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**Love on the Rocks:
Alcohol Abuse and Domestic Violence in Rural Mexico**

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March 2007

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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ABSTRACT

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What causes alcohol abuse and domestic violence and how can we stop them? These behaviors have multiple determinants, making the effects of changes in wife's and husband's income ambiguous. This paper estimates the effects of exogenous changes in wife's and husband's income on husband alcohol abuse and alcohol-induced violence using new data from rural Mexico. A long-lasting 20 dollar monthly increase in wife income decreases husbands' alcohol abuse by 15% and aggressive behavior by 21%; the extra money increase the wife's freedom and security, is spent on individual and household goods, and it crowds out transfers from the husband only for 5% of the wives whose income increases. Alcohol abuse and violence are insensitive to short-term fluctuations in husband's income. These findings suggest that the wife uses her higher income to reduce the consumption of goods that lower her utility, that alcohol abuse responds more to changes in permanent than in temporary income, and that targeting women as recipients of micro-credit or of other welfare programs may have beneficial effects in reducing alcohol dependence and domestic violence.

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1 Introduction

The World Health Organization (WHO) declared that interpersonal violence and harmful alcohol use are major challenges to global public health. These issues are especially severe in Latin American countries: in Mexico, 44% of women 15 and older and living with a partner were victim of physical, sexual, psychological, or economic violence in 2003; 70% of males aged 18 to 65 were habitual drinkers, and 40% of males in the same age range drank at least 1 to 3 times a month in 2002. There is also strong evidence of binge drinking: 34% of drinkers had between 5 and 24 drinks at once.[1]

Domestic violence and alcohol abuse have strong detrimental effects on both the victims and the drinkers, as well as negative externalities for society as a whole. The victims of violence are affected psychologically, physically, and economically.[2] Children who witnessed violence become more likely to accept and perpetrate this behavior (Pollack, 2002). While there are no data on the cost of domestic violence in Mexico, estimates of victims' loss of productive capacity are at least 1.6% and 2% of GDP in Nicaragua and Chile (Morrison and Orlando, 1999).

Excessive drinking has been linked to a wide range of diseases, such as gastrointestinal complications, increased risks of some types of cancers, and high blood pressure. Alcohol intoxication also affects physical motor coordination; it is a major cause of automobile accidents, as well as having detrimental social and psychological consequences because of its addictive nature: the WHO estimates that alcohol is responsible for 4% of all years of health lost through disability or premature death worldwide (Krug et al., 2002); in Mexico, 24% of male drinkers aged 12 to 65 committed some alcohol-related crime in 2002.

Lastly, there is a strong link between alcohol abuse and aggressive behavior. In 2003, one in four cases of domestic violence in Mexico involved alcohol abuse (ENDIREH, 2004). The psychiatric literature, summarized in Leonard (2000, 2005), finds that alcohol causes violence. These effects are sizeable: in 1976 a 10% increase in beer tax reduced the likelihood of severe parental violence against children by 2.3 percentage points in the United States (Markowitz and Grossman, 1998); between 1989 and 1991, the elasticity of violence with respect to alcohol

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[1]The Mexican data on violence come from the Encuesta Nacional sobre la Dinamica de las Relaciones en los Hogares, or ENDIREH, a 2003 nationally representative survey on relationship dynamics within the household. The Mexican alcohol data are from the nationally representative 2002 Encuesta Nacional de Adicciones, or National Survey of Addictions, henceforth ENA2002.

[2]Most of the victims from the ENDIREH sample report some form of psychological damage; moreover, 8% of the victims had bruises, 1.2% cuts and burns, or lost teeth; 1.9% had a hemorrhage or bled; 1% had a fracture; 1% had to undergo surgery; 1.2% had a premature delivery or an abortion; 1.8% had other gynecological problems; 1.8% fainted. 6% had to stop working or studying, while 1.7% had financial losses.

consumption for U.S. college students varied between 0.3 and 0.6 for offenses such as property damage, trouble with authorities, being involved in a fight, and sexual abuse (Grossman and Markowitz, 2001); higher alcohol prices reduce violence against wives (Markovitz, 1999).[3,4]

Understanding what causes alcohol abuse and aggressive behavior is both interesting in itself and essential to design effective policies. There are at least two competing explanations for domestic violence: 1) in the intrinsic value view, violence increases utility *per se*; 2) in the instrumental value view, violence is used instead as a tool to control the victim's resources. These two rationales may coexist. Tauchen, Witte, and Long (1991) model domestic violence as having both functions, and find an inverse relationship between the risk of violence and women's income. Bloch and Rao (2002), instead, consider violence as a mechanism to appropriate resources from the wife's family, and find that husbands from a sample of South Indian households from potter communities are more likely to beat wives who belong to rich families to extract more resources out of them. Alcohol abuse also may have an intrinsic or an instrumental value, increasing the consumer's utility either directly or through its un-inhibiting effects, or both.[5]

The effects of wife and husband's income on domestic violence and alcohol abuse differ according to which of the two motives dominate: the intrinsic value theory predicts that the consumption of these goods is a positive function of the husband's income (as he can "purchase" more of them) and a negative function of the wife's income. According to the instrumental value theory, instead, violence, and the alcohol intake needed to trigger it, depend positively on the wife's income and negatively on the husband's income.

Irrespective of the rationale for drinking and violence, higher wife income may favor the dissolution of abusive relationships, or reduce the level of violence and alcohol dependence in surviving relationships by making divorce a more credible threat: Farmer and Tiefenhalter (1996) show that battered wives may use shelter visits or police calls to signal their unwillingness to accept violence; using Canadian data, Bowlus and Seitz (2006) find that violent marriages end in divorce when the wife has the possibility to leave; Stevenson and Wolfers (2006) establish a negative relationship between the adoption of unilateral divorce law and domestic violence in the U.S.A..

How income affects alcohol abuse and violence determines what type of policies to imple-

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[3]Markovitz estimates alcohol price elasticities of violence against wife smaller than -1, but she warns that her estimates may suffer from multicollinearity.

[4]Mehlum *et al.* (2006) suggest that there may be a link between the higher rye price and the decreased violence through lower consumption of beer in 19th century Bavaria.

[5]Obviously, there may be additional causes for alcohol abuse and domestic violence. For example, Pollak (2002) discusses the importance of the inter-generational transmission of violence.

ment. For example, targeting women as direct recipients of conditional cash transfers or of micro-credit programs, which is becoming the norm in developing countries, might either have positive spillover effects by discouraging husbands' abusive behavior, or perverse effects on women's wellbeing, if it makes them the victims of violence.

The goal of this paper is to understand the determinants of alcohol abuse and domestic violence by estimating the causal effect of wife's and husband's income on alcohol abuse and aggressive behavior for poor husbands in rural Mexico. I estimate these effects using data from a sample of indigent families in rural Mexico that was collected to evaluate the Mexican flagship welfare program Oportunidades, a conditional cash transfer program that transfers money to women provided they attend nutrition and health classes, their family has regular health checks, and their children attend school regularly.

Since the program was offered only to a random group of villages in my sample, I use program availability as instrument for wife's income I use temporary health shocks of household members, natural disasters, and village agricultural wage as instruments for husband's income. The previous empirical literature regressed violence on income without accounting for its likely endogeneity (e.g. Tauchen, Witte, and Long, 1991, and Bloch and Rao, 2002). On the other hand, Miguel (2005) shows how extreme rainfall - normally associated with sizeable income decreases - causes a surge in witch killings in Tanzania, but has no income data.

I find that a 20 dollar monthly transfer to the wife - a 35% increase in the income of both spouses - decreases alcohol abuse by 15%, and that this reduces aggressive behavior by 21%. This is consistent with the intrinsic view. The extra income is managed by the woman, increases her freedom and security, does not crowd out transfers from the husband, and it is spent on goods that increase both spouses' utility.

