Vice and Virtue Behaviors: Disentangling Substitution and Direct Effects of the Price of Giving*

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Abstract: We examine how the U.S. tax policy that encourages charitable giving also affects seemingly unrelated virtue and vice behaviors: exercise and smoking. Using the Panel Study of Income Dynamics, we calculate tax liabilities for 16,712 individuals over 5 waves from which we can construct the price of giving to charity. We estimate the structural model of joint consumption developed by DiNardo and Lemieux (1992, 2001) to disentangle how changes in the price of giving affects exercise and smoking through two distinct channels: (1) an indirect effect through classical substitution effects and (2) a direct effect of the price of giving on the implicit price of exercise and smoking. Contrary to reduced form results which confound these two effects, we find that charitable giving and exercise are substitutes, but that the negative direct effect of the price of giving on exercise dominates. Similarly, charitable giving and smoking are also substitutes, but there is no significant direct effect of the price of giving on smoking behavior. Our results demonstrate the breadth of the effects of tax policy on charitable giving and suggest how policy may be more efficiently designed to increase virtuous behaviors.

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1 Introduction

The market for charitable giving in the U.S. is large, consisting of 2% of GDP in 2019, and diffuse, with nearly 60% of Americans making a charitable donation (Giving USA, 2020). These rates of giving are bolstered by a variety of incentives, perhaps most importantly the individual tax incentives (Clotfelter, 1980; Bakija and Heim, 2008; Bakija, 2013; Meer and Priday, 2019).[1]

We examine the possibility that the tax policy in the U.S., which encourages charitable giving by allowing individuals to deduct charitable gifts, has spillover effects into other policy-relevant behaviors in the public health space: smoking and exercise. Not only do smoking and exercise have significant public health costs of $289 billion and $1.7 trillion due to medical costs and lost productivity, respectively,[2] they have strong social connotations as virtuous (vice) or prosocial (antisocial) behaviors. From a virtue ethics perspective, physical self-care is considered a (modern) cardinal virtue (Keenan, 1995) and thus accordingly a "good" person engages in behaviors consistent with the cardinal virtues, i.e., "virtuous" behaviors, such as exercising and abstaining from smoking. From a social preference perspective, engaging in behaviors that are the norm and have high levels of social approval and avoiding behaviors with low levels of social approval is a form of prosociality (Kimbrough and Vostroknutov, 2016). To confirm our hypothesis that exercise is a virtuous behavior, while smoking is not, we conducted an online survey of 500 respondents in which we asked about their views of charitable giving, exercise and smoking. We asked whether they believed these behaviors were (1) socially approved behaviors; (2) consistent with their view of a "good" person; and (3) the types of behaviors in which they engaged. We find an overwhelming consensus that respondents believe that society approves of charitable giving and exercise, but not of smoking. Further, respondents overwhelmingly report that charitable giving and exercise are consistent with their view of a "good" person, while smoking is not. Thus, we study the effect of the price of giving on the joint decision to engage in virtuous behaviors (charitable giving and exercise) and a mixed or vice-virtue bundle (charitable giving and smoking).[3]

There are two distinct channels through which the price of giving may affect the likelihood

[1] There is a large and impressive literature that examines how incentives affect giving, including the match-price literature (Eckel and Grossman, 2003; Karlan and List, 2007; Hungerman and Ottoni-Wilhelm, 2021) as well as non-financial incentives, such as social pressure (Frey and Meier, 2004; Shang and Croson, 2009) and fundraising (Huck and Rasul, 2011).

[2] See Milken Institute for Public Health, 2019 on obesity and Warren et al. (2014) on smoking.

[3] There are certainly other interesting behaviors to study. For example, voting and other forms of political participation are often viewed as pro-social and virtuous activities, as is recycling. However, data on these behaviors is not available in the PSID.

that individuals make public investments. First, there may be a classical substitution effect: when the price of giving goes down, individuals increase their charitable giving and this change in charitable giving sparks a decrease in exercise (or smoking) if the behaviors are substitutes. In this sense, the price of giving *indirectly* affects exercise as it operates through the changes in charitable giving behavior. Second, a change in the price of giving may also have a *direct* effect on exercise, *irrespective of charitable giving*, through the *implicit price* of exercise. For example, a decrease in the price of giving may signal society's approval of virtuous behaviors more generally, making exercise (and smoking cessation) less expensive and thus increasing the prevalence of exercise.[4]

Following DiNardo and Lemieux (1992, 2001), we estimate a structural model of joint consumption that allows us to disentangle the indirect substitution effect of the price of giving on public health investment from the direct effect. In doing so, we distinguish ourselves from the existing literature that examines the effect of the price of giving on secondary behaviors, including religious attendance (Gruber, 2004; Yörük, 2013) and health outcomes (Yörük, 2014),[5] in a reduced form context that cannot differentiate the indirect and the direct effects of the price of giving on secondary behaviors. The key difference between substitution and non-substitution effects is that substitution effects can only occur if individuals already give to charity and make public health investments, otherwise, there is no cross partial utility to identify. By contrast, the price of giving can affect public health investments through non-substitution effects even if the individual does not give to charity. This distinction drives our psychological interpretations of substitution and non-substitution effects as well as our identification strategy.

Whether two behaviors are substitutes or complements is closely linked to the literature on moral consistency versus moral balancing (Monin and Miller, 2001; Fishbach, Dhar, and Zhang, 2006; Mullen and Monin, 2016). For example, Fishbach, Dhar, and Zhang (2006) ask under what conditions individuals who exercise more will also be more likely to treat healthy eating as a complementary behavior and thus engage in moral consistency or subsequently treat healthy eating as a substitute behavior and engage in moral balancing. Similarly, the logic of temptation bundling (Milkman, Minson, and Volpp, 2014) and vice-virtue bundles (Dhar and Simonson, 1999; Read, Loewenstein, and Kalyanaraman, 1999; Liu et al., 2015) is

[4]DiNardo and Lemieux (1992, 2001) refer to the indirect effect as the substitution effect and the direct effect as the non-substitution effect.

[5]Using an index for general health, Yörük (2014) finds that a lower price of giving corresponds to better health and concludes that charitable giving and "health" are complements. While our paper is related, it is also distinct in two important ways. First, our outcome variables are health behaviors that may speak to the underlying mechanisms driving health outcomes. Second, we move beyond reduced form analysis and estimate a structural model that disentangles the substitution effects that are studied in the previous literature from the non-substitution effects.

that individuals are better off if they can psychologically bundle together behaviors or goods that are virtuous with those that are considered vices, implying a type of moral balancing.

However, whether the price of one behavior has a *direct effect* on exercise or smoking is distinct from moral consistency or balancing in that the direct effect does not require the individual to even engage in the first behavior. For example, a change in tax policy that leads to a decrease in the price of giving may signal an increase in the value society places on virtuous behaviors more broadly (e.g., charitable giving and public health investments). An individual with image and identity concerns (Bem, 1972; Bénabou and Tirole, 2006; Ariely, Bracha, and Meier, 2009; Lacetera and Macis, 2010; Bénabou and Tirole, 2011) may be motivated by this signal to increase their engagement in virtuous behaviors, such as exercise.

To analyze the potential spillover effects from the U.S. tax policy on virtuous and vice behaviors, we use data from the Panel Study of Income Dynamics (PSID). We estimate marginal tax rates (τ) and tax liabilities (L) of 16,569 household heads and spouses from the PSID from 2003-2011 using the NBER's taxsim program. We follow Meer and Priday (2019) and use the tax liability variable to construct our price of giving to more precisely capture exogenous changes in tax codes that may affect the price of giving. Because an individual's donation choice affects their tax liability, and thus their price of giving, we instrument for the price of giving with the *zero-dollar* price of giving—the price of giving that the individual would have faced if they donated \$0 (Wilhelm and Hungerman, 2007). Further, we follow the current literature and identify and exclude individuals who we identify as endogenous itemizers (Wilhelm and Hungerman, 2007; Backus and Grant, 2019; Meer and Priday, 2019), which we discuss in more detail in Section 2.

We construct an unbalanced panel of 5 waves of 16,682 individuals, which contains the price of giving, charitable giving from the PSID's Philanthropy Module, smoking and exercise behavior from the PSID's Health and Aging Module as well as a vector of individual characteristics from the PSID Individual data files, including income, homeownership, family structure, education, and year and regional dummies to capture time and location effects.

