

**WORKING PAPER** · NO. 2021-131

# Depression and Shopping Behavior

*Katherine Meckel and Bradley Shapiro*

NOVEMBER 2021

## DEPRESSION AND SHOPPING BEHAVIOR

Katherine Meckel  
Bradley Shapiro

November 2021

We are grateful for helpful comments from seminar participants at ASHEcon. Results calculated (or derived) based on data from IRI Worldwide. The conclusions drawn from the IRI data are those of the researchers and do not reflect the views of IRI. IRI is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein. We thank Michael Cobb from IRI for his assistance with the data.

At least one co-author has disclosed additional relationships of potential relevance for this research. Further information is available online at <http://www.nber.org/papers/w29462.ack>

© 2021 by Katherine Meckel and Bradley Shapiro. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

Depression and Shopping Behavior  
Katherine Meckel and Bradley Shapiro  
November 2021  
JEL No. I1,I10,I12,M31

### **ABSTRACT**

Using a large survey panel that connects household shopping behavior with individual health information, this paper documents correlations between self reported depression and the size and composition of shopping baskets. First, we find that roughly 16% of individuals report suffering from depression and over 30% of households have at least one member who reports suffering from depression. Households with a member suffering from depression exhibit striking differences in shopping behavior: they spend less overall, visit grocery stores less and convenience stores more frequently and spend a smaller share of their baskets on fresh produce and alcohol but a larger share on tobacco. They spend similar shares on unhealthy foods like cakes, candy, and salty snacks. These cross-sectional correlations hold within counties, suggesting that they are not driven by region specific demographics or preferences that are incidentally correlated with depression status. They also hold when considering only single-member households. However, we rule out large differences in shopping behavior within households as they change depression status. Further, using the take-up of antidepressants as an event, we document little change in shopping in response to treatment. With our results, we discuss takeaways for the economic impact of depression and for decision modeling.

Katherine Meckel  
Department of Economics  
Econ 210  
University of California at San Diego  
9500 Gilman Drive #0508  
LaJolla, CA 92093  
and NBER  
kmeckel@ucsd.edu

Bradley Shapiro  
Booth School of Business  
University of Chicago  
5807 South Woodlawn Avenue  
Chicago, IL 60637  
and NBER  
Bradley.Shapiro@chicagobooth.edu

# 1 Introduction

Depression is a relatively common, often chronic, mental illness believed to be caused by a chemical imbalance in the brain. It is frequently characterized by cognitive distortions, leading to lack of self worth and motivation. Both the economics and medical literatures have connected these symptoms with economic impacts of depression that operate through the labor market (Berndt et al. (2000); Butikofer et al. (2019); Greenberg et al. (1993a,b, 2015); Shapiro (2020)). However, cognitive distortions, lack of self worth and lack of motivation may conceivably affect many aspects of an individual's economic life other than labor market activity. In this paper, we document correlations between depression and shopping behavior in a household panel survey that links health status and behaviors to shopping baskets.

The relationship between depression and shopping is important for several reasons. First, knowing the full economic impact of depression is important to policy makers deciding how much interventions to alleviate depression are worth. Second, the medical literature has documented associations between physical health, addiction and mental health (Stunkard et al. (2003); De Wit et al. (2010); Barth et al. (2004); Grant et al. (2003)). If depression negatively impacts the quality of shopping baskets individuals buy, it may provide a causal mechanism for those associations. This may help policy makers understand why some interventions do or do not work to induce healthier eating or to reduce dependence on alcohol and tobacco. Third, understanding how cognitive dysfunction affects decision making is important to the modeling of decision makers. Models of economic decision making often assume agents behave as if they are fully informed and maximize utility. Cognitive distortions may impact decision-making ability, leading to agents that use decision rules that are not well approximated by standard models. As a result, understanding the relationship between depression and shopping behavior may inform models of decision making.

Studying the connection between depression and shopping behavior is difficult, how-

ever, as data that link these outcomes at the individual level is rare. In this article, we leverage a unique dataset from IRI Worldwide, a marketing research company, that combines a large, nationally representative, shopper panel with a detailed survey about health conditions. Panelist households provide information about each of their shopping trips, including the date and location, and record each product purchased using in-home optical scanners. About 45% of the panelist households in our sample opted to participate in a survey called MedProfiler, which collects health information. The survey is administered annually, to all members of participating households.

The health data collected by MedProfiler is rich, including information on a large number of health conditions and associated treatment decisions. Participants are also asked about health outcomes such as height and weight; health behaviors such as exercise and substance use; and health attitudes. Among the health conditions surveyed is depression. For each year, we observe whether survey respondents identify as suffering from depression as well as if they are being treated for it with prescription drugs, over the counter drugs, or no drugs at all. Consistent with other national data sources, we find that depression is common. In any given year, roughly 16% of individuals surveyed report having depression and 34% of households have at least one member suffering from depression.

We first estimate a simple regression of shopping outcomes on depression status, adjusting only for household size. The results suggest important differences in shopping behavior by depressed status. In particular, households with depression spend about 5% less at grocery outlets than non-depressed households.<sup>1</sup> They visit grocery stores less often and convenience stores more often. They spend a smaller fraction of their basket on fresh produce, are less likely to purchase alcohol, and are more likely to purchase tobacco. Their spending on junk food (salty snacks, bakery goods and candy) is not significantly different, however.

---

<sup>1</sup>Grocery outlets include superstores for our purposes.

Next, we add controls for household characteristics. First, we add county of residence fixed effects. Results are largely unchanged, suggesting a limited role for county-level differences in outcomes such as preferences or income. Second, we add a set of demographic controls such as income, race, and marital status, and the correlations are moderated but persist. Adding the controls one-by-one suggests an important role for income, age and homeownership in moderating the initial correlation.

The results discussed thus far are identified using variation in depressed status across households as well as within households over time. To isolate the effects of variation within households over time, we control for household fixed effects. In these regressions, the relationship between depressed status and shopping is completely moderated and statistically indistinguishable from 0. In addition, we find little change in shopping behavior upon initiation of treatment with antidepressants within a household. These results suggest that the strong relationship between depression and shopping behavior observed in our initial regressions is driven by fixed differences across households.

