 (6): 537–545.

Phillips, Anna C., Geoff Der, and Douglas Carroll. 2010. Self-reported health, self-reported fitness, and all-cause mortality: Prospective cohort study. *British Journal of Health Psychology* 15 (2): 337–346.

Simon, Kosali, Aparna Soni, and John Cawley. 2017. The impact of health insurance on preventive care and health behaviors: Evidence from the first two years of the ACA Medicaid expansions. *Journal of Policy Analysis and Management* 36: 390–417.

Sommers, Benjamin, Genevieve Kenney, and Arnold Epstein. 2014. New evidence on the Affordable Care Act: Coverage impacts of early Medicaid expansions. *Health Affairs* 33 (1): 78–87.