Our empirical approach is twofold. First, we estimate cross-price elasticities between charitable giving and smoking and exercise, using a log-log specification and instrumenting for the price of giving with the "zero-dollar" price of giving, with and without individual fixed effects. We find that exercise has a negative cross-price elasticity with charitable giving, while smoking has a positive cross-price elasticity with charitable giving, though the latter is not robust to the inclusion of the individual fixed effects. If the reduced form elasticity estimates are driven entirely by substitution effects, then our results suggest that charitable

giving and exercise are complements and charitable giving and smoking are substitutes.

Second, and what we view as our main contribution, we estimate a structural model following DiNardo and Lemieux (1992, 2001), which disentangles the classic substitution effect arising indirectly through changes in charitable giving, from the direct effect of the price of giving that may occur on exercise and smoking irrespective of charitable giving. In the structural estimation, we implement our instrument using the control function approach and obtain estimates for our standard errors using a bootstrapping procedure (Cameron and Trivedi, 2005), which we discuss in more detail in Section 2.3.

Our results from the structural model demonstrate the importance of separating indirect substitution effects from the direct effect to understand the impact of changes in the price of giving. Contrary to our reduced form elasticity estimates, our structural estimates reveal that exercise and charitable giving are *substitutes*, but that the negative direct effect dominates, rendering a positive relationship between the two charitable giving and exercise. This is an important result from several perspectives. First, the substitution effect suggests that when the price of giving decreases, individuals substitute away from exercise because they are giving more to charity. This is discouraging for a social planner who wants to encourage both of these virtuous behaviors—an increase in charitable giving comes at the cost of exercise and health. However, the second result of the direct effect of the price of giving provides a ray of hope—a decrease in the price of giving serves as a signal of society's approval of virtuous behaviors and image-conscious individuals increase their engagement in at least one of these virtuous behaviors (exercise). Fortunately for a social planner who wants to encourage both charitable giving and exercise, our results suggest that the direct effect dominates the substitution effect. Our results on the joint decision to give to charity and exercise are similar to Feldman (2010) who also studies the effect of the price of giving on the joint decision to engage in two "virtuous" behaviors, charitable giving and volunteering. A key difference is that she uses the first-dollar price of giving as the price of giving instead of as an instrument for the price of giving.[6] She finds that the negative relationship between the price of giving and volunteering in the reduced form analysis is driven by direct effects of the price of giving and that charitable giving and volunteering are substitutes.

On the other hand, our structural results suggest that the relationship between smoking and charitable giving is driven entirely through substitution effects and that there are no significant direct effects of the price of giving. This pattern is consistent with the results in DiNardo and Lemieux (2001) who study the relationship between teenage drinking and

[6] In Section 3.3.1, we estimate our structural model with the price of giving variable used in Feldman (2010) and find equivalent results. Feldman (2010) uses cross-sectional, rather than panel data, from Independent Sector's Giving and Volunteering data.

marijuana use and find that when the drinking age increased (i.e., an increase in the price of drinking) drinking decreased but marijuana use increased because they were substitutes and no significant direct effects. Thus, the idea that the price of giving serves as a signal for other virtuous behaviors is supported by the results in the charitable giving-exercise decision, but it is not supported by our results in the charitable giving-smoking decision. However, while smoking can be classified as a "vice" behavior, the addictive nature of smoking might mean that individuals are not receptive to societal signals about their smoking behavior.

In sum, we find that a decrease in the price of giving leads people to donate more, but they also increase their public health investments by exercising more and smoking less. We contribute to a growing research that finds positive spillovers between pro-social behaviors, including charitable giving (Shang and Croson, 2009; Cairns and Slonim, 2011; Gneezy et al., 2012; Meer, 2013; Castillo, Petrie, and Samek, 2017; Heger and Slonim, 2020) (see Gee and Meer (2019) for a review), cooperation (Peysakhovich and Rand, 2016) and trust (Cassar, d'Adda, and Grosjean, 2014; Engl, Riedl, and Weber, 2018). However, our results provide a more nuanced understanding of moral consistency versus balancing and other theories that predict a preference for mixing virtuous and vice behaviors, such as theories of vice-virtue bundles (Dhar and Simonson, 1999; Read, Loewenstein, and Kalyanaraman, 1999; Liu et al., 2015) and temptation bundling (Milkman, Minson, and Volpp, 2014). By disentangling indirect substitution and direct effects of the price of giving, we identify whether health behavior responds to changes in the price of giving because charitable giving behavior changed (i.e., substitution effects) or whether health behavior responds to changes in the price of giving because of a change in its implicit price, which occur irrespective of changes in charitable giving behavior (i.e., direct effects). By doing so, we find that despite the positive correlation between exercise and charitable giving that may lead one to conclude there is evidence of moral consistency, the two behaviors are *substitutes* leading to a conclusion of moral balancing. Instead, the positive correlation is due to the dominating direct effect of the price and re-enforcing the importance of self- and social-image in decision-making contexts. Conversely, the negative correlation between smoking and charitable giving is driven entirely by the substitution effect, as there is no significant direct effect of the price of giving on smoking.

Our results also have implications for optimal policy design. We calculate that if the average price of giving decreased by approximately 10% (one standard deviation) that the fraction of individuals who give to charity would increase by 5 percentage points while the percentage of individuals who exercise would increase by 1 percentage point. We further disaggregate the policy effect and find that the substitution channel is responsible for a 1.6 percentage point decrease in the fraction of individuals who exercise while the direct effect

corresponds to a 3 percentage point increase in the fraction of individuals who exercise. In sum, our results show that charitable giving crowds-out exercise through the substitution effect and a policy intervention that leverages only the direct effects might be successful at encouraging exercise without sacrificing charitable giving. For example, a policy that is not price-based and thus can generate direct effects without changing the relative prices of the two behaviors, such as a nudge, would be more efficient if policy-makers care about encouraging both charitable giving and exercise.

1.1 Attitudes about charitable giving, exercise and smoking

While our analysis depends on observational data from the PSID, which we will describe in Section 2, we conducted a supplementary online survey to elicit views of charitable giving, exercise and smoking behaviors. Our conceptual framework outlined in the previous section relies on the notion that charitable giving and exercise are virtuous, pro-social behaviors while smoking is a vice, anti-social behavior.[7] To more robustly establish this point, we asked 500 workers in the U.S. from Amazon's Mechanical Turk (MTurk) three questions about their views of charitable giving, exercise and smoking to which respondents responded on a 5-point Likert scale. The three questions ask about the degree of (1) social approval of (2) "goodness" of and (3) participation in each behavior Below, we state each question from the survey, explain our reason for including the question and discuss the results from the survey.

In your opinion, do people in general approve or disapprove of people who (give to charity, exercise, smoke tobacco)?

The first question asks whether people in general approve or disapprove of each of the behaviors (*Social Approval*). Engaging in socially-approved or socially normal behavior and avoiding behaviors are that are disapproved is a form of prosociality (Kimbrough and Vostroknutov, 2016)–"[t]hose general rules of conduct, when they have been fixed in our mind by habitual reflection, are of great use in correcting the misrepresentations of self-love concerning what is fit and proper to be done in our particular situation" (Smith (1759), Section 3.5.2). Overwhelmingly, participants stated that they believed people strongly approve of charitable giving (92%) and exercising (91%) and strongly disapprove or disapprove of smoking (79%). As a placebo, we also asked participants whether people in general approve or disapprove of people who prefer yellow to orange. As expected, 85% of respondents stated

[7] See survey here.

that people neither approve nor disapprove of those who prefer yellow to orange.

Please state the degree to which you agree or disagree with the following statements. In my opinion, a good person (gives to charity, exercises, smokes tobacco)

The second question asks whether each behavior is associated with the behavior of a "good" person (*Good Person*). This question aims to capture the idea of ethical behavior as described by virtue ethics. Virtue ethics describes behavior as ethical if it is the type of behavior in which a "good" person engages.[8] Virtue ethicists define a "good" person by someone who strives to adhere to the cardinal virtues, originally put forth by Aristotle's *Nicomachean Ethics* and adapted (and updated) by modern Christian theology to include physical self-care Keenan (1995). Overwhelmingly, respondents either strongly agree or agree that a good person gives to charity (78%) and exercises (59%), while only 6% of respondents strongly agree or agree that a good person smokes. By contrast and as expected, 85% of respondents state that they neither agree nor disagree that a good person prefers yellow to orange.