Any proposed model of the causal relationship between depression and shopping will need to rationalize these facts. The stability of household shopping when faced with changes in depression status and changes in depression treatment provides some good news to those modeling decision-making. That is, it does not appear that depression is affecting the micro-processes involved in an individual's shopping. Second, it seems unlikely, given our results, that the effect of mental health on physical health and vice versa are mediated by choices about nutrition. Finally, we cannot rule out that there is a component of the economic cost of depression that operates through shopping, but if there is, it must be a slow-moving process.

## 2 Literature

This paper contributes to the understanding of the economic costs of depression by considering the relationship between depression and shopping. While there is an extensive literature documents the relationship between depression and labor supply, there is relatively little that documents the relationship between depression and demand. Berndt et al. (2000) finds that early-onset depression causes substantial human capital loss. Greenberg et al. (1993a), Greenberg et al. (2015), Stoudemire et al. (1986), Boyer et al. (1998) and Tomonaga et al. (2013) all find that the economic costs of depression in terms of labor supply and productivity are far in excess of the average cost of treatment. Stewart et al. (2003) estimates the productivity cost of depression to be about \$31 billion to employers in the US. Greenberg et al. (1993b) similarly estimates the annual costs of depression to be about \$44 billion per year in the US. Woo et al. (2011) finds that workers with major depressive disorder (MDD) lose about 30% of their annual salaries to costs associated with missing work or being unproductive at work. Additionally, Greenberg et al. (2015) update previous results and find that the economic burden increased substantially between 2005 and 2010.

We also contribute to the literature which associates depression with both physical health and addiction. For example, the medical literature has found robust correlations between depression and obesity (Stunkard et al. (2003); De Wit et al. (2010)), depression and heart disease (Barth et al. (2004)) and depression and reliance on alcohol and tobacco (Grant et al. (2003)). This is, of course, a very small cross section of review articles summarizing a large literature. Our work allows us to evaluate whether these relationships manifest themselves through grocery shopping choices. In particular, if depression causes self-medication in the form of junk food (and reduced fresh food), alcohol or tobacco, heart disease, obesity and addiction would be a natural consequence. However, it is also possible that physical health, mental health and substance abuse are correlated through other unrelated factors, and our work helps advance this understanding.

Finally, we contribute to the understanding of how cognitive limitations affect shopping. If depression were to impact the process of shopping, price sensitivity or preferences, it may have consequences for our posited models of consumer choice. Chintagunta, Goli & Kong (2019) studies how shopping is affected by hunger, looking towards the end of a fasting day during Ramadan. It finds that shopping is largely unaffected despite compelling evidence that shoppers are physically impacted by their hunger. Consistent with these results, Allcott et al. (2019) find that consumer preferences are remarkably stable given extreme changes in supply of different sets of products.

### 3 Data

The data in this study come from IRI Worldwide, a market research company. We use two datasets from IRI — the IRI shopper panel and the IRI MedProfiler Survey — which we merge together at the household-year level. Our data covers the years 2015 to 2019.

The shopper panel consists of daily, product-level expenditure data recorded by a sample of households that is designed to be representative of households nationwide and within individual markets throughout the United States. After each shopping trip, panelists report information, including the date and store and then record each product purchased, along with its price, using barcode scanners.<sup>2</sup> Panelist households receive points for submitting data that can be exchanged for prizes. Households also provide detailed demographic information on an annual basis, such as income, household size, and race.

Our initial sample includes 288,607 households that participate for at least one year between 2015 and 2019. For each shopping trip during this time period, we observe the total amount spent and information about the shopping outlet, such as type (e.g., “grocery store”). In addition, we have data at the product level for purchases of goods in the following categories: alcohol, tobacco, candy, frozen desserts, snacks, cookies and crackers, bakery, and produce. These types of products are of interest because they are

---

<sup>2</sup>IRI validates reported prices using scanner data they collect independently from retail chains.

thought to be particularly “healthy” or “unhealthy” (or addictive) and therefore allow us to investigate the relationship between depression and healthy shopping decisions.

We first collapse the shopper panel to the level of household-year, summing over all shopping trips. In doing so, we generate the following outcomes: total expenditures, expenditures at grocery stores and super stores, expenditures at convenience stores, total trips to grocery stores and super stores, and total trips to convenience stores.<sup>3,4</sup> We then calculate the share of total annual expenditures allocated to each of the following types of foods: fresh produce, “junk” food (bakery, candy and salty snacks), alcohol, and tobacco.

The MedProfiler survey is an optional survey offered to all households in the shopper panel on an annual basis. IRI incentivizes participation by awarding additional points to households that complete the survey. The survey covers topics such as health conditions, health behaviors, and treatment outcomes, and is administered to all members of participating households.<sup>5</sup> Of the 288,607 households in the shopper panel, 112,736 households participate in the MedProfiler survey for least one year between 2015-2019. This subset of households forms our analysis sample.

Among individuals in our analysis sample, about 21% ever report having depression from 2015 to 2019. At the household level, about 41% of households ever have a member who reports depression from 2015 to 2019 (compared to 30% in any given year).

Table 1 reports differences in depression status by household demographics, where “with depression” means at least one member of the household reports depression in at least one year from 2015 to 2019. Demographic information, collected from households participating in the shopper panel, is given at the household level. Any demographic vari-

---

<sup>3</sup>If households exit the panel during the year, we may conflate low annual spending with panel exits. Alternate versions of our analyses in which we first collapse the panel to the month level and then take annual averages produce highly similar results.

<sup>4</sup>In the IRI data, “superstore” refers to a subset of outlets belonging to national mass merchandising chains that offer a full selection of grocery goods. In 2012, about 80% of food-at-home was purchased at grocery stores and superstores Volpe et al. (2017). Convenience stores trips are of particular interest as such stores are often thought of as conducive to impulse buying as well as to purchasing of “vice” products such as candy, alcohol and tobacco.

<sup>5</sup>The survey is administered to both adults and childrens. If a child is too young to answer the survey on their own, answers are provided by their parent or guardian.

ables that are inherently individual level (e.g., race) describe the member of the household who is primarily responsible for scanning grocery purchases.

Table 1 reveals that households with and without depression differ in some significant ways. In particular, households with depression are 32% less likely to have a Black head of household, are 6% more likely to have a Hispanic head of household, are 14% less likely to own their own homes, are 13% less likely to be college graduates and 23% less likely to have post graduate studies. The average household with depression has 2.59 members while the average household without has 2.33 members. The median income for a household with reported depression is between \$50,000 and \$59,999, while the median income for a household without is between \$60,000 and \$69,999.