There are two main policy implications: first, increasing female income in poor rural Mexican households (through direct transfers, micro-credit programs, but also via better employment opportunities) is a useful tool to reduce alcohol dependence and eradicate domestic violence. Second, the success of a given policy crucially hinges on local cultural norms; a policy that might empower indigent Mexican women might harm South Indian wives.

The effect of husband's income is positive but statistically insignificant. Since the instruments for husband are temporary income shocks, this finding suggests that violence and alcohol abuse are insensitive to short-term income fluctuations, while they may depend on permanent income, which changes the relative bargaining power.

The rest of the paper has the following structure: Section 2 discusses the two contrasting theories of domestic violence and alcohol abuse, and their relationship with wife and husband's

income. Section 3 describes the sample and compare its data on violence and alcohol abuse with nationally representative data. Section 4 and 5 shows the econometric model, the assumptions under which the parameters of interest are identified, and the estimation issues, while Section 5 presents the results, discussing their interpretation and providing robustness checks. Section 6 concludes.

2 Domestic violence and alcohol abuse: two alternative explanations

The incidence of domestic violence and alcohol abuse may vary depending on what causes the abuser to drink and behave aggressively. In this section I discuss two different theories for domestic violence and alcohol abuse; the theories have opposite predictions of the effects of wife's and husband's income on these behaviors.[6]

Consider violence and alcohol abuse as activities that provide intrinsic utility for the husband, while decreasing the wife's utility.[7] Define these activities as v, and abstract from issues such as actual alcohol price, and endogenous marriage formation. Income is not pooled.[8] Husband income is higher than wife income. The husband consumes v, paying for it with a monetary transfer to the wife, t.[9] The transfer increases the wife's utility and decreases the husband's. In each period the spouses agree on a level of v and a transfer t such that both individuals are at least as well off in the marriage as outside of it. Once the relationship is severed, each spouse's utility depends only on the individual income. Assume that divorced spouses cannot get back together (or that the cost of forming a new relationship is high): in this case, a wife's endurance of husband's abuses is a function of both partners' current and permanent incomes. An increase in husband's income decreases his marginal utility of income, inducing him to trade off more money for violence and alcohol abuse. The wife accepts a higher level of these goods, as long as her marginal utility of income exceeds the marginal (dis)utility of violence and alcohol abuse. Conversely, an increase in wife's income reduces the level of v (and the transfer).

Changes in current and permanent income may have different effects on v and t. For

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[6]From now on I will assume that the husband is the perpetrator and the wife the victim of violence. This is consistent with the existing empirical evidence.

[7]This model does not consider the costs of alcohol abuse for the husband (e.g. health, forgone earnings, etc.).

[8]Attanasio and Lechene (2002) reject the hypothesis that households pool income using these data. This is also a feature of household arrangements in other countries. For instance, Duflo and Udry (2004) provide evidence from Cote d'Ivoire that each spouse has direct control of parts of their earnings, and that different types of income are earmarked for different expenditures.

[9]In the case of alcohol, he is paying for her consent to drink.

example, suppose that the price of v (i.e. how much violence and alcohol abuse the husband can buy with a transfer of one peso) is a function of permanent income, while the quantity depends on current income. This is much like the Pareto weights in a households risk-sharing model depend on wealth, while the size of the intra-spousal transfers depends on the income realization. In this case, an increase in wife's permanent income reduces v in two ways: by increasing the price of v, and by reducing the marginal utility of the transfer. Instead, a temporary income increase has only the latter effect, but does not change the price of v.

Now, instead, consider v as having an instrumental value, i.e. violence is a means to control the wife's resources, and drunkenness facilitates aggressive behavior. While the threat of violence is sufficient with perfect information, if there is asymmetric information the husband uses violence to receive more money from the wife. Bloch and Rao (2002) use this idea to analyze the relationship between dowries and post-marriage monetary transfers from the wife to the husband family in India, where wife abuse is a common means to extract resources from the wife family.[10] Their model predicts that an increase in husband's income reduces violence by decreasing his marginal utility from the wife's income. Conversely, an increase in wife's income causes higher violence by lowering her marginal utility of income and increasing the amount of money she is willing to transfer to her husband, hence making violence more attractive to him. A similar argument applies for alcohol abuse.[11]

Increases in wife's income will also increase her outside opportunities, especially when the woman is financially dependent on her husband. A credible threat of divorce would lower the level and alcohol abuse and domestic violence irrespective of the determinants of the husband's behavior.

3   Sample characteristics and comparisons with nationally representative data

The data I use are a sample of poor households who live in 506 rural villages from the Mexican states of Guerrero, Hidalgo, Michoacan, Puebla, Queretaro, San Luis Potosi, and Veracruz. The primary purpose for the data collection was the evaluation of the conditional cash transfer program Oportunidades - the flagship welfare program of the Mexican government, started in 1998 and still ongoing, aimed at fostering the accumulation of human capital and at improving

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[10]In their model, the money is actually obtained from the wife's family.

[11]This perverse effect of higher wife's income on domestic violence was perceived as a potentially important issue by the Mexican policy makers when they where debating whether to have the wife or mother in the household as the direct recipient of the *Oportunidades* transfer.

nutrition and health. I have information on a variety of outcomes, including detailed income data and questions on alcohol abuse and related aggressive behavior.

From an initial sample of roughly 12,200 poor households in treatment and control villages, I excluded households where the wife is not the survey respondent, since the husband is less likely to disclose information on his violent behavior.[12] I further omitted single-headed households, households where multiple families lived in the same dwelling, and families with at least one eligible child who was not enrolled in school in the academic year before the program started (for reasons I will discuss later). The data I use in the empirical analysis are a sample of 10,257 households.

Qualitative village-level data collected in May 1999 reveal that alcohol abuse and domestic violence are perceived as important issues: 27% and 6% of respondents consider respectively alcoholism and domestic violence major problems in the sampled villages. The main dependent variables are the existence of habitual drinkers in the households, and the existence of drunken aggressive behavior. Household-level data on alcohol abuse and aggressive behavior are collected in November 1998, about 6 months after the beginning of the program. The questions asked are "Who is (are) the individual(s) who drinks the most in this household, irrespective of the frequency?" and "While drinking, does this person (referred to the heaviest drinker) have an aggressive behavior?"[13] About 30% of the households have at least one drinker, which in 95% of the cases is the male household head. Very few households report having multiple drinkers. 70% of households report having no drinker. Since drinking is much more common in rural areas than what reported in my sample (about 61% of ENA2002 males aged 18 to 65 drink), the respondents most likely interpret this question as inquiring about alcohol abuses, or at least frequent consumption.[14] This is consistent with the national evidence: in ENA2002, 36% of rural males aged 18 to 65 drink at least once a month[15], while 26% are frequent drinkers (more than half of this group drinks once a week, and about 25% several times per week).

About 14% of drinkers in this sample behave aggressively after drinking. Thus, drunken violence occurs in 4.25% of the households. Despite keeping only households where the wife is the respondent, the sample proportion of domestic violence is substantially lower than the average from the rural sample of the ENDIREH data, in which 41% of rural Mexican women

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[12]Program eligibility is based on poverty status. Therefore, I considered all poor households in both treatment and control villages. Only poor households in treatment villages are offered the treatment.

[13]The questions in the original language are: "Quien(es) es(son) la(s) persona(s) que mas bebe(n) de este hogar, aunque sea de vez en cuando?", and "Cuando bebe, esta persona tiene una actitud agresiva?"

[14]A possible reason for the vague phrasing of the sentence may be its sensitive content.