Please state the degree to which you agree or disagree with the following statements. I view myself as someone who (gives to charity, exercises, smokes tobacco)

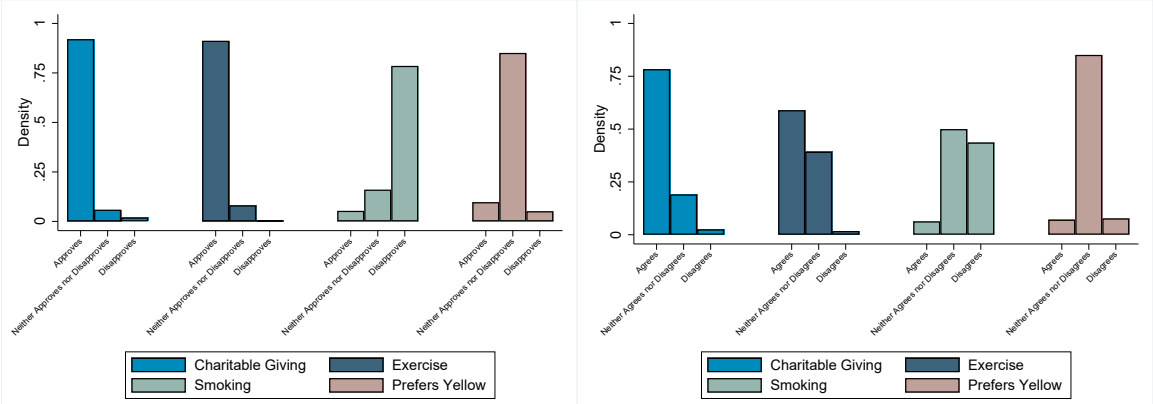
The third question asks how the respondent views themselves and whether they are the type of person who engages in each of the behaviors (*Myself*). In general, respondents characterize themselves as people who give to charity (63%) and exercise (74%), and not as the type of person who smokes (18%). As expected, people were equally likely to agree (25%), disagree (36%) and neither agree nor disagree (39%) that they are the type of person who prefers yellow to orange.

2 Data, Model and Empirical Specification

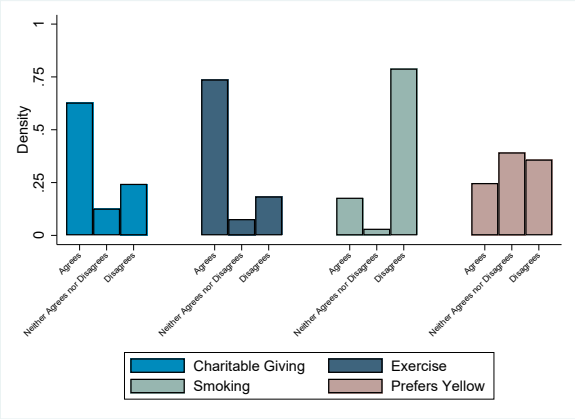
We use the 2003-2011 waves of the Panel Study of Income Dynamics (PSID, a nationally representative panel survey from the United States). We use the Philanthropy Module to obtain data on charitable giving which we match with the individual-level data to obtain information on exercise and smoking, as well as other individual-level characteristics. We

[8]This differentiates virtue ethics from deontological ethics where the focus is on duty and rules and behavior is deemed moral if it adheres to a specific duty or rule (e.g., "do unto others as they have done onto you") and a moral person engages in moral behavior.

FIGURE 1: SURVEY RESPONSES



(A) Social Approval (B) Good Person



(C) Myself

Distribution of survey responses.

thus create an unbalanced panel of 16,712 individuals, which includes all of the household heads and their spouses (if they have one) for whom we have a complete set of data.

2.1 Price of Giving

In the U.S., the tax code allows individuals to deduct their charitable giving from their income before taxation, thereby reducing their tax burden and incentivizing charitable giving. The NBER's TAXSIM (version 9.0) program, developed by Kimberlin, Kim, and Shaefer (2014),[9] pulls relevant demographic information from the PSID to estimate the household's marginal tax rate τ and tax liability L for 2003-2011 waves. Previous literature calculates the price of giving as $(1-\tau)$ for the households that itemize their deductions and 1 for households that

[9]The version of the program we use can be found here.

do not itemize (Gruber, 2004; Feldman, 2010; Yörük, 2013).

However, we follow Meer and Priday (2019) and calculate the price of giving for individual i at time t using the tax liabilities variable computed by TAXSIM as

$$P_{i,t} = 1 + \frac{L'_{i,t} - L_{i,t}}{100} \tag{1}$$

where $L'_{i,t}$ is the tax liability calculated after adding an additional \$100 to charitable donations. However, because $L_{i,t}$ is affected by the amount an individual donates, we instrument for $P_{i,t}$ using the *zero-dollar* price of giving. We compute the *zero-dollar* price of giving by calculating $L_{i,t}$ and $L'_{i,t}$ if charitable giving was \$0 and \$100, respectively.

Additionally, because the choice to itemize and the donation decision may occur simultaneously and thus itemization is not exogenous, we exclude individuals that are identified as endogenous itemizer (Backus and Grant, 2019). Endogenous itemizers are individuals whose total deductions, without their charitable gifts, fell below the standard deduction allowed by the tax policy.

In Section 3.3, we consider two additional specifications of the price of giving as robustness checks. First, in Section 3.3.1, we use the specification in Feldman (2010), the *first-dollar price* of giving, calculated as the $1 - \tau$ for itemizers and 1 for non-itemizers, where τ is the household's marginal tax rate with charitable donations set at \$0. This differs from our measure in that it uses that marginal tax rate, rather than the tax liabilities and it skips the instrument variables approach and directly uses the *first-dollar price* of giving in the main regression.

While we can directly control for the direct effect of income on giving, exercise and smoking, income also affects these behaviors *through* the price of giving—ceteris paribus, an increase in income results in a lower price of giving. To address this indirect effect of income through the price of giving, in Section 3.3.2, we calculate tax liabilities holding income constant at the 2005 inflation-adjusted level. We then use our IV approach described above.

2.2 Data Description

Table 1 provides a weighted summary of the data for our sample. The average age in our sample is 44.7 years and the majority, 62.5% are married. Over a quarter of our sample has a college degree and the 72% who work, work an average of 40.7 hours per week. The average household income (income of the head of household plus spouse), measured in 2005 dollars, is \$58,358 and the average price of giving is .95.

Approximately 61% of our sample donate to charity and those who donate give \$1980

per year. Nearly 81% of the sample exercise and those who exercise engage in approximately 277 hours of exercise per year. Only 21% of our sample smoke and those who do smoke approximately 13 cigarettes per day. In this table and throughout our analysis, we cluster at the individual level. We choose to do this because, while the price of giving and donations are determined at the household level, smoking and exercise behavior is determined at the individual level.

TABLE 1: Summary Statistics

	Mean	S.D.
Price of Giving (p_d)	0.952	0.0007
Manuf. wages (hourly) (p_e)	15.154	0.010
Cigarette Tax (p_s)	82.784	0.44
Income (1000s)	58.358	0.76
Donate?	0.608	0.003
Exercise?	0.805	0.002
Smoke?	0.208	0.003
Age	44.620	0.130
Children?	0.460	0.004
Work?	0.714	0.003
Full-time?	0.631	0.003
Married?	0.616	0.004
College?	0.255	0.004
Female?	0.553	0.004
Head of Household?	0.655	0.004
Homeowner?	0.627	0.004
White?	0.645	0.004
Latino?	0.010	0.000
Yearly Donation Amount	1980.537	36.397
Yearly Hrs of Exercise	277.276	2.172
Daily No. of Cigs	13.084	0.139
No. of Children	1.929	0.010

Estimates are adjusted for sampling weights and clustered at the individual-level. Intensive margin variables are conditioned on participation.