Table 1: Differences Between Households With and Without Depression

Variable	No Depression	Has Depression	Raw Diff	% Difference
% Black	8.93	6.60	-2.33	-26.14
% Hispanic	9.14	8.43	-0.71	-7.82
% Homeowner	71.37	62.12	-9.25	-12.96
% College Grad	58.86	50.13	-8.73	-14.84
% Post Grad	20.85	15.61	-5.24	-25.13
Avg. Family Size	2.62	2.79	0.169	6.43
Median Income Bracket	[\$60,000-\$69,999]	[\$50,000-\$59,999]		
Households	68,125	44,611		

All of the above comparisons statistically reject equality at the  $p < 0.05$  level

## 4 Design & Results

### 4.1 Design

In this section, we estimate correlations between shopping behavior and depression at the household-year level. We define a household as “depressed” in a given year if at least one member reports depression in that year. Our outcomes include: total household expen-

ditures at grocery stores and superstores, total trips to grocery stores and superstores, and total trips to convenience stores. We also report correlations between depression and shopping basket content, or the fraction of total spending that is dedicated to each of: fresh produce, “junk” food (bakery, candy and salty snacks), alcohol and tobacco.

Specifically, we estimate regressions of the form:

$$Y_{it} = \beta D_{it} + \gamma X_{it} + \alpha_{g(i)} + \epsilon_{it} \quad (1)$$

Where  $Y_{it}$  is a shopping outcome for household  $i$  in year  $t$ ,  $D_{it}$  is a dummy variable that takes on value of 1 when a household has at least one member with depression in year  $t$ ,  $X_{it}$  is one or more demographic controls for household  $i$ ,  $\alpha_{g(i)}$  is a fixed effect of varying level, and  $\epsilon_{it}$  is the econometric error term. We report  $\beta$  as the correlation of interest. Standard errors are clustered at the household level to account for serial correlation in the panel. When the outcome variable is expressed as a share of total spending, we weight by total spending.<sup>6</sup>

We first estimate Eq. 1 with no fixed effects, controlling only for family size to account for the fact that larger families will tend to buy more groceries. In this specification,  $\beta$  is the difference in shopping outcomes between households of the same size with and without depression. Note that, because a household’s depressed status can change from year to year, our estimate of  $\beta$  is identified using both variation in depression across and within households over time.

We then add fixed effects for county of residence to the specification. Doing so controls for cross-county differences in factors that may be correlated with both shopping and depression, such as income or preferences. Third, we add a vector of household demographic controls (in addition to family size), removing the county fixed effects. These

---

<sup>6</sup>Equation (1) is estimated across all households over the five year time period. Not all households remain in the panel for the same number of years. Controlling for years in the panel does not substantively change the results. Restricting only to households who are in the sample the entire five years also does not substantively change results, but reduces precision.

controls, which may vary over time, include: age, race, income (binned), marital status, employment status of the household head, education of the household head, BMI, smoker status of the household head, and homeownership status.<sup>7</sup> Adding these controls adjusts for differences in characteristics across households that may be correlated with both depression and shopping decisions. Finally, we control for household fixed effects (removing the demographic controls). Doing so isolates the correlation between depressed status and shopping behavior within households over time, by controlling for all permanent differences across households.

If depression influences shopping behavior, then receiving treatment in the form of anti-depressants may cause within-household changes in shopping decisions. We test this hypothesis by estimating an event-time specification, in which the “event” is defined as a member of the household initiating treatment with anti-depressant medication. The specification is given as follows

$$Y_{it} = \sum_{j=-2}^{j=2} \delta^j D_{it}^j + \rho X_{it} + \psi_i + \tau_t + \nu_{it} \quad (2)$$

where  $Y_{it}$  is a shopping outcome for household  $i$  in year  $t$ , as in Eq. 1 above;  $D_{it}^j$  is a dummy variable for the number of years  $j$  since the initiation of treatment (ranging from two years before to two years after);  $X_{it}$  is family size;  $\psi_i$  are household-level fixed effects;  $\tau_t$  are year effects to control for common trends over time; and  $\nu_{it}$  is the econometric error term, clustered at the household level. Among households with a member who starts taking anti-depressants during our panel, we require that the start year for anti-depressant treatment occurs at least one year after the household enters the panel and

---

<sup>7</sup>Specifically, the following variables are added as a series of indicator variables, corresponding to the categories listed in parentheses: race (Black, white, Asian, other); annual income (\$00,000 to \$9,999, \$10,000 to \$11,999, \$12,000 to \$14,999, \$15,000 to \$19,999, \$20,000 to \$24,999, \$25,000 to \$34,999, \$35,000 to \$44,999, \$45,000 to \$49,999, \$50,000 to \$59,999, \$60,000 to \$69,999, \$70,000 to \$99,999, \$100,000 and greater); marital status (married, widowed, divorced/separated, single); employment status of the household head (employed full-time, employed part-time, not employed for pay), education (no college degree, college degree, postgraduate degree), and homeownership status (owner, renter, other).

one year before they exit the panel.<sup>8</sup> Our sample also includes households in which no member takes anti-depressants – for these households, each dummy  $D_{it}^j$  is set to 0.

Finally, we re-estimate the correlations described above, restricting our sample to single-member households. This robustness check addresses the fact that, while, we observe depression and treatment status at the individual level, shopping outcomes are at the household level (and therefore may reflect the decisions of individuals other than the one suffering from depression). Focusing on single-member households enables us to more closely tie shopping decisions with depression.

## 5 Results

### 5.1 Amount of Shopping

Table 2 presents the results for the correlation between amount of shopping and household depression. The estimate shown is the coefficient on  $D_{it}$ , presented above the standard error in parentheses. The table shows the average household with reported depression spends about \$149 (5.06%) less annually on groceries, makes 9.64 (13.61%) fewer trips to grocery stores and makes 1.43 (35.60%) more trips to convenience stores than the average household without depression. All three of these correlations are statistically different than zero at any conventional level.