[15]More precisely, 21% drink 1 to 3 times per month, 12.5% 1 to 4 times per weeks, and 2.5% daily or almost daily.

15 or older who live with a partner were victims of some form of violence in 2003, and 10% were victims of alcohol-induced violence. The under-reporting is consistent with evidence from different databases that victims of violence may not provide this type of information because they are afraid of their husband's reaction. Moreover, in some cases the husband may be at home while the wife is interviewed.[16] Because of this under-reporting, the estimated effects of income on aggressive behavior may be a lower bound of the true effect.

Alcohol abuse and aggressive behavior increase with the household poverty level. In villages where the cash transfer to women is not offered, alcohol abuse and related aggressive behavior for the best off quartile are respectively 20% and 40% lower than for the remaining 75% of the sample. However, the evidence from the national surveys is more complex. For example, in the ENA2002 data alcohol abuses are more frequent in (wealthier) urban than (poorer) rural areas. Further, violence and female education follow an inverse u-shaped relationship: 38% of uneducated women sampled in ENDIREH are victims of violence; the proportion peaks at 52% for women with secondary education and declines beyond that point. Economically active women and women from rural areas are respectively 3 percentage point more likely and 5 percentage points less likely to be victims of violence than a randomly drawn woman. This evidence suggests that violence and alcohol abuse may be caused by multiple factors and confirms that the estimation of the causal effect of income may help unveil some determinants of these phenomena, as well as provide us with potential policy tools.

The other key variables in the analysis are wife and husband's income. The data on income are very detailed. For each household member aged 6 and above, I observe earnings and additional benefits from the main occupation, earnings from an additional job, net earnings from informal activities, income from pension, interests, rentals (land, machinery, and animals), and income from community-wide activities. I also know the value of state aid from various programs, including Oportunidades.[17] After I aggregated these data for wives and husbands separately, I dropped the few missing observations and further trimmed the top percentile and the few negative values (fewer than 1%).[18] Average wife and husband monthly incomes are 139 and 536 *pesos*, or roughly 14 and 54 dollars. While only 12% of husbands reported zero earnings, 48% of wives have no income. Oportunidades transfers are the major source of income for wives; their average income is respectively 16 and 217 *pesos* in control and treatment village.

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[16]The document summarizing the evidence from ENDIREH 2003 provides interesting, though saddening anecdotal evidence of problems with disclosing sensitive information and husbands monitoring the wives' answers.

[17]These programs are Ninos de Solidaridad, INI (National Indigenous Institute), Empleo Temporal, PROBE-CAT, and PROCAMPO.

[18]Negative income levels are possible because the money invested for informal activities may exceed the revenues.

The income of both spouses is 35% higher after the wife receives the transfer.

Income is likely endogenous, as it may be correlated to unobservable determinants of alcohol abuse and violence, therefore I need instrumental variables to obtain consistent estimates of its effect. Since one such variables is the random assignment to Oportunidades, I need to briefly describe some relevant features of the program, the data, and the randomization. In November 1998, Oportunidades provided bimonthly grants to poor households in the form of income subsidies, as well as scholarships for children attending third to ninth grade, which corresponded approximately to one half to two thirds of the wage a child would earn by working full time (Schultz, 2004), and the average monthly transfer amounted to 204 *pesos*, about 20 dollars. In these data only a random group of 320 villages participates to the program, out of the total group of 506 localities. Importantly, the cash transfers are handed to women only; thus, the randomized treatment assignment to the program increases women's incomes without being correlated with any unobservable characteristic.

The instruments for household income are job loss due to health shocks occurring to household members besides the husband, natural disasters, and village male agricultural wages. 0.7% of households have at least one member (besides the head) who could not work because of temporary health problems. In the six months preceding the interview, 42% of households were hit by at least one of the following natural disasters: water shortage, flood, frost, fire, pest, earthquake, and hurricane.[19] The share of households hit by at least one such natural disaster varies substantially both within and between villages, as shown in Figure 1. Agriculture is the main activity in 97% of villages; the daily wage averages 26.6 pesos and it varies substantially.[20]

Lastly, I observe the village price for one liter of aguardiente, the local liquor, as reported by a village official. In the case of unavailable price information, I use average municipal or state price instead. I use these price variables as exclusion restrictions in a selection model that I will discuss in the next section. Table 1 provides the means and standard deviations of the key variables.

4 Identification and estimation

Consider the following structural model:

$$D_i = \alpha_0 + \alpha_1 Y_i^w + \alpha_2 Y_i^h + \alpha_3 X_i + u_i \tag{1}$$

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[19]The most frequent natural disaster was water shortage, which affected 37% of the sampled households.

[20]Its standard deviation is 9.2.

$$V_i = \beta_0 + \beta_1 Y_i^w + \beta_2 Y_i^h + \beta_3 X_i + \epsilon_i \quad \text{if} \quad D_i = 1 \tag{2}$$

$$V_i = 0 \quad \text{if} \quad D_i = 0 \tag{3}$$

$$Y_i^j = \delta_0^j + \delta_1^j Z_i + \delta_2^j X_i + v_i^j \quad \text{for} \quad j = \{w, h\} \tag{4}$$

where D is a dummy for alcohol abuse, V an indicator for alcohol-induced aggressive behavior, Y^w is the wife's income, and Y^h the husband's. Since both incomes are likely endogenous, I use the instrumental variables Z mentioned in the previous section: random assignment to Oportunidades, health-related employment shock of household members other than the husband, natural disasters, and male agricultural wages. The X variables are frequency of health checks, regional dummies, intensity of natural disasters at the locality level, and village poverty level. The variables u, ϵ, and v^j are the unobserved determinants of alcohol abuse, aggressive behavior, and incomes, respectively.

I am interested in the effect of husband and wife's incomes on husband's alcohol abuse and aggressive behavior. Their effect on alcohol abuse is captured by the parameters α_1 and α_2. As regards the effect on aggressive behavior, I have two sets of parameters of interest: the effect of incomes on violence for both the individuals who drink and the whole sample. I will discuss identification and estimation of these parameters in turn.

4.1 The effect of income on alcohol abuse

The main identification issue in this case is the endogeneity of husband and wife's income. I assume I have valid instruments, that is i) $Cov(Z, u) = 0$, ii) the $\hat{\delta}_1^w$ and $\hat{\delta}_1^h$ are significant, and iii) the instruments are not weak. Since the zero covariance assumption is non-testable, I will first discuss whether the exclusion restrictions are plausible for each instrument.

The instrument for wife's income is program assignment. Since this assignment is random, the instrument is uncorrelated with pre-program unobservables by design. However, this variable may not be excludable, as it may affect the dependent variables besides its effect through income. There are four channels through which Oportunidades may affect alcohol abuse and aggressive behavior over and above its effect on female income: first, the program may influence alcoholism and violence also by causing an increase in school attendance. Women and children who were otherwise isolated may have contact with other people and report the abuses to the teachers; bruises and signs of violence may be noticed. To avoid this possibility, I dropped all families with at least one eligible child who was not enrolled in school in the academic year before the program started.[21] Thus, I restrict the sample to households without eligible children

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[21]I identify these children in the following way: first, they have to be up to 17 years old in September 1997.

or families whose eligible children were already attending school in the 1997-1998 academic year.

Second, program recipients are required to have quarterly health checks; the checks are respectively every three and two months for adults and children. Although infrequent, these checks may provide a disincentive for the husband to be physically abusive towards his wife and children. To control for this potential effect, I add dummies for frequency of health visits in the previous 6 months.[22] It turns out that most households did have health checks irrespective of their eligibility to Oportunidades; 72% of households in control villages had health checks, against 86% in treatment villages.