The price of giving is determined by a host of factors, including income, location, and year. Because of its dependence on income, the price of giving is also related to many demographic variables, including age, hours worked, education, and family structure and thus we control for these and other covariates in our analysis. We also formally test whether the price of giving and each of our covariates are independent. We present these results in Table 9 in Section 5.

Because of the panel structure of our data, our analysis exploits both between-individual variation and within-individual variation in the price of giving. Table 2 shows the overall variation as well as the within-individual variation and between-individual variation of our

TABLE 2: Source of Variation

Variable	Overall S.D.	Within Individual S.D.	Between Individuals S.D.
Price of Giving	0.105	0.058	0.086
Price of Exercise	1.563	0.943	1.363
Price of Cigs	57.730	24.382	53.511
Income (in thousands)	97.366	47.359	78.709
$ Donated	3125.872	1476.794	2670.072
Mins of Ex per week	398.589	311.224	298.603
Cigs per week	6.768	2.800	6.327

PSID Data 2003-2011. N = 16,712 Individuals. Obs = 57,375.
Summary of the overall, within- and between-individual variation in key variables.

key variables. The within-individual variation in the price of giving is $\frac{2}{3}$ of the between-individual variation, indicating that if two randomly selected individuals were drawn from the data, then the difference in the price of giving they faced is expected to be $\frac{3}{2}$ larger than the difference in the price of giving if the same individual was selected randomly over two separate years. Thus, while our between variation in the price of giving is larger, we are still able to exploit a significant amount of within variation in our price of giving. This is further demonstrated in our reduced form results in Table 4 where we also include an individual fixed effects model and thus only exploit within variation in the price of giving.

2.3 Model of Joint Consumption

We model the joint decision to (1) give to charity and exercise and (2) give to charity and smoke in the utility-maximizing model of DiNardo and Lemieux (1992, 2001). In what follows, we rely heavily on their notation and insight.[10] We will refer to the joint decision to give to charity and to exercise, but we also use the same approach to model the joint decision to donate and smoke.

We consider a utility function that is separable in a composite consumption good (X_0) and two-tuple of vice-virtue behaviors (X_e, X_d), where X_e denotes exercise and X_d denotes charitable giving behavior. Thus the household's utility follows:

$$G(X) = u(X_0) + v(X_e, X_d)$$

G is increasing, quasi-concave, twice-continuously differentiable. Following, DiNardo and

[10]We refer readers to DiNardo and Lemieux (1992, 2001) as well as Feldman (2010) for more detailed explanations.

Lemieux (2001), the sub-utility function $v(X_e, X_d)$ is modelled as a quadratic of X_e and X_d:[11]

$$v(X_e, X_d) = \gamma_0 + \gamma_e X_e + \frac{1}{2}\gamma_{ee} X_e^2 + \gamma_d X_d + \frac{1}{2}\gamma_{dd} X_d^2 + \gamma_{ed} X_e X_d$$

The individual maximises utility $G(X)$ subject to the following three constraints:

$$I = X_0 + p_e X_e + p_d X_d$$

$$X_e \geq 0$$

$$X_d \geq 0$$

where I is the individual's income and the price of the composite good X_0 is normalised to 1. This results in the following first order conditions:

$$u'(X_0) - \lambda = 0$$

$$\gamma_e + \gamma_{ee} X_e + \gamma_{ed} X_d - \lambda p_e - \varphi_e = 0$$

$$\gamma_d + \gamma_{dd} X_d + \gamma_{ld} X_e - \lambda p_d - \varphi_d = 0$$

where $\lambda, \varphi_e, \varphi_d$ are the Lagrangian multipliers on each of the three constraints, respectively. We can consider four decision regimes that may result from the optimization problem. An individual may (1) neither donate nor exercise, (2) only donate, (3) only exercise or (4) donate and exercise. Generally, an individual donates if the marginal utility of donating, measured at 0 (γ_d) is greater than the utility price of donating (λp_d). However, in a model in which there are substitution effects ($\gamma_{ed} \neq 0$), the marginal utility of donating also depends on whether the individual is exercising. Thus, to solve for the participation constraints that represent each of the four regimes, we must consider the decisions to donate and exercise jointly. For each of the four regimes, we first write the corresponding constraint on the decision to exercise and then the constraint for the decision to donate.

Regime 1: neither donate nor exercise, $X_e = X_d = 0$

$$\gamma_e < \lambda p_e \tag{2}$$

$$\gamma_d < \lambda p_d \tag{3}$$

[11] This can be considered as a local approximation of an arbitrary utility function. However, in future research, one might consider a very different function form to also capture the addictive and persistent nature of smoking.

Regime 2: donate only, $X_e = 0, X_d > 0$

$$\gamma_e - \left(\frac{\gamma_{ed}}{\gamma_{dd}}\right)\gamma_d < \lambda p_e - \left(\frac{\gamma_{ed}}{\gamma_{dd}}\right)\lambda p_d \tag{4}$$

$$\gamma_d > \lambda p_d \tag{5}$$

Regime 3: exercise only, $X_e > 0, X_d = 0$

$$\gamma_e > \lambda p_e \tag{6}$$

$$\gamma_d - \left(\frac{\gamma_{ed}}{\gamma_{ee}}\right)\gamma_e < \lambda p_d - \left(\frac{\gamma_{ed}}{\gamma_{ee}}\right)\lambda p_d \tag{7}$$

Regime 4: donate and exercise, $X_e, X_d > 0$

$$\gamma_e - \left(\frac{\gamma_{ed}}{\gamma_{dd}}\right)\gamma_d > \lambda p_e - \left(\frac{\gamma_{ed}}{\gamma_{dd}}\right)\lambda p_d \tag{8}$$

$$\gamma_d - \left(\frac{\gamma_{ed}}{\gamma_{ee}}\right)\gamma_e > \lambda p_d - \left(\frac{\gamma_{ed}}{\gamma_{ee}}\right)\lambda p_d \tag{9}$$

The key point in this model is the role of γ_{ed}. If $\gamma_{ed} = 0$, then the four sets of participation constraints are simplified to the four permutations of the constraints presented in Regime 1, because the decision to donate does not depend on the decision to exercise, and vice versa. However if $\gamma_{ed} < 0$, that is, if exercise and charitable giving are substitutes, then the marginal utility of one behavior will be negatively affected by engaging in the other behavior. Conversely, if $\gamma_{ed} > 0$ then exercise and charitable giving are complements and engaging in one of the behaviors will make the participation condition for the other less restrictive.

2.3.1 Stochastic Specification

In this section, we move from the theoretical model to an empirical model to construct the likelihood function used for estimation. In particular, we need to construct empirical expressions for $\gamma_e, \gamma_d, \lambda p_e, \lambda p_d$.

First, we assume that γ_e and γ_d are stochastically distributed across individuals and that the fraction of individuals in each of the four regimes corresponds to the fraction of γ_e and γ_d drawn in each of the four regimes.

Second, we specify empirical expressions for γ_e and γ_d given by

$$\gamma_e = \mathbf{W}\beta_e + \epsilon_e \tag{10}$$

$$\gamma_d = \mathbf{W}\beta_d + \epsilon_d \tag{11}$$

where $\mathbf{W}$ is a vector of individual characteristics, such as family structure and employment, that may affect the marginal utility of virtuous behaviors and ϵ_e and ϵ_d are jointly normally distributed with correlation coefficient ρ.

Third, we specify empirical expressions for λp_e and λp_d using a first order approximation of income and prices:

$$\lambda p_e \approxeq \alpha_{0e} + \alpha_{eI} I + \alpha_{ee} p_e \tag{12}$$

$$\lambda p_d \approxeq \alpha_{0d} + \alpha_{dI} I + \alpha_{dd} p_d \tag{13}$$

Combining equations 10-13, we obtain

$$e^* = \mathbf{Z}\theta_e + \epsilon_e$$

$$d^* = \mathbf{Z}\theta_d + \epsilon_d$$

where $e^* = \gamma_e - \lambda p_e$ and $d^* = \gamma_d - \lambda p_d$. Further, $\mathbf{Z}$ is the combinations of the variables contained in $\mathbf{W}$ from equations 10 and 11, as well as price and income from equations 12 and 13. We can then plug e^* and d^* into the four participation regimes to determine the probability of falling into each regime, for each individual, which is a function of θ_d and θ_e.[12] We can then estimate the model using maximum likelihood.