When county fixed effects are included, we find that, within counties, these correlations persist at similar magnitudes as in the cross-section. That is, a household with depression spends about \$180 (6.10%) less annually on groceries, makes 9.71 (13.71%) fewer trips to grocery stores, and makes 1.29 (32.17%) more trips to convenience stores

---

<sup>8</sup>Doing so creates a balanced panel of one year around the anti-depressant start year (i.e., from  $j = -1$  to 1). When samples are unbalanced in event-time, coefficient estimates for large or small values of event-time will tend to give unequal weight to households initiating treatment early or late in the sample. It is therefore important to define a window in which the sample of households is balanced (Kline 2011). However, because we only have five years of data (2015-2019), requiring a balanced panel for -2 to +2 years after the start of treatment year would restrict the treatment start year to 2017 only, limiting our ability to tease out unrelated time effects.

than the average household without depression *within the same county*. Again, these correlations are statistically different from zero at conventional levels. That suggests that the correlation between depression and shopping is not driven by systematic differences between geographies themselves such as geographic preferences or income.

When time-varying demographic controls are added, the correlations are moderated, but persist. Specifically, a household with depression spends about \$47 (1.61%) less on groceries per year, makes 5.37 (7.58%) fewer trips to grocery stores, and makes 0.38 (9.54%) more trips to convenience store compared to similar non-depressed households. Table 7 adds the demographic controls one by one, revealing that the following are especially important in moderating the initial correlation: age, income, and homeownership. In addition, smoking status is an important determinant of total trips to convenience stores.

When household fixed effects are included, the point estimates are almost entirely moderated and are no longer statistically different from zero. The point estimates imply that, when households have depression, they spend \$13 (0.39%) more, make 0.0017 (~0%) more trips to grocery stores and 0.10 (2.22%) more trips to convenience stores.

Table 3 presents these results looking only at single member households. The results are quantitatively and qualitatively consistent, suggesting that these results are not simply driven by the depressed household member not being the shopper.

Table 2: Depression and Amount of Shopping

	Grocery Spend	Grocery Trips	Convenience Trips
OLS	-149.17 [5.06%] (15.92)	-9.64 [13.61%] (0.39)	1.43 [35.60%] (0.13)
County FE	-179.99 [6.10%] (15.52)	-9.71 [13.71%] (0.39)	1.29 [32.17%] (0.12)
Demog. Controls	-47.36 [-1.61%] (15.49)	-5.37 [-7.58%] (0.38)	0.38 [9.54%] (0.13)
Household FE	12.98 [0.39%] (14.80)	0.00 [0.00%] (0.32)	0.10 [2.22%] (0.10)
N	234,175	234,175	234,175

The point estimates that are presented represent the coefficient on depression, or D from equation (1). Next to the point estimate in brackets is the percentage difference from non-depressed that the point estimate represents. In row (3), the controls are age, race, income, marital status, employment status of household head, college degree, postgraduate degree, BMI, smoker status, and homeownership status. No other rows have these controls. Standard errors clustered by household are presented below in parentheses.

Table 3: Depression and Amount of Shopping: Single Member Households

	Grocery Spend	Grocery Trips	Convenience Trips
OLS	-172.12 [7.90%] (24.80)	-11.57 [17.32%] (0.75)	1.08 [24.78] (0.30)
County FE	-185.75 [8.53%] (23.64)	-11.65 [17.43%] (0.75)	0.97 [22.13%] (0.28)
Demog. Controls	-44.10 [-2.02%] (26.18)	-5.85 [-8.76%] (0.77)	0.02 [0.35%] (0.32)
Household FE	19.69 [0.86%] (29.61)	0.31 [0.42%] (0.65)	0.12 [2.55%] (0.22)
N	57,144	57,144	57,144

The point estimates that are presented represent the coefficient on depression, or D from equation (1). Next to the point estimate in brackets is the percentage difference from non-depressed that the point estimate represents. In row (3), the controls are age, race, income, marital status, employment status of household head, college degree, postgraduate degree, BMI, smoker status, and homeownership status. No other rows have these controls. Standard errors clustered by household are presented below in parentheses.

## 5.2 Composition of Shopping Basket

Table 4 presents the results for the correlation between the composition of shopping baskets and household depression. The average household with depression spends 0.42 percentage points (18.51%) less of its basket on fresh produce, 0.29 percentage points (6.31%) more on junk food, 0.51 percentage points (20.57%) less on alcohol and 0.92 percentage points (72.30%) more on tobacco than the average household without depression. While the correlations between depression and the share of spending on fresh produce, alcohol, and tobacco are statistically different from zero at the 5% level, the correlation between depression and junk food is not statistically different from zero.

The cross-sectional results are mostly unchanged when county fixed effects are added. The average household with depression spends 0.36 percentage points (15.61%) less of its basket on fresh produce, 0.09 percentage points (1.89%) more on junk food, 0.52 percentage points (20.97%) less on alcohol and 0.84 percentage points (66.08%) more on tobacco than the average household without depression *within the same county*. The correlation between depression and junk food continues to be indistinguishable from zero, while the correlation between depression and alcohol is now only statistically different from zero at  $p < 0.1$ . When we control for household demographic characteristics, the correlations are again moderated to a certain degree, but not eliminated, with effects on produce and tobacco shares still statistically significant at the 5% level.

When household fixed effects are included, the correlations between depression and produce and depression and tobacco shrink considerably, while the correlations between depression and junk food and alcohol become noisier. The average household with depression spends 0.02 percentage points (0.81%) less of its basket on fresh produce, 1.15 percentage points (25.27%) more on junk food (though this correlation is extremely noisy and not statistically different from zero), 1.1 percentage points (37.21%) less on alcohol and 0.17 percentage points (13.91%) more on tobacco than the *same* household when it does not have a depressed member. While the point estimate for the correlation between

tobacco and depression remains economically reasonably significant, none of the within household correlations is statistically different from zero.

Table 5 presents these results looking only at single member households. Again, the results are qualitatively and quantitatively similar. In fact, the within-household results for the single member households are far more precise than the full sample, with the point estimates being small and precisely estimated on every outcome (as shopping is more likely to reflect the tastes of the depressed individual).