Third, the program may affect prices. However, Angelucci and De Giorgi (2006) show that this is not the case. In any case, I compared alcohol prices of treatment and control villages, which showed that average aguardiente prices are 11.95 in control villages and 12.05 in treatment villages; their difference is not statistically significant. Since village-level data on alcohol price were available in only 118 of the total 506 sampled villages, I computed the average municipal price when the village price was missing.[23] I also repeated this exercise considering only villages for which price data were available. The average prices for this smaller sample are 10.56 and 9.71 in treatment and control villages, and again their difference is not significant. As a further check, I estimated equations (1) to (4) alternatively including and omitting alcohol price from the set of covariates X; the results do not change.

Fourth, the cash recipients have to attend nutrition and health classes. These classes may teach women that domestic violence is an unacceptable habit, provide them with an opportunity to voice their discontent, and give support for confronting their husbands. To test that this is not the case, I estimate the effect of Oportunidades on the households who did not qualify for the program (because they are not poor enough), but who live in treated villages. The women of those households were also strongly encouraged to attend the meetings; however, the program does not change their earnings.[24] I do not find any significant effect for this group,

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This is because the program is only offered to individuals 18 and younger. Second, they must have completed grades 1 to 8 in the 1996-1997 academic year. Children with lower or higher education levels are not eligible for the program, which provides pupils attending grades 3 to 9 with scholarships in 1998 and 1999. I include in my sample all the families with no such children, as well as families with children in this category, as long as all of them were going to school in the academic year 1997-1998. For example, if one family has two children aged 9 and 10 with 3 years of education, but only one is enrolled in school in September 1997, I drop the entire family from my sample. This is because the eligibility to Oportunidades may induce the family to send the child to school, and this may affect the husband's drinking and abusive behavior in the ways described above. Note that families did not know about the program when they had to enroll their children to school in 1997.

[22]The possible responses to whether the family had health checks in the previous 6 months are "yes"; "yes, at times"; "yes, rarely"; "no".

[23]In a few cases I used instead average state prices, because there were no alcohol data at the municipal level.

[24]These households receive more transfers and loans from friends and relatives (Angelucci and De Giorgi, 2006). However, there is no difference in the amounts of loans and transfers to non-eligible wives in treatment

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suggesting that this channel may not be important, or that it may operate only when there is also a positive income change.[25]

Program assignment as an instrument identifies the expected change in alcohol abuse for each extra unit of income that wives eligible for Oportunidades have over wives who live in control villages, or:

$$\frac{E[D|T=1,X,Y^h] - E[D|T=0,X,Y^h]}{E[Y^w|T=1,X,Y^h] - E[Y^w|T=0,X,Y^h]} \tag{5}$$

where T is the random program assignment indicator (T=1 in Oportunidades villages, and 0 otherwise).[26] In the result section, I will report both the marginal effect and the effect of the average transfer size on the dependent variable, an estimate of the numerator of this ratio.

The three potential instruments for husband's income are the idiosyncratic component of natural disasters, village average daily agricultural wage, and employment shocks. The village aggregate component of natural disasters may affect drinking and abusive behaviors, for example by changing prices of labor, goods, and capital. Indeed, the average intensity of natural disasters at the village level is negatively and significantly correlated with both wages, by -28%, and alcohol price, by -22%. To control for this effect, I included the average incidence of natural disasters at the village level, a set of regional dummies, and the village poverty level to the set of conditioning variables, to capture both the long-term and the current riskiness of each locality.[27] The idea is that there are other factors besides this type of shock that influence prices, and I am assuming that these factors are conditionally independent of alcohol abuse and violence. Thus, my identification assumption is that in two villages from the same region and with the same current level of poverty and of natural disasters, the difference in wages and in whether the individual households suffered a shock will affect the dependent variables only through changes in income.

The case for the additional instrument, job loss of household members (other than the head) due to temporary incapacitation, is more straightforward: the identification assumption is that this type of health shock affects husband's alcohol abuse and aggressive behavior only by changing his income. Since only 0.7% of households have at least one such member, I can rule out price effects.

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and control villages.

[25]I estimated a reduced-form model of alcohol abuse and alcohol-induced violent behavior on the treatment assignment dummy and the X covariates using data on the non-poor in treatment and control villages: the marginal effects (and standard errors) were -0.014 (0.018) and 0.003 (0.006), respectively.

[26]This is under the assumption that the other instruments do not have a significant effect on wife's income.

[27]The average incidence of natural disasters at the village level is the fraction of households who were hit by at least one natural disaster in the previous 6 months.

One may argue that more vulnerable households may be both more prone to health shocks or natural disasters and more likely to have alcoholic and abusive husbands than other households. This hypothesis is non-testable. However, if this were the case, one would expect past consumption and income to be lower for families currently hit by a shock than for families who are not. I regress September 1997 household monthly income and March 1998 monthly food expenditure per adult equivalent, which averaged respectively 758 and 603 *pesos* (at current prices), on dummies for whether each type of shock occurred between May and November 1998, conditioning on the X covariates. The estimated coefficients are neither statistically nor economically significant, as shown in Table 2. Lastly, these shocks possibly have psychologic effects that may induce alcoholism or violence. I assume that these effects are functions of income, e.g. that a head whose household suffered a shock without incurring any income loss will not change his drinking and aggressive behavior.

These instruments identify the effect of random income shocks due to such factors as a lower than average harvest (if wages depend on output), or a loss of manpower caused by a co-worker's illness (if relatives work together). Importantly, while the wife's income change is expected and somewhat long-lasting, the husband's income shock is unexpected, and probably short-termed, since future shocks do not predict past income and expenditure.[28]

Although (1) is a linear probability model, I estimate it using both linear and non-linear estimators: 2SLS, LIML, and probit. When using linear probability models, I interpret the estimated coefficient as locally linear marginal effects at the mean of the explanatory variables. The same applies for the violence regressions.

4.2 The effect of income on alcohol-induced violence

I am interested in estimating two sets of parameters: the effect of income on the aggressive behavior of individuals who drink, and the overall effect of income on alcohol-related violence.

First, consider the effect of income on violence for drinkers. If income causes both alcohol abuse and aggressive behavior, an income increase will change both the set of individuals who drink and their likelihood of being violent. Therefore, the instrumental variables may no longer be independent of the unobservables in equation (2), since they select a different set of drinkers. In this case, I can identify the causal effect of income on violence under the following additional assumptions, besides the instrument validity assumptions i) to iii): iv) $u_i \sim N(0, 1)$; v) ϵ_i is a

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[28]The program characteristics are discussed in village assemblies; the transfers are initially guaranteed until the end on 1999.

linear function of u_i, $E(\epsilon_i|u_i) = \lambda u_i$. Consider the following selection equation:

$$D_i = 1\{\gamma_0 + \gamma_1 X_i + \gamma_2 Z_i + u_i > 0\}$$

Under these assumptions, $E(\epsilon_i|X, Z, D = 1) = \lambda I$, where $I = \frac{\phi(\gamma_0 + \gamma_1 X_i + \gamma_2 Z_i)}{\Phi(\gamma_0 + \gamma_1 X_i + \gamma_2 Z_i)}$ is the inverse Mills ratio. The above assumptions enable me to re-write equation (2) as

$$V_i = \beta_0 + \beta_1 Y_i^w + \beta_2 Y_i^h + \beta_3 X_i + E(\epsilon_i|X, Z, D = 1) + e_i \tag{6}$$

where $e_i = \epsilon_i - E(\epsilon_i|X, Z, D = 1)$. I can obtain an estimate of the inverse Mills ratio using the parameters from a probit regression of D on X and Z. Since $E(e_i|X, Z, D = 1) = 0$ by construction, I can regress V on income, the X covariates and the estimated inverse Mills ratio by 2SLS, and compute the standard errors with the bootstrap. This is a selection model with endogenous explanatory variables, as described in Wooldridge (2002). Identification is achieved through both the non-linearity of the inverse Mills ratio and the use of variables that affect aggressive behavior only through drinking. The instruments Z include both the variables discussed above and village-level alcohol price data; these are the price of one liter of aguardiente, and a dummy for price availability at the village level, as reported by the interviewed official. The absence of information on alcohol price may either mean that this product is not sold locally (probably because there is no local store or market), or that the respondent is either a teetotaller or does not purchase aguardiente. The absence of a local liquor retail outlet likely increases the effective price of alcohol, as one has to add transportation costs. Further, a non-drinking elected official may represent local preferences against alcohol. Thus, my additional identification assumptions are that, conditional on observables, villages with higher alcohol prices or with missing alcohol price data are less likely to have alcohol-abusing husbands, but that a higher price and price availability have no direct effect on alcohol-induced violence.