Before turning to our main results, it is useful to state the participation conditions clearly to demonstrate the channels through which exercise and charitable giving may be linked through the price of giving and in particular how the indirect substitution effect is distinguished from the direct effect. From our first order conditions, we can more succinctly write the participation conditions as follows:

$$\mathbf{1}_e = 1 \iff e^* - \frac{\gamma_{ed}}{\gamma_{dd}} \mathbf{1}_d d^* > 0 \tag{14}$$

[12] See DiNardo and Lemieux (2001) for the exact likelihood functions.

$$\mathbf{1}_d = 1 \iff d^* - \frac{\gamma_{ed}}{\gamma_{ee}}\mathbf{1}_e e^* > 0 \tag{15}$$

where $\mathbf{1}_e$ and $\mathbf{1}_d$ are indicator variables taking a value of 1 if the individual participates in exercise or charitable giving, respectively and 0 otherwise. If exercise and charitable giving are substitutes, $\gamma_{ed} < 0$, then an increase in the price of giving causes an increase in exercise *through* the decrease in charitable giving and vice versa for the case of complements. In other words, the substitution effect of the price of giving on exercise operates *through* a change in charitable giving. However, consider the case of an individual who does not give to charity—the price of giving cannot affect exercise through the substitution channel (i.e., γ_{ed}), but the price of giving can impact exercise directly through the implicit price of exercise (e.g., a decrease in the price of giving signals society's approval of virtuous behaviors and thus, for the image-conscious, lowers the implicit price of spending time exercising). We identify this direct effect through θ_e and if we expect that a decrease in the price of giving will directly increase exercise (as described in the example of society's approval), then the coefficient associated with the direct effect of the price of giving will be negative. Similarly for smoking, if a decrease in the price of giving signals that society values virtuous behavior, we might expect that the coefficient associated with the price of giving in the smoking equation would be positive.

2.3.2 Empirical Specification

To estimate our reduced form results, we implement a two-stage least squares IV regression. In the first stage, we regress the log of the price of giving on the log of the zero-dollar price of giving and in the second stage, we regress the log of our outcome variables (charitable giving, exercise and smoking) on the predicted values obtained in the first-stage and adjust the standard errors for the two-stage estimation procedure. When we are working with intensive margins, we deal with zeros by adding 1 to each of the outcome variables (Meer and Priday, 2019; Yörük, 2013, 2014). To obtain estimates for the bivariate probit regression and the structural model, we use the control function approach (Cameron and Trivedi, 2005): we estimate the first stage via OLS and we estimate the second stage via maximum likelihood with bootstrapped standard errors.[13]

First Stage Table 3 shows that the instrument is not irrelevant nor weak: the zero-dollar price of giving is highly correlated with the price of giving (p-values <.001) across all four

[13]The exception to this is the full structural model of smoking and charitable giving in which we were unable to bootstrap the standard errors.

columns. Further, the F-statistic in each regression easily surpasses the standard "rule of thumb" between 5 and 10 (Staiger and Stock, 1997).

Table 3: Instrument Relevance, OLS estimates of First Stage

	[1]	[2]
	Log(Price of Giving)	
Log(Zero-Dollar Price of Giving)	0.79***	0.77***
	(0.007)	(0.007)
Log(Income)	.	0.005***
		(0.0005)
Log(Income^2)	.	-0.0005***
		(0.0000488)
Age	.	0.0004
		(0.0008)
Age^2	.	9.86e-06***
		(2.51e-06)
Have Children?	.	0.0002
		(0.001)
No. of Child	.	-0.002***
		(0.0006)
Married?	.	-0.0001
		(0.001)
College?	.	-0.003
		(0.003)
Yrs of Ed	.	-0.0000152
		(0.0004)
Full-time?	.	0.0005
		(0.0007)
Homeowner?	.	-0.003***
		(0.0008)
White?	.	-0.0002
		(0.003)
Latino?	.	0.004
		(0.003)
Female?	.	.
Constant	-0.01***	-0.05
	(0.0004)	(0.04)
Observations	57375	57375
R^2	0.6	0.6
F statistic	12222.72	671.03
Demographic Controls	N	Y
Year Fixed Effects	N	Y
Region Fixed Effects	N	Y

OLS Fixed Effects regression coefficients. Robust Standard Errors in parentheses and *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. In columns [1] & [2], the standard errors are clustered at the individual level and in columns [3] & [4] they are clustered at the household level.

3 Main Results

3.1 Reduced Form Elasticities

TABLE 4: Reduced Form Results: the Price of Giving & Exercise and Smoking

	Probit			2SLS			Fixed Effects		
	Giving	Exercise	Smoking	Giving	Exercise	Smoking	Giving	Exercise	Smoking
Log(Price of Giving)	-1.81***	-0.5***	0.62***	-3.49***	-0.25**	0.31***	-1.09***	-0.29**	0.05
	(0.1)	(0.1)	(0.13)	(0.16)	(0.11)	(0.1)	(0.18)	(0.13)	(0.06)
Price of Exercise	.	-0.03***	.	.	0.0009	.	.	-0.002	.
		(0.004)			(0.01)			(0.02)	
Price of Cigs	.	.	-0.0003	.	.	0.0000487	.	.	-0.0005***
			(0.0002)			(0.0003)			(0.0002)
Log(Income)	-0.03***	-0.003	0.07***	-0.11***	0.05***	0.09***	-0.04**	0.02	0.01
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.009)
Log(Income^2)	0.008***	0.003***	-0.009***	0.02***	-0.0005	-0.01***	0.008***	-0.003	-0.0003
	(0.0009)	(0.0009)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.0008)
Age	.	.	.	0.05***	-0.01**	0.07***	0.14***	0.06*	0.03*
				(0.006)	(0.004)	(0.005)	(0.04)	(0.03)	(0.02)
Age^2	.	.	.	-0.000021	-0.0000937**	-0.0008***	-0.001***	-0.001***	-0.0001**
				(0.0000657)	(0.0000473)	(0.0000434)	(0.0001)	(0.0001)	(0.0000565)
Have Children?	-0.04	-0.11***	-0.06*	-0.12**	-0.19***	-0.05	0.02	-0.12**	-0.1***
	(0.03)	(0.03)	(0.03)	(0.05)	(0.04)	(0.04)	(0.06)	(0.05)	(0.03)
No. of Child	0.002	0.02**	-0.03**	0.04*	0.05***	-0.03*	0.07***	0.04*	0.05***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.01)
Married?	0.29***	0.05***	-0.27***	0.82***	0.06**	-0.36***	0.44***	0.06	-0.15***
	(0.02)	(0.02)	(0.02)	(0.04)	(0.03)	(0.03)	(0.06)	(0.05)	(0.03)
College?	0.07**	0.008	-0.4***	0.13**	-0.18***	-0.34***	-0.1	-0.09	0.04
	(0.03)	(0.03)	(0.04)	(0.06)	(0.04)	(0.04)	(0.1)	(0.07)	(0.04)
Yrs of Ed	0.11***	0.07***	-0.06***	0.29***	0.13***	-0.08***	0.04*	-0.003	-0.01
	(0.005)	(0.004)	(0.006)	(0.01)	(0.007)	(0.008)	(0.02)	(0.02)	(0.009)
Full-time?	-0.02	0.002	0.04**	-0.21***	-0.02	0.02	0.07**	-0.006	0.04***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	(0.01)
Homeowner?	0.3***	0.13***	-0.16***	0.78***	0.18***	-0.26***	0.28***	0.06	-0.02
	(0.02)	(0.02)	(0.02)	(0.04)	(0.03)	(0.03)	(0.05)	(0.04)	(0.02)
White?	.	.	.	0.31***	0.5***	0.42***	-0.26*	-0.08	-0.06
				(0.04)	(0.03)	(0.03)	(0.14)	(0.12)	(0.05)
Latino?	.	.	.	-0.1	0.12	-0.5***	-0.26*	0.18	-0.11**
				(0.12)	(0.1)	(0.07)	(0.14)	(0.13)	(0.04)
Female?	.	.	.	0.14***	-0.09***	-0.32***	.	.	.
				(0.04)	(0.02)	(0.03)			
Constant	.	.	.	-5.04***	2.56***	-0.98***	-1.27	3.99**	-2.24***
				(0.19)	(0.23)	(0.15)	(1.68)	(1.56)	(0.73)
Observations	57375	57375	57375	57375	57375	57375	57375	57375	57375
R^2	.	.	.	0.33	0.09	0.11	.	.	.
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Region Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y