Table 4: Depression and Composition of Shopping

	% Produce	% Junk Food	% Alcohol	% Tobacco
OLS	-0.42 [18.51%] (0.02)	0.29 [6.31%] (0.32)	-0.51 [20.57%] (0.23)	0.92 [72.30%] (0.05)
County FE	-0.36 [15.61%] (0.02)	0.09 [1.89%] (0.37)	-0.52 [20.97%] (0.29)	0.84 [66.08%] (0.05)
Demog. Controls	-0.22 [9.61%] (0.02)	0.25 [5.44%] (0.41)	-0.33 [13.39%] (0.20)	0.16 [12.99%] (0.05)
Household FE	-0.02 [0.81%] (0.01)	1.14 [23.66%] (1.11)	-1.10 [41.35%] (1.12)	0.17 [13.41%] (0.14)
N	234,175	234,175	234,175	234,175

The point estimates that are presented represent the coefficient on depression, or D from equation (1). Next to the point estimate in brackets is the percentage difference from non-depressed that the point estimate represents. In row (3), the controls are age, race, income, marital status, employment status of household head, college degree, postgraduate degree, BMI, smoker status, and homeownership status. No other rows have these controls. Standard errors clustered by household are presented below in parentheses.

Table 5: Depression and Composition of Shopping: Single Member Households

	% Produce	% Junk Food	% Alcohol	% Tobacco
OLS	-0.32 [12.92%] (0.04)	-0.23 [5.16%] (0.46)	-0.75 [27.35%] (0.53)	1.14 [75.02%] (0.12)
County FE	-0.28 [11.19%] (0.04)	-0.78 [17.52%] (0.72)	-1.29 [46.69%] (0.83)	1.03 [68.08%] (0.12)
Demog. Controls	-0.16 [6.50%] (0.04)	-0.41 [9.28%] (0.46)	-0.64 [23.17%] (0.53)	0.19 [12.41%] (0.10)
Household FE	0.01 [0.27%] (0.04)	0.06 [1.48%] (0.05)	0.05 [2.08%] (0.07)	0.08 [5.20%] (0.11)
N	57,144	57,144	57,144	57,144

The point estimates that are presented represent the coefficient on depression, or D from equation (1). Next to the point estimate in brackets is the percentage difference from non-depressed that the point estimate represents. Standard errors clustered by household are presented below in parentheses.

### 5.3 Event Studies

Finally, we look at how these correlations are affected by treatment for depression using antidepressants, estimating Eq. 2 above. If we think that the brain chemistry that leads to depression also affects preferences, then changing brain chemistry using antidepressants might also change preferences. Initiation of prescription treatment may also coincide with more active non-pharmaceutical management of depression, such as therapy or family attention. Figure 1 shows event study plots for households with depression before and after initiating treatment. The numerical estimates are provided in Table 8 of Appendix A. In panel (a) there is a positive, statistically significant estimate of the year of antidepressant treatment on total spending, which immediately reverts the following year and turns negative in the year after that.<sup>9</sup> In panel (c), there is an increase in junk-food consumption

<sup>9</sup>It is important to treat the estimates for two years before treatment (-2) and two years after treatment (+2) with caution. Recall that the panel of households used to estimate the event-time analysis is balanced between -1 to +1 years with respect to treatment. Therefore, while the coefficients for -1 to +1 are estimated using a uniform set of households, only a subset of these households are used to estimate the coefficients on -2 and +2 years, which may limit comparability.

two years after treatment. Otherwise, none of the other estimates is statistically different from zero. Examining the estimates in total, we conclude that no robust changes in shopping appear to be happening in the time surrounding initiation of treatment in our data. The statistically significant estimates may well be driven by noise.<sup>10</sup>

We also re-estimate these analyses for the subset of households with one member, as above. The results are presented in Appendix C. In this subsample, the increase in grocery spend in year 0, as well as the increase in junk food in year 2, are smaller in size and statistically insignificant.

## 6 Discussion and Conclusion

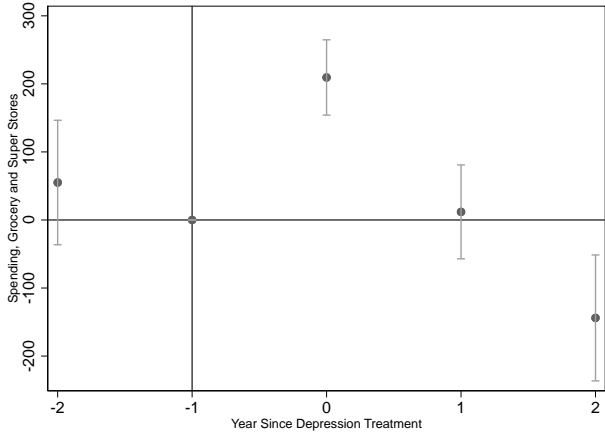
Together, these results show both a robust cross sectional relationship between depression and shopping as well as no detectable relationship between shopping and a new diagnosis of or recovery from depression at the household level. These results are consistent with a number of possible explanations.

First and perhaps most plausibly, it could be that the estimated association between depression and shopping in the cross section is driven by an omitted factor. Households with depression are simply different from households without in a number of ways. The depression itself doesn't change shopping behavior, but one of the omitted factors that make depressed households different from non-depressed households is driving it.

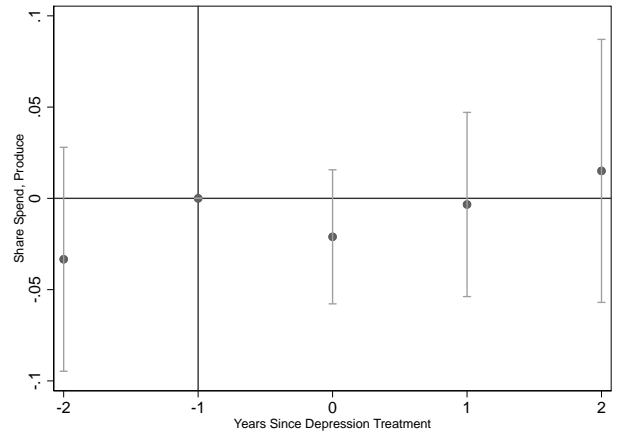
Second, there could be a true underlying causal relationship between depression and shopping that is a slow moving process. That is, changes may only occur after a considerable amount of time has passed, such that the relationship is not detectable in a panel regression over only four years. Indeed, for this explanation to be true, we would need for the process to take longer than the time horizon in our data, as our event studies show little movement over time within a household even after initiation of treatment.