The second parameters of interest are the effects of wife and husband's income on alcohol-induced aggressive behavior for the whole sample. The expected level of violence, irrespective of whether the husband drinks, is the following:

$$E[V|X, Y^w, Y^h] = E[V|X, Y^w, Y^h, D = 1] \times P(D = 1|X, Y^w, Y^h) \tag{7}$$

Thus, the overall effect of income on aggressive behavior is the sum of two partial effects: the direct effect of income on aggressive behavior for drinkers, and its indirect effect through

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changes in alcohol abuse. This is a non-linear function of income, if both effects are statistically significantly.

5   Results

5.1   The effect of shocks and treatment assignment on wife and husband's income

Table 3 provides OLS estimates of the first-stage regression coefficients. Treatment assignment is the only significant instrument in the wife's income regression: wives in treatment villages have on average 195 more pesos than wives in control villages; husband's income does not differ by village type. Husband's income is a negative function of both natural disasters and job loss of household members; compared to the average income in a household without negative shocks, husband's income is 46 pesos lower in households that suffered from some natural disaster, and 279 pesos lower if any relative could not work because of temporary health issues (see column 3). This latter effect suggests that there may be complementarities in income production, such as those generated by relatives working on the same plot of land or having the same business. An alternative explanation for this lower income may instead be that health shocks are correlated, e.g. both the husband and another relative fall ill: however, out of the households with one such health shock, only in 15% of cases the husband is temporarily incapacitated too. Moreover, the coefficient is the same when I estimate this regression omitting households where the head also suffered a health shock.

Interestingly, the effect of temporary incapacitation of the wife on husband's income is significantly larger than the effect of other members' health shocks. In unreported regressions, I estimated the separate effect of wife and other household members' health shocks on husband's income, and found that the coefficients are respectively -376 and -184 pesos, both statistically different from zero and from each other at the 1% level. This is perhaps due to wives being more likely than other relatives to work in the same business as their husbands'. Alternatively, when the wife falls ill the husband may have to attend to some of her duties, having less time to do paid work. Lastly, there is a positive and significant effect of agricultural wages on husband's income; a one peso increase in daily wage is associated with a 4 peso higher husband income.

The F test of joint significance of the instruments and the partial R^2 are very high in the the wife's income first-stage regression, but less so for husband's income. Nevertheless, the value of the F test of joint significance of the instruments for husband's income is never less than 10,

which is Staiger and Stock's (1997) rule of thumb to detect weak instruments.[29]

5.2 The effect of wife and husband's income on alcohol abuse and aggressive behavior

Table 4 shows estimates of the effect of wife and husband's income on husband's alcohol abuse. Higher wife's income causes a significant significant decrease in the husband's alcohol abuse; a 200 peso increase in her monthly income (i.e. the approximate income increase caused by the program) reduces the likelihood of alcohol abuse by 4.6 percentage points, a 15% drop compared with control villages (columns 1 and 3). The 2SLS estimates are lower than the OLS one, which are 0.001 and not statistically different from zero (column 2). This suggests OLS is upward biased.[30] Changes in husband's income, on the other hand, have no significant effect on the likelihood of abusing alcohol consumption; the point estimates are positive, but very imprecisely estimated.

The estimated effects do not change when I instrument for one endogenous variable only (columns 4 and 5). When there are two potentially endogenous explanatory variables X_1 and X_2, 2SLS provides consistent estimate of X_1 as long as the instrumental variable used is uncorrelated with X_2 (Ackerberg and Crawford, 2006). This is possible here because the instruments for husband's income - job loss due to temporary incapacitation, natural disasters, and agricultural wage - are not significantly related to wife's income, and vice versa. This is potentially useful especially to estimate the effect of husband's income, because I can exploit all the variation in wife's income to try and improve the precision of its estimate. However, the estimated effect is still insignificant. The instruments for both wife and husband's income are not weak, and the estimates' significance and magnitude are broadly unchanged when I use different estimators, as I discuss in the Appendix.

Table 5 provides estimates from selection models that use price of aguardiente and price availability as instruments for the likelihood of drinking.[31] Neither income coefficient is significantly different from zero. Thus, income changes do not seem to affect alcohol-induced violence for individuals who drink. However, the partial effect of husband's income must be interpreted with caution, since the instruments for husband's income are weak in this smaller sample. For example, when I regress husband's income on agricultural wages, health-related job loss of other

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[29]This rule of thumb applies for single endogenous explanatory variables.

[30]The OLS estimate of wife's income is also positive but not significantly different from zero when I estimate it for households in control villages only.

[31]The partial effects of alcohol price and price availability are respectively -0.061 (standard error 0.017) and -0.003 (0.001).

members (excluding wife and husband), and the two alcohol price variables (as well as on the X variables), the F-test of joint significance of the instruments is only 5.55, as shown in column 5.[32] In case of weak instruments, 2SLS is biased towards OLS. The evidence against a causal effect of wife's income is instead stronger.[33]

As for alcohol abuse, a comparison of the OLS and the 2SLS estimates shows that failing to control for the endogeneity of income results in upward-biased estimates.

Some of the individuals in this sample are husbands who did not stop drinking despite their wife's higher income. If individuals whose drinking habits are the least sensitive to their wife's higher income are also the most violent, then the effect of wife's income on this group may be a lower bound of the effect in the whole sample, and higher wife's income may deter aggressive behavior in at least some individuals. I can indirectly test for this hypothesis comparing the frequency of aggressive behavior for drinkers in control and treatment villages. Treatment villages have proportionally fewer drinkers than control villages because Oportunidades increases wives' incomes, causing a drop in alcohol abuse, without changing husbands' incomes. If the individuals who drink despite their wives' higher income are the most violent, their incidence of violence should be higher than for drinkers in control villages. Instead, the difference in aggressive behavior between these two groups of drinkers is very small and not statistically significant. The proportion of drinkers in control and treatment villages who committed aggressive behavior is actually lower in control (14.3%) than in treatment villages (13.7%), and their difference is not statistically significant, either with and without conditioning on the set of X variables. This provides further evidence against a direct effect of wife's income on alcohol-induced violence.

These results suggest that the overall effect of wife's income on alcohol-induced violence in this sample is simply the partial effect of income on alcohol abuse, times the probability of alcohol abuse:

$$\frac{E[V|X,Y^h,T=1] - E[V|X,Y^h,T=0]}{E[Y^w|X,Y^h,T=1] - E[Y^w|X,Y^h,T=0]} =$$
$$\frac{E[D|X,Y^h,T=1] - E[D|X,Y^h,T=0]}{E[Y^w|X,Y^h,T=1] - E[Y^w|X,Y^h,T=0]} P(V=1|X,Y^h,Y^w,D=1)$$

Under the restriction that the direct effect of income on violence is zero, I can obtain a reduced-form estimate of the overall effect of wife's income on violence simply by regressing violence on income for the whole sample and accounting for the endogeneity of wife's income.