All columns report instrumental variable regression results: columns (1)-(3) report IV probit marginal effects; columns (4)-(6) report 2SLS results and columns (7)-(9) report 2SLS with individual fixed effects. All columns include year and region fixed effects. In columns (4)-(9), the outcome variables (Y) are in the form of $log(Y+1)$. Robust standard errors clustered at the individual level in parentheses and *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

In this section, we present results from reduced-form models to analyze the relationship between the price of giving and charitable giving, exercise and smoking. In columns (1)-(3)

we estimate an IV probit regression, in columns (4)-(6) we estimate a 2SLS regression and in columns (7)-(9) we estimate a fixed-effects IV regression. In columns (4)-(9) we take the log of our dependent variable. First, our results suggest that charitable giving is elastic–our most robust specification in column (7) suggests that a 10% decrease in the price of giving results in a 9% increase in charitable gifts. This estimate is similar to the main results in Meer and Priday (2019). Second, our results suggest a negative cross-price elasticity between charitable giving and exercise–column (8) suggests that a 10% decrease in the price of giving results in a 2.9% increase in the minutes of exercise, suggesting that the two behaviors are complements. Third, our results suggest only a marginally positive cross-price elasticity between charitable giving and smoking. While columns (3) and (6) show a significantly positive coefficient on the effect of the price of giving on smoking when we include fixed effects in column (9) the significance disappears and the magnitude of the coefficient is small. Since we find larger coefficients and significance without fixed effects, but not with fixed effects, this suggests that the former results are driven by individual-level heterogeneity rather than by opposite substitution and non-substitution effects working in opposite directions. This third finding suggests that smoking and charitable giving are neither substitutes nor complements and that our structural results in Table 6 should be interpreted with caution.

In Table 4, we have also included our proxies for the price of exercise and the price of cigarettes. The price of exercise is approximated by the average state-year manufacturing wage. The price of cigarettes is approximated by the state-year per pack excise tax on tobacco. As expected, we find a negative association between the price of exercise and exercise and a negative relationship between the price of cigarettes and smoking behavior.

If an individual does not give to charity then a change in the price of giving should not affect their propensity to exercise through the substitution channel. Thus, any changes for the "No Givers" occurs through a direct effect of the price of giving on exercise (or smoking). As described by the model and outlined in Section 2.3, we disentangle the direct effect from the substitution effect using the "No Givers". We can show this in a reduced form regression in which we replicate columns (4)-(9) of Table 4 for only the "No Givers", effectively shutting down the substitution channel and only permitting for the direct effect of the price of giving on exercise. In Table 10 in 5, we find that the coefficient on the price of giving for the "No Givers" is negative (i.e., a decrease in the price of giving corresponds to an increase in exercise), despite the substitution channel being shut down.

3.2 Structural Estimates

In this section, we estimate the model presented in Section 2.3. The structural model allows us to disentangle the indirect substitution effect from the direct effect of the price of giving.

Tables 5 and 6 examine the joint decision to give to charity and exercise and give to charity and smoke and include a full set of demographic control (although we only display the price and income controls). The tables provide three sets of results that build up to the fully unconstrained structural model so that we can clearly show the changes that occur when we estimate the full structural model of joint consumption for exercise and smoking, respectively. In the first panel, we present coefficients from an uncorrelated bivariate probit model, which we estimate using two independent probit models. In the second panel, we show results from a bivariate probit model which allows for error terms in the two equations to be correlated, but we continue to restrict $\Psi_1 = \Psi_2 = 0$. Finally, in the third panel, we estimate the full structural model which accounts for the possibility of a correlated error structure between the two equations as well as an inter-dependency in consumption that may occur through (1) the indirect substitution effect and (2) the direct effect of the price of giving.

The substitution effect is captured in our model by γ_{ed} cannot be separately identified and instead can only be identified up to a scale. Thus, we estimate Ψ_1 and Ψ_2 where,

$$\psi_1 = \frac{\gamma_{ed}\sigma_e}{\gamma_{dd}\sigma_d}$$
$$\psi_2 = \frac{\gamma_{ed}\sigma_d}{\gamma_{ee}\sigma_e}$$

Thus, $\psi_1, \psi_2 > 0$ if and only if $\gamma_{ed} < 0$ (by concavity of v, $\gamma_{dd}, \gamma_{ee} < 0$), indicating that exercise and charitable giving are substitutes. Similarly, if $\psi_1, \psi_2 < 0$, then exercise and charitable giving are complements.

As in Table 4, we instrument for the price of giving with the *zero-dollar* price of giving. Instrumenting within the bivariate probit and the full structural model requires us to use the control function approach (Cameron and Trivedi, 2005), in which we estimate the first stage using OLS and the second stage using maximum likelihood estimation and bootstrap the standard errors to take into account the two-stage estimation procedure.

Exercise Consistent with the results in Table 4, the first column of Table 5 presents a negative relationship between the price of giving and exercise, suggesting that exercise and charitable giving are complements. In column (2), we allow the errors terms in the equation

TABLE 5: Main Results: the Price of Giving & Exercise

	1. Probits	2. Bivariate Probit	3. Structural Model
EXERCISE			
Log(Price of Giving)	-0.5***	-0.38***	-0.59***
	(0.1)	(0.09)	(0.13)
Price of Exercise	-0.03***	0.004	0.005
	(0.004)	(0.006)	(0.006)
Log(Income)	-0.003	-0.005	-0.007
	(0.01)	(0.01)	(0.01)
Log(Income^2)	0.003***	0.003***	0.003***
	(0.0009)	(0.0009)	(0.0009)
CHARITABLE GIVING			
Log(Price of Giving)	-1.81***	-1.79***	-1.81***
	(0.11)	(0.1)	(0.1)
Price of Exercise	-0.03***	0.01	0.01
	(0.005)	(0.007)	(0.007)
Log(Income)	-0.03***	-0.03**	-0.03***
	(0.01)	(0.01)	(0.01)
Log(Income^2)	0.008***	0.008***	0.009***
	(0.0009)	(0.0009)	(0.0009)
Constant	-2.58***	-3.39***	-3.17***
	(0.11)	(0.14)	(0.2)
ρ		.17***	0.38***
		(0.01)	(0.10)
Ψ_1			0.12**
			(0.06)
Ψ_2			0.20
			(0.13)
Observations	57375	57375	57375

PSID Data 2003-2011. N = 16,712 Individuals. Obs = 57,375.

All columns include a full set of demographic controls. All columns display coefficients, not marginal effects. Robust standard errors clustered at the individual level are presented in column (1). Bootstrapped standard errors clustered at the individual level are presented in columns (2) and (3). Standard errors are in parentheses and *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

for exercise and charitable giving to be correlated and estimate $\rho > 0$, suggesting that there is positive joint consumption of exercise and charitable giving. However, we still find that the coefficient on the price of giving is significant and negative. In column (3), we relax the restriction on the substitution effect, ψ_1 and ψ_2, to disentangle the substitution effect from the direct effect of the price of giving and our results are strikingly different from the previous columns. First, we find that ψ_1 and ψ_2 are positive, suggesting that exercise and charitable giving are *substitutes* rather than complements as suggested in the previous columns and Table 4. A χ^2 test for joint significance of ψ_1 and ψ_2 results in a test statistic of 5.41 (p-value= 0.07). Second, the coefficient on the price of giving is still negative, but larger in magnitude than in the previous columns. This suggests that in the restricted model, the negative coefficient on the price of giving was detecting conflicting substitution and direct effects of the price of giving on exercise. The negative coefficient on the price of giving in the full structural model suggests that when the price of giving changes, this impacts the *implicit*