---

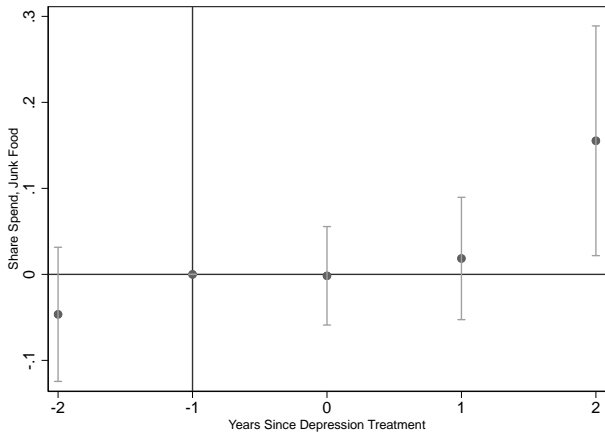
<sup>10</sup>This is not to say that the relationships in panel (a) and panel (c) *rule out* a causal effect of antidepressant treatment. Instead, a more robust research design including higher frequency data may be required to detect (or more precisely rule out) such an effect.



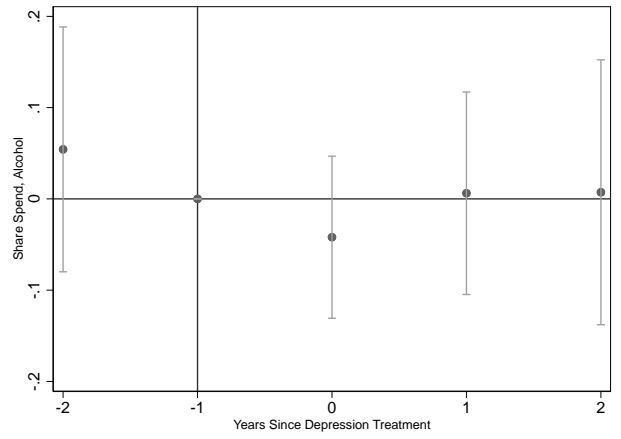
(a) Grocery Spend



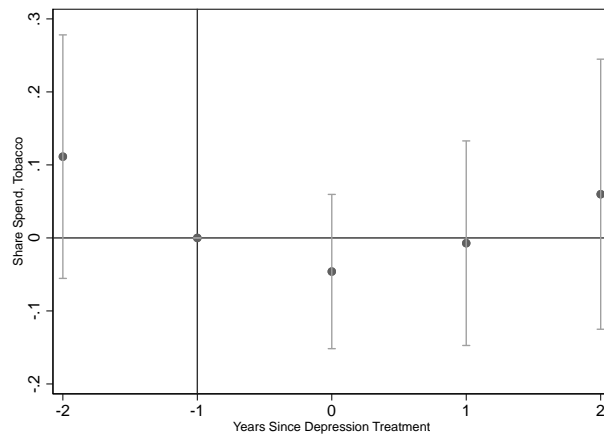
(b) Produce Share of Basket (%)



(c) Junk Food Share of Basket (%)



(d) Alcohol Share of Basket (%)



(e) Tobacco Share of Basket (%)

Figure 1: Event Study at Point of Antidepressant Treatment Takeup

Finally, it could be that consumption changes happen because of depression but prior to changes in self reported depression. A person may begin having symptoms of depression but not be sure they have depression until well after their consumption behavior has already changed. If this were the case, it may be difficult to detect such a relationship in our data.

In any event, the persistence of shopping behavior within households after changing either depression status or treatment status suggests that the existence of mood disorders may not be first order to modeling choices over time within a household. That is, if we can use household fixed effects in our choice models, the fact that many households have depressed members may not be an existential threat to the validity of standard demand models.

In terms of the economic impacts of depression, while our results show robust cross-sectional differences in shopping amounts between depressed and non-depressed households, the lack of within-household differences may cast doubt that depression causes a large reduction in shopping.

Our analyses of the composition of shopping baskets suggest that there may be some self medication through the use of tobacco, but the large cross sectional differences between the composition of shopping baskets on other dimensions between depressed and non-depressed households mostly disappear when looking within household. Finally, worse nutrition through the composition of shopping baskets seems unlikely to be the causal mechanism explaining the documented correlation between physical health and mental health.

We hope this simple descriptive research inspires the collection of better data to perhaps examine some of these questions at a greater degree of granularity and with better causal designs.

## Appendix A - Incremental Addition of Controls

In this section, we re-estimate the specifications that include demographic controls (i.e., row 3 in Tables 2-4), adding the controls one by one instead of all at once. Doing provides insight into which controls, by themselves, are important in mediating the correlation between depression and shopping.

Table 6: All Households - Total Shopping

	Grocery Spend	Grocery Trips	Convenience Trips
No Controls	-149.17 (15.92)	-9.64 (0.39)	1.43 (0.13)
Age	-58.45 (15.48)	-6.92 (0.38)	1.47 (0.13)
Race	-199.72 (15.88)	-9.84 (0.39)	1.41 (0.13)
Income	-80.14 (15.97)	-9.49 (0.40)	1.14 (0.13)
Marital Status	-91.15 (15.52)	-8.63 (0.39)	1.37 (0.13)
Employment	-158.15 (15.88)	-10.00 (0.39)	1.42 (0.13)
College	-169.69 (15.96)	-10.00 (0.39)	1.27 (0.13)
Post Graduate	-154.70 (15.95)	-9.70 (0.39)	1.33 (0.13)
BMI	-180.01 (16.01)	-9.14 (0.40)	1.31 (0.13)
Smoker	-149.34 (16.09)	-8.97 (0.39)	0.65 (0.12)
Quitting Smoking	-133.07 (15.99)	-8.91 (0.39)	0.98 (0.12)
Homeownership	-53.39 (15.79)	-8.05 (0.39)	1.25 (0.13)
All Controls	-47.36 (15.49)	-5.37 (0.38)	0.38 (0.13)
N	234,175	234,175	234,175

The point estimates that are presented represent the coefficient on depression, or D from equation (1). Standard errors clustered by household are presented below in parentheses.