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[32]I dropped natural disasters, which now appear to be insignificant.

[33]As in the previous case, I checked that these results are robust to using different estimators and instruments, as reported in the Appendix.

Table 6 shows that the estimates of wife's income are negative, significant, and robust to the choice of different estimators. The estimate of the marginal effect from column 4 is -0.047, significant at the 95% level, showing that a 200 peso increase in monthly income causes a reduction in alcohol-induced aggressive behavior of 1 percentage point. This a 21% drop, compared with the incidence of violence in control villages, which is 4.7%.

5.3 Interpretation: determinants of alcohol abuse and violence, wife utility, and policy implications

A 20 dollar increase in wife's income reduces alcohol abuse by 15% and this, in turns, causes a 21% drop in the related aggressive behavior. The estimated effect of income on violence is probably an underestimate of the true effect in the sample, as the actual level of violence is likely higher than reported. This is consistent with Bobonis *et al.* (2007), who, using different violence data, find that physical and sexual abuse against women is 30 percent lower in beneficiary than in control households. These effects are consistent with the intrinsic view that drinking and violence provide direct utility to the husband, while reducing the wife's wellbeing; therefore, the wife's higher income enables her to reduce the level of husband alcohol abuse and aggressive behavior. This is not surprising, considering that the wives in my sample have hardly any income, besides the program transfers, so the alcohol abuses and violence observed in areas where Oportunidades is not implemented are unlikely caused by a need to control the wives' monetary resources.

An alternative explanation is that the drop in alcohol abuse and violence are caused by the wife's more credible divorce threat, now that her income is higher, irrespective of whether the husband enjoys these goods *per se*, or uses them as tools to control the wife's income. The threat is probably not credible, though. Although the average Oportunidades transfer is more than a tenfold increase in wife's income, 200 *pesos* per month would not be sufficient to provide enough food for the wife and her children, if she were to leave her husband taking her children with her. The average monthly food consumption for adults and children are 128 and 94 *pesos* in the absence of the program (Angelucci and De Giorgi, 2006, and Di Maro, 2003). The wives in my sample have on average 1.14 children eligible for Progresa, and an additional 1.97 children aged 0 to 9, requiring in total 420 *pesos* per month only to provide food (including the food needed for the wife). Moreover, although guaranteed for two years, the transfers 1) may stop at the end of 1999, and 2) are linked to children's school attendance, and would eventually stop as the children complete the subsidized grades. Lastly, divorce is not as socially acceptable in Mexico as in other countries. For example, the divorce rate in rural Mexico is 0.10 per thousand

inhabitants, 5.7 times as small as the U.S. rate (United Nations Demographic Yearbooks 2002 and 2003).

How much money is the wife giving up to reduce the husband's alcohol abuse and drunken violence? While I have no quantitative data on intra-household transfers, I can look at how the wife's extra money is spent, and whether it crowds out transfers from the husband. For this purpose, I use follow-up interviews to the recipients of the Oportunidades grants, who explain how the program has affected them. These data are collected in May 1999 from the same sample of beneficiaries I observe in November 1998. Interestingly, only 5% of recipients receive fewer transfers from their husbands, and only 0.1% of recipients hand the money to their husbands. Instead, the wives manage the extra income, and transfer resources to the husbands by purchasing goods that increase the utility of all household members. The three most commonly purchased items are food (89%), shoes (38%), and clothes (33%), followed by school supplies, housewares, and medicines.[34] Thus, the cost of lower alcohol abuse and violence is only a fraction of the wife's extra income. For example, if the transfer is divided in equal shares between 5 household members, husbands on average receive resources worth 40 *pesos* per month.[35]

The respondents have a positive perception of the program overall effects. When asked about how being an Oportunidades beneficiary affected their lives, the receipients' most common answers suggest increased freedom and security: 55% of women report feeling safer, 50% having money at their disposal, 20% being able to decide what to purchase, and 13% being free to spend on whatever they need. Only 0.1% report having problems with their spouses. This additional evidence suggests that husbands are not simply changing their type of violent behavior (e.g. from drunken to sober violence), but that the quantity of overall domestic violence must also be dropping.

These results have clear policy implications: providing poor women with opportunities to increase their income may reduce the husbands' alcohol dependence and drunken violence. One way to achieve this is by targeting women as direct recipients of cash transfers or of micro-finance programs, both of which are becoming a common practice in developing countries. In order to assess the effectiveness of such policies, one would need some estimates of the cost of

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[34]The respondents could give multiple answers.

[35]These may actually be conservative estimates, because the household size of program beneficiaries is lightly bigger, and the largest increase in non-food expenditures if for child-specific goods: for instance, Attanasio and Lechene (2002) show that, as the share of household income brought by the wife increases, there is an increase in the consumption of food and child clothing, and a drop in tobacco and alcohol expenditures. Rubacalva *et al.* (2006) show that the income transferred to women through Oportunidades is spent on small livestock, on child goods, and to improve nutrition, and that overall it increases women's power in the household.

alcoholism and domestic violence, which, to my knowledge, are not available for Mexico.[36] At the very least, these findings lengthen the list of the known beneficial effects of cash transfers to poor women. At a broader level, they teach us that problems such as alcohol abuse and domestic violence, which seem to be endemic to particular cultures, are by no means ineradicable, and can be alleviated by an appropriate set of policies.

Another interesting result of this exercise is that alcohol-induced aggressive behavior declines only through a reduction in drinking; the higher wife's income does not reduce the aggressive behavior of drinkers. Therefore, when they are drunk husbands respond to incentives differently than when they are sober. This is not a new result: the medical and psychiatric literatures overwhelmingly point to this direction (e.g. Leonard, 2000, 2005). The importance of alcohol as a trigger for violence confirms that a further policy tool to reduce both alcohol abuse and violence may be alcohol price, consistent with the evidence provided by Grossman and Markovitz, and Mehlum *et al.* (2006).

Lastly, husband's income has no significant effect on alcohol abuse, while the instruments are not sufficiently strong to provide reliable evidence on its direct effect on domestic violence. Since the instruments are temporary income shocks with supposedly no long-term effects, these results suggest that alcohol abuse does not respond to transitory changes in husband's income. This behavior may instead be a function of permanent income as a proxy for the spouses' bargaining power, as shown by the fact that long-lasting changes in wife's income lower alcohol abuse.

6 Conclusions

Alcohol abuse and domestic violence are severe public health issues in Mexico; understanding their causes and how they respond to income changes is fundamental for their eradication. Using a sample of poor households from rural Mexico, I showed that long-lasting increases in wife's income reduce alcohol abuse and drunken aggressive behavior, unlike short-term fluctuations in husband's income, which have no significant effect.

I coupled the quantitative analysis with evidence that the higher wife's income is managed by the recipient, does not crowd out transfers from the husband, is spent on goods that increase

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[36]The World Health Organization (WHO, 2004) reported an increase in mortality rates from ischaemic heart disease and cirrhosis of the liver, for which alcohol is one of the underlying risk factors: for example, liver cirrhosis is one of the top 10 causes of death among the Mexican population, and it is the most common cause of death among males between 35 and 54 years of age. The mortality rate due to alcohol has increased from 7.8/100 000 persons in 1970 to 12/100 000 persons in 1995 within the population 15 years of age and older (Medina-Mora *et al.*, 2000). Higher mortality is only a fraction of the overall costs of alcohol abuse and domestic violence.

the utility of all household members, and causes an increase in security and independence. These results have important policy implications, suggesting that female income or labor force participation may be used as policy tools to reduce alcoholism and domestic violence. They also confirm that the growing practice of targeting women as recipient of cash transfers or micro-credit has positive spillover effects in this dimension.