TABLE 6: Main Results: the Price of Giving & Smoking

	1. Probits	2. Bivariate Probit	3. Structural Model
SMOKING			
Log(Price of Giving)	0.62***	0.55***	-1.77***
	(0.13)	(0.12)	(0.1)
Price of Cigs	-0.0003	0.0000254	0.0000995
	(0.0002)	(0.0002)	(0.0002)
Log(Income)	0.07***	0.07***	-0.01
	(0.01)	(0.01)	(0.01)
Log(Income^2)	-0.009***	-0.009***	0.007***
	(0.001)	(0.001)	(0.001)
CHARITABLE GIVING			
Log(Price of Giving)	-1.81***	-1.79***	-1.77***
	(0.11)	(0.1)	(0.1)
Price of Cigs	-0.0002	0.0000838	0.0000995
	(0.0001)	(0.0002)	(0.0002)
Log(Income)	-0.03***	-0.03**	-0.01
	(0.01)	(0.01)	(0.01)
Log(Income^2)	0.008***	0.008***	0.007***
	(0.0009)	(0.0009)	(0.001)
Constant	-3.01***	-3.23***	-3.06***
	(0.09)	(0.09)	(0.11)
ρ		-0.11***	0.27* * *
		(0.01)	(0.09)
ψ_1		0.67***	
			(0.13)
ψ_2		0.18**	
			(0.08)
Observations	57375	57375	57375

PSID Data 2003-2011. N = 16,712 Individuals. Obs = 57,375.

All columns include a full set of demographic controls. All columns display coefficients, not marginal effects. Robust standard errors clustered at the individual-level are presented in columns (1) and (3). Bootstrapped standard errors clustered at the individual level are presented in column (2). Standard errors are in parentheses and *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

price of exercising, making it *less* expensive to exercise. The average individual responds to a decrease in price through two channels. First, they increase their charitable giving which results in a decrease in exercise due to the substitution effect but this is offset by the second channel in which they increase their exercise due to the direct effect of the price giving.

From a psychological perspective, we interpret the substitution effect as a type of moral balancing, whereby individuals maintain a balance of virtue-vice behaviors. When the price of giving decreases, individuals increase their charitable giving and thus reduce their engagement in other virtuous behaviors, such as exercise. However, this desire to maintain a moral balance is offset by the direct effect of the price of giving, which we interpret as a desire to maintain a self or social image. When the tax policy changes in such a way that the price of giving decreases, individuals view this as a signal that society's value on virtuous behaviors, including exercise, has increased and thus lowers the implicit price of engaging in these behaviors. Thus, due to image concerns, the direct effect of a decrease in the price of

giving causes individuals to increase their exercise, irrespective of their charitable giving.

Smoking In Table 6, we follow the same structure as Table 5 using the probability of smoking as our dependent variable for the first equation. In the first column, we estimate two independent probit regressions and find a significant positive relationship between the probability of smoking and the price of giving, suggesting that the two behaviors are substitutes. In the second column, we estimate a bivariate probit and find that the positive relationship holds and $\rho < 0$, suggesting that smoking and charitable giving are negatively related in terms of joint consumption. Finally, in the third column, we estimate the full structural model. First, we find that ψ_1 and ψ_2 are positive (χ^2 test statistic of 31.19, p-value< 0.001) suggesting that smoking and charitable giving are indeed *substitutes*. However, we find that the coefficient on the price of giving is no longer significant, indicating there are no significant direct effects of the price of giving on smoking.

3.3 Robustness: Alternative Measures of Price of Giving

3.3.1 First-Dollar Price of Giving using Marginal Tax Rates

Feldman (2010) estimates the effect of the price of giving on the joint decision to donate money and time. While we use the same structural model of DiNardo and Lemieux (2001), she uses data from Independent Sector's Giving and Volunteering data from 1996 and 1999 and uses the *first price of giving* as her measure of the price of giving. This measure is calculated by estimating the marginal tax rate (τ) of households setting their charitable deductions to \$0. The first price of giving is then $1 - \tau$ for itemizers and 1 for non-itemizers.

In Table 7, we use the first-dollar price of giving as our measure of the price of giving and find qualitatively similar main results for the joint decision to give to charity and exercise. We find that there is a significant direct effect of the price of giving and that exercise and charitable giving are substitutes (joint test of significance: $\chi^2 = 9.30$, p-vale< 0.01).

3.3.2 Price of Giving with Fixed Income

Throughout our analysis we explicitly control for the effect of income on giving, exercise and smoking behavior and find that income is positively related to giving and exercise and negatively related to smoking. However, income may also indirectly affect these behaviors through the price of giving—ceteris paribus, individuals with greater income will have a lower price of giving. To investigate whether income-induced differences in the price of giving are the sole source of variation driving the results in Table 5, we construct a *fixed income* price

TABLE 7: Feldman (2010) Specification: the First-Dollar Price of Giving

	1. Probits	2. Bivariate Probit	3. Structural Model
EXERCISE			
$Cln PriceOfGiving_{F}irstPrice$	-0.47***	-0.46***	-0.67***
	(0.06)	(0.06)	(0.09)
Price of Exercise	0.002	0.002	0.003
	(0.007)	(0.007)	(0.007)
Log(Income)	0.003	0.002	0.001
	(0.01)	(0.01)	(0.01)
Log(Income^2)	0.002**	0.002**	0.002**
	(0.0009)	(0.0009)	(0.0009)
Constant	0.07	0.06	-0.09
	(0.15)	(0.15)	(0.16)
Observations	55851	55851	55851
CHARITABLE GIVING			
$Cln PriceOfGiving_{F}irstPrice$	-1.69***	-1.69***	-1.73***
	(0.06)	(0.06)	(0.06)
Price of Exercise	0.009	0.009	0.009
	(0.007)	(0.007)	(0.007)
Log(Income)	-0.002	-0.002	-0.005
	(0.01)	(0.01)	(0.01)
Log(Income^2)	0.005***	0.005***	0.005***
	(0.0009)	(0.0009)	(0.0009)
Constant	-3.19***	-3.19***	-2.92***
	(0.15)	(0.15)	(0.22)
Observations	55851	55851	55851

All columns include a full set of demographic controls. All columns display coefficients, not marginal effects. Robust standard errors clustered at the individual level are presented in column (1). Bootstrapped standard errors clustered at the individual level are presented in columns (2) and (3). Standard errors are in parentheses and *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

of giving in which we hold household income constant at the 2005 inflation-adjusted level and recalculate the household's tax liability. We also calculate a *fixed income zero-dollar* price of giving to use as an instrument for the fixed income price of giving.

The fixed income price of giving is calculated by copying the income variables for a family from 2005 to subsequent years and adjusting these values for inflation. In 2005, the PSID increased the number of income variables to include asset and transfer components; these additional variables are required by the TAXSIM program for calculating tax liabilities from 2005 onwards, meaning the 2003 data (which did not include these additional variables) could not be used for to construct the fixed income price of giving and are thus excluded from the analysis. This reduces the number of individuals in our analysis to 12,057. We replicate Table 5 with the Fixed Income sample in Table 8. Our results are qualitatively similar to our main results; that is, there is a significant and dominating direct effect of the price of giving. As in Table 5, we also find that exercise and charitable giving are substitutes—a joint hypothesis test shows that ψ_1 and ψ_2 are positive (χ^2 test statistic=5.34; p-value=0.07).

TABLE 8: Fixed Income Price of Giving & Exercise

	1. Probits	2. Bivariate Probit	3. Structural Model
EXERCISE			
Log(Fixed Income Price of Giving)	-0.47***	-0.44***	-0.69***
	(0.11)	(0.12)	(0.15)
Price of Exercise	0.01**	0.006	0.007
	(0.006)	(0.009)	(0.009)
Log(Income)	-0.004	-0.007	-0.01
	(0.01)	(0.01)	(0.01)
Log(Income^2)	0.003***	0.003***	0.004***
	(0.001)	(0.001)	(0.001)
CHARITABLE GIVING			
Log(Fixed Income Price of Giving)	-1.83***	-1.80***	-1.81***
	(0.13)	(0.13)	(0.14)
Price of Exercise	-0.03***	0.01	0.01
	(0.006)	(0.009)	(0.009)
Log(Income)	-0.03**	-0.03**	-0.03**
	(0.01)	(0.01)	(0.01)
Log(Income^2)	0.008***	0.008***	0.008***
	(0.001)	(0.001)	(0.001)
ρ		0.18* **	0.24*
		(0.01)	(0.14)
ψ_1			-0.03
			(0.19)
ψ_2			0.16*∗
			(0.07)
Constant	-2.48***	-3.38***	-3.39***
	(0.14)	(0.2)	(0.26)
Observations	39041	39041	39041

PSID Data 2005-2011. N = 12,057 Individuals. Obs = 39,041.