Table 7: All Households - Composition of Shopping

	% Produce	% Junk Food	% Alcohol	% Tobacco
No Controls	-0.42 (0.02)	0.29 (0.32)	-0.51 (0.23)	0.92 (0.05)
Age	-0.43 (0.02)	0.26 (0.26)	-0.51 (0.23)	0.92 (0.05)
Race	-0.39 (0.03)	0.24 (0.30)	-0.56 (0.24)	0.89 (0.05)
Income	-0.37 (0.02)	0.32 (0.42)	-0.33 (0.19)	0.74 (0.05)
Marital Status	-0.41 (0.02)	0.34 (0.37)	-0.46 (0.21)	0.89 (0.05)
Employment	-0.42 (0.02)	0.31 (0.34)	-0.50 (0.22)	0.91 (0.05)
College	-0.38 (0.03)	0.31 (0.39)	-0.49 (0.23)	0.83 (0.05)
Post Graduate	-0.39 (0.03)	0.24 (0.30)	-0.51 (0.24)	0.87 (0.05)
BMI	-0.35 (0.03)	0.17 (0.32)	-0.40 (0.25)	0.94 (0.05)
Smoker	-0.33 (0.02)	0.36 (0.38)	-0.54 (0.21)	0.25 (0.05)
Quitting Smoking	-0.38 (0.02)	0.34 (0.36)	-0.52 (0.22)	0.58 (0.05)
Homeownership	-0.43 (0.02)	0.37 (0.39)	-0.45 (0.20)	0.84 (0.05)
All Controls	-0.22 (0.02)	0.25 (0.41)	-0.33 (0.20)	0.17 (0.05)
N	234,175	234,175	234,175	234,175

The point estimates that are presented represent the coefficient on depression, or D from equation (1). Standard errors clustered by household are presented below in parentheses.

## Appendix B - Event-Time Estimates

The table below contains estimates and standard errors corresponding to  $\delta^j$  in Eq. 2, the coefficients on the event-time indicators. These estimates, along with 95% confidence intervals, are displayed in Figure 1.

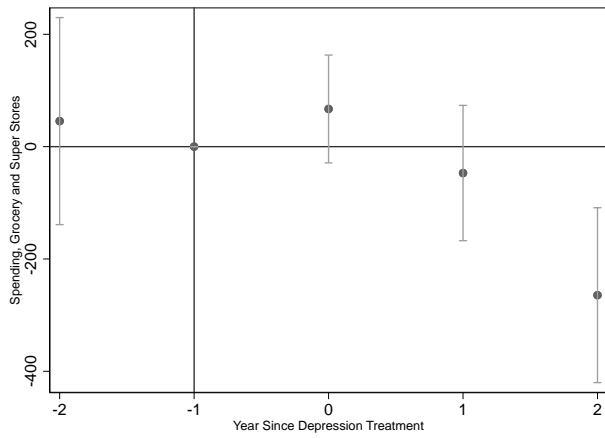
Table 8: Event-Time Estimates

	(1)	(2)	(3)	(4)	(5)
	Grocery Spend	% Produce	% Alcohol	% Tobacco	% Junk Food
Two Years Before	55.07 (46.67)	-0.03 (0.03)	0.05 (0.07)	0.11 (0.09)	-0.05 (0.04)
Anti-Dep. Start Year	209.43 (28.23)	-0.02 (0.02)	-0.04 (0.05)	-0.05 (0.05)	-0.00 (0.03)
One Year After	11.88 (35.20)	-0.00 (0.03)	0.01 (0.06)	-0.01 (0.07)	0.02 (0.04)
Two Years After	-143.92 (47.21)	0.02 (0.04)	0.01 (0.07)	0.06 (0.09)	0.16 (0.07)
Obs.	324,492	324,492	324,492	324,492	324,492

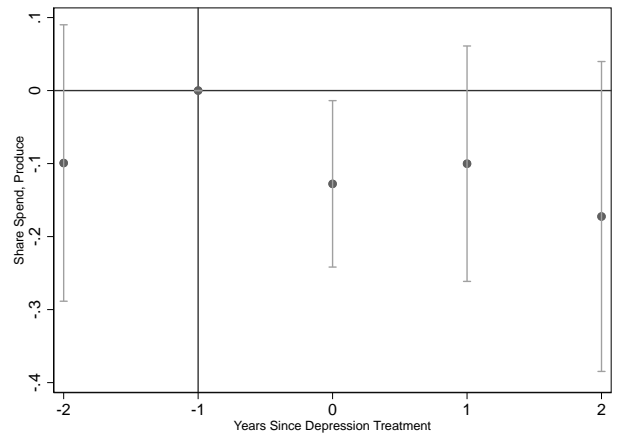
The point estimates that are presented represent the coefficient on event-time indicators from equation (2). Standard errors clustered by household are presented below in parentheses. "One Year Before" is the omitted category.

## Appendix C - Event-Time Estimates, Single Member Households

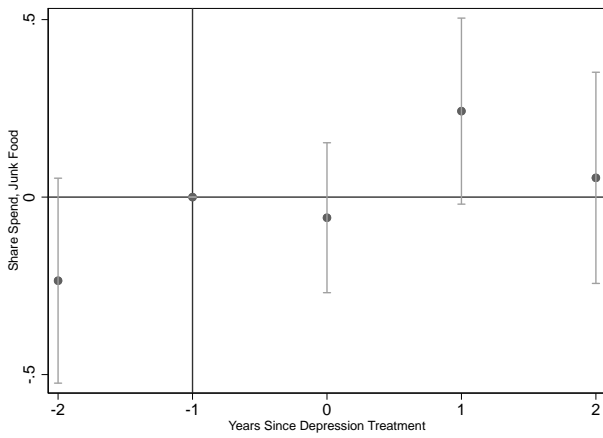
Below we replicate Figure 1, restricting our sample to households with one member.