As usual, these results should be interpreted with caution: what applies for poor rural households may not work for wealthy urban ones. Further research is needed, for example, to assess the effect of income for wealthier households, for whom the instrumental value of alcohol abuse and domestic violence may be more relevant. A better understanding of these phenomena is essential for the design of appropriate policies: my paper is a step in that direction.

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7   Appendix: robustness checks

Table 7 estimates the effects of income on alcohol abuse and violence using the same data described in the text, but trying different estimators and changing the set of instrumental variables. The magnitude and significance of the estimated effects do not vary. I report LIML estimates, which are robust in case of weak instruments, probit estimates, and 2SLS estimates accounting for the endogeneity of husband's income only. When I estimated equations (1) and (4) jointly, the likelihood function did not converge easily. Thus, I am reporting the results from a two-step procedure using a control function approach (e.g. as in Blundell and Smith 1989), estimating the standard errors with the block-bootstrap (where the block is the village). Columns 3 and 6 show that the instruments for husband's income are not weak; the Cragg-Donald F-test for weak instruments is 24.03. These values reject the null hypothesis of weak

instruments at the 5% level for a 10% desired maximal size of the Wald test.[37] Also, note that the overidentification tests can never reject the null that the instruments are uncorrelated with the error term, and that they are correctly excluded from the estimated equation.[38]

My second set of robustness checks regards the effect of income on the unconditional likelihood of violence. First, I estimate the overall effect of income on alcohol-induced violence in two steps, multiplying the estimate of the partial effect of income on drinking by the average probability of violence in my sample, assuming that the partial effects of wife and husband's income on violence are both zero, and computing the standard errors by the bootstrap. In that case I obtained a point estimate of -0.033 (standard error 0.006) for the effect of wife's income, and of 0.008 (0.020) for the effect of husband's income.[39]

Second, I measure the indirect effect of wife's income on violence by estimating the effect of drinking on the related violence, π_1 in the following regression,

$$V_i = \pi_0 + \pi_1 D_i + \pi_2 X_i + \nu_i$$

I then multiply this number by the effect of income on drinking from Table 4. Since drinking and violence may be both driven by unobserved factors, I use price of aguardiente, and the availability of this price, as instruments for drinking in the violence equation. The instruments are strongly significant in the first stage and pass both the weak instruments tests in Stock and Yogo (2005) and the overidentification test with flying colors.[40] The estimated partial effect of alcohol abuse on aggressive behavior is 0.320 (with a standard error of 0.089). Using the partial effect of wife's income on alcohol abuse from column 2 in Table 4, and estimating the standard errors with the bootstrap (selecting villages as the sampling block and having 500 repetitions), I estimate an indirect effect of wife's income on aggressive behavior of -0.074 (standard error 0.037).

My final set of checks controls that the results are robust to using a different subset of households, a different definition of income, and different instruments. First, I additionally excluded families whose children may finish primary school and have to choose whether to enroll in secondary school while the program is being offered, i.e. children who completed either fifth or sixth grade by the end of the academic year 1996-1997. These are the families whose

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[37]The critical values are 16.38 and 19.93 for a test based on the desired maximal size of a 5% Wald test of the significance of the 2SLS estimate for one endogenous variable and using respectively one and two instruments (Stock and Yogo, 2005).

[38]For 2SLS, this test is Hansen's J statistic, for LIML it is the Anderson-Rubin statistic.

[39]I used 500 replication and randomly selected blocks of villages.

[40]The Cragg-Donald F-statistic is 21.41, the p-value of the overidentification test is 0.444.

children's schooling decisions are most likely affected by Oportunidades, since pre-program enrollment rates drop dramatically from primary to secondary school (i.e. from grade 6 to 7), and Oportunidades has been shown to be especially successful in furthering school attendance beyond sixth grade (columns 1-3 of Table 8).[41] Second, I experimented with a different definition of income that includes the value of loans and transfers received by the wife and husband (columns 4-6 of Table 8). Third, I slightly changed the instrument set. For example, I replaced the health-induced job loss dummy with the number of household members who were ill in the previous month. The results are robust to these changes.

A further concern is that I did not detect any significant effect of husband's income on alcohol abuse and aggressive behavior because the sample size is too small. For this reason, I estimated the effect of husband's income on these two outcomes on the entire sample, including households non eligible for the program who live in control and treatment villages. In this way the overall sample sizes are 17312 and 4910. When I use the whole sample, the instruments are robust and the main results are unchanged; temporary shocks to husband's income do not affect alcohol abuse and violent behavior. However, the instruments are weak for the sample of drinkers (columns 7-9 of Table 8).

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[41]However, note that the enrollment to the 1997-1998 academic year is most likely exogenous, because in September 1997 the households did not know about the program, which started in 1998.
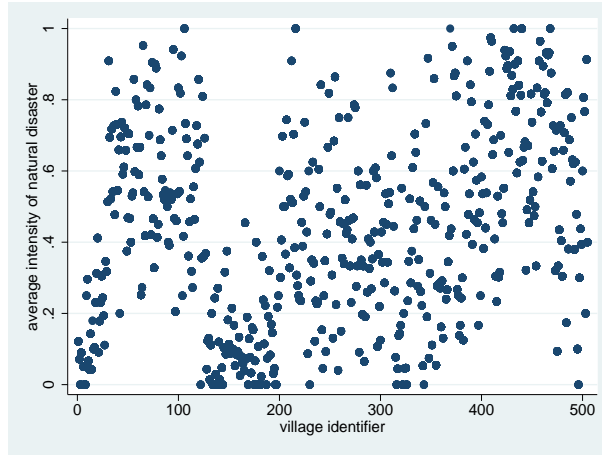
Figure 1: Village share of households hit by at least one natural disaster between May and November 1998.

Table 1: Means and standard deviations of the main variables

Alcohol abuse	Aggressive behavior	Wife income	Husband income	Oportunidades eligibility
0.29	0.04	0.14	0.54	0.61
(0.45)	(0.20)	(0.21)	(0.74)	(0.49)
Job loss (health)	Natural disaster	Daily wage	Price of alcohol	Price unavailability
0.007	0.42	27.31	12.02	0.77
(0.08)	(0.49)	(10.00)	(4.80)	(0.42)

Wife and husband monthly incomes are in thousand *pesos*. Daily wages (in *pesos*) are average wages for male agricultural workers. No agricultural wage is reported in 19 villages. In that case, average municipal or state price are used instead. Wage and price data averages are based on 506 observations, the number of villages in the sample.

Table 2: Difference in past income and consumption by current shock type

	Sept. 1997 income	March 1998 food expenditure
Natural disaster	-7.72	-1.297
	[16.092]	[1.943]
Job loss (health)	28.661	-10.025
	[99.696]	[7.299]

Standard errors clustered at the village level. The additional covariates are regional dummies, average natural disaster at the village level, village marginalization index, and frequency of health checks.