All columns include a full set of demographic controls. All columns display coefficients, not marginal effects. Robust standard errors clustered at the individual level are presented in column (1). Bootstrapped standard errors clustered at the individual level are presented in columns (2) and (3). Standard errors are in parentheses and *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

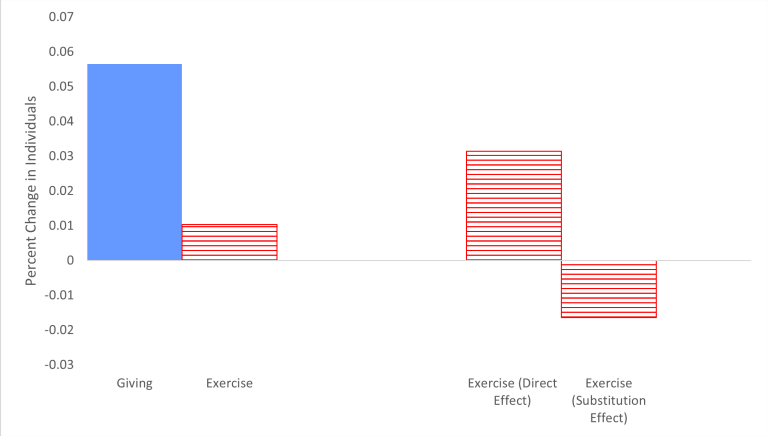
3.4 Policy Analysis

In this section, we consider how behavior changes if there is a change in fiscal policy such that the effective average price of giving decreases by 10% (one standard deviation).[14] We use the estimates from Table 5 to calculate the fraction of households that fall into each of the four participation regimes in Section 2.3: (1) Neither donate nor exercise; (2) Donate only; (3) Exercise only; and (4) Donate and exercise. We can then compare the fraction in each of the four participation regimes under the current average price of giving and under the "new policy" price of giving (i.e., 10% lower than the current average price), holding all else constant.

Figure 2 shows the percent change of individuals who give money and who exercise if

[14]We chose this change in tax policy as it is in line with current policy debates and change. For example, the Tax Policy Center estimates that the 2017 Tax Cuts and Jobs Act increased the after-tax price of giving by 7%.

Figure 2: New Policy Effects: A Decrease in the Price of Giving



The effect of decreasing the average price of giving by 10% (one standard deviation) on the fraction of households who give to charity and exercise.

the new policy were implemented. Overall, we find that a 10% decrease in the price of giving increases the share of individuals that donate by 5 percentage points and increases the share of households that exercise by 1 percentage point. However, if we disaggregate the substitution and direct effects of the change of the price of giving on exercise, we find that the share of individuals who exercise increases by 3 percentage points due to the direct effects of the price of giving, but decreases by 1.6 percentage points due to the substitution effects. Disentangling substitution effects from the direct effect of the price of giving reveals that different policies aimed at charitable giving may have differential effects on secondary behaviors depending on the sign of the substitution effect versus the direct effect. A policy that does not change the relative prices of charitable giving and exercise and thus does not generate any substitution negative effects would be preferable to a price-based policy with substitution effects if exercise and charitable giving are both behaviors that policy-makers wish to encourage. For example, nudging charitable giving but not changing the price of giving would maintain a direct effect on exercise without generating the negative substitution effect.

4 Conclusion

In this paper, we have considered the behavioral spillovers from the tax policy that encourages charitable giving into seemingly unrelated behaviors with strong moral connotations and policy relevance—smoking and exercise. In a reduced form analysis, we find a negative relationship between exercise and the price of giving and, to a lesser extent, a positive rela-

tionship between the price of giving and smoking. This suggests that exercise and charitable giving are complements and smoking and charitable giving are substitutes.

However, the reduced form analysis confounds the indirect substitution effect, that is the effect of the price of giving on exercise (smoking) that operates through a change in charitable giving, and the direct effect of the price of giving on exercise (smoking) that may arise if a change in tax policy serves as a signal of what society values. To disentangle the substitution and the direct effect of the price of giving, we estimate a structural model of joint decision-making and find that exercise and charitable giving are *substitutes* but the direct effect of the price of giving dominates, rendering a positive relationship between exercise and charitable giving.

Our results have two important implications for policy. First, our results suggest that a comprehensive policy analysis will have to consider far-reaching effects. Specifically, the tax policy that encourages charitable giving also impacts people's propensity to volunteer (Feldman, 2010), to exercise and to a lesser extent smoke. There are likely effects on other behaviors as well, a point we leave to future research. Second, our results provide some evidence of the types of policy interventions that might encourage virtuous and pro-social behavior. While our results show that charitable giving crowds-out other virtuous behaviors through the substitution effect, a policy intervention that only leverages the direct effects might be successful at encouraging exercise without sacrificing charitable giving.

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5 Appendix A

TABLE 9: Correlations with the Price of Giving

Variable	Correlation Coefficient	P-value (test of Independence)
Log Income	-0.575	0.000
Log Income^2	-0.575	0.000
Age	-0.158	0.000
Age^2	-0.158	0.000
Children?	-0.009	0.033
Num of Children	-0.003	0.533
Married?	-0.325	0.000
College?	-0.320	0.000
Yrs of Ed	-0.357	0.000
Full-Time?	-0.173	0.000
Homeowner?	-0.431	0.000
White?	-0.241	0.000
Latino?	0.026	0.000
Female?	0.049	0.000
Region		
NE	-0.082	0.000
MW	-0.018	0.000
S	0.115	0.000
W	-0.051	0.000
Year		
2003	-0.032	0.000
2005	-0.000	0.921
2007	-0.001	0.849
2009	0.004	0.355
2011	0.028	0.000
Price of Exercise	-0.193	0.000
Price of Cigs	-0.092	0.000

PSID Data 2003-2011. N = 16,682 Individuals. Obs = 57,011.

TABLE 10: Reduced Form Results: the Price of Giving & Exercise

	2SLS		Fixed Effects	
Log(P_G)	-2.93***	-0.61**	-0.62	-0.39
	(0.29)	(0.31)	(0.53)	(0.54)
Price of Exercise	-0.03***	-0.009	-0.22***	-0.06
	(0.01)	(0.02)	(0.02)	(0.04)
Log(Income)	.	0.01	.	0.03
		(0.02)		(0.03)
Log(Income^2)	.	0.002	.	-0.005
		(0.002)		(0.003)
Age	.	-0.02***	.	0.05
		(0.006)		(0.06)
Age^2	.	-0.0000478	.	-0.001***
		(0.0000663)		(0.0002)
Have Children?	.	-0.08	.	0.03
		(0.06)		(0.09)
No. of Child	.	0.03	.	0.03
		(0.02)		(0.04)
Married?	.	0.09**	.	0.17**
		(0.04)		(0.08)
College?	.	-0.13**	.	-0.11
		(0.07)		(0.16)
Yrs of Ed	.	0.1***	.	-0.006
		(0.01)		(0.03)
Full-time?	.	0.04	.	-0.04
		(0.04)		(0.05)
Homeowner?	.	0.14***	.	0.16**
		(0.04)		(0.07)
White?	.	0.52***	.	-0.23
		(0.04)		(0.2)
Latino?	.	0.18	.	0.01
		(0.14)		(0.22)
Female?	.	-0.15***	.	.
		(0.04)		
Constant	4.29***	3.26***	7.13***	4.61*
	(0.18)	(0.33)	(0.27)	(2.48)
Observations	22602	22602	22602	22602
R^2	0.003	0.09	.	.
Demographics	No	Yes	No	Yes
Region & Year FE	No	Yes	No	Yes

All columns report instrumental variable regression results: columns (1) & (2) report 2SLS results and columns (3) & (4) report 2SLS with individual fixed effects. The outcome variable Y=minutes of exercise is in the form of $log(Y+1)$. Robust standard errors clustered at the individual level in parentheses and *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.