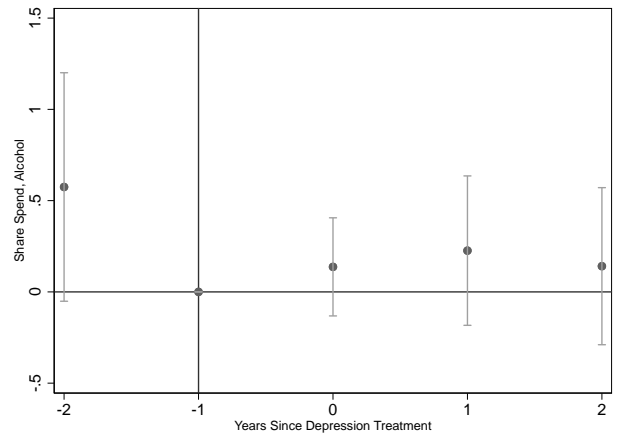
(a) Grocery Spend



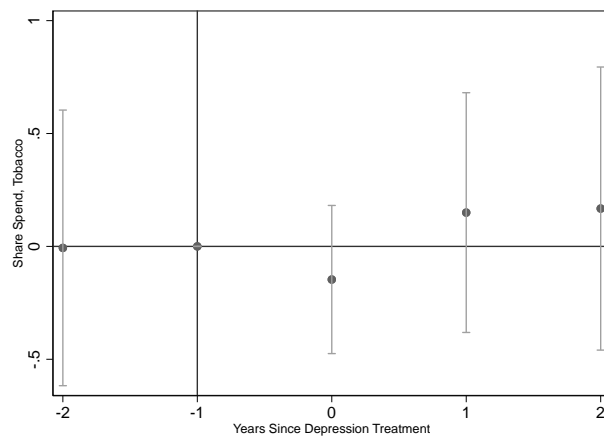
(b) Produce Share of Basket (%)



(c) Junk Food Share of Basket (%)



(d) Alcohol Share of Basket (%)



(e) Tobacco Share of Basket (%)

Figure 2: Event Study at Point of Antidepressant Treatment Takeup, Single Member Households

The table below replicates Table 8, restricting the sample to households with one member. These estimates, along with 95% confidence intervals, are displayed in the figure above.

Table 9: Event-Time Estimates, Single-Member Households

	(1)	(2)	(3)	(4)	(5)
	Grocery Spend	% Produce	% Alcohol	% Tobacco	% Junk Food
Two Years Before	45.48 (94.05)	-0.10 (0.10)	0.57 (0.32)	-0.01 (0.31)	-0.24 (0.15)
Anti-Dep. Start Year	67.08 (48.95)	-0.13 (0.06)	0.14 (0.14)	-0.15 (0.17)	-0.06 (0.11)
One Year After	-46.98 (61.47)	-0.10 (0.08)	0.23 (0.21)	0.15 (0.27)	0.24 (0.13)
Two Years After	-264.43 (79.44)	-0.17 (0.11)	0.14 (0.22)	0.17 (0.32)	0.05 (0.15)
Obs.	44,592	44,592	44,592	44,592	44,592

The point estimates that are presented represent the coefficient on event-time indicators from equation (2). Standard errors clustered by household are presented below in parentheses. "One Year Before" is the omitted category.

## References

- Allcott, H., R. Diamond, J.-P. Dubé, J. Handbury, I. Rahkovsky, and M. Schnell (2019). Food deserts and the causes of nutritional inequality. *The Quarterly Journal of Economics* 134(4), 1793–1844.
- Barth, J., M. Schumacher, and C. Herrmann-Lingen (2004). Depression as a risk factor for mortality in patients with coronary heart disease: a meta-analysis. *Psychosomatic medicine* 66(6), 802–813.
- Berndt, E. R., L. M. Koran, S. N. Finkelstein, A. J. Gelenberg, S. G. Kornstein, I. M. Miller, M. E. Thase, G. A. Trapp, and M. B. Keller (2000). Lost human capital from early-onset chronic depression. *American Journal of Psychiatry* 157(6), 940–947.
- Boyer, P., J. Danion, J. Bisserbe, J. Hotton, and S. Troy (1998). Clinical and economic comparison of sertraline and fluoxetine in the treatment of depression: A 6-month double-blind study in a primary-care setting in France. *Pharmacoeconomics* 13(1), 157–169.
- Butikofer, A., C. Cronin, and M. Skira (2019). Employment effects of healthcare policy: Evidence from the 2007 fda black box warning on antidepressants. *NHH Dept. of Economics Discussion Paper* (1).
- De Wit, L., F. Luppino, A. van Straten, B. Penninx, F. Zitman, and P. Cuijpers (2010). Depression and obesity: a meta-analysis of community-based studies. *Psychiatry research* 178(2), 230–235.
- Grant, B. F., D. A. Dawson, F. S. Stinson, P. S. Chou, W. Kay, and R. Pickering (2003). The alcohol use disorder and associated disabilities interview schedule-iv (audadis-iv): reliability of alcohol consumption, tobacco use, family history of depression and psychiatric diagnostic modules in a general population sample. *Drug and alcohol dependence* 71(1), 7–16.
- Greenberg, P. E., A.-A. Fournier, T. Sisitsky, C. T. Pike, and R. C. Kessler (2015). The economic burden of adults with major depressive disorder in the United States (2005 and 2010). *The Journal of Clinical Psychiatry* 76(2), 155–173.
- Greenberg, P. E., L. E. Stiglin, S. N. Finkelstein, and E. R. Berndt (1993a). Depression: A neglected major illness. *The Journal of Clinical Psychiatry*.

- Greenberg, P. E., L. E. Stiglin, S. N. Finkelstein, and E. R. Berndt (1993b). The economic burden of depression in 1990. *The Journal of Clinical Psychiatry*.
- Shapiro, B. (2020). Promoting wellness or waste? evidence from antidepressant advertising. *American Economic Journal: Microeconomics* (forthcoming).
- Stewart, W. F., J. A. Ricci, E. Chee, S. R. Hahn, and D. Morganstein (2003). Cost of lost productive work time among US workers with depression. *JAMA* 289(23), 3135–3144.
- Stoudemire, A., R. Frank, N. Hedemark, M. Hamlet, and D. Blazer (1986). The economic burden of depression. *General Hospital Psychiatry* 8(6), 387–394.
- Stunkard, A. J., M. S. Faith, and K. C. Allison (2003). Depression and obesity. *Biological psychiatry* 54(3), 330–337.
- Tomonaga, Y., J. Haettenschwiler, M. Hatzinger, E. Holsboer-Trachsler, M. Rufer, U. Hepp, and T. D. Szucs (2013). The economic burden of depression in Switzerland. *Pharmacoeconomics* 31(3), 237–250.
- Volpe, R., A. Kuhns, and T. Jaenicke (2017). Store formats and patterns in household grocery purchases. *EIB-167*.
- Woo, J.-M., W. Kim, T.-Y. Hwang, K. D. Frick, B. H. Choi, Y.-J. Seo, E.-H. Kang, S. J. Kim, B.-J. Ham, J.-S. Lee, and Y. Park (2011). Impact of depression on work productivity and its improvement after outpatient treatment with antidepressants. *Value in Health* 14(4), 475–482.