Table 3: Effect of different income shocks on wife and husband's income

	(1) Wife income	(2) Wife income	(3) Husband income	(4) Husband income	(5) Husband income
Oportunidades	0.195	0.195	-0.025	-0.024	
	[0.006]***	[0.006]***	[0.024]	[0.024]	
Job loss (health)	0.01		-0.277		
(no husband)	[0.025]		[0.042]***		
Job loss (health)		0.032		-0.181	
(no husband or wife)		[0.037]		[0.061]***	
Natural disaster	0.001	0.001	-0.052	-0.053	
	[0.004]	[0.004]	[0.016]***	[0.016]***	
Agricultural wage[a]	0.005	0.006	0.432	0.430	0.444
	[0.047]	[0.046]	[0.128]***	[0.128]***	[0.124]***
R^2	0.23	0.23	0.03	0.03	0.03
Instrumental variables' partial R^2:					
	0.20	0.20	0.004	0.003	0.002
F test of joint significance of the instrumental variables:					
All	248.25***	248.26***	20.43***	12.02***	12.71***
Excluding Oportunidades	0.10	0.35	26.47***	14.18***	12.71***

Standard errors clustered at the village level. ***, **, *: significant at the 1%, 5%, and 10% level. The additional regressors are frequency of visits to health clinics; village poverty level, regional dummies, and village intensity of natural disasters in the previous 6 months. [a]: the wage is in hundreds of pesos.

Table 4: Effect of wife and husband's income on the probability of alcohol abuse

	(1) OLS reduced form	(2) OLS	(3) 2SLS	(4) 2SLS wife only	(5) 2SLS husband only
Oportunidades	-0.046 [0.016]***				
Job loss (health) (no husband)	-0.033 [0.051]				
Natural disaster	0.015 [0.081]				
Agricultural wage	0.006 [0.011]				
Wife income		0.001 [0.028]	-0.232 [0.083]***	-0.234 [0.082]***	0.002 [0.028]
Husband income		0.001 [0.006]	0.018 [0.124]	0.001 [0.006]	0.029 [0.119]
Instruments:					
Treatment assignment			Yes	No	No
Agricultural wage			Yes	Yes	Yes
Natural disaster			Yes	No	Yes
Job loss (health) (no husband)			Yes	No	Yes
Job loss (health) (no husband/wife)			No	No	No
Overidentification test (p-value):			0.699		0.709
Cragg-Donald test			10.74	2576.50	14.49

Monthly income in thousand *pesos*. Standard errors clustered at the village level. ***, **, *: significant at the 1%, 5%, and 10% level. The sample size is 10257. The estimated effects of husband's income in column 4 and wife's income in column 5 are biased and inconsistent.

Table 5: Effect of wife and husband's income on the probability of aggressive behavior conditional on drinking

	(1) OLS Reduced form	(2) OLS	(3) 2SLS	(4) 2SLS wife only
Oportunidades	-0.004			
	[0.015]			
Agricultural wage	0.047			
	[0.081]			
Job loss (health)	0.274			
(no husband/wife)	[0.136]**			
Wife income		0.093	0.105	0.085
		[0.035]***	[0.127]	[0.095]
Husband income		-0.009	-0.035	-0.011
		[0.08]	[0.185]	[0.008]
Inverse Mills ratio	-0.277	-0.294	-0.300	-0.276
	[0.117]**	[0.099]***	[0.167]*	[0.125]**
Instruments:				
Treatment assignment	No	No	Yes	Yes
Agricultural wage	No	No	Yes	No
Job loss (health) (no husband/wife)	No	No	Yes	No
Alcohol price	Yes	Yes	Yes	Yes
Price availability	Yes	Yes	Yes	Yes
F stats of instruments in 1st stage:				
Wife income			100.43***	165.91***
Husband income (all IVs)			5.55***	
Husband income (no price or treatment assignment)			11.15***	

Monthly income in thousand *pesos*. Standard errors clustered at the village level. ***, **, *: significant at the 1%, 5%, and 10% level. In case of block-bootstrap estimates of the standard errors, the block is the village. The sample size is 2936. The estimated effect of husband's income in column 4 is biased and inconsistent.

Table 6: Effect of wife and husband's income on the unconditional probability of aggressive behavior

	(1) OLS reduced form	(2) OLS	(3) 2SLS	(4) 2SLS wife only	(5) 2SLS husband only
Oportunidades	-0.009 [0.005]*				
Natural disaster	0.015 [0.027]				
Agricultural wage	0 [0.004]				
Wife income		0.017 [0.011]	-0.043 [0.026]*	-0.047 [0.024]**	
Husband income		-0.003 [0.002]	0.023 [0.050]	-0.003 [0.002]	0.027 [0.050]
Instruments:					
Treatment assignment			Yes	No	No
Agricultural wage			Yes	Yes	Yes
Natural disaster			Yes	No	Yes
Job loss (health) (no husband)			No	No	No
Job loss (health) (no husband/wife)			No	No	No
Overidentification test (p-value):			0.676		0.640
Cragg-Donald test			11.01	2576.50	16.79

Monthly income in thousand *pesos*. Standard errors clustered at the village level. ***, **, *: significant at the 1%, 5%, and 10% level. These regressions do not use the health-induced job loss variables as instruments because I rejected the exogeneity test for these variables (I performed a C statistic, i.e. the difference of the Hansen-Sargan statistic of the equation with the smaller set of instruments - valid under both the null and alternative hypotheses - and the equation that includes the job loss instrument). The sample size is 10257. The estimated effects of husband's income in column 4 and wife's income in column 5 are biased and inconsistent.

Table 7: Effect of wife and husband's income on alcohol abuse and (unconditional) aggressive behavior: using different estimators and instruments

	(1)	(2) Alcohol	(3)	(4)	(5) Violence	(6)
	LIML	IV-Probit	2SLS Husband only	LIML	IV-Probit	2SLS Husband only
Wife income	-0.232 [0.083]***	-0.232 [0.070]***	0.001 [0.028]	-0.043 [0.026]*	-0.044 [0.028]	0.018 [0.011]
Husband income	0.019 [0.126]	0.018 [0.120]	0.006 [0.139]	0.022 [0.050]	-0.009 [0.023]	0.041 [0.062]
Instruments:						
Treatment assignment	Yes	Yes	No	Yes	Yes	No
Agricultural wage	Yes	Yes	Yes	No	Yes	Yes
Natural disaster	Yes	Yes	Yes	No	Yes	No
Job shock (health) (no husband)	Yes	Yes	No	No	No	No
Overidentification test: (p-value)	0.692			0.677		
Cragg-Donald test	10.74		24.03	11.01		24.03

Monthly income in thousand *pesos*. Standard errors clustered at the village level. ***, **, *: significant at the 1%, 5%, and 10% level. In case of block-bootstrap estimates of the standard errors, the block is the village. The estimated effects of wife's income are biased and inconsistent in columns 3 and 6.

Table 8: Robustness checks: varying the sample and the definition of income

	Families with no 5th/6th graders			Income including transfers			Larger sample (husband income only)		
	(1) Alcohol	(2) Violence (if D=1)	(3) Violence unconditional	(4) Alcohol	(5) Violence (if D=1)	(6) Violence (unconditional)	(7) Alcohol	(8) Violence (if D=1)	(9) Violence (unconditional)
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Wife income	-0.252 [0.117]**	-0.047 [0.194]	-0.08 [0.039]**	-0.236 [0.085]***	0.107 [0.117]	-0.051 [0.028]*	—	—	—
Husband income	0.027 [0.136]	-0.156 [0.209]	0.02 [0.064]	0.018 [0.122]	-0.025 [0.143]	-0.002 [0.052]	0.066 [0.206]	-0.137 [0.293]	-0.004 [0.079]
Inverse Mills ratio		-0.228 [0.184]			-0.301 [0.141]**			-0.130 [0.213]	
Observations	8095	2255	8095	10257	2936	10257	17312	4910	17312
F-test of instrument joint significance in the first-stage regressions:									
Wife income	213.76	83.75	285.09	242.97	100.32	242.53	—	—	—
Husband income	21.88	4.84	11.13	20.34	5.31	12.09	9.43	2.07	9.43

Monthly income in thousand *pesos*. Standard errors clustered at the village level. ***, **, *: significant at the 1%, 5%, and 10% level. In case of block-bootstrap estimates of the standard errors, the block is the village.